Developing an Application for Assessing the User's Functions while Operating the Touch Screen (Short paper)

Alexandra Danial-Saad

University of Haifa

The Academic Arab College for Education – Haifa

saadalexandra@gmail.com

Lorenzo Chiari

University of Bologna – Italy

lorenzo.chiari@unibo.it

Abstract

In today's highly technology-oriented world, touch screen technology is rapidly becoming essential for participation in social, personal, and occupational activities. The aim of this study was to describe the processes of reaching consensus regarding the assessment of the user's skills required to operate various touch screen devices. A six-step procedure was used to collect and validate the required skills by a multidisciplinary team of 52 experts. Content validity was calculated to determine the agreement levels between the experts. A comparison was made between the discipline groups in order to test correlation between each group and their choice of specific clusters of tasks. The final number of domains and skills/measurements was 15 domains and 50 skills/measurements. The result of Cronbach's α test for the final assessment questionnaire (50 skills/measurements) was 0.94, which indicates a high degree of internal consistency. The results of Kruskal-Wallis test showed the lack of any significant difference between agreements of the clinicians and the technicians groups, but significant differences were found between the educators and the clinicians groups. Each of the skills appearing in the final questionnaire was illustrated in a flowchart in preparation for developing the assessment (tool) for using touch screen devices.

Keywords: Touch screen technology; Assessment; Multidisciplinary team.

Introduction

Touch screen technology (TST) is playing an essential role in our world's rapid technological development in the social, personal and occupational activities (Irwin & Sesto, 2012), and is becoming more prevalent due to its convenience, design flexibility, and the ease involved in manipulating touch interfaces (Chen et al., 2013). However, regardless of the setting, one of the roles of technology as intervention for people with disability is to improve an individual's ability to engage in the basic and instrumental activities of the modern daily living, such as communication, navigation and access to information (Trewin, Swart, & Pettick, 2013), and enhance one's independence in life's roles (American Occupational Therapy Association. 2010).

Assistive technology professionals are aware of the lack of dependable assessment tools to determine clients' behavior and needs in AT adaptation in general (Desideri et al., 2013), and in TST in particular (Mott et al., 2016). Although existing models provide an important general framework for AT prescription, they do not always offer sufficiently detailed guidance for clinicians (Danial-Saad et al., 2013). The assessment process is critical because it leads to the provision of the required information for AT users, clinicians, parents, teachers and care givers, in order to build an appropriate and thorough AT intervention program (Danial-Saad et al., 2012).

In order to bridge the gap that exists in the assessment field in terms of having dependable assessment tools to determine clients' behavior and needs in AT adaptation in general (Desideri et al., 2013), and in TST in particular (Mott etal., 2016), a measurements needs to be designed to quantify the interaction performance and touch characteristics of individuals with varying abilities and disabilities (Irwin & Sesto, 2012). This paper reports on a study that describes the processes of collecting and creating the required knowledge needed for developing an application to help clinicians assess the user's skills for operating touch screens of various devices in a comprehensive and objective manner, with a summary report presented through a graphic display.

Method

Participants

Two AT expert groups participated in this study. Expert Group 1 (n=23), are senior professionals from different disciplines whose expertise is in developing assessments in general, or assessing the user's skills required for operating touch screens of various devices.

Participants of Expert Group 2 (n=40) consisted of 11 members of Expert Group 1 and 29 new members. The group answered an online questionnaire, in order to rate the skills and assign their relevance to the process.

Procedures

A six-step procedure was used. Firstly, the skills needed to operate a touch screen and the measurements were collected through direct observation and the literature, and then a list of the skills/ measurements was prepared and used to develop a semi-structured questionnaire (step 2) which was used as a basis for conducting a semi-structured interview (step 3) with Expert Group 1 to determine the assessment process. In step 4, a revision of the items was conducted by the experts, and an expanded questionnaire was constructed by adding or deleting certain items. In step 5, a validation of the assessment was carried out by the multidisciplinary team (n=40), and, finally (step 6), the new list of skills/measurements, including their definitions, was used to develop the assessment application. Each task was illustrated in a flowchart and forwarded for programming.

Data Analysis

Statistical analysis was carried out using IBM SPSS Statistics, and descriptive statistics was used to summarize the results of the questionnaires. Content validity was calculated and the cut-off percentage for the agreement level was set at ≥ 0.78. Cronbach's α was used to assess the internal consistency between the different items within each domain and in the whole questionnaire with $\alpha \geq 0.9$. Kruskal-Wallis test was used to determine differences in agreement levels between the three groups in the whole questionnaire and in each domain , with a significance level of $p<0.05$. Mann_Whitney test was used to determine the source of the differences between the groups, with a significance level of $p<0.01$

Results

Thirteen domains and 41 skills/measurements were converted into a semi-structured questionnaire. The expanded questionnaire (step 4) comprised 17 domains and 84 skills/measurements, after the addition and deletion of items in accordance with the experts' recommendations (Table 1).

A final assessment form was constructed containing 15 domains and 50 skills/ measurements after having determined the level of agreement between the experts - content validity.

Table 1. Summary of results for the number of skills/measurement assigned for each domain reaching the final form

Domain	Semi-structured questionnaire – Skills/measurements in each domain (Step 2)	Expanded questionnaire (Step 4)			Final assessment form (Step 5)
		added	deleted	final	
Reach the screen	0	3	0	3	3
Tap	8	6	8	6	4
Press	0	2	0	2	2
Combined tasks	4	0	4	0	0
Drag	3	6	1	8	3
Swipe	3	0	1	2	1
Pinch	3	2	2	3	0
Rotation	0	1	0	1	0
Text entry	2	6	1	7	5
Vision	4	12	4	12	11
External buttons to operate and control	0	7	0	7	2
Cognitive-motor	3	0	3	0	0
Multi-stage tasks	0	7	0	7	3
Accuracy	2	2	0	4	4
Pressure	1	2	0	3	3
Timing	4	4	2	6	5
Movement range	2	6	3	5	2
Mode of operation	2	4	1	5	1
Input device	0	3	0	3	1
Total tasks	**41**	**73**	**30**	**84**	**50**
Total domains	**13**	**-**	**-**	**17**	**15**

The result of Cronbach's α test for the final assessment questionnaire was 0.94, which indicates a high degree of internal consistency. The results of Mann-Whitney test showed the lack of any significant differences between agreements of the clinicians and the technicians groups, but significant differences were found between the educators and the clinicians groups in the Vision ($p=0.016$) and Input device ($p=0.01$) domains, and between the educators and the technicians only in the Input device ($p=0.01$) domain.

Discussion and Conclusion

In this study we developed a final assessment form that includes the required skills/measurements needed to assess the user with varying abilities and disabilities in objective manner.

The development of the TST assessment may contribute to bridging the existing gap in the assessment tools for determining clients' needs to operate TST and may help AT experts to increase their awareness of new information and measurements about TST, which is becoming essential for participation in social, personal, and occupational activities and its use has become prevalent in every day environments (Irwin & Sesto, 2012).

The results of the assessment will enable clinicians to provide tailor-made recommendations for a touch screen that will suit each specific user.

The team of multidisciplinary experts, who were selected for their professional seniority and length of experience (O'hara, Souza & Ide, 2000; Werneke et al., 200)5, provided the study with a variety of viewpoints (Okoli & Pawlowski, 2004), which helped in defining, sharpening and executing the skills/measurements needed for the creation of the assessment process.

Acknowledgements

This work has been supported by EDEN- Erasmus MunDus AcadEmic Network.

References

Irwin, C. B., & Sesto, M. E. (2012). Performance and touch characteristics of disabled and non-disabled participants during a reciprocal tapping task using touch screen technology. *Applied ergonomics, 43*(6), 1038-1043.

Chen, K. B., Savage, A. B., Chourasia, A. O., Wiegmann, D. A., & Sesto, M. E. (2013). Touch screen performance by individuals with and without motor control disabilities. *Applied ergonomics, 44*(2), 297-302.

Mott, M. E., Vatavu, R. D., Kane, S. K., & Wobbrock, J. O. (2016, May). Smart Touch: Improving Touch Accuracy for People with Motor Impairments with Template Matching. *In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (pp. 1934-1946). ACM. doi.acm.org/10.1145/2858036.2858390

Trewin, S., Swart, C., & Pettick, D. (2013, October). Physical accessibility of touchscreen smartphones. In *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility* (p. 19). ACM.

American Occupational Therapy Association. (2010). Specialized knowledge and skills in technology and environmental interventions for occupational therapy practice. *American Journal of Occupational Therapy, 64*(Suppl.), S44-S56. doi:10.5014/ajot.2010.64S44.

Desideri, L., Roentgen, U., Hoogerwerf, E. J., and de Witte, L. (2013). Recommending assistive technology (AT) for children with multiple disabilities: A systematic review and qualitative synthesis of models and instruments for AT professionals. *Technology and Disability, 25*(1), 3-13.

Danial-Saad, A., Kuflik, T., Weiss, P.L., and Schreuer, N. (2013). Building an Ontology for Assistive Technology using the Delphi Method. *Disability and Rehabilitation: Assistive Technology, 8*(4), 275-286.

Danial-Saad, A., Weiss, P.L., and Schreuer, N.(2012). Assessment of Computer Task Performance (ACTP) of Children and Youth with Intellectual and Developmental Disability. *Disability and Rehabilitation: Assistive Technology, 7*(6), 450-458. doi: 10.3109/17483107.

O'hara, L., De Souza, L. H., & Ide, L. (2000). A Delphi study of self-care in a community population of people with multiple sclerosis. *Clinical rehabilitation, 14*(1), 62-71.

Werneke, U., Northey, S., Knapp, M., Bhugra, D., Crowe, M., & Smith, S. (2005). Prescribing for erectile dysfunction: A Delphi based consensus study. *Sexual and Relationship Therapy, 20*(2), 181-194.

Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & management, 42*(1), 15-29.