Gathering and Applying Evidence in Computer Access Services

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Abstract. Evidence-based practice (EBP) provides an opportunity to powerfully enhance assistive technology (AT) service delivery. In this paper, we present the concept of EBP and its role within AT service delivery. Focusing on the area of control interfaces for assistive technology, we describe tools that can help AT teams gather useful evidence about their clients' abilities. We also describe a particular assessment tool called Compass. Finally, we present case studies illustrating the use of EBP to diagnose difficulties with an existing interface, compare performance with different input devices, and track changes over time.

Keywords. Assistive technology, computer access, accessibility, evidence-based practice

Introduction

Assistive technology (AT) practitioners need effective methods of demonstrating the rationale behind their clinical decisions and the ultimate outcome of those decisions. This is important as a means of providing the best possible service to our clients, and it also part of the trend toward increasing accountability in AT service delivery. Evidence-based practice should be an integral component of the service delivery process, regardless of setting (e.g., educational, vocational, rehabilitation) or assistive technology device (e.g., communication, computer access, seating and mobility). Many of the most widely used frameworks for AT service delivery, including the Quality Indicators for Assistive Technology (QIAT) <www.qiat.org>, the HAAT model [1], the SETT framework <www.joyzabala.com>, and others [2], emphasize the need for clear evidence to support decision-making.

1. Evidence-based Practice

Evidence-based practice involves making decisions based on evidence that relates to the client [3]. This evidence can be classified into three categories. The first category is *external evidence*. The relevant question to ask for external evidence is: What are published outcomes for similar individuals with similar needs? This is typically the focus of evidence-based practice in medicine [4]. In assistive technology, where clients often have very diverse and unique needs, and where the research base relevant to a

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particular individual may be limited, we also need to consider the more "local" and specific evidence in the remaining two categories. The second category is the *experience of the skilled professional*, in which the practitioner asks: What has worked well for similar individuals that I've worked with? The third category is *individual evidence,* in which the practitioner performs a careful assessment of the client's limitations and abilities, as well as considering the client's subjective opinion. While all three types of evidence are important, this paper focuses on the role of individual evidence and describes methods of gathering quality individual evidence for access assessments.

Individual evidence helps answer key questions such as the following:
1. How well is my client's current access system meeting her needs?
2. Will a new access system benefit this student?
3. Which access system will be the most effective? Why?
4. Is the new system an improvement over the old one?
5. Are my student's abilities changing over time?
6. Are there barriers to better performance that we can work on?

2. Tools for Gathering Individual Evidence

Good, clear answers to these questions are crucial in providing high-quality access interventions. While these questions can be difficult to answer, the use of computer-based tools for gathering evidence can ease the process considerably. Several specific tools for assessing computer access skills have been developed, including: the Assessment of Computer Task Performance [5], EvaluWare <www.assistivetech.com>, the Single Switch Performance Test <www.aacinstitute.org>, Custom Solutions website <www.customsolutions.us>, and Compass software <www.kpronline.com>.

Some key features to look for include:

1. **Automatic Test Presentation**: A software-based tool that can present a variety of skill tests on the computer can improve the efficiency of the assessment. However, the practitioner must be able to tailor the skill tests to meet client needs, such as adjusting the size and color of objects on the screen, or the cognitive complexity of the task. Additionally, the skill tests must be carefully designed to ensure that successive presentations are similar (so that the results can be validly compared to previous performance) but not identical (so that the client is unable to "learn the test"). For Compass software as well as the Assessment of Computer Task Performance, research demonstrating the validity and reliability of the skill tests has been performed and published [5, 6].

2. **Automatic Data Collection**: When properly programmed, computers are good at measuring time and counting errors. This is not something that people are particularly good at, and when assistive technology practitioners attempt to do this manually during a computer access assessment, they are unable to use their knowledge and skills to observe important aspects such as the quality of movements or a client's approach to a task. Therefore, a tool that lets the computer measure speed and accuracy yields more comprehensive information in the same amount of time, and provides "hard data" to complement human judgment. A key requirement, of course, is that the data be correct, so that the information provided by the software is absolutely trustworthy. For Compass software, careful video benchmarking has been performed to ensure the accuracy of its measurements [7].

3. **Storage and Retrieval**: The ability to store and retrieve assessment results is key to making the results useful both now and in the future. This allows a practitioner to quickly review past results and provide important information at any time to the client, family members, other professionals, administration, or funding agencies.

3. Compass Software

Compass software is a tool for AT practitioners who perform computer access and augmentative communication evaluations. It measures a client's skills in various kinds of computer interaction, such as text entry, mouse or pointer use, and switch use. Compass automatically records speed and accuracy measures during task performance and presents the results in an easy-to-understand format.

The current version of Compass includes eight skill tests in three input device domains (pointing device use, text entry, and switch use). Each test is configurable to match it properly to the client's needs. For example, the size and color of text and objects can be adjusted if necessary. These configurations are saved, allowing for efficient re-use in a subsequent session if desired. Each test run presents a series of trials, during which the speed and accuracy of user actions are recorded. Following the test, Compass can generate a report, summarizing results for the test and providing trial-by-trial detail if desired. The currently available Compass tests are described in the list below.

1. Aim - Move mouse pointer into a target. Click (or dwell) to select target.
2. Drag - Move mouse pointer into a target.   Click (or dwell) to select target. Drag target to a destination. Release target.
3. Menu - Select a specific item from a menubar.
4. Letter - Enter a specific letter.
5. Word - Enter a specific word.
6. Sentence - Enter a specific sentence.
7. Switch - Press and release a switch.
8. Scan - Select a letter using a row-column scan matrix.

All Compass tests are compatible with a wide range of input devices, such as physical keyboards, on-screen keyboards and other alternative keyboards, speech recognition, all types of pointing devices, and all types of switches. The software can also be used to assess the effect of varying output displays as well, as it is compatible with screen magnifier programs such as ZoomText <www.aisquared.com>.

4. Examples of Using Compass

4.1. Example #1 – Keyboard Use

This example involves a 68 year old woman (called "M") with multiple sclerosis. She had been typing for years on a standard computer keyboard but had some mild complaints about her typing speed. We used the Compass Sentence test to get a baseline understanding of how well she could use her keyboard. This test presents a

series of sentences for the client to type. During performance of her Sentence test, it was clear on observation that M had a significant problem with the automatic key repeat, particularly with the space bar. She would carefully enter the letters of a word, and then hit the space bar. This almost always resulted in numerous repeated spaces, because she had trouble getting her hand off the space bar quickly enough. Then she would press the backspace key, again with limited release ability, and would usually erase the extra spaces as well as most of the correct text she had just typed. Her typing was a laborious back-and-forth cycle, which she patiently continued until completing each sentence.

Compass results showed the consequences of this situation, with a baseline typing speed of 2.2 words per minute, a total error rate of 60% (meaning that 60% of her keystrokes were errors), and a net error rate of 1% (meaning that she fixed 99% of those errors). Compass also provided a list of all letters entered, which clearly showed the auto-repeat problem with the spacebar and backspace keys. This reinforced the observation that this client would benefit from an adjustment to the Windows key repeat settings. M did not know that this adjustment was built-in to her computer.

	Typing Speed (wpm)	Total Errors (%)	Net Errors (%)
Baseline	2.2	60	1.1
Slower Key Repeat Rate	3.2	28	1.7

Table 1. Summary of Compass data for Example #1, showing speed and accuracy of typing at baseline and then slowing down the key repeat rate. Total Errors reflects how many errors were made during the course of typing the sentences, regardless of whether those errors were eventually fixed. Net Errors reflects the number of errors remaining in each sentence at the completion of each trial.

The key repeat rate was slowed down significantly, and M was asked to complete a second Compass Sentence test. This showed definite improvement (see Table 1), to 3.2 words per minute and 28% total error rate. While this was a clear enhancement, it also showed that the change to key repeat rate did not solve all of M's keyboarding challenges. This provided documentation to justify further investigation into other keyboarding methods for M. This example illustrates the power of Compass to clearly document a presenting problem and demonstrate intervention effectiveness.

4.2. Example #2 – Pointing Device Use

Our second example involves a young adult with cerebral palsy. She uses at least two different computers on a regular basis - one with a standard mouse, and a laptop with a trackpad. While she appeared on observation to have adequate ability with both pointing devices, Compass measurements revealed a clear difference. Table 2 shows two measurements taken during the Compass Aim test, in which a series of targets are presented on the screen, and the client is asked to click on each one. Looking at performance on the Aim test for three different pointing devices, the mouse was about twice as fast as the trackpad and trackball. The number of Entries, i.e., the number of times the cursor entered each target, is similar for all three input devices, suggesting that she did have a similar level of control with each one. This individual did not realize that the mouse was so much faster for her, and now she is in a position to make a more informed decision about what pointing devices she will use.

	Trial Time (sec)	Entries
Mouse	2.6	1.4
Trackpad	4.9	1.3
Trackball	5.4	1.3

Table 2. Summary of Compass data for Example #2, showing performance in the Aim test using three different pointing devices. Trial Time reflects how long it took to click on each target. Entries is the number of times the mouse cursor entered the target during each trial.

5. Conclusions

With current tools such as Compass software, it is now possible to get clear quantitative data about performance when providing computer access services. This quantitative evidence, when interpreted by a skilled professional or AT team, yields insights into the specific nature of any difficulties experienced by the client, the types of solutions that may yield improved performance, and the extent to which those solutions resulted in a positive outcome for the client. Combining quantitative evidence with the full context of the client's situation provides a solid basis for AT decision-making, and is a key step in providing the best possible AT services for our clients and students.

Acknowledgements

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