

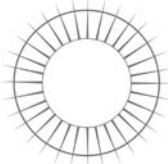
A New Look @ Research-Based Keyboarding Instruction

White Paper

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Executive Summary

Keyboarding is an essential skill. Even during preschool years, children use computers and must be guided towards efficient keyboarding habits. Appropriate placement of keyboarding instruction in the elementary curriculum and reinforcement throughout their school years can provide the necessary foundation for the rest of our students' lives.

Typically taught at the middle school and high school levels, Rogers' study (2006) of Wisconsin schools showed that 85% of their schools introduce keyboarding at the elementary level. While the most popular grade levels are 3rd and 4th grade, recent years have seen successful introduction into even kindergarten classes. This early introduction reduces bad habit development and provides additional benefits that include improvements in spelling, writing, and reading comprehension.

While business teachers are primarily responsible for teaching keyboarding at the secondary levels, in 2005 over half of the keyboarding teachers at the elementary level were classroom teachers (Rogers, 2006). This can be a problem because only a small proportion of classroom teachers have any formal preparation for teaching keyboarding (Sormunen, 1991).

Keyboarding is a life long skill. It has evolved from a *transcription* typing skill where secretaries typed hand-written letters into a *generative* typing skill involving composing original thought at the keyboard (Cooper, 1983). Student writing develops faster through word processing because it facilitates the review and revision learning process. Efficient keyboarding skills allow students to emphasize concept development instead of focusing on key location.

Mastering keyboarding involves learning technique (physical positioning and movement), ergonomics (safe and comfortable keyboard interaction), and key location. Learning key location requires a sequential introduction of the keys along with a great deal of repetition and reinforcement to develop the kinesthetic memory traces leading to keyboarding automaticity. Efficiency is expanded if keyboarders type short letter clusters and words as single units instead of groups of individual letters (e.g., er, ing, the, my).

Sunburst Technology's Type to Learn 4: Agents of Information software provides a research-based interactive learning environment for K-12 keyboarding learners. It is designed to guide the student and support the classroom teacher through the keyboarding skill development process. Technique and ergonomics are addressed from the beginning and reinforced throughout the curriculum. Students are placed in skill-appropriate lessons and given individualized goals and remediation based upon initial pretests and formative testing as they progress through the program. Key location is taught in cumulative sequence where new keys are integrated with previously learned skills and highly motivational activities are provided to encourage and reinforce practice. Quick-Words and Quick-Blends are letter combinations taught to optimize keyboarding efficiency. Original composition skills are developed through the many original-writing opportunities provided for the learner. Diverse student needs are addressed through multiple teacher-selected settings throughout the program. Spanish ESL students are supported through an option to provide instructions in Spanish to complete typing lessons in English. Teachers can add original content to align keyboarding subject matter with the classroom curriculum. Visual and auditory adaptations are included to extend accessibility to visually and hearing impaired students. An extensive data management system enables instructors to monitor student achievement and facilitate student progress.

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Introduction

Keyboarding Overview

Computing is a way of life today. In April 2002 the billionth personal computer was shipped. The second billion mark was reached in 2007 (Worldometer, 2008). We live much of our technological lives through the keyboard. The key to success when living in such a computer-centric world is to be able to interact with computers effectively and efficiently through well-developed keyboarding skills.

“Keyboarding is the penmanship of the computer age.” (Johnson, Nelson and Townsend, 2002). As a fundamental skill in today’s society, keyboarding provides our connection with the rest of the world through electronic communication. Students who become efficient keyboarders **“compose better, are prouder of their work, produce documents with a neater appearance, and have better motivation,”** (Nieman, 1996).

Technology has become an active part of children’s lives even at very young ages. The National Association for the Education of Young Children (NAEYC) supports children as young as three years old using developmentally-appropriate computer software (NAEYC, 1998). However, when children begin confronting the keyboard without guidance at this formative time in their lives, they tend to develop their own methods for pressing the keys which often develop into “bad habits” that hinder later typing skills. It is critical, therefore, to introduce students to efficient keyboarding strategies as soon as it is developmentally-advisable, to limit the number of behaviors that need to be unlearned to develop effective and efficient keyboarders.

Beyond the benefit derived from students being able to enter their thoughts into the dynamic world of word processing and communication through the keyboard, there are a variety of studies that document additional benefits that accompany increased keyboard proficiency. These benefits include:

- Improvement in language arts (Cooper, 1983; Erickson, 1960; Wetzel, 1985; Wood & Freeman, 1932)
- Improved quality of writing (Bangert-Drowns, 1993; Goldberg, Russell, & Cook, 2003; Owsten and Wideman, 1997)
- Greater enthusiasm about using the computer for writing (Wetzel, 1985)
- Improvement in spelling (Hoot, 1986)
- Improvement in reading comprehension (Hoot, 1986; Wronkovich, 1988).

Keyboarding Instruction in Schools

Keyboarding is a staple in school curricula. In the past, it has been taught at the middle school and high school levels by business teachers. It has been a separate course which involved learning the motoric skills of typing as well as formatting skills in writing reports and various forms of correspondence (Erthal, 1998; Rogers, 2006). Today the majority of school districts introduce students to keyboarding basics in elementary school. Teaching keyboarding/typing in the elementary classroom is nothing new. Articles as early as 1932 (Freeman, 1932) advocated using typewriters in the elementary grades. With the introduction of the microcomputer in the 1980s, came a resurgence of interest in teaching elementary students how to keyboard (Stewart & Jones, 1983). Individuals and families began purchasing personal computers and making them available for young children to use. These computers were interactive and much more interesting for children to use than typewriters. These early encounters with computers, twenty years ago and today, make it important for keyboarding to be taught at an earlier age to build computer facility and develop good keyboarding habits before users develop their own personal approaches to typing.

Introduction

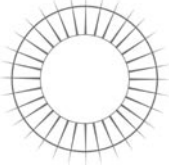


Keyboarding success will increase as a student's opportunity to practice keyboarding skills increases. Unfortunately, limited access to computers in school prevents classroom teachers from involving much keyboard technology in their students' daily activities. Consequently, additional practice in keyboarding requires students to participate in this task outside of the school. This means that students who are learning to keyboard must have access to instructional software specifically targeted to the skill of keyboarding. A less-guided choice but potentially helpful activity would be to engage in other computer activities (i.e., word processing, email, Instant Messaging, etc.).

A comprehensive keyboarding software program such as Sunburst's Type to Learn 4: Agents of Information, which is developmentally appropriate for learners at various grade levels and abilities (Kindergarten to grade 12), is an important tool for developing necessary keyboarding skills. Beginning with alphabetic keyboard awareness at the earlier grades and progressing through a sequential, interactive series of touch-typing lessons, Type to Learn 4 provides much-needed continuity for students as they achieve a district's keyboarding requirements. Keyboarding practice outside of the classroom is supported through student access to the web-downloadable version or single CD version of Type to Learn 4.

Life Long Skill

Keyboarding is a life long skill. Unlike the days-gone-by when *transcription typing* (Cooper, 1983) was considered a talent that ensured a secretarial position for typing someone else's letters, typing has become an integral part of our daily lives. Keyboarding is no longer a routine for transferring ideas from scribble to print. Most keyboardists today are involved in *generative typing* (Cooper, 1983) which involves composing original thought directly into electronic documents and email. It is estimated that about 52 billion (non-spam) emails were sent daily in October, 2007 from about 1.2 billion email users (Tschabitscher, n.d.). Few of these emails were typed from a hand-written copy. They were keyed from original thought which is less hindered when keyboarding skills do not interfere with this thought process. Computer-based communication is an important part of our daily communication and efficient keyboarding skills enable individuals to prosper in this environment.



Keyboarding Educational Issues

What Needs to be Taught?

Mastering keyboarding involves more than just learning the locations of keys. The foundation for masterful keyboarding is technique. Technique involves the positioning and action of the body and fingers as the student is keyboarding. Ergonomics is an important aspect of keyboarding that students need to learn from the beginning of their keyboarding instruction. Learning key location involves a sequential process beginning with letters followed by punctuation, numbers, and symbols. Mastery develops through practice.

Technique

Effective and efficient keyboarding begins with learning proper technique. Students should be provided with models of keyboarders assuming good posture as they type. More specifically, correct hand placement should be demonstrated and explicitly discussed. This should be followed by instruction on proper key stroking. Key stroking is more than pressing keys. Rapid keyboarding requires that the keys are addressed with a quick finger-action. If the finger-action is quick, then keyboarding speed will increase as the time between keystrokes is reduced. **Speed and accuracy** are built upon well-developed technique, which should be taught at the beginning and then developed through on-going reinforcement (Crews, North, & Erthal, 2006).

On-going reinforcement of technique is a challenge for teachers because it requires them to be ever-vigilant so that they can recognize and reward proper technique in the classroom or lab. *The Type to Learn 4 software supports teachers in teaching proper technique by providing visual and auditory instruction on proper posture, body and hand positions, and finger striking techniques. Detailed explanations of the home row position, posture, and key stroking technique are provided in the earlier lessons, and shorter reminders are provided throughout the rest of the program. 3D model reference hands on the keyboard demonstrate the proper location for each finger, key press, or reach.*

Ergonomics

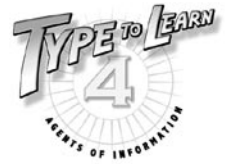
An important part of learning technique is learning ergonomically-sound behaviors that support proper body posture and placement. It is important for students (and teachers) to learn and follow these guidelines. Once students have an ergonomically-sound foundation and have learned about the proper way to tap the keys, only then can they work to achieve their maximum efficiency in keyboarding.

A series of international studies found that “up to 60% of the students across the globe reported eye strain, neck & shoulder pain, wrist and back discomfort, headaches and fatigue,” (Hajic, 2008, para. 4). Children as young as fourth grade reported these symptoms. Posture patterns begin developing as young as seven years old so it is imperative that students are taught the proper way to sit when keyboarding and that it is reinforced by both teachers and parents (CUErgo, 2000; Hajic, 2008).

Beyond sitting position, a variety of healthy practices should be followed to reduce potential problems:

- Students should rest their eyes by looking away from the screen and blinking rapidly while focusing on distant objects approximately every 15 minutes to reduce eye strain (CUErgo, 2000).
- A rest from typing should be taken at least every 30 minutes. Students should use different muscles during this break (SAU 16, 2007).

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Type to Learn 4 directly addresses these ergonomic concerns through modeling and monitoring. All lessons begin with auditory and visual cues demonstrating how to sit, how to address the keyboard, and how to place the hands, wrists and arms in the safest and most productive positions. Ergonomic standards are further supported by monitoring each student's progression through the lessons.

- *Eye Breaks, which ask the student to change focus from the computer screen to across the room to rest their eyes, are introduced every 5-10 minutes (customizable by the teacher) directly before the student takes a game break.*
- *Every 20 minutes (adjustable by the teacher), Type to Learn 4 reminds the student that it is time to take a 30 – 90 second (adjustable) Ergonomic Break during which the software program cannot be accessed. This Ergonomic Break provides a variety of exercises and stretches for the eyes, arms, wrists, and back to avoid injury.*

These exercises not only loosen the body and prepare the student for continuing with the lesson, but they also model positive and safe computer usage. Instead of just telling students about these safeguards, Type to Learn 4 actually initiates these breaks so that they become “part of the routine” and students will be more likely to actually take breaks when they are working on their own.

Key Locations

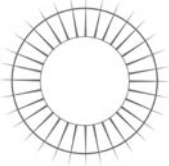
Keyboarding is a psychomotor activity that needs to be taught through introduction, repetition, and reinforcement. Key/letter locations should be introduced two at a time in a sequential format with repetitive activities that begin to build the **kinesthetic memory traces that will link each letter with the appropriate finger movement and key**. These activities must be designed to guide the learner toward successful completion and reinforce accomplishment.

*Type to Learn 4 introduces the letters/symbols in pairs in most of the lessons. Each lesson begins with a warm-up review where students practice the home row to locate their home base and prepare for the lesson's exercises. Once students are warmed up, the Security Check provides an opportunity to practice all of the letters learned so far by typing character clusters and words. New keys are introduced in the next section, following a pattern of using the same fingers on either hand. These new keys are practiced alone and then through a series of lesson exercises using the other keys learned so far. **Exercises provide varying levels of scaffolding and instruction, such as:***

- *hints as to which side of the keyboard the character is on,*
- *3D animated hands on a lettered reference keyboard to provide guidance when incorrect keys are pressed,*
- *presenting full lines of text so students can discover a comfortable typing rhythm,*
- *instruction for typing letter combinations.*

Letter Combinations

Facility with letter combinations is the key to rapid keying. Leonard West (1983) proposed that mastering digraphs (two-letter combinations) was the key to maximum typing speed and accuracy. This aligns with earlier research showing that expert typists were greatly facilitated when typing text that contained “frequent letter combinations or common words,” (Fendrick, 1937, p. 620). For example, the common word “me” can be considered two single letters, “m” and “e”. The keyboarder must read the letter “m”, identify that the right index finger must be used to type the “m”, and then send the command to the finger to type it. The same process is used to type the “e” using the left middle finger. If, however, the word “me” is considered a single unit that requires using the right index and left middle fingers, then the processing time to type it is reduced. This process of “chunking” letter combinations together works well with blends like “th” or “at” as well. As a student becomes more proficient in keyboarding, the task becomes one of keying letter groups rather than single letters and the processing time is



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thereby dramatically shortened. This means that keyboarding mastery will be augmented when digraphs, frequent letter combinations, and common words are taught to students as units. This decreases response time and improves keyboarding speed (Zeitz, 2005).

Type to Learn 4 teaches letter combinations in the form of Quick-Blends and Quick-Words. Quick-Blends are common letter combinations that appear frequently in the English language. They were identified based upon phonogram frequency lists (Fry, 1998) and lists of the most common prefixes and suffixes (Honig, Diamond & Gutlohn, 2000). Quick-Words are common short words. They were identified through lists of commonly used words in the English language (World-English, 2003). Quick-Blends and Quick-Words are introduced in the seventh lesson in Type to Learn 4. This lesson introduces the concepts behind learning these keyboarding tricks as well as the letter combinations that can be constructed from the characters that have already been learned (J, F, U, R, K, D, I, E, H, G, L, & S). Throughout this lesson and in many of the ensuing lessons, the Quick-Combos (Quick-Blends and Quick-Words) are emphasized to reinforce how often they can be found in words. Beginning with Lesson 8, an entire exercise is dedicated to practicing the Quick-Combos learned to that point.

The level of complexity for the letter combinations used in these lessons is based upon grade levels. K-2 students only encounter Quick-Blends of two letters in length. About half of the Quick-Words that these younger keyboarders encounter are also two letters in length. The longer Quick-Words used with this age group are listed in the Dolch Sight Word list (Dolch, 1936) so learners should have some familiarity with them. Quick-Blends and Quick-Words for older students in grades 3-12 increase in length and complexity appropriate to each grade level. Quick-Combos are the basis of more efficient keyboarding and are an important part of the Type to Learn 4 curriculum.

When Should Keyboarding be Taught?

Educators generally agree that students have developed the proper level of dexterity and eye-hand coordination for efficient keyboarding by third or fourth grade. Their hands have grown to fit the standard-sized keyboard and their attention span has developed enough to last the length of a typical keyboarding lesson which is 20-to-40 minutes (Boyce & Whitman, 1987; McLean, 1994; Russell, 1994). At this level, students' writing requirements have also developed enough to have a need for efficient written communication.

This does not mean that keyboarding should be ignored at the earlier grades. Developing keyboard familiarity at earlier ages will facilitate students' later success in computing. As soon as students begin using computers for more than simple responses, familiarity with the keyboard and keyboarding techniques will enable younger learners to interact faster and lessen the probability of developing bad keyboarding habits. Bartholome and Long (1986) describe how they were able to successfully introduce first and second graders to keyboarding through half-hour instructional sessions three days a week. At the end of the semester, the students were able to type 15 – 30 words per minute. Introducing the computer keyboard to primary students can facilitate computer interaction and build a foundation for later development of keyboarding skills (Bernazza, Bloomer & Cline, 1971; Hoot, 1985; Rogers, 1997; Troutner, 1983).

Type to Learn 4 has been developed to accommodate students of all ages. The lessons, activities, and assessments have been written at three levels: Grades K-2, 3-6, and 7 -12, with content and pedagogy designed to address each of these levels. Content is controlled for word length and subject interest level. Younger learners have shorter lessons, while older learners are expected to key longer and more complex text. The program also provides differing design interfaces for the various grade levels, and can be further customized to fit individuals' personal scholastic needs.

Type to Learn 4 is designed to address the specific needs of K-2 students as well. Their content begins with two pre-lessons developed to build familiarity with the keyboard, conducted as an alphabetical tour of the letters on the keyboard. Students practice keyboarding using the appropriate hands to press keys. They continue to explore by

typing short words and sentences. Capital letters, numbers, and common punctuation are also introduced in these earlier lessons. These K-2 lessons are shorter to accommodate the younger learners' shorter attention spans.

Who Should Teach Keyboarding?

While business teachers or technology teachers are still the primary keyboarding instructors at the high school and middle school levels, the most frequently seen keyboarding instructor at the elementary level has changed from business teacher to classroom teacher over the past 15 years. National statistics are difficult to find, however a 15-year longitudinal study of keyboarding in Wisconsin (Rogers, 2006) found that in 1993 70% of the teachers responsible for teaching elementary keyboarding were business teachers. In 2005, elementary classroom teachers were the primary keyboarding instructors (51%) with business teachers responsible for this instruction only 27% of the time. The remaining 22% of the teaching was provided by teacher-librarians, technology coordinators, and instructional aides. While recent figures for classroom teacher professional preparedness for teaching keyboarding are not available, Sormunen (1991) found that only 12% of teachers had formal preparation for teaching keyboarding. This drop in supervision by business teachers means that classroom teachers need a system that can provide students with the necessary instruction, scaffolding, motivation and reinforcement to learn keyboarding. While not a replacement for a business teacher's knowledge and experience, well-designed keyboarding software such as Sunburst's *Type to Learn 4* can assist in supporting classroom teachers in teaching keyboarding (Russin, 1995).

How Should Keyboarding be Taught?

Having identified what needs to be taught and by whom, we must next consider *How* this curriculum should be brought to students. This consideration includes a variety of areas including: sequence of introduction, motivation, practice, and application.

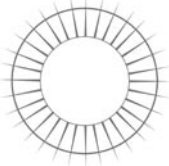
Sequence of Introduction

The development of keyboarding skills is a cumulative process. New skills must be introduced in a consistent sequence that builds upon previously learned skills. Crews, North, & Erthal (2006) describe three stages of learning that a keyboarding student experiences. These three stages include: Cognitive Phase (Key Introduction), Associative Stimulus Phase (Kinesthetic Memory Traces), and Autonomous Muscle Response Phase (Automaticity). Benjamin Bloom (1986) supports this sequence of learning for touch typing.

1. Cognitive Phase (Key Introduction): This initial stage involves the students deliberately thinking about the rules of technique (body, arm, and hand position; key stroking; and ergonomics). The beginning typist is also consciously thinking about the position of each individual key. Entering lines of text involves seeing, processing, and tapping strings of characters separated periodically by spaces. Learners are also purposely working to accomplish key combinations like the proper use of shift keys.

In this phase it is important to introduce the keys in a sequence that will foster student success. The learner's progression while learning the keyboard should be a cumulative process. Pairings of characters should be introduced together with sufficient practice activities in a variety of contexts to afford the learner a certain amount of mastery before moving to the next set of keys. The following lesson should introduce a new set of characters and provide fresh practice activities that incorporate the first set of characters as well as the newly-learned keys. This collective process should be continued throughout the entire keyboard.

Type to Learn 4 introduces the keys mainly in pairs in a logical sequence beginning with the index fingers. These fingers are the strongest and most often used so students will have the greatest amount of immediate control for their initial venture into touch keyboarding. After introducing the J and F keys, U and R are introduced using



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the index fingers as well. This sequence continues to use the strongest fingers and introduces a vowel to allow the learner to begin typing actual words in the second lesson. The sequence then progresses to the middle fingers, ring fingers, and finally the little fingers, which are the weakest and most difficult to use when keyboarding. Each of the 34 lessons involves a series of exercises that provide students with engaging tasks using the new keys as well as all of the previously-learned keys.

2. Associative Stimulus Phase (Kinesthetic Memory Traces): On-going practice through exercises and activities that are of high interest, high motivation, and high activity can motivate learners to engage in the repetition necessary for “kinesthetic memory traces” to develop. Through this process, students learn to connect the recognition of the character with the action of striking the corresponding key. Developing kinesthetic memory traces is part of the psychomotor learning process (Starr, 2001).

This stage of learning is the longest of the phases and involves developing a sense of continuity and rhythm in keyboarding. Continuity is cultivated through practicing and mastering common character combinations and words, and acquiring the aforementioned kinesthetic memory traces. Rhythm is developed through a steady repetition of keystrokes. At this stage accuracy is not as important as speed and rhythm. Support during this phase could begin with a consistent rhythm as with a metronome. However, as the learner masters keyboarding an individualized cadence will naturally develop based upon how the typist addresses groups of letters, rather than from an external musical beat.

Type to Learn 4 is specifically designed to ensure that the practice and repetition necessary to achieve this phase of learning is amply present, interesting, and motivational:

- *The game-based format provides an active learning environment that turns ordinary practice drills into engaging activities with purpose and relevance to the student’s success as Agents of Information.*
- *Quick-Blends and Quick-Words provide an emphasis on building continuity through mastering character combinations. This increases efficiency because students develop the mindset to type groups of characters when possible instead of processing and tapping individual characters one at a time.*
- *Speed can be emphasized throughout Type to Learn 4 since learners are not required to perform at 100% accuracy all the time. Performance goals are based upon their own level of expertise rather than perfect performance. This allows the keyboarder to forge ahead to the next character instead of cautiously making sure each key is correct, or frequently using the backspace key to correct a possible mistake.*
- *Building a keyboarding rhythm and cadence is developed through a teacher-controlled metronome that accompanies one of the practice activities. Available with every lesson, this activity provides a variable-speed beat to which students can type along.*

3. Autonomous Muscle Response Phase (Automaticity): **The goal of teaching keyboarding is to familiarize students with the keyboard to a point where they develop automaticity** (Bloom, 1986). Automaticity is a level of proficiency where the learner is able to complete a task as a whole without devoting attention to each individual component task. Keyboarding automaticity requires facility in typing to the point where the operator is keying without thinking of the individual keys. In fact, if an accomplished keyboarder tries to think about what each finger is doing, “the entire typing process would collapse,” (Bloom, 1986, p. 73).

Type to Learn 4 fosters automaticity by encouraging on-going practice through a series of varied and motivating activities. Keyboarding proficiency is further facilitated by mastering keyboarding short-cuts (i.e., Quick-Blends and Quick-Words). While the motivation for keyboarding at the previous learning stages may have been to succeed at challenges presented by Type to Learn 4’s activities (extrinsic reward), success in keyboarding becomes its own reward in this phase as students feel empowered by their keyboarding acumen (intrinsic reward).

Motivation

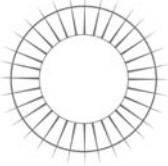
Motivation has a great deal to do with novelty, excitement, and challenge. Prolonged activities will bore learners into inaction. While all students tend to be drawn to computer-based activities, these activities also need to be interesting and provide feedback about students' rates of progress to retain their interest. Students learn best when they have immediate indications of their ongoing success (Olinzock, 1998). Such immediate feedback of results supports both performance and motivation (Garris, Ahlers, & Driskell, 2002). Activities should be challenging but not overwhelming. This means that students will perform best if the activities are presented at their individual skill levels. Matching the tasks' requirements with the learners' skills makes the learning experience more enjoyable (Csikszentmihalyi, 1990). It is important that students feel a sense of accomplishment as they master the keyboard. The most effective challenges are ones where the expected level of accomplishment rises as the learner's skill levels improve. Contextualizing learning in a fantasy world can also enhance students' interest and engagement (Randel, Morris, Wetzel and Whitehill, 1992). The task-oriented gaming world of *Type to Learn 4* provides a highly motivational learning environment in a variety of ways that would not be possible using a typing textbook:

Gaming World: *Type to Learn 4: Agents of Information* is designed to provide a novel learning environment that is both challenging and motivational. The program takes place in a futuristic world where information is in danger of coming to a disastrous halt. This is a task-oriented gaming world where learners use their newly developing keyboarding skills to achieve their missions. As *Agents of Information*, the students are given the tools of their trade: the communicator device where they will perform their keyboarding, and the sequential training on all keys to help them ascend the ranks from Recruit to Master Agent. They are taught the necessary skills: recognizing, finding, and striking specific keys. These agents must then accomplish missions that range from saving ideas from being lost, to piloting drones, to uncovering long lost information. Completing each of these missions successfully is dependent upon accurate and rapid keying. Their newly-found keyboarding world is an adventure in success.

Placement Test: Students begin their adventures by completing a placement test. This test assesses each student's skill level and places the student at the lesson that best fits his/her needs. The placement test also identifies the learner's beginning keyboarding speed (WPM) and accuracy percentage, and uses this information to identify a goal speed and expected accuracy level for upcoming lessons. This moderately increasing goal creates challenges that encourage students to succeed. As students proceed through each lesson, they are continuously informed of their WPM performance and level of accuracy. This immediate feedback is necessary to place the learner in control.

Individualized Remediation: As students progress, they must pass a Final Challenge at the end of each lesson to prove that they can meet their individualized speed and accuracy goals before continuing to the next sequential lesson. If the student does not pass the Final Challenge, or fails to meet speed or accuracy goals at any time during the lesson, remediation is automatically provided. *Type to Learn 4* analyzes the student's errors and provides a remediation task on the specific keys with which he/she is struggling. These remediation exercises are specifically developed to address the individual's weaknesses, ensure that students gain the skills needed to continue in the program, and that they remain motivated to succeed.

Acceleration: The Final Challenge can also be used to accelerate a learner's progress through the *Type to Learn 4* sequence of lessons. If the supervising teacher allows it, students may try to "test out" of a lesson by attempting the Final Challenge before going through the lesson and its exercises. If the student performs at his/her individualized level of accomplishment, the lesson is considered complete and the student may progress to the next lesson. This allows capable students to skip lessons teaching skills they have already mastered, thereby sustaining interest and motivation.



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Game Breaks: *Optional Game Breaks within Type to Learn 4 present students with an opportunity to break from the lesson and engage in one of the program’s keyboarding-based gaming activities. These breaks are presented at teacher-adjustable intervals to enhance motivation and avoid boredom or restlessness. Game Breaks specifically support younger students or those with shorter attention spans. These Game Breaks always encourage resting the eyes before continuing, which is a necessary ergonomic inclusion.*

Practice

Perfecting keyboarding skills requires a great deal of practice. The typical elementary school spends 10 - 20 hours per year teaching students to keyboard. This might be in a compressed format (i.e., 30 minutes a day for four weeks = ten hours) or spaced (i.e., 30 minutes per week for 36 weeks = 18 hours) (Fleming, 2002). Either way, this is not enough time to reach a level of competence or automaticity with keyboarding. Crews, North, & Erthal (2006) provide a table of “Speed Expectations” where they indicate that it is reasonable to expect students to type at 10 – 15 WPM after 15 – 18 hours of instruction. Secondary schools typically spend a whole period teaching typing. Intermingled with the correspondence activities that integrate with learning to type, a 15-week class might yield 45 hours of keyboarding instruction and practice. This would yield a typing speed of 45-60 WPM on the Speed Expectations table.

As mentioned earlier, the goal of learning to keyboard is to develop automaticity in one’s keyboarding skills. This level of expertise is not seen until one is keyboarding at least 50 WPM. Such proficiency requires practice beyond that available in the typical school classroom or computer lab. While an avid learner might practice skills through answering email or writing a report, these activities do not provide the guided practice that leads to developing an effective and efficient keyboarding technique. In fact, bad keyboarding habits may reemerge during such unsupervised activities. However, using Type to Learn 4 outside of school can provide this important extended learning environment.

Students are able to continue their instruction at home through the web-downloadable and single CD versions of Type to Learn 4. When a school purchases a web license, their students can download the keyboarding program onto their home computer, accessing the central database and their own scores over the Internet, so that they can continue their Type to Learn 4 instruction on weekends and in the evenings as homework. This important extension of the instruction not only bridges the school and home, but also enables struggling students to gain the additional practice time they need, and advanced students to progress at their accelerated pace. The typically limited classroom time does not sufficiently allow for either.

Application

Learning to keyboard using a software package can be quite successful, but will it translate to the “real world?” In most software, students read or hear words that they then key into the computer as quickly and accurately as possible. But how will this process of reading and typing text translate into their lives where most keyboarding time involves original composition? Cooper (1983) describes a distinction between transcription and generative keyboarding. *Transcription keyboarding* is the style of keyboarding used in most tutorials where a passage of text is presented to the learner to be keyed into the program or word processing document. *Generative keyboarding* identifies the style of keyboarding where one generates original text at the computer. Generative keyboarding is now the predominate form of computing so it is important that skills learned through a transcription method will transfer into a generative world.

Salomon and Perkins (1989) identified behavioral transfer like keyboarding as *low-road transfer*. They found that low-road transfer is facilitated through automatization and varied practice. Automatization is the result of extensive practice, whereby the skill being practiced becomes fast and effortless. New environments or conditions do not adversely affect the level of transfer because the behavior is executed automatically, regardless of the

situation. Crews, North, & Erthal (2006) say that automaticity, and by extension skill transfer, is not certain until one is keyboarding at least 50 WPM.

Varied practice describes practice that occurs in a variety of contexts. This, too, facilitates low-road skill transfer. Performing a behavior in multiple situations requires one to adapt to subtle differences in those contexts. Performing despite these differences increases the actor's repertoire and makes functioning in an unfamiliar situation easier to accomplish. Considering the level of keyboarding sophistication necessary to reach automatization, varied practice is the method of choice to facilitate transfer from transcription to generative keyboarding, and from the world of a software application to real-world typing situations. It only requires the instructional program to place the learner in a variety of original composition situations to provide transferable experiences to later situations.

Type to Learn 4 successfully promotes skill transfer from transcription to generative keyboarding by providing a variety of original writing opportunities for the learner. One entire activity, Message Master, includes opportunities for imaginative writing in response to grade-appropriate prompts. Furthermore, one full lesson at the end of the scope and sequence is dedicated to students' original responses to writing prompts. Another way Type to Learn 4 promotes real-world skill transfer is by including keyboarding of literature passages, poems, historical documents, menus, and recipes – real world examples of writing.

Customizing Program Presentation to Meet Students' Needs

Teachers today face an incredibly diverse group of students in their classrooms. Instructional methods, including software programs, must allow for individualization of the learning and differentiated instruction appropriate for: remedial learners, advanced learners, mentally challenged learners, and those with hearing or visual impairment. *Type to Learn 4* provides extensive customization options and settings for all types of learners.

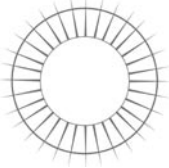
All options can be set for an entire class or individual students, and allow customization of lessons, activities, and assessments. The teacher can customize the vocabulary level and difficulty of material, based on grade ranges (K-2, 3-6, or 7-12). The learning environment can be further customized by controlling the design interface, availability of music and sound effects, narration, and visual 3D reference hand support. Additional useful settings include: allowing or preventing activities before lessons have been completed, controlling access to the top scores list, and assessing students using printed text or on screen text. Game Breaks and Ergonomic Breaks can also be controlled in length and frequency to fit the class work cycle.

Accessibility for Disabled Learners

Type to Learn 4 provides extended accessibility for visual and hearing impaired learners. Closed captioning, rollover text, and adjustable volume can accommodate the needs of hearing impaired students. The visually impaired are assisted through both audio and visual accommodations:

- Auditorily, the software can be set to automatically read aloud all instructions, messages and text to be typed. Navigational buttons can also be set to verbally identify themselves when a mouse rolls over them.
- *Type to Learn 4* can read characters to visually-impaired students as they type and provide audible feedback when the wrong key is pressed.
- Partially-sighted learners can use customized text with adjusted size, color, contrast, and background color.

These adaptations fulfill the federal requirements (American Disabilities Act and Individuals with Disabilities Education Act) for accommodating the special needs of learners with disabilities (U.S. Department of Justice, 2005; NecTac, 2004). *Type to Learn 4* also contains multi-modal opportunities that address many of the *Universal Design for Learning Guideline* checkpoints to align with the *Individuals with Disabilities Education Act (IDEA) 2004*.



Keyboarding Educational Issues

Spanish ESL

Another teacher setting allows switching the instructional presentation between English and Spanish. **Spanish ESL content provides instructions, navigation, support, and reinforcement in Spanish, while the keyboarding lessons themselves remain in English.** This unique feature provides valuable support to Spanish-speaking students as they learn to keyboard in English. English language learners can participate equally in the keyboarding class, bolstering students' confidence and language skills.

Teacher-Added Content

A valuable feature for teachers allows them to add their own original material into the *Type to Learn 4* program for students to type. This teacher-added content is then presented to students and automatically scored for accuracy and speed the same way as system content. This feature fosters greater integration of the classroom curriculum with the keyboarding curriculum, as spelling lists, vocabulary words, and even science or social studies content can be imported into *Type to Learn 4* as it is being covered in the classroom.

Managing Student Data

Instructor utilities in *Type to Learn 4* provide important class and individual progress reports that enable the teacher to monitor and facilitate student progress. This reporting capability is recommended throughout the literature (Olinzock, 1998). *Type to Learn 4* offers an enhanced, user-friendly teacher management system that enables educators to administer their learners' progress throughout the curriculum. The program is designed to automatically take students through the sequence of lessons based upon their performance against pre-determined goals. With every goal in speed or accuracy that they reach, the program rewards the student for success and uses predetermined formulas to present an increasingly higher goal to keep the experience challenging, yet attainable. In special cases, the teacher can use the data management system to easily move a student forward or back in the lessons when necessary. Speed Goals (WPM) as well as Accuracy Goals (% correct) can be manually increased or reduced depending upon the teacher's recommendations.

Robust reports can be generated to detail progress, scores, and areas of challenge for an individual, group of individuals, class, group of classes, or the whole school. These reports include tables, charts, and graphs to provide the data in the most easily usable format. Individual narrative reports highlighting areas of strength and weakness can be generated as well. A unique parent report, accessible through the student's login, allows parents to participate in the learning process and track their child's progress and scores throughout the program.

Standards Alignment



It is critical in today's landscape of educational legislation and accountability that instructional software aligns directly to relevant state and national curriculum standards. *Type to Learn 4* is no exception. The program has been directly correlated to keyboarding and technology standards in all 50 U.S. states, the District of Columbia, and Ontario, Canada. *Type to Learn 4* also aligns with the International Society for Technology in Education (ISTE) 2007 National Educational Technology Standards for Students (NETS-S), outlined below (ISTE, 2007):

1. Creativity and Innovation
Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
 - a. apply existing knowledge to generate new ideas, products, or processes.
 - b. create original works as a means of personal or group expression.

6. Technology Operations and Concepts
Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
 - a. understand and use technology systems.
 - b. select and use applications effectively and productively.
 - c. troubleshoot systems and applications.
 - d. transfer current knowledge to learning of new technologies.

Grades PK–2 (Ages 4–8)

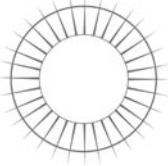
The following experiences with technology and digital resources are examples of learning activities in which students might engage during PK-Grade 2 (Ages 4-8):

1. Illustrate and communicate original ideas and stories using digital tools and media-rich resources. (1,2)
7. Demonstrate safe and cooperative use of technology. (5)
8. Independently apply digital tools and resources to address a variety of tasks and problems. (4,6)
9. Communicate about technology using developmentally appropriate and accurate terminology. (6)
10. Demonstrate the ability to navigate in virtual environments such as electronic books, simulation software, and Web sites. (6)

Grades 3–5 (Ages 8–11)

The following experiences with technology and digital resources are examples of learning activities in which students might engage during Grades 3-5 (Ages 8-11):

8. Practice injury prevention by applying a variety of ergonomic strategies when using technology. (5)



Funding Opportunities

No Child Left Behind (NCLB)

The following funding opportunities represent subsections of the No Child Left Behind legislation:

Title III Grant Funding

Language Instruction for Limited English Proficient and Immigrant Students (Title III of NCLB) - This program is designed to improve the education of limited English proficient (LEP) children and youths by helping them learn English and meet challenging state academic content and student academic achievement standards. Title III funds are used to implement language instruction educational programs designed to help LEP students achieve these standards.

Type to Learn 4 incorporates a Spanish ESL option to display all instructions, directions, navigation, help, reinforcement, and rewards in Spanish alongside the English translations. This unique capability expands the keyboarding curriculum to ESL students in all grades who need guidance in their native language while they learn to keyboard in English, and also assists with English language learning.

21st Century Community Learning Centers Grant (Title IV, Part B)

This NCLB program supports community-learning centers that give students from low-performing and high-poverty schools academic enrichment opportunities. Authorized activities include:

- remedial education activities and academic enrichment learning programs, including providing additional assistance to students to allow the students to improve their academic achievement;
- programs that provide after school activities for limited English proficient students that emphasize language skills and academic achievement;
- telecommunications and technology education programs

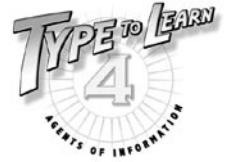
Type to Learn 4 is a perfect fit for community-learning and after-school centers. The software provides academic enrichment while building critical 21st Century keyboarding and computer literacy skills. Continuous reinforcement of home row positioning and proper fingering for each key supports proper technique as the foundation for developing effective keyboarding skills. Efficient keyboarding is the gateway to competent computer usage. Type to Learn 4 thereby also supports this grant's call for technology education. Spanish ESL content throughout the Type to Learn 4 program supports limited English proficient students as they learn to keyboard in English, which also strengthens language skills.

Enhancing Education Through Technology Grant (Title II, Part D)

Enhancing Education Through Technology (EETT) is a No Child Left Behind initiative that seeks to improve student academic achievement through the use of technology in elementary schools and secondary schools. An additional goal is to ensure that every student is technologically literate by the time the student finishes the eighth grade.

Type to Learn 4 brings technology usage directly to students' own hands by teaching the fundamental skill of keyboarding. Without effective keyboarding skills, students cannot proficiently interface with a computer or be considered technologically literate. The software is developed for grades K-12, beginning with keyboard awareness for the youngest learners and advancing to keying passages and original writing tasks at the upper levels.

Funding Opportunities

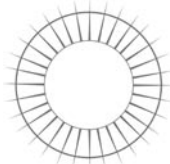


Carl D. Perkins Career and Technical Education Act of 2006

This grant assists states in developing a comprehensive system of Career-Technical Education:

- Integrate academic and career-technical education through a coherent sequence of courses;
- Promote student attainment of challenging academic and career-technical standards;
- Develop, improve and expand the use of technology.

Type to Learn 4 builds critical career-technical touch-typing skills through its sequential, leveled system of instruction that is individualized for each student's needs and keyboarding abilities. A variety of design interfaces allow the software to be equally appropriate for elementary, secondary, or adult learners. The software provides access to valuable skill-training that is necessary to attain a job in today's 21st Century, computer-centric work force. Effective keyboarding skills are critical for proficient use of computer technology. In accordance with the grant, Type to Learn 4 aligns with the ISTE National Educational Technology Standards for Students (NETS-S) and NCLB Technology Requirements. The Internet-downloadable version is widely accessible, allowing students to use the software from home or anywhere with an internet connection.



Conclusion

Efficient keyboarding skills clear the path toward effective expression. Learning to keyboard accurately and efficiently requires more than being taught location of the characters on the keyboard. It requires a sequential curriculum that integrates technique with key location and encourages a great deal of practice to build the automatic skills for transcribing ideas onto the computer screen. Keyboarding instruction succeeds based upon content, pedagogy, and individualization.

Sunburst Technology's *Type to Learn 4: Agents of Information* is based upon an adventure theme where learners are tasked with preserving information for the entire world. The game-based content provides exercises and activities corresponding to the "secret agent" theme. This thematic direction provides relevance and purpose for the learner and encourages students to spend time completing the activities to develop the skills necessary to master keyboarding. Content is differentiated between grade levels to address the specific needs of various groups of students.

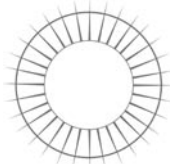
The pedagogical design is based upon decades of research concerning effective keyboarding instruction. It integrates proven instructional procedures with the immediate feedback that computer-based instruction makes possible. Teaching and promoting technique and ergonomics are at the foundation of the program. Keyboard characters are introduced through a pairing sequence that optimizes motoric strengths and asks students to type actual words as soon as possible. Keyboarding continuity is promoted through the instruction of Quick-Blends and Quick-Words as letter-combination units rather than individual letters. Rhythm is developed through auditory stimuli. A plethora of strategies are combined to support students in developing the keyboarding automaticity that is necessary to become accomplished keyboarders.

The *Type to Learn 4* curriculum has been designed to individualize to student needs. A pretest and periodic formative assessments are used to begin each student at the proper level of difficulty and expectation, as well as to modify the expected levels of accomplishment or to provide remediation throughout the program. The rich reporting system provides teachers with a wealth of information about student progress so that educators can modify settings to address students' personal needs. Visual and sound adaptations have been included to provide accessibility for visually and hearing impaired students. Spanish ESL students can have directions provided in Spanish while completing lessons in English.

Type to Learn 4: Agents of Information synthesizes research-based design with proven pedagogy to create a highly motivating learning environment that challenges learners and promotes success.

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