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Assisting people with multiple disabilities to improve computer typing efficiency through a mouse wheel and On-Screen Keyboard software

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ABSTRACT

The main purpose of this study was to find out whether three students with multiple disabilities could increase their keyboard typing performance by poking the standard mouse scroll wheel with the newly developed Dynamic Typing Assistive Program (DTAP) and the built-in On-Screen Keyboard (OSK) computer software. The DTAP is a software solution that allows users to complete typing tasks with OSK software easily, quickly, and accurately by poking the mouse wheel. This study was performed according to a multiple baseline design across participants, and the experimental data showed that all of the participants significantly increased their typing efficiency in the intervention phase. Moreover, this improved performance was maintained during the maintenance phase. Practical and developmental implications of the findings were discussed.

1. Introduction

In the Information Age, computers are widely used and play an important role in our daily life. With the assistance of computer technologies, people with disabilities are able to enhance their capabilities in terms of communication, education, employment, and independent living, and have more opportunities to participate in social activities (Davies, Stock, & Wehmeyer, 2002a, 2002b; Houlihan et al., 2003).

A keyboard is a basic input device for texting messages or entering commands to control the computer. In general, a standard keyboard is designed for normal users, without taking into account that it might be used by people with disabilities. Disabled users often encounter difficulties and obstacles when using a standard keyboard, and need to use specially designed assistive devices or alternative keyboards (Cook & Hussey, 2002). For instance, a cherry compact keyboard is a small size keyboard that can fit on a wheelchair tray (Aidis, 2014); a keyguard is a metal or plastic cover for the keyboard with drilled holes that can be helpful for users with fine motor difficulties to help them avoid pressing the wrong keys (Fentek, 2014); the look and functionality of a IntelliKeys keyboard can be changed by sliding in different overlays to match users' needs (IntelliTools, 2014), etc.

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Fig. 1. On-Screen Keyboard (OSK) software is a visual keyboard on the computer screen that allows people to enter data using a mouse or other pointing device.

The On-Screen Keyboard (OSK) software (Wiki, 2014) is an alternative keyboard input mode that is now a built-in function of the Windows Operating System (OS). Instead of relying on a physical keyboard, it displays a visual keyboard with all the standard keys on the computer screen so that users can select keys on the screen using a mouse or other pointing devices (Microsoft, 2013), as shown in Fig. 1.

OSK software can reduce the reliance on physical keyboards and can enable people who have difficulties using a standard keyboard to complete typing tasks by operating a mouse. To use OSK software, the prerequisite is that users must possess basic mouse operation ability in order to move the computer cursor accurately.

Most computer operating systems now conform to Graphical User Interface (GUI) design, making a mouse one of the important input devices for a computer. In the same way as standard keyboards, most standard mice are designed for the mainstream population, without taking into account that these devices might also be used by people with disabilities who frequently encounter computer operation problems. For people with fine motor difficulties or physical disabilities, it is difficult or impossible to use OSK software with a standard mouse precisely due to frequently encountered mouse operation problems such as the inability to aim at small targets, difficulty in moving a mouse device, or difficulty in controlling the mouse buttons (e.g. inability to press the buttons or to relocate the cursor from the target after clicking), etc.

To solve this issue and provide disabled people with the opportunity to use a computer, various specialized alternative computer pointing devices have been proposed to meet the needs of people with disabilities (Brodwin, Star, & Cardoso, 2004; Hedrick, Pape, Heinemann, Ruddell, & Reis, 2006; Tu, Tao, & Huang, 2007). Normally, compared to standard devices, these specially designed input devices have some disadvantages due to their specific design: (a) costs of these devices are higher than standard ones, (b) they are more difficult to obtain or maintain, and (c) the shapes are quite different from standard devices, and thus may weaken users' intention to use these specially designed devices.

In contrast, there are many advantages to standard devices, such as low cost, good technical support, wide accessibility, etc. Therefore, turning standard devices into high performance computer input assistive devices can offer people with disabilities the opportunity to use these standard devices, and provide them with additional choices in terms of computer assistive technology.

To make each hardware device function properly in a computer, a corresponding driver program is required. For example, a keyboard requires a keyboard driver program, and a mouse requires a mouse driver program (Microsoft, 2008b), etc. Generally, a driver program is provided by an OS vendor or a hardware manufacturer for the purpose of ensuring that the connected hardware device can function normally. Since a mouse is a standard device for a computer, its driver program is already built into the OS, meaning that there is no need to change the driver. If a mouse is connected to a computer, the OS will identify it as a mouse device and will install its standard driver automatically. As a result, a mouse device will be set to its default functions and these functions cannot be changed.

Redesigning or modifying a mouse driver can reset the mouse functions and turn it into a more powerful tool, but this technique is rarely proposed by researchers because it is very complicated, with high technical threshold and requiring complex software technology (Microsoft, 2008a, 2008c, 2008d). Few studies have been carried out using software technology to redesign a mouse driver to reset the default functions of a mouse and turn it into a high performance computer assistive input device dedicated to helping people with disabilities (Shih, 2011a, 2011b; Shih, Chiu, et al., 2010; Shih, Huang, Liao, Shih, & Chiang, 2010; Shih, Li, Shih, Lin, & Lo, 2010; Shih & Shih, 2010; Shih, Shih, & Peng, 2010; Shih, Shih, & Wang, 2010).

A software-based mouse driver solution is powerful because it enables a standard mouse to be adapted to the special needs of people with disabilities, and provides disabled people with choices in terms of being able to operate a computer using a standard mouse like people without disabilities.

Therefore, in this study, the concept of allowing people with disabilities to have the opportunity to use a standard computer is discussed. The Dynamic Typing Assistive Program (DTAP) software was developed to help people with disabilities who have difficulties typing using standard keyboards to perform computer typing tasks efficiently and precisely.