Finding Your Way in the Maze of Computer Access Technology

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Occupational therapists who must provide alternative computer access are faced with a daunting task. From nearly 500 types of devices, they must decide on a specific access technology that will meet clients’ needs. Without extensive clinical experience, it is difficult to select an appropriate level of intervention from the alternatives without guidance. The RoadMap to Computer Access Technology is a tool that assists clinicians in using the information obtained in an occupational therapy evaluation to select an appropriate level of intervention for a specific client. Clinicians answer a series of yes or no questions and follow the directions on the RoadMap. The RoadMap leads clinicians to a small group of devices that should meet the access needs of the client.

For the occupational therapist exploring the world of assisted computer access, the number of products available can be overwhelming. Catalogs from vendors of assistive technology list hundreds of possible adaptations to the computer interface. Adaptations range from low-cost shift-key latches to exotic devices with which the client can type merely by looking at the desired word or character. Therapists with little experience in assistive technology may have difficulty deciding which device to use. With experience, clinicians can learn to organize the vast maze of products into a meaningful pattern. They learn which specific deficits each type of product addresses and what skills each product requires. Through clinical practice, therapists learn an organizational pattern that works for their caseload. Developing that pattern enables practicing therapists to compare new equipment to the appropriate existing devices and to evaluate the new device quickly and accurately.

All selection strategies, or taxonomies, have limitations. Because they attempt to fit a diverse population of devices into predefined categories, taxonomies necessarily compromise in some categories. Some devices will fit into more than one category; others do not quite fit into any category. Such devices can be placed into the category that fits best or into more than one category. If a new device represents a fresh approach, additional categories can be created as they are needed.

Perhaps the greatest limitation of taxonomies of assistive technology is the speed with which new products are introduced. Few revisions move existing products from one category to another, but old products drop out of use and new ones are constantly being added. For a taxonomic guide to be effective, it must allow easy addition of new products and removal of outdated ones.

This article presents the RoadMap to Computer Access Technology. The RoadMap is one method of organizing information about assistive technology interventions to the standard computer interface. It is intended to assist the therapist in selecting a class of devices that may be functional for a given client.

At the end of each path of the RoadMap is a cluster of products taken from Hyper-ABLEDATA (4th ed, 1991) from the Trace Research and Development Center in Madison, Wisconsin. This cluster represents all the devices known to the author at the time the RoadMap was developed. Inclusion or exclusion of a specific product should not be taken as a recommendation regarding that product. Because of the inevitable lags in the publication process, the RoadMap cannot include products developed most recently. However, most new products will fit within the clusters defined by the RoadMap and so can be added to the basic pattern.

Assessing the Need for Adaptations

The first step in providing adapted computer access is to
assess the need for such adaptations. This assessment should include two components: (a) Does the client need to use a computer? and (b) Can the client use a conventional interface functionally? Each of these components is considered before the RoadMap is used. Our culture is rapidly approaching the point at which the first issue is moot. In the near future, all members of society will need access to a computer. Even today, most jobs require that employees be able to access information systems. Additionally, computers are used by school systems as writing aids, by computer hobbyists as a source of leisure activities, and by people with communication difficulties. SeniorNet is a nationwide computer network of elderly computer users who share information and ideas via computers. At all ages, and in all aspects of life, computer access should be considered.

The meaning of functional use varies with individual needs. A person who uses a computer primarily to write personal letters will need a different level of productivity than an office worker will. Some employers demand that employees be able to maintain specific typing rates over long periods. In school-based applications, the required speed is that which allows the student to keep up with his or her schoolwork. In each environment, there are productivity standards that the client must achieve to access a computer and be functional. If the client is not able to use the standard computer interface, then alternative access should be considered. It is at this point that the RoadMap can be used.

The RoadMap to Computer Access Technology

The RoadMap to Computer Access Technology is a branched flowchart intended to direct the therapist's thinking in the process of evaluating a client. After completing a conventional occupational therapy evaluation, the therapist should have enough information to select the first device to be evaluated. The RoadMap guides the thinking process by linking functional capacities and limitations to specific intervention strategies. Each branching of the RoadMap is indicated by a diamond symbol containing a simple yes or no question. The answer to this question indicates the direction to be taken in the evaluation. To explain this process, two case examples are provided.

Case 1

The client is a 15-year-old boy with mild upper-extremity spasticity and apraxia secondary to a traumatic brain injury sustained 9 months ago. The client has some impulsivity, slurred speech, and tangential thinking, and he tires rapidly. He is able to walk with a rolling walker for up to 300 feet without resting. The client first received inpatient rehabilitation, then he received 6 months of outpatient treatment three times per week for rehabilitation of motor control and cognitive functioning. He wants to graduate with his class, and his therapists think that he is now ready to return to his public school part-time.

The client needs some method to produce written work for his class. His handwriting is illegible. He is able to reach approximately 12 in. side to side and 4 in. backward and forward with his right hand. His left upper extremity has extreme intention tremor. The client has attempted to use a standard keyboard but tends to drag his hand from key to key and thus makes frequent false keystrokes. The school system has requested recommendations for adaptations to their Apple IIGS computer that will allow the client to complete in-class assignments. We begin the evaluation at the first diamond of the RoadMap (see Figure 1).

Is the client able to reach all keys of the standard keyboard? We know that the client is able to reach 12 in. side to side and 4 in. backward and forward with his right hand. This range will allow the client to reach all keys of the standard keyboard but not the numeric keypad. Because these keys appear on the top row of the standard keyboard, his therapists think that this will be satisfactory. (In some higher-level applications, the number keys of the numeric keypad perform different functions from those of the standard number keys. In this case, the client's range would not be satisfactory.)

Is the client able to press more than one key at a time? Because the client is typing with one hand, he will occasionally be unable to rely solely on one-handed typing, so the answer is no, and thus we move to the "Use Sticky Keys" array. For his Apple IIGS, which is not a read-only memory (ROM) 3 version, we will use either Easy Access GS or the Adaptive Firmware Card (AFC) Assisted Keyboard, depending on the features the client needs. Therefore, we make a note of the options for sticky key operation and continue the evaluation (see Figure 2).

Does the client have frequent accidental keystrokes? According to our evaluation, the client does have frequent false keystrokes, so we follow the yes branch of this path.

Is the client able to strike a single key on demand? On evaluation, we find that he generally strikes the correct key on demand, but that his errors are caused by dragging his hand from one key to another. We are thus able to answer yes to this query and follow the yes path.

Does the client release accidentally struck keys quickly? Because the client makes false keystrokes by dragging across the keyboard, he releases his incorrect keystrokes quickly, so we answer yes to this question. At this point, we move to "Use Delayed Acceptance Adaptation." The only option at this time for the client is the AFC Assisted Keyboard.

1Manufactured by Apple Computer, 20525 Mariani Avenue, Cupertino, California 95014.
2Manufactured by Don Johnston Developmental Equipment, 1000 N. Rand Road, Bldg 115, Wauconda, Illinois 60084.
We have now addressed the major issues limiting the client’s ability to use the computer and found that the best adaptation was the AFC Assisted Keyboard. Before we recommend this adaptation to his school, the client will type in this mode and evaluate the effect of the adaptation.

After adjusting the keyboard response to meet the client’s needs, we explore the results of our intervention. The first consideration is whether this adaptation improves his performance. We find that the client types slightly more slowly with delayed acceptance but has considerable improvement in accuracy. The time to produce an acceptable copy is reduced, so he is able to function at a higher overall level with the intervention than without it.

Is the client willing to use the device? The client reports that he finds the delays in response produced by delayed acceptance typing frustrating, but he thinks that they are less frustrating than the many false keystrokes he has experienced in the past. He is willing to use this approach.

Is the device available to the client? The school is willing to purchase an adaptive firmware card for the client. In fact, the school computer laboratory already has one that is not in use at this time, and they are willing to install it in the school computer that the client will be using.

Can the client or third-party payer cover the cost of the device? Because the device is already available, this is not an issue.

Is there a local distributor or support service? The AFC must be returned to the manufacturer for service, but the school reports that they have never had a failure, so this is not a consideration with this choice.

Can the device be repaired quickly when it fails? The manufacturer reports that repairs can be completed in less than 1 week, on average, in the event of failure. The experience of other technology consumers supports this claim.

Will the addition of this adaptation require changes in the operation of the base device? Adding an AFC Assisted Keyboard expands the input options of the Apple IIGS but allows the computer to be used with its standard keyboard. However, if the AFC Assisted Keyboard is left running after our client uses the computer, it is possible that other users will accidentally find them-
Go to Expanded Keyboards

Use KeyGuard
Apple Ile Apple IIGS Macintosh MS-DOS

Evaluate
Impact

Use Delayed Acceptance Adaptation
Apple Ile Apple IIGS Macintosh MS-DOS

Figure 2. The RoadMap to Computer Access Technology: KeyMods 2.

selves in Assisted Keyboard mode. To minimize the chances of this happening, we will teach the teachers and classroom aids how to activate the AFC Assisted Keyboard, select the client’s Assisted Keyboard setup, and return the computer to its regular setting. Thus, although no basic change in operation is required, we will provide some training in device operation to minimize the device’s effect on other users of the computer.

Will this device have an impact on others in the immediate environment? When operating in Assisted Keyboard mode, the adaptation beeps to signal that a key has been accepted. The other students find this beeping to be distracting. However, the volume of the beeps can be adjusted to a level that does not interfere with normal classroom activities. This modification is acceptable to the students in the classroom.

On the basis of our findings, we formally recommend that the school install the currently unused AFC in the computer that the client will be using and that the computer be programmed so that its default is Assisted Keyboard mode. This mode will provide sticky keys operation and delayed keyboard acceptance. We recommend that the level of delay be adjusted to provide the client with the fastest typing that does not produce frequent false keystrokes. We also recommend that the client be taught to type using the keyboard delay and sticky keys and that his teachers be taught how to deactivate these adaptations so that others in the class can use the computer when he is not using it.

Case 2

The client is a 28-year-old woman who sustained a complete C–4 level spinal cord injury 14 years ago. She is proud that she has never had any skin breakdown in 14 years of quadriplegia. She is articulate and an excellent advocate for herself. She has excellent head control but no functional use of any extremity. She has 24-hr attendant care and is able to manage her attendants well.

The client plans on returning to school to study law and is seeking equipment recommendations for a writing system that will allow her to produce papers for school...
Figure 3. The RoadMap to Computer Access Technology: Mini-Keyboards.

and to write briefs for her eventual law practice. The state Department of Vocational Rehabilitation has tentatively committed to providing her with a computer system if a functional input system can be found. The client has asked for assistance in selecting a typing system to allow her to complete her schooling. She will only be able to apply to school once, and the system must last throughout her 3 years of study.

This client’s evaluation begins at the same point as the previous one.

Is the client able to reach all keys of the standard keyboard? Because the client has no movement in her arms, we answer no and are directed to “Go to Virtual Keyboards” (see Figure 3).

Does the client have sufficient ROM to reach all keys of the mini-keyboard? Obviously, the client is not able to reach these keys with her hands, but she might be able to type using a mouth stick, so we explore this option with her. She had used a mouth stick for a number of years, but began to develop jaw pain with typing and was diagnosed with temporomandibular joint breakdown. Thus, continued mouth stick use is contraindicated. We answer no to this question and are directed to “Go to Virtual Keyboards” (see Figure 4).

Does the client have sufficient pacing skills and memory for encoded entry? Although there are no hard standards to determine what constitutes sufficient skill for encoded entry, we know that many Boy Scouts and radio operators learn Morse Code. Some anecdotal evidence suggests that the lower limit of skills for learning Morse Code is approximately a third-grade reading level. Because the client is a bright, articulate person, we are sure that she meets this standard and respond with a yes. We will confirm this decision through training if Morse Code proves to be a final choice.

Does the client require mouse movement in addition to text input? The client says that she will need to use WordPerfect and on-line law library software known as WestLaw. Both of these programs are completely key-

\(^{1}\) Manufactured by WordPerfect Corporation, 1555 N. Technology Way, Orem, Utah 84057.

\(^{2}\) Manufactured by West Publishing, 620 Opperman Drive, Eagan, Minnesota 55123.
Does the client have learning capacity and ability to respond to timed patterns? The client appears to have good time sense and above-average intelligence, so we answer yes to this question. This leads us to the selection of Morse code as a desirable input method for her.

When the client is approached regarding the use of Morse code, she has a negative reaction that immediately answers the second question of the impact evaluation: "Is the client willing to use this device?" We learn that during rehabilitation 5 years ago, it was recommended that the client use Morse code and that she was provided with some equipment but received no training. Her experience with Morse code was one of exceptional frustration, and she is unwilling to consider it as an input method. Therefore, we must consider other options.

Following our logic trail backward, we find the most recent branch directs us to consider mouse emulators combined with on-screen keyboards (see Figure 6).

Is the client able to use the conventional mouse or alternative effectively? The client is not able to use any device that is driven by hand motion, so we consider mouse emulators. Because she requires access to MS-DOS for WordPerfect and WestLaw, we are restricted to the HeadMaster and FreeWheel options for her. The client expresses a preference for the HeadMaster after trying the two systems and says that she will always have an attendant nearby who can place the headpiece of the HeadMaster on her head as needed. The client will also require an on-screen keyboard for functional typing. In the text environment, we can consider HandiKey, FreeBoard, and Help-U-Keyboard. Of these, the client likes

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Figure 4. The RoadMap to Computer Access Technology: Virtual Keyboards.
the macro options and possibility for customizing of HandiKey. Additionally, we know that she will need to type boiler plate (frequently repeated text) in legal contracts, and the immense abbreviation expansion capacity of HandiKey will facilitate this. Next, we assess the effect of these choices.

Is the client able to function at a higher level with this device than without it? Using the suggested adaptations, the client is immediately able to type at 10 words per minute. Because she is unable to type without it, this is a major improvement in typing speed. As she is not familiar with the capabilities of the on-screen keyboard, we expect that her typing speed will increase substantially with practice.

Is the client willing to use this device? The client continues to refuse to consider Morse code but enjoys typing with the HeadMaster and HandiKey combination.

She expresses a strong preference for this combination over any other text input method that she has tried during the evaluation process.

Is the device available to the client? Both the HeadMaster and HandiKey are commercially available products with a history of customer satisfaction.

Can the client or third-party payer cover the cost of the device? The client has a commitment from the Department of Vocational Rehabilitation to provide her with a new computer, and a community group has raised money to purchase the access system. She will have both the computer and the access system within 1 month of the formal recommendations.

Is there a local distributor or support service? Prentke Romich, the HeadMaster vendor, offers regional support through paid consultants, so service should be available for the HeadMaster. Microsystems Software offers telephone-based support for their products, and the client is fortunate to have access to a regional consultant who can customize the HandiKey keyboards for her.

Can the device be repaired quickly when it fails? Through the combination of regional service and consul-
Figure 6. The RoadMap to Computer Access Technology: Mouse Emulators.

...and telephone support from the manufacturers, it is likely that the client will be able to have her access system repaired quickly in the event of failure. HandiKey is supported through on-line updates that will allow the client to receive updates and solve problems over the telephone for immediate installation. The HeadMaster must be returned to the vendor for repair, but both the HeadMaster and Prentke Romich have good track records regarding durability and repairs. Repairs on the HeadMaster can generally be completed within 1 week, and loaner units are available when the HeadMaster cannot be repaired quickly (D. Spaeth, September 1992, personal communication).

Will addition of this adaptation require changes to the operation of the base device? The conventional access method is fully available on the client's computer despite the adaptations. With the exception of attendants who may occasionally help her, she is the only projected user of this computer, so the adaptation will not be a problem.

Will this device have an impact on others in the immediate environment? The only effects external to the client will be the novelty of having a student using a computer via an alternative access system and the need for a standard outlet to power her system. Both of these are minor adjustments, and the school is willing to support these needs.

Based on these findings, our recommendations for a writing system for this client are the HeadMaster from Prentke Romich and HandiKey from Microsystems Software. It is likely that Morse code would have afforded her faster text input in the long run, had she been willing to consider it. However, faced with a choice between a potentially faster system that the client will not use and a slower system that she will use, we recommend the most productive system.

Conclusion

As shown by these two case studies, the process of finding an appropriate alternative access method is one of progressive refinement. The goal is to find the alternative access system that will provide the most functional access...
for the person and that is tolerable by others in the environment. The RoadMap to Computer Access Technology will assist the therapist in finding a category of devices that meets the needs of the client. Selecting from the options within a category must be done on a case-by-case basis, depending on the specific needs of the client for software access, hardware compatibility, and local support. A client who is returning to work in an office that exclusively uses MS-DOS computers will not benefit from an adaptation that only works on Macintosh computers. Likewise, a client who needs access to only a limited range of software may be able to use a less expensive access system than a client who needs to use extremely diverse programs. Only experience with the specific options available can guide therapists in this final choice.

The RoadMap to Computer Access Technology is one method of finding workable solutions to computer access problems. It is intended to help clinicians who are uncomfortable with computer access, or who are just beginning to explore this area, to quickly find access solutions for their clients. Although this system will not answer all access questions, it should assist therapists in finding workable solutions for most of their alternative access clients.

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Reference


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