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When and how should keyboarding be taught in the elementary school?

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Abstract

This literature review addresses the topic of when and how keyboarding should be taught in the elementary school. It is apparent that keyboarding needs to be taught in the elementary school, but when and how formal keyboarding instruction should be taught is still in question. The review of the literature indicates that there is no concrete answer as to when keyboarding should be taught in elementary school. Most of the research says that instruction should begin one year prior to student use of the computer. As to how to effectively teach keyboarding, it seems that it is a conglomerate of the instructor, software, and modeling. It takes all three components to make a successful curriculum. Ultimately, it is the responsibility of the school district to evaluate the relevant issues of keyboarding and structure a keyboarding curriculum that is appropriate for its students.

WHEN AND HOW SHOULD KEYBOARDING BE TAUGHT IN THE ELEMENTARY SCHOOL?

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Abstract

This literature review addresses the topic of when and how keyboarding should be taught in the elementary school. It is apparent that keyboarding needs to be taught in the elementary school, but when and how formal keyboarding instruction should be taught is still in question. The review of the literature indicates that there is no concrete answer as to when keyboarding should be taught in elementary school. Most of the research says that instruction should begin one year prior to student use of the computer. As to how to effectively teach keyboarding, it seems that it is a conglomerate of the instructor, software, and modeling. It takes all three components to make a successful curriculum. Ultimately, it is the responsibility of the school district to evaluate the relevant issues of keyboarding and structure a keyboarding curriculum that is appropriate for its students.

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Introduction

What once was a novelty in the elementary school has now become a staple. Computers appear to have made their way into the classroom and are being used as tools for learning. "Some of these children have even come to rely on the technology for all of their writing, and will likely continue to do so for the rest of their formal school and adult life" (Owsten & Wideman, 1996, p. 1).

If for some reason these computers have not found their way into the classroom, they soon will. According to a study done in December of 1994, more than 18.1 million computers were in our nation's 109,000 public and private K-12 schools (Bialo & Sivin-Kachala, 1996, p.1). With such a large number of computers available as a learning tool, when and how will children learn to properly use them? It is not a question of whether keyboarding should be taught to students, it is a question of when and how it should be done.

The justification as to why keyboarding should be taught is simple. Our society has become one that is geared toward technology. More than fifty percent of the workforce uses a computer in its daily job (Bartholome, 1996). Students of today need to know how to keyboard properly and effectively if they are to be successful in the future. In 1996, it was found that the number of United State's homes with personal computers was over 37 million. This number was expected to rise by 16% annually (Bartholome, 1996). This would mean that today at least 80 million homes have a personal computer. One web site (National semiconductor, 2002) states that for the year 2000, 52% of homes in the United State have access to the Internet. Children have access to these machines both day and night. Nearly 72% of 8 to 12 year olds have spent time on a computer

within the past 30 days as well as 55% of six to seven year olds (Bartholome, 1996). Without proper education, these children will learn and practice incorrect methods of inputting information into the computer.

It has been shown that developing keyboarding skills requires constant reinforcement and teaching in order to maintain the desired skills (Olinzock, 1998). Instead of children developing poor keyboarding habits such as hunting and pecking, it is important that they learn the proper way to touch type and use it regularly. This will allow the students not to have to relearn the correct method.

Elementary educators, middle and high school business teachers, and business professionals have discussed the great debate of when elementary children, grade kindergarten through fifth, should begin keyboarding at length. It seems that each group has its own viewpoint on when children should begin keyboarding. While the business teacher may feel it is necessary for young children to learn touch typing, some elementary educators disagree by saying that children are not developmentally ready for such a task at a young age. Elementary educators also feel that there is not enough time in an already saturated elementary curriculum to teach touch-typing (Olinzock, 1998). This task should be left to the middle and high school business teachers. Who is right and who is wrong?

This leads one to ask, when and how should keyboarding be taught to elementary students? While viewpoints differ as to when and how to teach keyboarding to elementary students, it is clear that it is an issue that requires attention as an increasing number of students rely on computers for communication and learning.

The results of this review may be applied in the elementary teachers' classroom as well in elementary schools' curriculum. By understanding how and when children in the primary grades attain both gross and fine motor coordination, one can then implement the results in an elementary classroom.

Currently, at Horizon Elementary in Johnston, Iowa, the students are using software programs entitled, *Type to Learn*, *Type for Fun* and *Type to Learn Junior*. These programs are introduced in the second grade and are written into the standards and benchmarks of the district. By using the information gained from this review, Horizon Elementary, and others like it around the country, will have the information needed to make an informed keyboarding decision for their students. A decision such as this needs to be based on research and facts. The goal of this review is to prepare the facts for educators so that they can provide their students with a research-based keyboarding curriculum.

Methodology

The researcher used three different methods for identifying and locating sources of information for this review. The first method implemented was a search on the World Wide Web. By using a variety of search engines and terms, the reviewer was able to locate several reliable sources of information. The author started her search broad and then narrowed the focus as it became apparent that there were many issues surrounding this area of review. For example, keyboarding was a keyword used in the beginning. At the end of the search, the keywords more specifically focused on skills that dealt with keyboarding such as manual dexterity. In the end, the scope of the articles collected

varied from general such as technology, to specific such as keyboarding in the primary grades. The second method for identifying and locating sources was through Heartland Area Education Agency's Professional Library. The professional librarian aided in the review by providing an AskEric search. This provided the reviewer with many pages of journal article summaries that were pertinent to the topic. The reviewer selected articles based on the abstract and title. The Heartland librarian then provided these articles to the reviewer for inspection. Three different AskEric searches were completed to ensure that all of the areas had been covered. A majority of the articles were obtained from the library at the University of Iowa. While additional sources were sought, many were not available from either the Drake Library or the University of Iowa's library.

Finally, the author employed the Drake University Library. A day of research was spent reading in books, journals and other periodicals. The author also looked at the reference sections of articles that were relevant and found additional articles. These provided both applicable and worthy information for the review.

After having read through the written material, the author decided which sources were appropriate. The criterion used to select materials was simple. The author based her review on timeliness and relevancy to the topic. Articles that were written within the past ten years were used for a majority of the review, although the reviewer did find some pertinent information in articles of earlier dates.

Literature selected also had to be relevant to the topic. Each article was read thoroughly for any applicable material. If the material was not on the primary level, the author discarded it. While researching the topic, the author wanted to be sure that the

articles provided unbiased research. This is important because many times an author's view can be skewed because of his/her profession or interest in the subject.

Another point that the author considered was having a variety of authors who were experts in the field of keyboarding. The researcher wanted diverse perspectives so a proper conclusion could be drawn.

After collecting and selecting sources for the review, the process of analyzing each source commenced. This was done by reading through all of the articles found on the Web, in journals, and reading pertinent excerpts from books. Important information was then selected based upon its relevancy to the subject, while other sources were discarded due to bias or unfounded results. All of the important data was then transcribed so that the author could obtain a clear picture of the paper's direction.

Analysis and Discussion

"Keyboarding is a cumulative psychomotor skills involving the touch method of input to a keyboard" (Keyboarding instruction, 1999, p.1). The objective of keyboarding education is to allow children to become more proficient in computer use and to avoid the re-teaching of keyboarding skills. Texas, New York, Virginia, and Minnesota are a few of the states that now require keyboarding class beginning in the fifth grade. These states mandate not only the amount of instructional time that will be spent on keyboarding but also specify speed and accuracy standards (Erthal, 2002). One wonders how many more states will follow in the same footsteps.

It seems that children are excited about learning to keyboard properly. Kaake (1983) and Hoot (1986) reported that of 50,000 children in grade kindergarten through

sixth, 91% when given the choice to write by hand or type, chose the latter. It appears that students are motivated by the computer and are eager to learn more about it. With this stated, the author will now analyze and discuss when and how keyboarding should be taught in the elementary school.

Many agree that formal keyboarding instruction should come one year prior to the start of using keyboarding or computer applications (Prigge & Braathen, 1993; Waner, Behymer, McCrary, 1992). Texas Guidelines (1987) suggest that there are two indicators as to whether a child is ready to keyboard. The first indicator is that student has the ability to independently move his/her fingers, and secondly he/she has a need for keyboarding knowledge.

Robinson (1992) believes that children should learn to keyboard when they have a need to communicate. This need could be their personal lives or for school assignments. Prigge and Braathen (1993) feel students should develop their keyboarding skills before they learn to hunt and peck and the Instructional Resource Branch of Curriculum and Instruction Division of Saskatchewan Education (1999) suggests that keyboarding instruction should begin before pupils make extended use of the computer for writing.

The Policies Commission for Business and Economic Education suggests that students should be introduced to keyboarding in the elementary grades (Bartholome, 1996). Prigge and Braathen (1993) agree with this by saying that students need to learn keyboarding skills and techniques before using a computer.

It appears that there is more than one benefit to learning touch-typing keyboarding. Students are more enthusiastic about using the computer for their writing when they know how to touch-type (Texas Guidelines, 1987). Students who were able to

type showed greater progress in spelling than non-typing students. Third and fourth grade students also increased their reading comprehension by four months and vocabulary by seven months (Hoot, 1986). The control group in the project demonstrated a loss in all areas. Other research found that the children's self-esteem improved and there were no signs of competitiveness. (Kaake, 1983). Finally a study by Wronkovich (1998) reinforced the findings that elementary children could learn to use a keyboard while at the same time improve their language arts and reading skills.

Developmental Appropriateness

So why delay the teaching of keyboarding to elementary students? The topic of when to teach keyboarding or touch-typing to elementary students is a hot subject. There are many people who have different views and reasons for when keyboarding should be taught. The first view is based on the child's development. Finger size, manual dexterity, coordination, fine motor skills and attention spans are all factors in deciding when a child is able to touch-type.

When children's fingers are smaller than the keyboard, it can be difficult for them to reach all keys (Waner, Behymer, & McCrary, 1992). The authors point out that even some high school students cannot key properly because of their fingers are not long enough for the keyboard. One company, Datadesk Technologies, produced a solution to this problem: a smaller keyboard, known as Little-Fingers® (Feutz, 2001). Some schools are seeing this as one answer to the problem. The developmental issue of small hand size and large keyboard size is an area addressed by Kahn and Freyd (1990a). "The prescribed reaches of touch typing were designed for adult hands" (Kahn & Freyd,

1990a, p. 42). These researchers felt that younger students focused more on their spelling than using the correct finger for the correct key.

While finger size is important, Denkla (1973) found that finger dexterity or movements in children are related to both their gender and age. It seems obvious that older children would possess faster finger movements than their younger counterparts. It is not as obvious that gender would play a role. A study by Denkla (1973) of 20 children ages five to eight, ten boys, and ten girls, examined both the successive and repetitive finger movements of the children. It was found that girls outperformed boys at all ages with regards to successive movements and only boys at age five were more proficient than girls at repetitive movements. Denkla (1973) attributed these findings of sex difference to the maturation of the cerebrum. It is interesting to note that no other studies found this difference in the genders (Wronkovich, 1998; MacIntyre, 1990). Wronkovich (1998) did find in his study, that fifth and sixth grade students possess the finger coordination needed to effectively touch keyboard. At the conclusion of his research it was found that the students could key 34.4 words per minute in three-minute testing periods.

Developmentally, some researchers believe that keyboarding is too abstract of a skill to learn at a young age. In order for the skill of keyboarding to be mastered, one must be able to let his/her fingers flow freely (Waner, Behymer, & McCrary, 1992). This concept is backed by Bloom's idea of automaticity as discussed by Wronkovich (1998). Automaticity is defined as a " system of automatic habits corresponding to the system of tasks" (p. 43). Keyboarding is a skill that requires this "system of automatic habits". For example if one were word processing and trying to concentrate on what each finger was

doing, the whole process would fail. The entire point of teaching keyboarding is built on ideas, not the typing process (Wronkovich, 1998).

Dewey and Piaget believed that learning is "rooted in action" (Kaake, 1983, p. 643). Keyboarding is an action that requires cognitive, affective, and psychomotor skills. Children ages six to twelve, according to Piaget, are in the concrete operations stage. This stage is characterized by the student being able to cognitively process the skill of touch-typing. It is important to remember that while students are able to perform this skill, they still have different learning styles. This needs to be taken into consideration when designing keyboarding curricula (Kaake, 1983; Cuffaro, 1984).

The development of fine motor skills definitely plays an important role when examining the touch-typing process. Starr (2001) states that young students are just beginning to develop their large muscle groups. The older the students are, the more time they have had to develop their smaller muscle groups. These are the groups of muscles that take extreme precision to operate. This precision can be seen in cutting, printing or tracing.

Opponents of keyboarding instruction feel that students first should learn the skill of handwriting. Pisha (1993) wonders why keyboarding is not taught before handwriting in the elementary school stating that it is easier to type on key on a keyboard than to write one letter with a pencil. He found that handwriting requires five distinct motor skills in order to compose one letter. Pisha (1993) notes that keyboarding requires less physical and cognitive demands than handwriting. It does seem strange that one requires students to struggle with such a difficult psychomotor task without hesitation, but when the topic is keyboarding there is no hesitation on the part of the teacher.

While elementary teachers argue that there is not enough time in the day to teach keyboarding, Pisha (1993) suggests that teachers take some of the time allotted to handwriting and devote it to keyboarding. He found that kindergarten through third grade classroom teachers spent an average of eleven to twenty minutes daily on handwriting. The author wonders if this time could be used in a more effective way by dividing the time between the two topics. Students receive formal instruction on how to form letters, should they receive instruction on how to keyboard correctly?

Touch-Typing Versus Familiarity

The issue of whether to teach touch-typing or just have the students become familiar with the keyboard and use the hunt and peck method is a strategy that has increased in popularity. This support is based upon several research studies that have been completed. The first study done by Kahn and Freyd (1990a) suggested that even though they received no formal training in typing, second, third and fourth graders became more familiar with the computer as they wrote and preferred the computer as a writing tool versus having to learn touch-typing on the keyboard.

In another study by Kahn and Freyd (1990b) it was found that five-minute practice sessions dealing with familiarity of the keyboard versus touch-typing produced better keyboarders initially. The problem with students only becoming familiar with the keyboard instead of learning touch-typing is that it causes the student not to be able to type as fast as they write by hand. This idea was backed by Pisha (1993) who found that students gradually learned the keyboard on their own through hunting and pecking, but eventually, they were not able to achieve the same speed as students who learned to touch

type. Hunting and pecking relies too much on visual feedback. This proves a waste of time for the student (Pisha, 1993).

Finally, Rosegrant (cited in Pisha, 1993) studied four and five year olds. His research revealed the fact that these children were able to develop search strategies for locating individual keys. Children are able to quickly pick up speed by using a typing software program (Hoot, 1986). "Familiarity can be achieved without placing additional demands on the early childhood curriculum" (Hoot, 1986, p.99). This supported the strategy of teaching familiarity of the keyboard may be best for younger students (Hoot, 1986).

By having the students learn touch keyboarding, one allows them to concentrate on problem solving and composing rather than mechanics (Texas Guidelines, 1987). Hunting and pecking typing requires conscious attention to the fingers. The student then spends more time focusing on how to keyboard than actually composing a paper (Texas Guidelines, 1987).

Robinson (1992) disagreed with this by stating that keyboarding by familiarity will allow students to achieve computer literacy goals at a young age. There is no reason to place a demand on early childhood teachers to begin instruction on keyboarding. Other supporters of the "keyboarding by familiarity" approach, state that it only takes twelve hours of formal keyboarding instruction to undo any bad habits that may have formed (Kahn & Freyd, 1990b).

Handwriting and Keyboarding

A comparison has been made between teaching printing and cursive forms of handwriting to teaching the hunt and peck and touch typing methods of keyboarding.

The argument has been made that printing is a transition to writing in cursive. Therefore, hunting and pecking is a transition to formal keyboarding (Waner, Behymer, & McCrary, 1992).

Kahn and Freyd (1990b) talked of how the primary focus in early handwriting is legibility not formation of the letter. This would mean that the primary focus of keyboarding should be finding the correct letter, not hand positions or fingering patterns.

The reviewer disagrees with this proposition. In her third grade classroom, she has to spend time re-teaching students how to form print letters correctly because they are illegible. It is disheartening to have to spend so much time on this, but if it is not done, the student will have a difficult time with cursive.

According to Kahn and Freyd (1990a), "Printing is not seen as a bad habit," (p. 41) but as a transitional skill. Teachers spend a lot more time on the teaching of cursive handwriting compared to the amount of time it takes to teach keyboarding to students (Kahn & Freyd, 1990b).

Studies have found that students who are able to write by hand quickly are able to type quickly (Kahn & Freyd, 1990a). There has also been research to support the fact that students do not lose handwriting skills when they learn to type (Kaake, 1983; Pisha, 1993). Hopkins (1998) disagrees with these studies, saying that students' handwriting will suffer. With this suffering also comes a loss of hand-eye coordination due to the fact that children are not able to look at their hands when keyboarding. Interestingly enough, kindergartners were found to compose more meaningful text earlier with keyboarding, than with writing using a pen or pencil (Kahn & Freyd, 1990b).

Whole Language Theory and Keyboarding

Supporters of the whole language theory believe that keyboarding conflicts with their philosophy and is not developmentally appropriate for children (Waner, Behymer, & McCrary, 1992). In the end, they feel the students will be turned off by computers and no longer be excited to use them. They want the students to learn to focus on the product rather than the process. According to Kahn and Freyd (1990a), "research indicates that for very young children, physical production of text claims attention and therefore interferes with the ability to compose" (p.45). They suggest that keyboarding in the kindergarten and first grade classrooms is not necessary because children spend as much time deciding what letter to type as it takes to find the letter on the keyboard. The focus is on making meaning, not the students' handwriting.

Then there are those who support the whole language theory, but feel with early keyboarding instruction, the student can then focus on the product and not the process. By learning keyboarding in the early grades, they can change their focus in the later grades (Waner, Behymer, & McCrary, 1992). Kahn and Freyd (1990b) believe that there is too much emphasis on fine motor skills during the composition of text. This makes both writing and typing difficult for young students. The researchers feel that it is not necessary to have extensive preparation before using the computer as a writing tool.

Finally, the topic of young children not having the attention span to sit and keyboard is discussed in the literature. Wronkovich (1998) found that attention span was not a factor in the development of small movement skills. It also appeared that as students became more proficient at keyboarding in relation to skills improvement, their attention span increased as well (Kaake, 1983). While opponents will say that a five-

year-old does not have the attention span to sit at a computer and learn how to keyboard, research has demonstrated otherwise.

Best Age to Teach Keyboarding

So when is the best age to begin teaching keyboarding to elementary students? Research provides no magic number. Bartholome (1996) found that third grade is appropriate for touch keyboarding, but first and second graders could learn this skill as well if given instruction three days a week for thirty minutes. The Instructional Resource Branch of Curriculum and Instruction Division of Saskatchewan Education (1991) agrees with keyboarding beginning in the third grade. If the student can play the piano, he/she should be able to keyboard effectively. The author goes on to argue that kindergarten through second grade should be a time of readiness for the child. The students can be learning about the home row keys, correct posture, etc.

Contrary to Bartholome (1996) and Saskatchewan Education's (1991) findings, Erthal (2002) found that third graders do not possess the manual dexterity to keyboard. She feels that keyboarding is best left to students age ten to twelve. Stating that fourth through sixth graders exhibit greater "smoothness and command of small muscle expression" (p. 1).

Pisha's (1993) study, supports Bartholome's (1996) findings by saying that students in the third grade can master touch-typing if given thirty hours of instruction a year. This needs to be done over a two to three year period in order to attain the best results. Bartholome continued to cite several studies that have shown that preschool and elementary students can use a keyboard. Another study found that second graders and some younger students were able to keyboard (Feutz, 2001). While the younger children

may be capable of keyboarding, Bartholome said that many feel that fifth grade is the right time, but he, himself, felt differently. He believes that students should learn to keyboard as soon as they begin inputting information into a computer (1996).

By the fifth grade many bad habits have already been instilled in the students. The research done by MacIntyre (1990) indicated that formal keyboarding should not begin until the fifth or sixth grade. This supported Wronkovich's (1998) claim as well.

Boone (n.d.) agreed with Wronkovich (1998) and MacIntyre's (1990) claim, suggesting that young primary children do not have the ability to keyboard with ten fingers, but he did feel that they could still learn to use the keyboard productively. For example have the student use his/her thumb for the spacebar and correct finger for the shift key. He/she can also learn to differentiate between keys on the left and the right. Formal keyboarding should not begin until fourth grade said Hopkins (1998). Prior to the fourth grade, students do not possess the necessary coordination to effectively keyboard. Waner, Behymer, and McCrary (1992) disagree stating that it is not a question of whether young children can learn keyboarding skills, but rather if they should. Those authors took the perspective of an elementary educator saying that it is not psychologically or physically appropriate for a young child to learn to keyboard (Waner, Behymer, & McCrary, 1992).

Finally, Starr (2001) found that students in third grade should learn the keyboard. At this age they possess the necessary skills to keyboard. She compared the keyboard to math facts. Students in the third grade are expected to memorize their math facts. This is then a building block for fourth and fifth grade. This can be applied to learning the keyboard as well. Students will learn the skills for keyboarding in third grade and then

build on those skills in succeeding grade levels. She does not feel that pre-kindergarten students are developmentally ready for such a task.

While it seems that one could conclude there is no perfect time to begin keyboarding, it does seem obvious that it is a skill that needs to be addressed in the elementary curriculum at some point. It is necessary for school districts to examine their pedagogical philosophies and determine when and how keyboarding instruction would be best aligned with their institutional beliefs. The debate of whether keyboarding is necessary before students learn to word process or whether it simply turns them away from a useful tool may keep schools and state departments on opposite sides (Kahn & Freyd, 1990b). Ryan (1997) found that those students who showed the most gain in keyboarding were those who used the computer at home.

How to Teach Keyboarding

Once the school district decides when keyboarding should be taught, the question of how to effectively teach the skill arises. The topic of how to teach keyboarding goes back nearly 100 years to the beginning of typewriters. How to teach keyboarding is based on the research of business educators (Bartholome, 1996). Touch-typing has been taught in the public school system successfully since 1915 (Kahn & Freyd, 1990a). The consideration of who is teaching keyboarding to the students is important. Sormunen (1991) found that only 12% of teachers have had formal preparation in teaching keyboarding.

It is important that keyboarding programs that are being created embrace change. Hoggatt (1998) believes that there are five major areas to consider when writing a keyboarding program. These components are the learner, teacher, curriculum, resources

and administration. Without all five of these areas, it is impossible to create an effective master-keyboarding plan.

While keyboard familiarity is a topic in regards to when to teach keyboarding, it is also a topic in how to teach keyboarding. Hopkins (1998) believes that it is important for the students to become familiar with the keyboard. It is important to introduce to the child at a young age to use the left hand and right hand.

Instructional Time for Keyboarding

One question that many educators wonder is how much time should be spent on keyboarding? Studies on this topic provide a variety of answers. Current research indicates that students of late receive less than ten hours of keyboarding instruction (Sormunen, 1991). Boone (n.d.) found that less than fifty hours over three elementary school grades was a sufficient amount of time to produce proficient keyboarding skills. A program of 35 minutes a day for four weeks appears sufficient from research results produced by Robinson (1992).

It is important to keep in mind that reviews are needed to maintain the ability to touch-type. Robinson's research (1992) revealed that keyboarding instruction was most effective when spread out over several years and designed to build on the student's prior knowledge. He concluded that a minimum of 15 hours be spent on instruction a year. One thing that is reiterated throughout the research is that once skills are taught it is important to use them, reinforce them and refine them (Texas Guidelines, 1987; Adams, 1984; Wronkovich, 1998).

The Brain and Keyboarding

Before discussing how to teach keyboarding, it is relevant to understand how students learn to keyboard. Keyboarding is a kinesthetic skill. It requires the learning of fine motor skills that are achieved through a gradual blending of smaller sub-units of motor control (Pisha, 1993).

Robinson (1992) has found that students learn where the key position is quickly, but must continue to practice. This practice helps the learner achieve what Robinson calls the kinesthetic response rate. This is the rate at which the learner can type as fast as his/her flow of thought.

Students first learn the location of the keys and how to stroke the keys both firmly and rhythmically. Then the student can combine letters into words. It is important for early keyboarding instruction not have words with meanings. This interferes with the motion of keyboarding (Starr, 2001).

The muscles in one's hands create this motion. Its function is to memorize the key location. Starr (2001) compares this hand memory to that of riding a bike. This is why it is important to teach posture, home row keys etc, because all of these things come back with the memory of keyboarding. Keyboarding is a motor skill. It requires the fingers to be trained to respond correctly and quickly. Just as athletes practice over and over again for his/her sport, this is necessary with keyboarding (Starr, 2001). It takes practice (Bartholome, 1996).

Starr (2001) found that in the beginning, this motor skill is stored in the neocortex of the brain. The neocortex is responsible for conscious thought. As the skill is developed it moves into deeper areas of the brain that bypass conscious thought (Starr,

2001). Sladden (1997) points out that this can be difficult for younger students. Because the ring finger and middle finger are shared by the same nerve, the brain can sometimes confuse the signals, which could lead to confusion during the early stages of keyboarding. Sladden (1997) reminds his readers that "Learning to keyboard is a complex language-based motor skill that requires the ability to synchronize mind and body" (p.3). This idea goes back to Bloom's concept of automaticity of how the entire process would be ineffective if the student had to focus on what each finger was doing (Wronkovich, 1998).

Because keyboarding is a kinesthetic skill, it seems clear that students should not look at the keyboard monitor while typing (Boone, n.d.). Starr (2001) contradicted this by allowing students to look at the keyboard. Her reasoning behind this was that it helped to build the hand-eye coordination of the student.

West (1967) tends to agree with Starr's (2001) view stating that not only does hand-eye coordination improve, but it helps students reduce anxiety and provides guidance for making responses. In the end, students will benefit most with instruction that allows hands-on interaction with the computer (Robinson, 1992). Therefore, it is important to have a keyboard for every student in the room (Bartholome, 1996; Kahn & Freyd, 1990a).

Keyboarding Software

The integration of software programs into keyboarding instruction has shown positive results. Olinzock (1998) believed that software should be in addition to an instructor. The programs can help to individualize the curriculum. Boone (n.d.) found that software-generated lessons provided just as an effective program as those created and

directed by the teacher. Even though it is an effective program, he felt that it is still best if the teacher is there to monitor and make sure directions are followed. Kahn and Freyd (1990b) agreed with this and also stated that only older children should use the typing programs. The younger children should be focused on familiarizing themselves with the keyboard. Robinson (1992) recommended a program that includes both an instructor and a software tutorial.

While many feel that keyboarding software should be a part of balanced keyboarding program, there are others who disagree. Sladden (1997) found that many programs such as *Mavis Beacon*, *Type to Learn*, etc, are based on a behaviorist approach. The programs stress the home-row keys and a conditioned response. In order to move on to the next step or level, the student is required to demonstrate accuracy and speed. These methods arose from the days of the secretary having to efficient at what he/she did. Robinson (1992) believes that students do not need the touch-typing skills of secretaries. The idea of students using the word processor is for the composition of writing not dictation.

Today one strives for students to use thought processes which require higher order thinking skills (Sladden, 1997). This is in contradiction with the thought that technique should be stressed first in a keyboarding program (Bartholome, 1996). Erthal (2002) also found that software can enhance a keyboarding curriculum but it should not take the place of the instructor. According to Erthal (2002) most software violates students' psychomotor skill development.

Keyboarding in the Curriculum

Where should keyboarding come in the daily curriculum? Some believe that it should be an integrated part of other subjects, while others feel it should be an isolated skill. Waner, Behymer, and McCrary (1992) believe that because keyboarding is a communication skill, it should be taught as part of the language arts curriculum while still being integrated into other subject areas. Integrating keyboarding skills with classroom activities is an option for Sormunen (1991). Contrary to Sormunen, Bartholome (1996) found that keyboarding should be taught independently. They don't feel that there should be integration. This is a decision that might be better left to the individual teacher.

The order of how the keyboarding skills are taught is significant. Bartholome (1996) recommends starting with a foundation and building on the student's knowledge and skills. Let the students become familiar with the keyboard. This helps to facilitate learning (Kahn & Freyd, 1990a). The first thing that needs to be stressed with any keyboarding program is that the process is more important than the product. Therefore, technique is the first skill stressed. Accuracy and speed do not play a role in the program until later (Bartholome, 1996; Robinson, 1992). The introduction of keys should be introduced randomly (Bartholome, 1996). Most models follow the home-row key placement of fingers. Students learn these eight keys and their fingers always return to these keys after striking other keys. Once the keys have been introduced and students have learned the proper technique, the instructor should focus on speed. Accuracy should be the last item that is covered in the program (Texas Guidelines, 1987).

Several studies show that direct instruction and student monitoring are essential when students are learning to keyboard. By modeling the instruction, the teacher is

helping the student develop fine motor skills (Texas Guidelines, 1987; Instructional Resource Branch, 1991).

Activities that are introduced to students should be varied and change frequently. This will help keep the lessons fresh and exciting for the students. A weekly review lesson is suggested after formal lessons have been completed (Instructional Resource Branch, 1991).

In the Nebo School District located in Utah, keyboarding instruction is based on technique. Direct instruction is used to teach the student touch-typing. Peer tutoring is used for the students as well. Students are aware of their progress through the keyboarding program. It has been found that when students know how they are progressing, their efficiency of learning increases (Bartholome, 1996). Therefore, it is important to let students know how they are doing through both positive reinforcement and speed and accuracy rates.

In the end, it is important to remember that students learn those things that teachers make easy (Kahn & Freyd, 1990b). The instructor should place an emphasis on how the students keyboard rather than how much they produce (Texas Guidelines, 1987). The learner should be able to concentrate on his/her ideas and not the typing process (Wronkovich, 1998). This should be the ultimate goal of any keyboarding program.

Conclusions and Recommendations

This literature review revealed that teaching keyboarding is not an exact process. While most research supports formal keyboarding beginning in third grade, whole language opponents differ. The whole language believers feel that students do not need

to learn to touch-type. They feel it is more important for the student to explore with the computer. It is up to the individual educator to evaluate his/her educational philosophies in deciding whether keyboarding is right for his/her class. The research supports the teaching of keyboarding skills.

The concept of how to teach keyboarding is a bit more concrete then when, but still not an exact science. According to the research it best to focus on having the students learn the placement of the keys. Accuracy and speed should not be emphasized until students have mastered key locations. In order to have an effective keyboarding curriculum, it is important that there is a teacher who is trained to teach keyboarding to students. Many times elementary teachers are not aware of the skills needed to teach keyboarding. It may advantageous for a district to have both the elementary educator and business teacher work together to meet the needs of the students. One important piece to an effective keyboarding curriculum is keyboarding software. While not all educators believe this is good for students, it does allow the program to be somewhat individualized and students can work at their own pace.

While suggestions and ideas are given, exact grade levels and ages are missing. The author feels that it is important to take into consideration the development of the child both physically and psychologically. The author would like to see studies done by schools that have a keyboarding program in place. It would be interesting to measure the students' keyboarding rates as compared to those districts that lack a curriculum.

Recommendations from the reviewer for keyboarding in the elementary classroom are as follows:

1. Begin introducing the keyboard early to students. Let them become familiar with it.
2. After the students have developed a familiarity with the keyboard, allow them to learn the proper techniques.
3. Begin formal touch-typing instruction in the third grade. First and second graders can work on developing the skill of differentiating between the left and right hand.
4. Set a time aside each week for keyboarding instruction, just as would be done for handwriting instruction.
5. Remember to have the students focus on training their fingers to press the correct keys.
6. Have a keyboarding instructor, or a person who is knowledgeable in the area, train teachers on the subject. This will ensure that all students are learning the same thing at the same age.

With an increasing number of states mandating keyboarding instruction in the elementary, districts will become responsible for teaching this complex psychomotor skill to their students. Depending on the district's current standards and benchmarks, it is up to each school to review the literature and make an informed choice for its district.

References

Adams, J. (1984). Learning of movement sequences. Psychological Bulletin, 96 (1), 3-28.

Bartholome, L. (1996). Typewriting/keyboarding instruction in elementary schools. [On-line]. Available: http://www.bus.usu.edu/bise/faculty/lwb/typewrit.htm

Bialo, E., & Sivin-Kachala, J. (1996). The effectiveness of technology in schools: A summary of recent research. [On-line]. Available: http://www.ala.org/aasl/SLMMR/slmr_resources/select_bialo.html

Boone, R. (ND). Using computers within the classroom. [On-line]. Available: http://www.ocis.net/~dturner/magazine/arcc412.htm

Cuffaro, H. (1984). Microcomputers in education: why is earlier better? Teachers College Bound, 85, (4), 559-568.

Denkla, M. (1973). Development of speed repetitive and successive finger movements in normal children. Developmental Medicine and Child Neurology, 15, 635-645.

Instructional Resource Branch Curriculum and Instruction Division of Saskatchewan Education. (1991, February). Elementary keyboarding. [On-line]. Available: http://www.sasked.gov.sk.ca/docs/elemkey/recommendation.html

Erthal, M. (June 7, 2002).Who should teach keyboarding and when should it be taught? [On-line]. Available: http://www.usoe.k12.ut.us/ate/keyboarding/Articles/Who%20Should%20Teach%20Keyboarding.htm

Feutz, R. (2001). LittleFingers: The first and only adult-quality keyboard scientifically designed to fit the smaller fingers of children. [On-line]. Available: http://www.datadesktech.com/media_news_2html

Hoggatt, J. (1998). A master plan for evaluating and updating your keyboarding program. Business Education Forum, 52 (4), 34-36.

Hoot, J. (1986). Keyboarding instruction in the early grades must or mistake? Childhood Education, 63 (2), 95-101.

Hopkins, G. (1998). Keyboarding skills: When should they be taught? [On-line]. Available: http://www.education~world.com/a_curr/curr076.shtml

Kaake, D. (1983). Teaching elementary age children touch typing as an aid to language arts instruction. The Reading Teacher, 36 (7), 640-644.

Kahn, J., & Freyd, P. (1990a). Touch typing for young children: Help or hindrance. Educational Technology, 30 (2), 41-45.

Kahn, J., & Freyd, P. (1990b). Online: A whole language perspective on keyboarding. Language Arts, 67 (1), 84-90.

Keyboarding instruction: Research, synopsis, and trends. (1999, January). [On-line]. Available: http://www.iceberg.org/bdahlstr/keyboarding.html

MacIntyre, P. (1990). The development of elementary keyboarding skills using typewriters and computers. [On-line]. Available: http://www.ssta.sk.ca/research/curriculum/90-16.htm

National Semiconductor: The sight and sound of information. (2002). [On-line]. Available: http://www.national.com/appinfo/solutions/0,2062,310,00.html

Olinzock, A. (1998). Computer skills building-the answer to keyboarding instruction. Business Education Forum, 52 (3), 24-26.

Owsten, R., & Wideman, H. (1996). Word processors and children's writing in high computer access setting. [On-line]. Available: http://www.eduyorku.ca/~rowston/written.html

Pisha,B. (1993). Rates of development of keyboarding skills in elementary school aged children with and without identified learning disabilities. Unpublished master's thesis, Graduate School of Education at Harvard University. [On-line]. Available: http://www.google.com/search?q=children+keyboarding+research&hl=en&lr=safe=off&start=40&sa=n

Prigge, L., & Braathen, S. (1993). Working with elementary students in keyboarding. Business Education Forum, 48 (1), 33-35.

Robinson, J.T. (1992). Improving computer keyboarding skills in third through fifth grade students. Unpublished manuscript, Nova University at Fort Lauderdale.

Ryan, R. (1997). Typing to learn, learning to type: A study of children's keyboarding skills. [On-line]. Available: http://www.gseis.ucla.edu/research/uesc/fal97/type/html

Sladden, E. (1997). Keyboard coach an instructional keyboarding system that provides access to literacy for diverse learners. [On-line]. Available: http://www.dinf.org/csun_99/session0247.html

Sormunen, C. (1991). Elementary school keyboarding a case for skill development. Business Education Forum, 45 (6), 28-30.

Starr, L. (2001). Teaching keyboarding—when? why? how?. [On-line]. Available: http://www.education~world.com/technology/

Texas state guidelines for keyboarding and information. (1987). Retrieved January 22, 2001 from the World Wide Web: http://www.lisd.net/intra/elemcurr/keybrdht.htm

Waner, K., Behymer, J., & McCrary, S. (1992). Two points of view on elementary school keyboarding. Business Education Forum, 47 (1), 27-35.

West, L. (1967). Vision and kinesthesis in the acquisition of typewriting. Journal of Applied Psychology, 51 (2), 161-166.

Wronkovich, M. (1998). The relationship of early keyboard instruction to computer proficiency. Educational Technology, 28 (9), 42-47.