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Literacy, Technology and Discernment: Investigating the Role of Information Technology in Literacy Education

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Investigating the Role of Information Technology in Literacy Education

by

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Abstract

Regardless of geography, segments of the population struggle to read and write. This struggle is so pronounced that literacy has become an issue for many governments, and policies have been set in place to help ensure a literate society. Educators, in their struggle to respond to the problem, have looked to a variety of methods to help children become literate. One prominent means is the use of information technology and computer-assisted instruction. Because of its significant role, it is necessary for the Christian educator to examine the impact of computer technology, to investigate the role and extent of use of information technology in the classroom, and to form guiding principles that direct the purchasing and use of such technology. When the aforementioned is carefully examined and Biblical discernment is used in making decisions, information technology and computer-assisted instruction can be effectively employed to help students become literate citizens in society.

Introduction

In May of 2005, the Organization for Economic Co-Operation and Development (OECD) and Statistics Canada released results of a multi-national literacy survey. The survey revealed that 14.9 percent of adult Canadians had only a level one, prose literacy level (ABC CANADA Literacy Foundation, 2005). Prose literacy is defined as the skills needed to understand and use information from texts such as editorials, brochures and instruction manuals. The ABC Canada Literacy Foundation defines level one literacy as "any persons with very poor skills, where the individual may, for example, be unable to determine the correct amount of medicine to give to a child from information printed on the package" (ABC CANADA Literacy Foundation, 2005). The survey further revealed that 27.3 percent of Canadians possessed only a level two reading level. This level is defined as people who "can only deal with material that is simple, clearly laid out, and in which the tasks involved are not too complex." This level identifies people who can read but test poorly and whose low level of proficiency makes it difficult for them to deal with challenges such as new job skills (ABC CANADA Literacy Foundation, 2005). The statistics for document literacy - the knowledge and skills needed to locate and use information contained in formats such as job applications, payroll forms, maps, and transportation schedules - reveal similar data. 15.6 percent of Canadians operate at a level one-document literacy level, and 27 percent operate at a level two-literacy level (ABC CANADA Literacy Foundation, 2005). The United States and Switzerland scored slightly lower than Canada.

Problem

When one considers that approximately 42.6 percent of Canadians operate below what the government of Canada believes to be the minimum skill level (Level 3) required for coping with "the demands of everyday life and work in a complex, advanced society" (ABC CANADA Literacy Foundation, 2005), it becomes clear that Canada and other western societies are faced with a difficult problem. The gravity of the situation is further emphasized by authors Leu Jr. and Kinzer (2000) who assert that within a global economy, the ability to read and write will become even more important because these basic skills allow people to access and manage information efficiently and thoroughly.

It would prove difficult to find an educator who would disagree with the aforementioned authors. Nor would many people find a politician who would disagree. In an effort to maintain an economic advantage in a global economy, governments such as the US, UK, Ireland, Australia, and New Zealand have all instituted government policies meant to improve the reading and writing literacy rates of their citizens (Bussiere & Gluszynski, 2004; Leu, Jr. & Kinzer, 2000; Oppenheimer, 1997). Many of these governments have included within their policies, a strong recommendation and/or mandate to incorporate the use of technology in the instruction of reading and writing literacy. The provincial government of Manitoba believes strongly that one of the panaceas to the literacy problem comes in the form of technology. In Manitoba alone, public schools spend more than 26 million dollars annually on information technology (Zwaagstra, 2008). The Alberta government, which touts itself as a leader in supporting educational technology, just announced in 2009 that it would spend 18.5 million in new money for the next three years in order to facilitate the integration of technology in the

classroom (Government of Alberta - Education, 2009b). Furthermore, they have implemented a pilot project entitled "Emerge One-to-One Laptop Learning Initiative" in 20 school districts. The government of Alberta hopes to enhance student learning with laptops for each student in the classroom. The states of Maine, Virginia, Indiana and Michigan ran similar projects. The costs of these projects varied between 9.8 and 17 million for each of its four years (Government of Alberta - Education, 2009a). At the end of the first year, the researchers for the Alberta government following the project have found that most jurisdictions are exploring the ways in which computers might be used but have yet to implement the technology in any significant way (Government of Alberta Education - Stakeholder Technology Branch, 2009). Although not all of this money is earmarked for literacy, a quick survey of just two provinces shows the extent to which governments are willing to invest in information technology.

Research Questions

The fact that governments invest so much money in technology is not surprising. Already in 1986, a group of researchers at the Calvin Center for Christian Scholarship recognized the role technology plays in modern life. According to Monsma, Christians, Dykema, Leegwater, Schuurman and Van Poolen (1986), “Technology plays so central a role in modern society that it is impossible to live responsibly without understanding it and its role in human affairs” (p.10). However, this technology is often rooted in beliefs, assumptions, and values that declare human autonomy from God and from his will for human beings and his creation (Monsma et al, 1986). Because technology plays such a vital role and because it is rooted in beliefs that often do deny the supremacy of God, it is imperative that Christian educators thoughtfully examine the role of information

technology. For the purpose of this study, the scope will be narrowed to the role of information technology and computer-assisted instruction in literacy. The questions to be investigated fall under three main areas and are as follows:

- The impact of information technology (IT) and computer-assisted instruction (CAI) in literacy instruction.
    - What are the drawbacks?
    - What are the benefits to literacy of CAI and IT for middle school students?
    - Are there elements of literacy instruction where CAI is best suited?
    - Do students retain what CAI teaches?
- The role and extent of use of CAI and IT in literacy instruction
    - At what point is CAI and IT more beneficial than a human teacher is?
    - How much should be expected of teachers in their knowledge of CAI and IT?
- The guiding principles for CAI and IT in literacy instruction
    - What philosophy should help form the principles which guide teachers in their use of CAI and IT?
    - What principles should guide the teacher when using CAI and IT?

Definitions

A basic understanding of the terms used is central to any thoughtful consideration of a piece of work and must be laid out before attempting to answer the aforementioned questions. Unless otherwise stated, all definitions are the author's. For the purposes of this work, the following definitions are put forth:

Basic literacy is the ability to read, write, and understand a simple English, statement concerning everyday life.

Functional literacy is the ability to read, write, and understand the English language to the degree that one can successfully complete his or her secondary education schooling and complete a successful college entry form.

Technology can be defined as a distinct cultural activity in which human beings form and transform the natural creation, with the aid of tools and procedures, for practical ends and purposes (Monsma et al, 1986).

Information technology (IT) In the words of the Manitoba government, information technology includes "computers and their peripherals, computer software, the Internet, and electronic multimedia" (Zwaagstra, 2008, p. 2).

Computer-assisted Instruction (CAI) is any interactive software that is used for educational purposes to aid in the instruction of students.

Summary

Important questions which consider the responsible use, the role and extent of use, and the guiding principles behind the use of information technology in the literacy classroom need to be asked before educators plunge into the expensive and ever-changing world of technology. As these questions are explored, it is hoped that wisdom, as Israel

understood it, will guide the investigation. This wisdom then becomes the reality that this "is God's world and all our claims for human knowledge, human freedom, and human responsibility must be set in that context. The deep riddle of wisdom is the full affirmation of human responsibility and the full affirmation of God's sovereign purpose" (Brueggemann, 1982 p. 83). As with all questions that require Biblical wisdom, the answers to the questions are not immediately clear because sinful people, who have been called to the task of forming culture, respond in either selfish disobedience or loving obedience. It is the selfish disobedience that has allowed humanity to declare itself independent of God, to assert that technology is a neutral construct, and to hold forth technology as the panacea for an education system that struggles to graduate every student with an adequate literacy level. One must question and examine the claims of those who put forth such views of technology, and then one must make wise decisions concerning the use of the technology. When humanity affirms God's sovereignty and acknowledges their responsibility in terms of technology, technology can have a place in educating students.

Literature Review

Advantages

Cultural factors

For those who advocate the role of information technology in the classroom, the support for its use mounts. According to Sternberg, Kaplan and Borck (2007), the use of information technology must play a part in any effective adolescent literacy program. They pushed the point further in insisting that to be fully literate, students must be proficient in information and communication technologies. Even Zwaagstra (2008), a vocal opponent of computer technology in the classroom, affirmed that a moderate level of computer access has a positive correlation with student achievement. This viewpoint is further supported by Leu and Kinzer (2000) who insisted that to understand where literacy is going or where it needs to go, one needs to look at the influences within today's culture. The three major, cultural influences they list are global economic competition, public policy initiatives made by governments, and the major point of reference to understand any technology – the literate ability of the reader. The cultural impact of technology is concretely seen in Pearson, Ferdig, Blomeryer and Moran's (2005) meta-analysis of the effect of technology on reading performance in the middle school grades. Their analysis revealed that middle school children spend more time with media than with any other activity. Many youths suggest that using information technology has become essential for them in the completion of their schoolwork and some even see the Internet as their primary textbook. In a survey of 754 youth and their parents, Alverman (2006) found that most believed the Internet was essential for completing homework and had replaced the library as their source of information.

Pearson et al (2005) in their study further revealed that 87.9% of Canadian, 15 year olds have at least one computer available at home and 51.6% of these youths use the computer every day. These Canadian statistics are slightly higher than world statistics put out by the OECD; among developed nations, 73% of 15 year olds have at least one computer at home. Combine these statistics with the government policies which advocate the use of technology in the classroom, and it is clear that the culture of the developed world clearly encourages the use of information technology.

General education uses and advantages

How is this information technology being used in schools? According to Roschelle, Pea, Hoadley, Gordin and Means (2000) technology has been most successfully used in the area of science and math. Its successful use parallels reforms in other parts of the curriculum and must be accompanied by teachers who are literate in technology. Their study gave the following proven uses for technology. Information technology and Computer-assisted instruction use methods beyond lecture and textbook learning, a proven benefit for students with different learning styles. Computer technology provides tools for applying concepts in a variety of contexts thus breaking out of the isolation of the school walls and into real world situations. Computer technology in the form of computer-assisted instruction can represent subject matter in less complicated ways and break down concepts to their essential parts. Finally, Roschelle et al. (2000) asserted that computer technology improves what children learn by providing exposure to ideas and experiences that would otherwise be inaccessible. The benefits seen in mathematics and science are transferable to language; however, the gains are not as great. Hobbs (2002) further asserted that using information technology has an impact

on student motivation, and by extension, develops more sophisticated skills in areas such as reading and writing.

Advantages to literacy

Pearson et al (2005) examined twenty studies that specifically studied literacy and technology in the middle school grades. In their words, "On the basis of the overall mean weighted effect size, one can and should conclude that the range of digital technologies used to ameliorate the reading performance of middle-school students is quite effective" (p. 15). The researchers discovered a moderate overall effect size of 0.5- 0.8, with the majority (58%) having a large or moderate effect. They did state that researcher-developed programs seemed to have a larger effect than commercial programs. MacArthur, Ferretti, Okolo, and Cavalier (2001) supported the findings of Pearson et al. (2005) According to their review, computer-assisted learning has three main functions. First, it can improve phonemic awareness and decoding skills. Second, electronic texts enhance the student's comprehension, and third, computer-assisted instruction provides tools that assist and support the writing process. Furthermore, Lefever-Davis and Pearson (2005) cited the following *possible* benefits of computer-assisted instruction in literacy. In theory, when students use CAI, such as an electronic book, they do not use the majority of their energy decoding words or struggle with new vocabulary; consequently, more time and energy can be directed toward comprehension. The computer pronunciation guide included in such programs builds self-confidence especially for struggling readers. They went on to say that because students associate the computer with games, such CAI allows them to see reading as a game and not a task. Another possible benefit is that CAI allows for individual control of the learning

environment. MacArthur et al (2001) extended the benefits of CAI in their review by stating that in five studies that compared CAI with paper texts, learning disabled students who used the computer bi-modally (both saw the text and heard the story) had similar scores to the average student who just read the story from the paper text version. Additionally, they noted that some students who struggled with phonemic awareness benefited from the speech feedback included in many programs.

Information technology has proved beneficial in the area of writing literacy as well. One of the sharpest critics of technology used in the classroom, Oppenheimer (1997), noted that diligent students often use electronics to improve their writing. MacArthur et al (2001) stated that for learning disabled students, tools such as the word processor are a benefit. These students do require more instruction and often their progress is slower on a word processor, but they do not need to make as many revisions. Sternberg (2007) reported that artificial intelligence holds great promise for the student who struggles with writing. Although the use of artificial intelligence is relatively new, she recorded that the preliminary studies done on this technology show that the immediate, specific feedback given to students throughout the writing process helps them to increase their writing proficiency.

Disadvantages

Affects on brain development

It is clear that information technology can and is playing a role instructing youth. However, this technology also has its detractors who caution against the use or over use of technology. Healy (1999) traced the development of the brain as it is affected by media. Healy commented, “using any medium affects the underlying neural circuitry that

is being established during childhood and adolescence" (p. 130). Repetition of an activity or experience strengthens the connections and causes that type of learning to become more automatic. Once the brain connections are formed, the patterns are hard to break. These patterns help students to integrate learning. In Healy's opinion, much of the software today, including educational software, fragments students' learning rather than integrating it (p. 137). Furthermore, she asserted "brains tend to become custom-tailored for skills that the environment promotes … If we had grown up in a totally screen-based culture with icons instead of written text, the reading connections might have withered away in favor of stronger visual systems" (p. 133). Healy continued by suggesting that engaging in "too many electronic escape routes, one being the many forms of computer 'education,' interferes with the brain's own wisdom" (p. 134). She asserted that students need various forms and degrees of concrete, scaffold learning even into the middle school years in order for the brain to understand complex concepts. Because computers are primarily a visual medium, concrete learning is inhibited.

A vital part of understanding intricate concepts revolves around the brain's ability to think creatively -- to solve problems, to express thoughts and emotions, and to engage in metacognition. Oppenheimer (1997) quotes Dingman, a professor of psychology at Marist College who believes that if children begin to use a computer before they have an extensive education, especially in the area of reading and writing, the children will struggle with developing imagination. This imagination is the beginning of what Healy (1999) called "mental imagery." In Healy's investigation into the effects of computers on the brain, she found many teachers who "lament the fact that many (students) now have to be taught to play symbolically or pretend – previously a symptom only of mentally or

emotionally disordered children" (p. 164). Without imagination, the ability to think creatively is seriously curtailed. Oppenheimer (1997) further suggested that technologies, including educational technology, offer lively visions of other worlds for students, but these constantly changing visions may endanger the neural substrates for reasoning.

Goffinet's investigation into brain development supported Oppenheimer's assertion. In his investigations, he examined the interconnections between the left and right hemispheres of the brain. In order for the brain to function efficiently, multiple connections need to develop between the two sides. Visual software, especially those containing fast moving images stimulate the right hemisphere at the expense of the left (as cited in Healy, 1999) and leave left-hemisphere skills such as language to suffer.

Incidentally, research is also suggesting that an overactive right hemisphere results in negative moods, yet another factor that impacts learning. Not only is the right hemisphere affected by overuse of computers but also the prefrontal cortex and limbic systems. These parts of the brain develop at about age two, age six, and during puberty. These later maturing circuits responsible for functions such as paying attention, motivation, sequencing and organizing information, examining ethical issues, personality, and monitoring social behavior are best developed through interaction with children and adults as well as interaction with the physical world (Healy, 1999). When too much computer or screen time is given to children, the brain only registers a two dimensional world and the brain does not fully develop as it should.

The affects of computers and other screen based media on the brain which Healy and others have been noticing was recently reinforced by a study published by Landhuis,

Poulton, Welch and Hancox (2007). In this study, researchers followed a cross-section of students from the age of two to thirty two to evaluate whether television viewing lead to attention problems. What they discovered was that the amount of television viewed by small children predicted adolescent attention problems. Furthermore, adolescents who spent a large amount of time with media had further attention problems. The researchers hypothesized two possible reasons for the attention problems. Of particular interest was their first reason. The researchers believed that the rapid image and scene changes commonly found in television may over stimulate the child's mind and affect the plasticity of the brain. This hypothesis supports the aforementioned elements of brain development.

Negative effects on literacy

Armstrong and Casement (2003) narrowed the focus and argued that because children who are engaged by computers are bombarded by visual stimuli, they often suffer from a lack of listening skills - something that is crucial to cognitive development. Armstrong and Casement believe electronic media does not allow for the meaningful conversation between the child and the media. Meaning is made in conversation (reading) when it flows at a pace that enables the child to follow what is said. They asserted that the succession of images used in electronic media "is so rapid that children either cannot or choose not to pay attention to what they are hearing. They may hear, but they don't listen. Children who don't learn to listen can easily develop habits that let them avoid exercising – and thus building- important auditory-processing connections in the brain" (p.62).

Armstrong and Casement (2003) extended this explanation to the use of electronic books used in educational settings. These authors believed that the multimedia features of electronic books overwhelm the text, and the animation and sound effects lead to additional distractions for the reader. For Landhuis et al (2007), these distractions lead to inattention and the inattention then becomes a conditioned response.

Lefever-Davis and Pearson (2005) were not as sweeping in their criticism. Based on their study, they believed that only certain students become distracted by the extra features, and the distraction is largely due to differing learning styles. However, they did note various other disadvantages to using computer-assisted learning in the area of reading and writing. They found that students become dependant on the electronic supports including the decoding features integrated in the software rather than developing their own strategies. Because students have readily available assistance to help them, the use of reading strategies does not become integral and student risk taking is reduced. The lack of risk taking and the availability of reading help can lead to reader passivity. The results of Lefever-Davis and Pearson's study were supported by MacArthur et al. (2001) in their review of the benefits and drawbacks of various technology applications for students with literacy problems. They noted that learning-disabled students who used programs such as CD-Rom books and drill and practice software were indiscriminant in their use of electronic helps. They postulated that students with learning disabilities may lack the metacognitive ability to distinguish between what they knew and what they needed help understanding.

Furthermore, Korat and Shamir (2007) found that in younger readers, those who struggled with reading were more attracted to the iconic or electronic features than those

who had a more advanced reading level. They also found that students' phonetic understanding was not improved by the use of computer-assisted material and that the less animation included, the greater the level of comprehension. It would not be a stretch to draw similar conclusions with respect to middle school students.

PISA study findings

The critics of technology in the classroom would not be surprised by any of the aforementioned information. Nor would they be surprised by Fuchs and Woessman analysis of the PISA (Programme for International Student Assessment) 2000 study. In their analysis, they noted that simply having computers and computer software present in the classroom did not ensure higher academic achievement. In fact, when they controlled for the variables of family background and school characteristics, "the mere availability of computers at home is negatively related to student performance in math and reading, and the availability of computers at school is unrelated to student performance" (as cited in Bielefeldt, 2005). Bussiere and Gluszunski (2004) did a similar analysis of the same study, only this time using Canadian data. Interestingly, they came to the same conclusion. They note that when the variables for family background and family income were controlled, students who used classroom computers and its corresponding software showed no improvement on test scores and even showed a negative relationship between *reading* (emphasis mine) and math and the use of computers.

Economic Costs

Murgatroyd (2009)**,** the former head of Athabasca University, would not find these statistics all that startling; in fact, they would simply support his claim that in spite of the Alberta government spending 1.8 billion dollars on technology over the last ten

years, technology is not being used effectively, nor do most schools have adequate IT equipment to make learning with technology successful. Murgatroyd is not alone in his observations. The government's own data supports his claim. The 1.8 billion quoted by Murgatroyd does not include the cost of Alberta's SuperNet, a 193 million dollar infrastructure project meant to provide all schools, libraries and hospitals with access to high speed broadband service (Bray, 2008). For schools, the SuperNet was meant to aid in the innovative integration of technology into the classroom. As of 2007, most schools were using access to the SuperNet for basic Internet searches such as Google and Wikipedia searches (Government of Alberta – Education, Stakeholder Technology Branch, 2007) Nor does the 1.8 billion include the new money (18.5 million) announced for technology projects in the beginning of 2007. Emerge One-to-One Laptop Learning project is one such project that is slated to run until August 2010. At present, schools who signed up for the project are two and a half years into the three-year project; they have the laptops and access to the SuperNet. Still the majority of schools as of November 24, 2009, report they are exploring how to use the laptops but most have not implemented firm plans (Government of Alberta - Education, November, 2009). These are only two examples within the province of Alberta that demonstrates the extraordinary cost of information technology and some of the pitfalls with it.

According to Armstrong and Casement (2003), what Alberta has and is experiencing is not uncommon. In their survey of schools, they found that many schools have outdated equipment that requires constant fixing or software that will not run on the current hardware. The primary reason it seems is that schools rarely prepare for the inevitable need to replace or fix outdated hardware and software. In Armstrong and

Casement's investigations, they found that most businesses dedicate at least an additional 30 percent of the purchase price of technology equipment and software to the maintenance and repair of their systems. Schools rarely allocate the extra money needed, nor do they have the adequate funds within their budgets to dedicate to the upkeep of technology. In 1999, the Alberta government surveyed the various school districts to determine how much of the per-pupil grant was going to IT. Ten years ago, schools used anywhere from 96 dollars to 132 dollars per student of their per student grant; the money was never intended to be used to aid in the maintenance of IT (Government of Alberta - Education, 1999). Since that time, the Alberta government has begun providing money on a per student basis that is ear marked for the upkeep of various technologies; in 2009/ 2010, 37 dollars per student was allocated (Government of Alberta – Education, 2009 – 2010). Even with ten-year-old data, the discrepancy between the dollar amounts is clear.

Summary

It is clear that there are as many detractors as supporters in the debate over information technology and its use. It is also evident that educators can no longer deny the role technology plays in the world and in education. Its prevalence has become so entrenched that some even advocate expanding the understanding of literacy to include computer literacy (Alvermann & Hagood, 2000; Hobbs & Frost, 2002). However, simply incorporating computers into classrooms and teaching students how to use them does not ensure a literate society, nor does it solve the many educational problems some of its supports purport it to solve. In fact, if the critics are to be heeded, technology may be creating its own problems. The role for the thoughtful educator then becomes the

navigation of the technological world so that he or she might be better able to educate literate children who are obedient to God's call to be formers of culture.

Studies Examined

In order to begin navigating through the technological maze, five studies were investigated. Each study took a slightly different approach to technology and literacy. For the most part, the findings were positive and the impact of CAI and information technology proved beneficial.

"Literacy Instruction For Older Struggling Readers: What is the Role of Technology?"

Hasselbring and Goin (2004) examined a "technology-based intervention program" (p. 123)--the Peabody Learning Lab--which uses integrated media to help middle and high school students who struggle to read. The Peabody Learning Lab is a virtual lab that resulted from a research and development project out of Vanderbilt University. Before constructing the lab, the researchers looked at a number of factors that contribute to literacy problems in adolescence. They discovered that parents' socioeconomic status explained the largest amount of variance among the fixed factors. They also discovered that within the majority of schools, no explicit reading instruction was offered passed grade four. This lack of specific instruction lead to what has been called the "Matthew Effect": "good readers become better readers and poor readers become more frustrated and fall further behind" (p. 125). When examining student factors, the researchers found that students who struggle to read had not developed sufficient word recognition skills and lacked the ability to apply word recognition strategies to the task. Furthermore, they found that students who were taught skills in isolation often lacked motivation and comprehension, instead resorting to word calling

when reading. The aforementioned, fixed, school based, and student based factors resulted in a program that was centered on four basic principles:

a. A reading program designed to be relevant and motivating
b. Student dignity must be preserved and lack of ability hidden.
c. Students needed to control their own learning.
d. The program must be built on strengths rather than weaknesses.

Once the principles were set, the researchers set about to come up with the most important areas in reading acquisition which they identified as phonological awareness and orthographic knowledge.

The Peabody Lab directed the learner's attention to word recognition, decoding, spelling and comprehension of text passages. Each segment centered on a contemporary topic and began with a video anchor. The "anchored instruction" provided a visual cue, a context and the background learning necessary for the piece the students were about to read. Once the students had watched the video, they entered a reading lab, word lab or spelling lab and completed individualized, scaffold lessons based on their needs. In the Reading Lab, the video anchor was used to help students create a mental picture. The students then read a passage that described the video just watched. If the students were unable to read it, a computer tutor offered support. They also completed other activities such as modified cloze passages and discrepancy passages. In the word lab, students developed automatic word recognition skills and were taught phonological process skills. Students worked through a sequence of activities consisting of study, practice and speed. The final lab, the spelling lab, was set up to develop or enhance orthographic knowledge and phonological processing skills by learning to spell. In the spelling lab, students were

led through a variety of activities that use the words they have encountered in the Reading Lab and Word Lab. When students made a mistake, the computer tutor tried to analyze the error and provide students with specific information or help on how to correct the error.

The study was conducted with the Orange County Public Schools as an intervention program for delayed readers. Sixty-three students in grades six through eight from three different schools were chosen; approximately twenty students from each school participated. Students used the Peabody Literacy Lab for thirty minutes a day for the entire year. As well, students were encouraged to listen to books on tape and read high interest, low-level books. Sixty-two students who did not participate in the Peabody Lab and were below grade level in reading were selected as a contrast group. The Stanford Diagnostic Reading Test (SDRT) was given to the students in the fall and then again in the spring. Data from the test was then analyzed. The data revealed a medium effectual size for auditory vocabulary, literal comprehension, inferential comprehension, and total reading comprehension. However, little or no significant change or difference was found between the two groups in the areas of phonetic analysis and structural analysis. The SDRT showed a gain of 7.9 points in auditory vocabulary for the Peabody group where as the contrast group had a -3.3 point loss. In the area of literary comprehension, students in the Peabody group gained 7.7 points while the contrast group lost .9 points. The Peabody group gained 4.9 points in the area of inferential comprehension, whereas the control group lost 1.9 points. In the area of reading comprehension, the Peabody group gained 9.3 points while the contrast group lost .4

points. Finally, the Peabody group was able to gain 10.3 points in their understanding of structural analysis while the contrast group only gained 5.3 points.

It is clear from the data that the Peabody Learning Lab with its multimedia applications allowed students who would otherwise continue to lose ground in reading to gain in their understanding and knowledge. For some, it may have been for the first time.

"Computer-assisted reading intervention in a secondary school: an evaluation study"

The second study, by Lynch, Fawcett and Nicolson (2000) built on the success educators had with the primary grades using Reading Intelligent Teacher Assistant, a computer-assisted literacy support system that allowed teachers to provide specific support based on a specific reading needs. These researchers evaluated the effectiveness of the program for eight middle school children.

RITA is a computer-based literacy support system that assists, rather than replaces, the literacy teacher. In the UK, RITA proved beneficial with children in the elementary grades. Because of its success with younger children, the researchers wanted to discover if a similar program could work with older students. This study considered the effectiveness and cost effectiveness of using RITA at the secondary level to help teachers fulfill student's individual education plans. The study was quite small, consisting of only eight students, but based on the results from those students, preliminary conclusions were drawn.

After examining many of the computerized reading interventions available, the developers of RITA noted that much of the material available only offered solutions for one area of literacy or another. The developers decided to create an intelligent teacher

assistant (ITA) that could replicate repetitive learning tasks, thereby leaving the teacher to conduct tasks that require human intervention to be successful. In the case of RITA, three aspects of literacy were selected: meaning, phonics, and fluency.

The program, RITA, required that the teacher select the tasks each child would undertake. The advantages of such an approach centered on the teacher still controlling the learning environment, and being able to integrate non-computer methods seamlessly into the curriculum. Additionally, the activities could be geared toward specific student's needs. This made the program ideal for the individual education plans of students with learning difficulties.

The study was conducted in a secondary, British school and was limited to ten weeks of intervention. Within those ten weeks, students received three 20-minute sessions per week while under the supervision of the special needs coordinator. As mentioned earlier, eight students were selected – three were labeled dyslexic/ specific learning difficulties, three were non-dyslexic poor readers and two were English-as-Second-Language students. The mean age of the eight students was 11.7 with each of the students falling over four years behind their chronological age in the areas of reading and spelling.

To determine the effectiveness of RITA, the researchers examined the amount of improvement for the eight students (the experimental group) from pre-tests to post-tests. In this case, the students acted as their own controls. To determine the base line for each student, The Wechsler Objective Reading Dimension Reading and Spelling test, the Dyslexia Screening Test, the British Picture Vocabulary Scale test and the Neale Analysis of Reading Ability Test were used. The Neale test proved most helpful in

comparing pre and posttest performance. The posttests revealed positive outcomes. The results from the WORD reading and spelling tests were changed into standard scores. The group improved 2.4 standard scores in reading and 1.7 standard scores in composite literacy. Essentially the tests revealed that the students read better and at a faster rate of speed after the RITA intervention. The Neale test scores also revealed improvement, especially in the areas of comprehension (1/2 year improvement) and reading rate (1/2 year improvement). When all the data was converted to an "effect size", the analysis showed a medium effect for reading (.49) and literacy (.39), but for spelling only a small effect was noted (.18).

The data supports the overall effectiveness of the RITA intervention. For students with dyslexia, RITA stopped the spiral downward. Statistically, these students lose five standard score points per year over their peers. With this intervention, they managed to maintain and slightly increase their reading level. For the non-dyslexic students, similar data was recorded. Unfortunately, for the ESL students only a slight improvement was seen after the RITA intervention.

Because RITA can be set to cater to the individual needs of students (IEP), it proved itself an effective tool for some children who experience delayed reading. It was most effective for non-dyslexic children and slightly less effective for dyslexic children. It does not seem an appropriate program for children for whom English is their second language.

"An Evaluation of the Merit Reading Software Program in the Calhoun County (WV) Middle/ High School"

The third study by Jones, Staats, Bowling, Bickel, Cunningham and Cadle (2005) studied the effects of the reading software, Merit Reading, on middle school students. This study was commissioned by Merit Software to evaluate the effectiveness of their reading software for students in grades six and eight. The study was conducted during the winter of 2003.

Merit Software's comprehensive skills intervention program was created to match state requirements as "measured on standardized instruments" (p. 179). The various modules covered skills in reading vocabulary, reading comprehension, grammar, spelling, math problem solving, writing and critical thinking. The idea behind Merit is that "in addition to the basics, students should learn to connect concepts, solve unfamiliar problems, communicate ideas, and apply facts and skills that they have learned" (p.180). Each module is based on self-based learning, meaning it is based on the particular needs of the student and moves only as quickly as the student can demonstrate mastery over a concept. As the researchers completed the study, three questions guided their investigation:

1. Did the software complement everyday classroom teaching?
2. Did the software affect students' achievement as measured by standardized tests?
3. What does use of this software intervention strategy imply for educational reform?

The study was conducted in Calhoun County Middle/ High School on eight heterogeneous classrooms: four grade six classrooms and four grade eight classrooms. One hundred and sixteen students participated in the Merit sessions while thirty-five acted as a control group. Those who participated received two 45-minute computer sessions per week for four weeks. To measure the effectiveness, the Stanford Achievement pre and posttests (SAT – 9) were used. The researchers were primarily concerned with the amount of change between the two tests, but did take into account such variables as gender, GPA, ethnicity, and special education to name a few. They also examined whether the number of Merit sessions in which the student engaged had a significant impact or was the impact merely because the students were part of the treatment group; results showed that those two variables were orthogonal.

For the purposes of this paper, the results of reading vocabulary, reading comprehension, language mechanics, language expression and spelling are relevant. When the data was converted in Cohen's D, it revealed that reading vocabulary (.54) and reading comprehension (.42) saw the most significant effect, rated medium by Cohen's scale. The data from language mechanics (.2), spelling (.31) and expression (.34) all revealed a small effect size. The one interesting anomaly in the data was in the area of language mechanics. The data revealed that being part of the Merit group had no real significant effect on the mechanics of student's writing; however, the number of Merit sessions students participated in resulted in a medium effect size (.45). For the students involved in the Merit Group, the greatest percent gain occurred in reading vocabulary, (13.1%), reading comprehension (10.5%) and language expression (11.1%)

Overall, the study shone a positive light on the Merit software. In the author's words, "computer-based instruction, when used to complement everyday classroom instruction by teachers, can significantly improve the performance of middle school students reading skills as measured by standardized tests" (p.191).

"Improving the Reading Comprehension of Middle School Students with Disabilities Through Computer-Assisted Collaborative Strategic Reading"

The fourth study, by Kim, Vaughn, Klingner, Woodruff , Reutebuch and Kouzekanani (2006), investigated the effects of a researcher-developed computer program, CACSR, on thirty-four students with disabilities. This study used a researcher-developed computer program that built on the collaborative strategic reading strategy. The base for the program and the strategy was the idea of reciprocal teaching. According to the authors, "CACSR provides students with an interactive learning environment intended to maintain their interest while teaching them how to apply comprehension strategies as they read expository text passages" (p. 237). In the program, students are led through four basic strategies: preview, click and chunk, get the gist, and wrap-up. The preview strategy helps students to brainstorm what they already know about the topic and to predict what they might learn upon reading the segment. The click and chunk strategy helped them to define unknown terms and apply "fix-up strategies" when students did comprehend the passage. The "get the gist" strategy helped students to identify the main ideas in the passage, and the wrap–up strategy helped them generate questions concerning their reading as well as review the main idea.

For this study, students who participated were legally identified as having a disability, could decode words at least at a grade 2.5 level "as measured by the

Woodcock Reading Mastery Test –Revised" (p. 237), were at least one grade level below their peers in reading comprehension as measured by the same aforementioned test and the Gates-MacGinitie Reading test, and attended a reading class for students with reading difficulties. Sixteen students participated in the intervention group and eighteen students continued in the control group. Students in the control or comparison group continued to receive resource room reading instruction. The sixteen students in the intervention group met twice a week for ten to twelve weeks or for seventeen, twenty-three minute sessions. The students were placed in pairs and progressed through the program which first instructed them in how to use the collaborative reading strategy and then had them use the computer-assisted, collaborative reading strategy to learn.

Two measures were used to investigate the effectiveness of the CACSR. The first was the Woodstock Reading Mastery Test – Revised (Passage Comprehension). The passage comprehension test is a subtest of the Woodstock test and was used as a pretest and posttest measure of students' reading comprehension. The second was a CSR measure. The CSR measure was a researcher-developed "proximal measure" that concentrated on students' abilities in writing the main idea of the passage and in asking questions about the passage they had read. In order to score the CSR test, researchers developed two five-point rubrics, one for the main ideas and one for the questions. 20% of the student responses were scored by an independent researcher; this was done to test for accuracy in scoring.

The quantitative results were quite positive for CACSR. After all means were adjusted, the treatment group outperformed the comparison group on all tests. When the data was converted to Cohen's D, it revealed a medium effectual size (.59) on the

Woodstock Reading Mastery Test – Revised (Passage Comprehension), a very large (1.19) effect size on the researcher developed CSR tests, and a large effect size (.95) in instructional reading level. Quantitatively, the results showed a statistically significant difference between the experimental group and the comparison group. It should be noted that the researcher-developed tests showed a much greater effect; this may have been due to the bias of test or to the reality that the test would be closely aligned to the content of the program. The researchers also measured CACSR qualitatively. Overall, the students involved in the program felt it was effective and that their reading had improved. Many students did note that they found the program "boring" especially during the learning phase of CSR.

Whether it is because CACSR was built around a researcher-develop and tested product or because it is based on a proven method when teaching literacy, it is clear that CACSR does have a positive effect for the students who used the program.

"The Journey Ahead: Thirteen teachers report how the Internet influences literacy and literacy instruction in their K-12 classrooms"

The fifth study by Karchmer (2001) analyzed how the Internet influenced literacy and literacy instruction. The purpose of this ethnographic study was three-fold: explore how the Internet influenced literacy and literacy instruction, explore the implications to education if the Internet is changing literacy, and examine how the research community can keep up with the changes technology brings to literacy and literacy instruction.

The participants in this study were either nominated by fellow peers as teachers who used technology in an exemplary fashion or nominated by researchers from a previous study who felt the teachers were proficient with the Internet and had

successfully facilitated its transition into the classroom. Of the thirty-one teachers who were contacted, thirteen responded: ten women and three men. The teachers came from eleven different states and across the K-12 spectrum.

The data was collected over the course of three months in various ways. First and most importantly, it was collected through email interviews. Each participant corresponded with the researchers approximately thirty times. The central question to the e-mails was "Do teachers report that the Internet influences literacy and literacy instruction in their classroom? If so, how?" (p. 452). Second, the researcher asked each teacher to write a reflection journal. No guidelines were given for the journal, so the responses were often a step-by-step outline of how technology was used in the classroom, a reflection on what lessons worked and which did not, or a compilation of stories involving students, teachers and technology. Third, data was retrieved from classroom Web pages that posted student work, homework assignments and class projects; various Web addresses teachers used as a resource; and articles teachers had written for online journals. After all the data was collected, it was organized into three themes: "appropriateness of Internet material, evaluating the accuracy of the Internet material, and publishing student work on the Internet" (p. 453). Subcategories fell under each theme.

When looking at the appropriateness of reading material, two areas were considered: the reading level of the site and safe Internet use. For the elementary and middle school teachers, finding appropriate reading material that was neither too easy or too difficult often added many hours to their preparation time, and sometimes it was simply not possible to find appropriate Web sites, especially for weaker children. Most

of these teachers pre-selected the Web sites for their students. When considering the reading material, the textual aids were often seen as an asset and sometimes the aids were seen simply as an extension of print-based material rather than electronic material. The high school teachers did not see the readability of Web sites as a concern and spent more time investigating whether the site had correct information. The researcher did postulate that high school teachers may not be as concerned with the readability because they tend not to teach literacy.

Of concern to all teachers was safety on the Internet and accuracy of information presented. In terms of safety on the Internet, three methods were prominent and most were district wide mandates. The first and most commonly used method was to require parents to sign a permission form "acknowledging that their children might possibly view inappropriate material" (p. 457). To avoid any possibility of this occurring, many teachers allowed students to only search through sites they had set up on a classroom homepage. The second method used was to install software that monitored activity and blocked access to any unsuitable Web sites. Finally, some schools and districts simply banned any online searches.

All teachers felt that teaching students how to evaluate the appropriateness of information found on the Internet was vital, especially concerning the vast amount of information available. Two methods for teaching students how to do this came to the fore. First, teachers discussed the importance of evaluating information and turned discrepancies into learning experiences where students were asked to use their metacognitive skills to identify why information was incorrect. Second, many teachers developed Web page criteria so students could evaluate the information on their own.

Another aspect related to accessing information on the Internet was the need to teach students the skills required to effectively use electronic media. These skills need to be taught in addition to the other required literacy proficiencies.

Another area investigated was the benefits of publishing student work online. In general, most of the high school and middle school teachers did not make a practice of publishing their student's work online. However, many of the elementary teachers used the web as a virtual audience for their students. Teachers found that "students seemed more motivated to complete projects and displayed greater interest in creating quality work when they knew it would be published online" (p. 459). Teachers used classroom Web pages and online children's journals as places where the student writing would appear. In spite of its motivating factor, teachers did acknowledge that simple publishing online was not a solution. In the words of one teacher,

> What I find is that children who have been reluctant writers previously continue to drag their feet on the computer. Yes, they are more engaged because of the interactivity. But they are not more fluent (p. 461).

In concluding her study, Karchmer discussed the implications of her findings for teacher education and professional development. She highlighted three main points. First, teachers must become knowledgeable about the technological literacy skills necessary for students to succeed in today's workforce. Second, teachers must be taught how to use these literacy skills. Third, although using the Internet results in confronting new problems which need solutions, it also provides many solutions and ways of communicating between teachers that previously were not present.

Karchmer's study clearly shows some of the benefits and trials associated with using the Internet within the curriculum and with teaching the skills needed to use the tool wisely. In spite of the difficulties and time required by teachers, she sees this technology and the corresponding skills needed to use it as vital to students' education.

Considerations for evaluation

All five of these studies cast a positive light of the use of information technology and CAI in the classroom, and overall, the use of such technology has proven beneficial for the intended audience. However, a few points must not be overlooked. The study completed by Kim et al. (2006) and the study completed by Lynch et al. (2000) had relatively small sample sizes; the first having only eight students and the second having only sixteen students. These small sample sizes may provide preliminary data but additional studies need to be performed before such programs can be deemed beneficial. Second, it needs to be noted that the study completed by Kim et al. (2006) produced very good results in part because the testing done to validate the program was created by the same researcher who created the computer program. As often is the case in such situations, the tests closely align with the program and the results are often strongly positive. Because of the close relationship between the program and the test to prove the program, the bias of the tests must be taken into account. Third, for three of the studies, the intervention time was quite short, ranging from four weeks to twelve weeks. One needs to ask the question, how many of the skills learned were retained by the students six months later or whether gains made were lost shortly after the interventions stopped? There are no answers for these questions.

Finally, one cannot overlook the method of testing for the various programs. All of the studies, except the ethnographic study, used at least one form of standardized test to determine the effectiveness of the program. Standardized tests come out of a positivist philosophy which only allows for data that is observable and measurable, a right or wrong answer. Although the tests do provide researchers with measurable means of evaluation, those who interpret data need to be aware of two things. First, "scores could be readily affected by short-term coaching" (Fremer & Wall, p.14). An intervention lasting four to twelve weeks might be considered short term coaching. Second, in the research Wallace (2000) did on achievement tests, he found that "socioeconomic status was by far the strongest predictor of students' performance on … achievement tests" (p. 68). His findings are supported by such researchers as Bussiere and Gluszunski (2004) and Bielefeldt (2005). Aside from the Merit Reading study, no other study took into account external variables such as socioeconomic class.

Philosophical Foundations

Even when one takes into account the various shortcomings of the studies, it is clear that when software is developed well, it can help students to become literate. An example of a well-developed program is clearly seen in the Peabody Lab developed at Vanderbilt University. However, the Peabody Lab was a research and development project that took five years to develop. Purchasing and implementing the program costs between 30,000 dollars per division, per school for the base licensing package (Education Development Center, Inc, 2008)) to 37,000 plus dollars for a complete license for one division (College Station Independent School District, 2009 June agenda). In many schools, including Christian schools, where budgets are limited, such expenditures cannot be entered into lightly. Principles need to guide the purchaser. These principles must be based on a well-developed philosophy that under girds the educators' understanding.

Foundational Undergirding

First, Christians must acknowledge the truth that they are called to be formers of culture, responsibly using what God has provided for them to advance His kingdom here on earth. God began this command in Genesis 1 when He set out the cultural mandate for His children. In Genesis 2:15, God makes the mandate specific for Adam: "The LORD God took man and put him in the Garden of Eden to work it and take care of it." Examples of using tools to form or transform culture can be seen as far back as King David's time. 1 Samuel 13:16 and following records the plight of the Israelites. Verses 19 and 20 record, "Not a blacksmith could be found in the whole land of Israel, because the Philistines had said, 'Otherwise the Hebrews will make swords or spears!' So all Israel went down to the Philistines to have their plowshares, mattocks, axes and sickles

sharpened." By the time of King David's rule, the Philistines had been subdued and Israel had the technology to create their own weaponry; technology David presumably learned while living among the Philistines at Gath (1 Samuel 27). David used this weaponry to carry out God's command to subdue the pagan nations that surrounded Israel on all sides and to make Israel a prominent voice among the land.

Not only are Christians called to be formers of culture, they are to exclaim that all of life and all of the earth is the LORD's. Psalm 24:1 clearly declares, "The earth is the LORD's, and everything in it; he has founded it upon the seas and established it upon the waters." To negate God's Lordship of technology is to negate a central, Biblical tenet. This tenet also requires that the Christian grasp the holiness of all that God has created including technology. In prophetic words, Zechariah declares that all of life is holy unto the Lord:

> On that day HOLY TO THE LORD will be inscribed on the bells of the horses, and the cooking pots in the LORD'S house will be like the sacred bowls in front of the alter. Every pot in Jerusalem and Judah will be holy to the LORD Almighty, and all who come to sacrifice will take some of the pots and cook in them… (Zechariah 14:20 -21).

Zechariah gives a beautiful vision of Christ's return, a vision that has partially been fulfilled in Christ's death and resurrection. As Christians wait for Christ's kingdom to come in complete fulfillment, they are called to see all of creation, including technology, as holy to the LORD.

Unfortunately, humans are sinful and since the fall have lived as if God were non-existent. Humanity, who God created to seek after Him, has instead created gods out of

the created world. Idolatry – "having or inventing something in which one trusts in place of or alongside of the only true God who has revealed himself in his Word"- (Heidelberg, p. 905) has been the result. Some of the most prominent idols or gods of this age stem from an elevation of science to the position of god, in this case the god of technology or technicism (Monsma, 1986). According to Postman (1995) science produced the god of technology and this god speaks only of power while it offers convenience, efficiency and prosperity. This god comes complete with an ideology of progress that presumably cannot be stopped, of information that will enhance lives, of tools that will lead to a better life for all. This ideology is not questioned because it is assumed it accompanies progress. Unfortunately, when the god of technology is not questioned, computers fill classrooms without principles to guide their use. Educators, administrators, and parents assume that computer-based education is better simply because computers hold the promise of technological sophistication. The continual desire for progress and human supremacy drives a technologically saturated society forward, and questions concerning the wisdom of such progress, the value of such a technology, and the impact of both are left unasked and unanswered.

Biblical Tenets

As Brueggemann (1982) so aptly stated, the deep mystery of Biblical wisdom understands the place of human responsibility and affirms the sovereignty of God's purpose in human activity at the same time. This wisdom begins when humankind gives heed to Proverbs 9:10 which states, "The fear of the LORD is the beginning of wisdom, and knowledge of the Holy One is understanding." When educators and parents begin here, they quickly see that for much of society, technology has become a type of god.

This god is even influencing the Christian schools set up by parents who desire to raise their children in the fear and knowledge of the Lord. This god infiltrates, because Christians, too, fail to ask questions and examine the philosophy behind the reason for the technology that has become part of their schools.

So, what should guide the thinking of educators? To give a rigid answer to that question would be rather presumptive as each educator is surrounded by unique circumstances. However, three overarching Biblical tenets need to inform the principles that guide one's thinking. First, Christians must uphold God's dominion over all the earth; there is only one true God. Paul is explicit in restating this creed in both Romans and Acts. In Romans 11:36 Paul ends his doxology with the words "For from Him and through Him and to Him are all things. To him be the glory forever! Amen." He reiterates the same theme in Acts 17:28 when he says, "For in him we live and move and have our being." God's dominion is secure and to forge ahead with technology without careful consideration of God's dominion and His normative will for His creation is to fall into sin.

Second, Christians must subscribe to the normative criterion of love: love of God and love of neighbor. In Matthew 22, Luke 10 and Mark 12: 30 and 31, Christ answers the question concerning the most important commandment:

> "The most important one," answered Jesus, "is this: 'Hear, O Israel, the Lord our God, the Lord is one. Love the Lord your God with all your heart and with all your soul and with all your mind and with all your strength. 'The second is this: 'Love your neighbor as yourself.' There is no commandment greater than these."

To love God first and our neighbor as ourselves means that Christians take God's normative laws and will for his creation, including humanity, into account when investigating the role of technology in schools. Educators ask the following questions: will this technology truly benefit the students for whom it is intended? What is the impact on other parts of the curriculum if this technology is included? How will this technology impact the school budget? Does this technology help the students to become Spirit-filled disciples and responsible discerning citizens in society?

The third tenet requires that Christians seek after shalom in all of their living, including schooling. Wolterstorff (2002) describes shalom this way: "To dwell in shalom is to enjoy living before God, to enjoy living in one's physical surroundings, to enjoy living with one's fellows, to enjoy living with oneself" (p.191). Shalom then is living in right relationship with God, humanity, the world, and ourselves. This right living, which is central to character, is both God's purpose and Christians' calling (Wolterstorff, 2002). In terms of technology and education, seeking after shalom means that information technology is used as a tool for learning but it and its peripheries do not supersede the curriculum, the students, the teachers, the budget or any other area of education. When technology is used with the idea of shalom in mind, it acts as a servant rather than a god.

The Shalom Principle and Dooyweerd's Modalities; a way to develop practical principles

These three tenets need to create the foundation for the principles. One possible way of organizing these principles is around what Basden (2008) in his Dooyeweerd papers calls the shalom principle. This principle echoes the very thing Wolterstorff wrote

about when he wrote of shalom. For Basden and other Dooyeweerdian philosophers the shalom principle is define in this way:

> Shalom "speaks of [a] holistic, full, rich well-being, often translated 'peace', but with strong root meaning of 'whole' or 'complete'… [Shalom expresses] the idea of multi-aspectual goodness: good in all aspects, leading, if we adopt the creation-fall-redemption ground-motive that Dooyeweerd also adopted, to 'what God intended' for human and other life." (Basden, 2008).

Dooyweerd put forth fifteen "multi-aspects or modes of being. However, Monsma et al (1986) pointed out that "normative principles arise only from the last eight aspects, since the first seven by their very nature involve 'laws' or principles that cannot be broken" (p. 70). Blomberg (2005) concurred with Monsma et al. Blomberg asserted that life is understood through "aspects of experience" and these aspects, when understood according to God's normative laws, leads to wisdom. Blomberg's ways of wisdom mirror Dooyweerd's last eight aspects. The last eight aspects then can create the guiding principles for educators seeking to incorporate technology into the classroom. When each aspect is balanced, neither receiving too much attention nor too little, shalom is achieved. Of course, because sin exists, shalom is something for which Christians strive as they wait eagerly for Christ's return. For each of the eight aspects, questions are put forth that are not intended to be exhaustive in nature but to provide a starting point for consideration.

The first aspect out of which normative principles come is the formative aspect; it is the ability to plan, create and shape and is the aspect which defines cultural formation. If the formative aspect is abused, technology budgets overtake other aspects of school

resources. Teachers are seen as technicians and students become mere numbers. When educators are careful about formation, they move ahead more slowly, asking questions such as the following:

- Does this software, hardware, or technological periphery allow students and educators to plan, create and shape projects or curriculum?
- Does this technology stifle creativity, forcing teachers and/ or students into a pre-programmed way of thinking?
- Does this technology serve the school community in which it is being used or has this technology been placed there at the expense of other much-needed resources?

The second aspect is the symbolic or linguistic; it is the ability to speak, write, communicate, and express oneself. It is not limited to language alone but can include multi-lingual symbol making. Some possible questions to consider when purchasing and using software are as follows:

- Does the program enhance student's writing, speaking, reading and listening capabilities?
- Does the program allow students to express themselves in various forms?
- Does the program guard against deceit? Is it easy for students to deceive the system or program?
- Does the software guard against plagiarism, breach of copyright, or any other illegal use?

Another of Dooyweerd's aspects is the social aspect; it involves the ability to interact socially, to develop vital relationships, to understand one's place in a given organization and to give proper respect where respect is due. A significant facet of the

social aspect is the ability to communicate. Within a school setting, the people who purchase, service, and run the technologies have an obligation and responsibility to provide open communication concerning the benefits, drawbacks, and ramifications of purchasing and using various technologies. Without open communication, the teaching and learning implications may not be fully understood by the constituents, educators, students, or possibly even the administration. For those who have the task of purchasing hardware and software, they might consider questions such as these:

- Do the program(s) allow for or help students interact in a positive way?
- Does the technology promote respect for self, others, God, and His creation?
- Does the technology demand the attention of the student, or can he or she easily operate the program without engaging in metacognition?

Another aspect out of which normative principles can be drawn is the economic aspect. This modality involves the stewardly use of time, material resources and individual or human resources. If one thinks of the theological definition of economy or ecclesiastical economy, it involves the handling or management of various issues, questions and problems. This definition helps to broaden one's understanding of economy and expands this modality beyond the use of money. Thus, the economic aspect demands that respect be shown not just to the school budgets, but also to God's creation in terms of resources used to create technology and to God's creatures as image bearers. Economics takes on a much richer meaning when questions such as these are considered:

- Has the school allotted time and resources toward the upkeep of hardware and software?

- Have teacher's skills and abilities been taken into account prior to purchasing the various technologies?
- Has the school allotted time and resources toward teacher in-service and training?
- Is the time required to access and use the various hardware and/ or software balanced against the other requirements of teachers and students?
- Is the budget for technology balanced when compared to other elements of the school budget?
- Does the software provide greater benefit for the teacher and/ or the student then some other means or resources?
- How will the school deal with the built in obsolescence of software and hardware?
- After using the various technologies, can those using it truly see the technology as a gift for which to give thanks?

A fifth aspect that helps to form normative principles for working with technology is the aesthetic; this is the modality that concerns itself with harmony between God and His creation, with experiencing joy and delight in the task at hand, with seeing and hearing beauty within created reality. Typically, the hardware and software used are seen as utilitarian; most people do not consider aesthetics when considering technology. However, some questions one might consider when thinking about the aesthetic follow:

- Does this technology allow students to take joy and delight in learning?
- Is this technology easy to use; is it intuitive, or is it frustrating for either the student or teacher?

- Does this technology enable the students to explore the various gifts God has given them?
- Does this hardware or software encourage the user to marvel at God's created reality?
- Is the use of this hardware or software balanced with the use of other learning tools and techniques?

The juridical aspect is the sixth modality that helps to form normative principles for the use of technology. This aspect seeks to preserve the inherent value of all of God's creation, including his image bearers. It requires that God's children take responsibility for that which they have been given and have respect for all people, animals, and other created things. The following questions can help to form the normative principles around this aspect:

- Does this technology (hardware or software) enhance the skills and abilities of the students?
- Does this software provide a lasting benefit to the teacher or student?
- Does this software safeguard students and teachers as image bearers of God with many layers of being or does it reduce them and their skills to mere numbers?
- Does this technology encourage students to take responsibility for their own learning and help them to develop respect for the God's creation?

The seventh aspect that helps to form the principles concerning technology is the ethical or moral aspect. This aspect demands that people put into action the command to love, that people create communities of caring, that they act as servants within the

communities they inhabit. Some ethical and moral questions in regard to technology that help form the normative principles are the following:

- Does this software enhance students' skills and abilities?
- Does this hardware or software improve the curriculum for students?
- Does this hardware or software reduce the overall workload of the teacher? Does it improve his or her ability to complete the work required?
- Does the technology serve the school community?
- Is the technology being used as a beneficial tool for learning?

The final modality out of which principles come is the pistic; this modality brings the ideas full circle, reminding one that all of life, including technology, springs from a faith commitment. It asks if the three tenets, God's dominion, love of God and neighbor of self, and shalom, are being followed when a school seeks to implement a particular technology. This modality reminds one that all of life is religious and the values to which one adheres impact the choice made. To help examine this modality, one might ask the following questions:

- In choosing this technology, this hardware or software, has God's supreme rule been adhered to and acknowledged or is the technology being implemented merely because technology promises progress?
- When examining the software, have the underlying messages been considered?
- Does the software encourage love and care of God's creation and His creatures?
- Does the software help educators strive to nurture and educate children to be Spirit-filled Disciples of Christ and responsible, discerning citizens in society?

Asking and answering the questions each of the modalities brings to the fore is not an easy task, but to do less weakens the witness Christians have as Christ's agents in this world.

Questions for the literacy teacher to help create principles

After having considered all the aforementioned questions, one might ask how this specifically relates to literacy and technology. The question is fair, and for literacy teachers a very real struggle, especially in light of the many options placed before them. Hence, in addition to the questions already examined, a listing of specific questions related to the teaching of literacy needs to be considered.

Aspect or Modality	**Questions to consider**
Formative	• When considering the many pedagogical techniques used to teach literacy, is this the best program to help students in their quest to become literate?
Lingual	• Because literacy deals largely with the linguistic modality, the general aforementioned questions serve the literacy teacher well.
Social	• Does the program encourage students to think about and examine what and how they are learning? • Does the program encourage positive interaction with others and with the material? (eg. If games are included in the program, do they advance the students' understanding and do they promote a constructive versus destructive view.)

	• Does the software encourage cooperation among students or does it promote competition?
Economic	• Does the teacher have the skills to run the necessary hardware and software? • Does the teacher have access to support when there are problems? • What specific benefits, skills or abilities does this literacy software provide? Is this the best way to teach these skills? • Based on past versions of the software program, does the author/ supplier, vendor encourage built in obsolescence?
Aesthetic	• Does this technology allow students to enhance their ability to read and write, and consequently lead to less frustration? • What literacy skills, abilities and gifts does this program build upon or enhance? • How does this software encourage students to marvel at the way language is constructed and the way they learn about it?

Juridical	• How is literacy skills enhanced with this technology? • Does this software provide a permanent, positive change in students' skills and abilities? • How are students' skills and abilities measured with this program? • Does the program encourage students to take responsibility for their own progress in reading and writing?
Ethical / Moral	• How does this program improve the learning of literacy and the curriculum as a whole? • Does this technology support the overall aims of the literacy curriculum? • Does this software reduce the workload of teachers while still giving benefit to students?
Pistic	• Does this technology fill a real, identifiable need? • What messages are inherent in how progress is measured, how the program is run, and how progress is rewarded? Are these messages consistent with a Biblical view of the child?

Summary

The underlying foundations, the three Biblical tenets and the questions raised by Dooyeweerd's modalities all help to form a Biblical, philosophical foundation. Because ideas have legs, these ideas, this philosophy, can give practical guidance to educators and help them become discerning in their decisions concerning technology.

Discussion/ Implications

The responsible use of computers in the literacy classroom must be a concern for all literacy teachers, and the only way to use computer-assisted instruction and information technology responsibly is to reflect on its use, using discernment to make good decisions. To make the decisions, a discussion of the implications of the technology for teaching and learning is essential.

Impact of information technology and Computer-assisted instruction

As with most things, the impact of CAI and IT is both positive and negative. It is clear from the studies that many students show increased comprehension of text after using the CAI programs examined. As was clearly seen in the RITA study, students who struggle also benefit from the repetitive learning tasks that CAI can give. Information technology provides students and teachers with textual aids that help in the process of comprehension, and younger children seem to be motivated by the online publishing medium. Other benefits are more specific to one program or another. The Peabody Learning Lab showed the benefits of a wholistic approach to CAI. With this program, students' learning can be scaffolded, bimodal learning is at work, and the various ways the material is presented appeals to students who have learning styles other than the traditional linguistic style. Additionally, programs such as RITA help the educator to tailor the learning to a specific student, in this case to students whose learning is governed by an individual education plan.

It is clear from the studies that were examined in depth, that CAI and IT can have a positive effect on student learning. Its greatest effect emerges in the area of auditory and read vocabulary, reader comprehension, and reader rate. When spelling, writing

mechanics, phonics and structural analysis were measured, they either had low effect measurements or lacked any positive gain depending on the study. Still, as the RITA study showed, there is a place for technology, especially CAI, when repetitive learning is required.

There are diverse drawbacks to CAI and IT. Three of the issues are not specific to literacy instruction but are inherent to a discussion of technology. The first that impacts schools across the spectrum is the cost involved in hardware and software purchasing and upkeep. These costs need to be balanced against other aspects of schooling, a task that can prove to be complicated. A second drawback involves a societal tendency to believe that technology will provide a panacea for the problems education encounters, including the problem of illiteracy. In the words of Postman (1985), "…we believe nothing if not that history is moving us toward some preordained paradise and that technology is the force behind that movement." (p. 158). Monsma et al (1986) reiterated Postman's idea:

> The technical prowess of human minds and hands is worshiped so devoutly that questions or purpose, ends, and direction never arise. Under technicism society constructs a definition of the good based on means, which it has elevated to a position of genuine moral purpose. Thus we streamline methods, increase sophistication, and improve speed – all apart from God-directed ends or discernible purposes.
>
> Computers, for example, invade classrooms without a clear philosophy of education to orient them. The rhetoric promises a decisive edge for schools equipped with the latest computer hardware. After all, computers are 'modern,'

> technologically sophisticated. A technicistic society makes the facile assumption that a computer- based education is a better education (pp. 211 – 212).

When a Biblical philosophy is foundational and serves to guide technological decisions, this weakness can be minimized.

A third possible shortcoming stems from the trust society has in technology. It is the notion that a specific program or technology should be used because it is entertaining and motivates the learner. Many proponents of educational technology use student motivation as a selling point. This was clearly seen in studies such as the 2005 Lefever-Davis and Pearson study and the 2002 Hobbs study. This concern is address briefly in the Merit Reading study and more extensively in Merit Software's *An Insider's Perspective on Educational Software: 10 Secrets the Educational Software Industry Does Not Want You to Know* (2008). In this Internet brochure, one of the secrets it reveals is that students do not need to be entertained to be engaged. Granted, this is one company's perspective on motivation, but it is not alone in this viewpoint. In discussing television's impact of education, Neil Postman (1985) stated, "No one has ever said or implied that significant learning is effectively, durably, and truthfully achieved when education is entertainment" (p. 146). When student motivation becomes one of the primary reasons for the use of software and hardware, questions concerning the philosophical underpinnings for the use of the technology need to be asked. John Dewey's (1938) words provide some fodder for thought, even for the educator who is not guided by a Biblical perspective:

> Perhaps the greatest of all pedagogical fallacies is the notion that a person learns only what he is studying at the time. Collateral learning in the way of formation

> of enduring attitudes…may be and often is more important that the spelling lesson or lesson in geography or history… For these attitudes are fundamentally what count in the future (p. 48).

It is essential that educators ask what is being taught in addition to the stated curriculum of the software. Without the questioning, educators risk encouraging students to believe the work they do must be entertaining and to describe that which is not as "boring" as was the case with many of the students who took part in the CACSR study.

A fourth weakness that can result from the use of various CAI is reader passivity. This is especially a problem for students who use CAI to assist them in learning to read. The Lefever-Davis and Pearson (2005) and the MacArthur et al. (2001) studies were just two studies which pointed out that students who struggle to read will often simply allow the program to read for them and not engage in the process. Closely related to this issue is the problem of reader distraction. As Korat and Shamir (2007) pointed out, programs with less animation often resulted in the best gains for students. The more animation, the more students were attracted to it rather than to reading. Both these issues are hinted at in the statement by Merit Software that students do not need to be entertained to be engaged. It may prove beneficial to specifically choose software that contains little or no "edutainment" when selecting software.

A fifth obstacle about which educators should be aware is the lack of divergent thinking that is allowed when using CAI. Because CAI is developed by people who program an expected outcome in order for a person to move on in the course, any student who thinks differently will face a series of "wrong" answers. Postman (1992) wrote, "embedded in every tool is an ideological bias, a pre-disposition to construct the world as

one thing rather than another, to value one thing over another, to amplify one sense or skill or attitude more than another" (p. 13). In CAI, a world is constructed for the learner, a world that can force the learner into a particular way of thinking. That does not mean that CAI has no value, but for those who use CAI, they need to be cognizant of how the programs are developed and use them only where appropriate.

A series of drawbacks should be noted concerning the use of information technology. The first is the many extra hours required on the part of teachers in order to incorporate IT into their curriculum. As was noted in Karchmer's (2001) study, "… all of the teachers, … stated that using the Internet in their classroom on a regular basis increased the amount of time they spent on school related work" (p. 456). This increased time amounted to three to four hours of additional preparation time for every lesson in which a teacher choose to use Internet material.

The second disadvantage of IT use which requires consideration is the sheer volume of material found on the Internet. As Monsma et al. (1986) pointed out, as the "amount of information increase[s], the ability to understand and critique decreases" (p. 232). Without an ability to properly understand and critique material, people loose a sense of wisdom concerning the information and what the information means for them as they relate to themselves, to their neighbors, to God, and to his created world. The volume of material might also be a contributing factor to the increased workload for teachers who choose to use IT in the classroom.

A third difficulty with using IT in the classroom centers on the safety of students who use the Internet. To protect students, educators have used various blocking programs and education of the dangers involved with revealing information over the

Internet. Still, it is a concern not just for the teacher who asks students to research, but also for parents who often understand the dangers to a far greater degree than their children do.

Finally, the accuracy of IT material can prove a hurdle for teachers. Students need additional skills if they are going to effectively use electronic media. These skills need to be taught by teachers who understand the world of IT; the skills add another layer or branch to the world of literacy, a category of education that seems far broader than the hours allotted for students to gain a grasp of its essentials. Still, as was demonstrated in the Karchmer's (2001) study, many teachers have found ways to incorporate the learning and have engaged students in significant metacognition as they have gone through the process.

There are many limitations when considering CAI and IT. Still, when the use of CAI and IT is carefully considered, the benefits can prove effective for students in their acquisition of literacy. As with all things, when discernment is used and the philosophical, the beneficial and the detrimental implications are considered, wise choices can be made concerning the use if CAI and IT.

The role and extent of use

As one might deduct so far, this researcher does not believe CAI or IT could replace the human teacher. Yes, there are definite areas where these types of technology help the educator in his or her job, but it seems unlikely that it could ever replace the teacher. Of course, this area definitely needs more research before a scientifically defensible argument could be made. However, in both the RITA study and the Merit Reading software study, the researchers make it clear that the programs are best used in

conjunction with the current curriculum and teacher. Merit Software, in commenting on its own product, states that the teacher is critical to the success of a child (Merit Software, 2008).

The question then is what should be required of teachers in their knowledge of CAI and IT? As more and more school districts mandate the use of technology in various parts of the curriculum, it becomes imperative that teachers are prepared to use it wisely. The Karchmer (2001) study highlighted two areas worth of note. First, teachers must be prepared to use their own technological, literacy skills. This means teachers need to be taught in college or in staff development how the technologies work. Second, teachers need to work at integrating technology into the curriculum rather than teaching and using it as a separate entity. Additionally, educators, Christian or not, need to become thoughtful about the technology they use, why they use it, how it is use, and where and when it is used. Only then can they claim to be discerning about technology, only then will wisdom be gained, and only then can they claim that they are trying to use technology in the way God intended. This one area requires much more research. As Karchmer (2001) pointed out, in 1999, 80 percent of teachers did not feel well prepared to use educational technology in their teaching. Although the statistic is over ten years old, the situation has not changed for many of the older generation. With governments spending over ten times more on software and hardware than on teacher training (Karchmer, 2001), the issue of how to prepare and support teachers in their use technology is paramount for schools who wish to make use of the resource. For the younger and older generation, the issue of a guiding philosophy needs to be brought to the fore or schools will continue to fill computer labs with hardware and software without

an understanding of God's Biblically designed ends. This too requires Biblical thought and more research into how such ideas become foundational to educators' thinking.

Guiding Principles

If educators and parents are serious about training up children in the fear and knowledge of the Lord, they need to think seriously about the type of technology in the schools and the ways the technology is being used. As a base, they need to recognize that technology is a gift from God but a gift over which God has dominion. Teachers, administrators and parents must operate out of the Biblical, normative principle of love, love of their neighbor and God. This group of people must also be committed to creating shalom within the community they operate, recognizing that true and complete shalom is impossible until Christ's return. With these tenets as a base, the educational community needs to form guiding ideas. In this case, Dooyweerd's modalities were used as a starting point because of the breadth of life the aspects cover. However, it is recognized that Dooyweerd's modalities become quite cumbersome and might be overwhelming for some. Different ways to develop a complete set of guiding principles may prove interesting for further research. If educators and parent desire to raise wise children, they need to be wise and discerning in the decisions they make, including the decisions they make concerning technology, and how technology is used to teach literacy.

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