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Comparing Data Input Methods on Handheld Computers

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Summary: Three data entry methods (external keyboard, internal keyboard, or Graffiti2™) were compared in terms of speed, accuracy and satisfaction. Results indicate that data entry was fastest on the external keyboard and slowest the Graffiti2® data entry method. Data entry was most accurate on the external keyboard for alpha-only and most accurate on the internal keyboard for numeric and alpha/numeric data. Participants generally reported greater satisfaction for the external keyboard than the other two methods.

INTRODUCTION

Handheld computers (HHCs) are small, palm-sized portable, programmable, electronic devices that can store, retrieve, and process data. These devices have quickly become popular in many areas including K-12 education (Vincent, 2003; BayCHI, 2001) and medicine (Dean, 2004; Scheinfeld & Goldblum, 2003; McAlearney, Schweikhart, & Medow, 2004; Courtney, n.d.). Popular use, however, does not always equate with universal acceptance. In a qualitative study by McAlearney, Schweikhart, & Medow (2004), doctors reported frustration with data entry as a potential barrier to the adoption and use of HHCs.

The purpose of this study was to compare three data entry methods (external keyboard, internal keyboard, or Graffiti2™) in terms of task speed, accuracy and user satisfaction. Participants used each method of data entry to enter sets of alpha-only, numeric-only or alpha-numeric data sets.

METHOD

Participants

There were nine participants in this study (3 male, 6 female). Participants were recruited from an Advanced Handhelds for Education class at Wichita State University. Participants' ages ranged from 25 to 45; the mean age of the participants was 35.29. All students reported having college degrees, with five students reporting having advanced degrees. Over half (55.6%) reported using HHCs for both personal and professional use, while the other participants reported using them for either personal (22.2%) or professional (22.2%) reasons.

Materials

Figure 1. Zire™ 71

The handheld computers (HHCs) tested in this study were all Zire™ 71's (See Figure 1) provided by WSU's College of Education. The HCCs measured 4.4 x 2.9 x 0.6 in and weighed 3.8 oz. The HHC screens had a 160x160 pixel and 320x320 color display and used a 126MHz TI OMAP 311 ARM processor. There were three data entry conditions: external keyboard, internal keyboard, & Graffiti2®. All participants were provided with a Palm Ultra-Thin™external keyboard (See Figure 2). Keyboard dimensions (fully opened) measured 9.9 x 5.8 x0.5 inches. The keyboard used the QWERTY keyboard arrangement with other Palm™ specific function arrangement of input keys. Participants connected the keyboard to the Zire™ 71 with the Palm™ Universal Connector. Data was input in this method by typing the information on the external keyboard; however, the numeric keys on the keyboard are the top row and needed a function key pressed simultaneously as the numeric keys. All HHCs were equipped with an internal keyboard using the QWERTY arrangement of input keys. Data was input in this method by tapping on individual keys displayed on the HHC screen with a stylus. The HHCs were also equipped with the Graffiti2® software, which involves data input using a stylus in a manner of writing similar to pen and paper.

Figure 2. Palm Ultrathin™ external keyboard

Procedure

Investigators read instructions and demonstrated the data entry methods to the participants. Participants were given practice opportunities and were encouraged to play Giraffe, a HHC Graffiti2® practice game. A data entry sheet was provided to each participant containing both alpha and numeric data to be entered into Sheets To Go, the HHC version of Excel. The alpha and numeric data were organized into two columns with 20 entries of 6 characters each. The entries for the alpha/numeric data were entered by the participants from the alpha and numeric columns by taking 3 characters from each column. Each participant entered the data in each of the data entry methods (see Figures 3 & 4). Conditions were counterbalanced to control for the practice effect. Participants recorded their own task start time and task end time. Finally, participants beamed their Sheets To Go files into the investigator HHC for data collection. Errors were counted if there were any discrepancies between original data provided and the data as input by the participants.

At the end of each data entry condition, participants completed a satisfaction survey and then

completed a final survey at the end of the study. The satisfaction survey was a series of Likert-type questions adapted from the Software Usability Survey (Brooke, 1986).

Figure 3. Data entry using External Keyboard

Figure 4. Data entry using Graffiti2™ with stylus

RESULTS

Speed and Accuracy

Participants completed the data entry tasks more quickly on the external keyboard than with the internal keyboard or Graffiti2® data entry method. In terms of accuracy, there was an interaction between the data entry method and the type of data being entered. Participants entered alpha-only data more accurately when using the external keyboard but were more accurate in the numeric-only condition with the internal keyboard. Similarly, in the alpha/numeric generation condition, participants performed best using the internal keyboard. Participants expressed dissatisfaction with having to simultaneously press a function key while pressing number keys to input numeric data.

Table 1. Speed & Accuracy for HHC Data Entry Methods (Mean, SD)

	External	Internal	Graffiti
Speed (Task Time in Minutes)	***11.0(2.87)***	14.67(2.74)	17.0(4.27)
Accuracy			
Alpha (20 possible)	***19.44(.73)***	19.11(1.05)	17.38(3.54)

Numeric (20 possible)	18.78(1.48)	***19.67(.71)***	19.0(1.12)
AlphaNumeric (20 possible)	18.89(1.36)	***19.0(1.12)***	18.13(2.23)
***Total Score* (60 possible)**	56.6(3.68)	***57.78(2.3)***	52.25(11.85)

Satisfaction

Overall, participants (77.8%) were most satisfied with the external keyboard data entry method. They reported it to be the easiest to use and felt the most confident entering data with it. Participants were least satisfied with the Graffiti2® data entry method, reporting it to be the most complex, most cumbersome and requiring the most practice.

Table 2. Participant Satisfaction with HHC Data Entry Method (Mean,SD)

	External	Internal	Graffiti
I think I would like to use this data entry method frequently	4.56(.73)	2.22(.97)	2.11(1.45)
I found this data entry method unnecessarily complex	2.44(1.33)	2.67(1.22)	3.33(1.50)
I thought this data entry method was easy to use	4.33(.87)	3.44(1.24)	2.44(1.13)
I think that I would need the support of a technical person to be able to use this data entry method	1.44(1.01)	1.22(.44)	1.33(.71)
I would imagine that most people would learn to use this method very quickly	4.63(.52)	3.56(1.13)	2.44(1.13)
I found this data entry method very cumbersome to use	1.78(.83)	3.11(1.27)	3.56(1.33)
I felt very confident using this data entry method	4.33(.71)	3.89(.60)	3.22(1.09)
I need to practice a lot before I could get going with this data entry method	2.00(1.22)	1.44(.88)	3.44(1.33)
Overall, I am satisfied with the ease of entering data in this method	4.44(.73)	2.78(.83)	2.56(.88)
Overall, I am satisfied with the amount of time it took to enter the data in this method	4.11(1.36)	2.11(.93)	2.00(1.22)

DISCUSSION

Participants were asked to input alpha, numeric and alpha/numeric data from a provided data sheet into Palm Zire™ 71's. They were asked to input the data with each of the three data entry methods: external keyboard, internal keyboard, or Graffiti2®. Results indicated that data entry with the external keyboard was fastest for all data types and most accurate with alpha-only data. However, data entry was most accurate for the numeric and alpha/numeric data with the internal keyboard.

Not surprisingly, there was a bias for the more traditional, external keyboard both in terms of performance and satisfaction. It is quite possible that this bias might have been even greater had the participants not been required to press a function key while entering numeric data. However, not all users purchase external keyboards, and this comparison shows that the internal keyboard is generally

favored over the Graffiti2®'s method.

These results are limited to the brand of HCC used in this study; to fully understand the impact of using different data entry methods available with HHC's, other brands and devices should be evaluated.

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