

**GUIDELINES OF ASSISTIVE COURSEWARE (AC)
FOR HEARING-IMPAIRED STUDENTS**

By :

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**A thesis submitted to the Academic Dean Office in partial
Fulfilment of the requirement for the degree
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ABSTRACT

The increasing number of Person With Disabilities (PWD) in Malaysia is very worrying especially to Ministry of Education because this population, eg: hearing impaired people remain disproportionately uneducated, untrained, unemployed, and poor. Accordingly many researchers work together with Information Technology (IT) experts to design and develop varieties of Assistive Technology (AT). So, AT is one of the technologies used to help this population in gaining knowledge and fortunately bridge the gap between PWD with normal people.

This study defines the disabilities and technologies suitable for the disabled which is called assistive technology (AT). Two types of AT are hardware-based and software-based. In this study, the software-based is focused, specifically in the form of courseware which is referred to as assistive courseware (AC). With concerns to develop an AC for hearing-impaired people, proper guidelines should be followed. The aim of this study is to propose guidelines for developing AC for hearing-impaired people. Adapted model, Jakob Nielson Usability Guidelines, and User Agent Accessibility Guidelines 2.0 were based on as guidance in proposing the guidelines. In accomplishing this study waterfall methodology was adapted. IntView methodology was also adapted in developing the prototype of AC and proposed guidelines were followed. Focus groups and experts tested the prototype of AC and Heuristic Evaluation was adapted. The results of this study concluded that guidelines proposed must be followed and were important in developing AC for hearing-impaired people.

ABSTRAK

Peningkatan jumlah bilangan golongan kurang upaya di Malaysia amat membimbangkan terutamanya pihak Kementerian Pelajaran Malaysia kerana populasi, contohnya golongan yang mengalami masalah pendengaran ini didapati ketinggalan dalam pelajaran, kurang pendedahan dalam latihan, tidak bekerja dan kurang berkemampuan untuk menyara hidup mereka sendiri. Justeru, ramai pengkaji bekerjasama dengan pakar-pakar Teknologi Maklumat mereka dan membangunkan pelbagai ‘Assistive Technology’ (AT). AT merupakan salah satu teknologi yang digunakan untuk membantu golongan ini mencapai maklumat dan pengetahuan dan secara tidak langsung dapat merapatkan jurang diantara golongan kurang upaya dengan golongan biasa.

Kajian ini mentakrifkan AT sebagai teknologi yang bersesuaian mengikut kekurangan individu dikalangan populasi kurang upaya. AT boleh dikategorikan kepada dua iaitu hadwer and sofwer. Fokus kajian ini adalah kepada sofwer atau perisian di dalam bentuk koswer yang dikenali sebagai ‘Assistive Courseware’ (AC). Untuk membangunkan AC bagi golongan yang menghadapi masalah pendengaran, beberapa garis panduan diperlukan untuk memastikan AC yang dibangunkan memenuhi kehendak populasi ini. Kajian ini bertujuan mencadangkan garis panduan untuk membangunkan AC bagi golongan yang menghadapi masalah pendengaran. Dalam merangka garis panduan ini, model yang telah diadaptasikan, Jakob Nielson Usability Guidelines dan User Agent Accessibility Guidelines 2.0 telah dijadikan sebagai panduan. Untuk mencapai objektif kajian, metodologi waterfall telah diadaptasikan. Manakala untuk membangunkan prototaip AC metodologi IntView turut diadaptasikan dan garis panduan yang telah dirangka telah dijadikan panduan. Bagi memastikan kepentingan setiap garis panduan yang dirangka, prototaip AC telah diuji oleh kumpulan focus dan pakar. Dalam fasa ujian, Heuristic Evaluation telah diadaptasikan. Keputusan ujian menunjukkan setiap garis panduan yang dirangka amat penting dalam membangunkan AC bagi golongan yang menghadapi masalah pendengaran.

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LIST OF ABBREVIATION

ABBREVIATION

AC	: Assistive Courseware
ACT	: Assistive Computer Technology
APCD	: <u>Asia-Pacific Development Center</u>
AT	: Assistive Technology
CAI	: Computer Assisted Instruction
CAL	: Computer Assisted Learning
CS	: Course Structure Benchmark
dB	: Decibel
HARP	: Hearing Aid Recycling Program
HTL	: Hearing Impaired Teaching and Learning Process Benchmark
ICT	: Information Computer Technology
ILTC	: Independent Living & Training Centre
IMM	: Interactive Multimedia
IQ	: Intellectual Quality
IT	: Information Technology
N/A	: Not Applicable
PAC	: Prototype Assistive Courseware Benchmark
PC	: Personal Computer
PWD	: Person With Disabilities
SEN	: Special Educational Needs
UI	: User Interface
UNDP	: United Nations Development Programme Malaysia

CHAPTER 1

INTRODUCTION

1.1 Background of Study

“For people without disabilities, technology makes things convenient; for people with disabilities, it makes things possible.”

Treviranus (2000)

The increasing number of people with disabilities (PWD) in Malaysia attracts the concerns of researchers to co-operate with the IT expertise to develop various technologies, hoping that these technologies could assist the disabled in carrying out their tasks in everyday life. The examples are accessing information and services (such as learning), and improving their quality of life. This type of technology is known as assistive technology (AT). Unluckily, most of the ATs available in the market were very expensive, whereby disabled people have to have a big amount of money to afford for the AT. This statement is supported by Dawe (2006), who in her study found out that a mother of a disabled guy had to spent big amount of money to buy an expensive communication device, called LightWriter. It is also observable that the availability of AT in Malaysia for the disabled was still lacking. AT could be designed in terms of hardware (such as a wheelchair) and software (such as assistive courseware). AT is a technology used by PWD to accomplish certain work or tasks. AT is used by disabled people who can be categorized into vision impairment, motor impairment, hearing impairment, learning disabilities, speech impairment, and cognitive impairment. The disabled use different AT depending on their category of disabilities. For example, hearing-impaired people use a system that provides highly

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REFERENCES

Allan, J., Ford, K., Richards, J., & Spellman, J. (2009). *User Agent Accessibility Guidelines (UAAG) 2.0 : W3C Working*. 23 July. Adaptive Technology Resource Centre, University of Toronto.

Alonso, F., Antonio, A., Jose L. F., & Monte, C. (1995). *MEHIDA: an intelligent multimedia tutoring system for the hearing-impaired*. 14 March. Informatik and Interactive System Institute, University of Duisburg, Duisburg.

APCD. (2007). *Statistical Data on Disability Profile*. Retrieved on 15/6/09 from <http://www.apcdproject.org/>.

Aris, B., Ahmad, M. H., Kok , B. S., Ali, M. B., Harun, J. & Tasir, Z. (2006). *Learning “goal programming” using an interactive multimedia courseware: design factors and students’ preferences*. April. *Malaysian Online Journal of Instructional Technology (MOJIT)*, Department of Educational Multimedia, Faculty of Education, Universiti Teknologi Malaysia. 3(1). 85-95.

Baloian, N., Luther, W. (1997). *Various modeling aspects of tutoring systems for people with auditory disabilities*. Institute Informatik and Interactive System, University Duisburg.

Barnum, C.M. (2002). *Usability testing and research*. Pearson Education, Inc. USA

Brown, C. (1992). Assistive Technology Computers and Persons with Disabilities. *Communications of the ACM*. 35(5). 36-45.

Canter, P., Gonzalez, A.L., Mariscal, G., & Ruiz, C. (2007). Conference & Workshop on Assistive Technologies for People with Vision & Hearing Impairments Assistive Technology for All Ages. *Towards A Methodology For Educating Students With Special Needs*. M.A. Hersh (ed.). Faculty of Informatic, University Politecnica of Madrid.

Carroll, J.M. & Thomas, J.C. (1988). Fun. *SIGCHI Bulletin*. 19(3). 21-24.

Cherney, L., Clanton, C. & Ostrom, E. (1997). Entertainment is a human factor: A CHI 97 workshop on game design and HCI. *SIGCHI Bulletin*. 29(4). 50-54

Cooper, R.A. (1995). *Rehabilitation Engineering Applied to Mobility and Manipulatio.*, Institute of Physics Publishing, Bristol, U.K.

Dawe, M. (2006). Desperately Seeking Simplicity: How Young Adults with Cognitive Disabilities and Their Families Adopt Assistive Technologies. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Canada. ACM.

Department of Social Welfare Malaysia. (2009). *Orang kurang upaya*. Retrieved on 12th July 2009 from
http://www.jkm.gov.my/jkm/index.php?option=com_content&view=category&id=46&Itemid=81&lang=ms

Devaraju, A., Mohd Yusoh, Z., Zakaria, M. & Techanamurthy, U. (2007). MyLexic : An Assistive Multimedia Courseware for Teaching and Reinforcing Basic Reading Skills among Dyslexics. In T. Bastiaens & S. Carliner (Eds.), In the *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, Chesapeake. 7058-7063

Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). *Human-computer Interaction 3rd edition*. Pearson Education Limited. England

Grützner, I., Angkasaputra, N. & Pfahl, D. (2002). A systematic approach to produce small courseware modules for combined learning and knowledge management environments. In *Proceedings of the 14th International Conference on Software Engineering and Knowledge Engineering (SEKE)*. Italy.

Grützner, I., Pfahl, D. & Ruhe, G. (2002). Systematic courseware development using an integrated engineering style method. In *Proceedings of the World Congress Networked Learning in a Global Environment: Challenges and Solutions for Virtual Education*. Technical University of Berlin, Germany.

Grützner, I., Weibelzhal, S. & Waterson, P. (2004). Improving courseware quality through life-cycle encompassing quality assurance. In *Proceedings of 2004 ACM Symposium on Applied Computing*. Cyprus.

Hamel, C.J., & Ryan, J.D. (2002). *Designing instruction with learning objects ; Screen design guidelines for motivation in interactive multimedia instruction: A survey and framework for designers*. Joint ADL Co-Laboratory, University of Central Florida.

Hearing Impairment Module (1999). *Increasing the IMPACT of assistive technology*. Hearing impairments version summer.

Hornbæk, K. (2005). Current practice in measuring usability: Challenges to usability studies and research. *International journal of human-computer studies*. 64(2006). 79-102.

Jayaratna, N. (1994). *Understanding and evaluating methodologies*. McGraw-Hills.

Jintavee, M. (2008). Higher Education E-Learning Courseware: Pedagogical-Based Design and Development. In *Proceedings of 5th International Conference on E-Learning for Knowledge-based E-Society*. Bangkok. ACM.

Kaur, A.(1998). Rethinking multimedia courseware design . *Masalah Pendidikan. Jilid 21*. Faculty of Education, University of Malaya.

Kurniawan & Zaphiris. (2005). *Guidelines Management Framework*. Australia.

Lee, S. H., & Boling, E., (1999). *Educational technology*. University of Calgary. pg. 19-26.

Liffick, B.W. (2003). Assistive Technology in Computer Science. In *Proceedings of the 1st International Symposium on Information and Communication Technologies*. 49. Ireland. ACM.

Maguire, M. C. (2006). *A review of user-interface design guidelines for public information kiosk systems*. HUSAT Research Institute, Loughborough, Leics, UK.

Malone, T.W. (1980). What makes things fun to learn? Heuristics for designing instructional computer games. In *Proceedings of the Joint Symposium of 3rd SIGSMALL and 1st SIGPC Symposium on small system*. Palo Alto, USA.

Malone, T.W. (1982). Heuristics for designing enjoyable user interfaces: Lessons from computer games. In Thomas, J.C. & Schneider, M.L. (Eds), *Human Factors in Computer Systems*. Norwood, NJ: Ablex Publishing Corp.

Mandryk, R.L., Inkpen, K.M. & Calvert, T.W. (2006). Using psychophysiological techniques to measure user experience with entertainment technologies. *Journal of Behaviour and Information Technology*. 5(2). 141-158.

Ming-Liang, H., P. T. Li, P. Y. Lin, Shih-Tsang, T., Tsung-Chieh, L. & Shuenn-Tsong (2001), Y. *A computer based software for hearing-impaired children's*

speech training and learning between teacher and parents in Taiwan. Institute of Biomedical Engineering, National Yang-Ming University, Taiwan.

Morrison, K. (2007). *Implementation of assistive computer technology: A model for school systems Special Education.* International Journal Of Special Education 22(1).

Murniawati, A. (May 2007). *Wireless Notification System for The Hearing-impaired.* Universiti Teknologi Malaysia.

Newman, W. & Taylor, A. (1999). Towards a methodology employing critical parameters to deliver performance improvements in interactive system. In *Proceedings of International conference of human-computer interaction.* IOS Press. Amsterdam. 605-612.

Pearson, E. & Koppi, T. (2001). Developing More Effective Access to Higher Education for People With Disabilities: A Case Study in the Design of Accessible Online Courseware. In C. Montgomerie & J. Viteli (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2001* (pp. 1470-1472). Chesapeake.

Phantachat, W. & Parnes, P. (2007). *Implementing Assistive Technology Service Delivery System Internationally – A complex issue.* In *Proceedings of the 1st international convention on Rehabilitation engineering & assistive technology: in conjunction with 1st Tan Tock Seng Hospital Neurorehabilitation Meeting.* Singapore. ACM.

Preece, J., Rogers, Y., & Sharp, H. (2007). *Interaction Design: beyond human-computer interaction 2nd edition.* John Wiley& Sons, Ltd. England

Quesenberry, W. (2004). *Language and Usability.* Maaziner Tekom 2004, Weisbaden, Germany.

Rattana, H. (2006). IBM Methodology for Implementing Accessibility into E-Learning. In T. Reeves & S. Yamashita (Eds.), In the *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2006* (pp. 1401-1404). Chesapeake.

Regan, M., & Sheppard, S. (1996). *Interactive Multimedia Courseware and the Hands-on Learning Experience: An Assessment Study.* August 11. Stanford

University.

Richards, S. (1996). *Educational software design: Applying models of learning*. University of Teesside.

Rooney, E.J., Carraro, F., Dempsey, W., Robertson, K., Vaughan, R., Jack, M.A., & Murray, J. (1994) HARP: An autonomous speech rehabilitation system for hearing-impaired people. In *Proceedings of International Conference on Spoken Language Processing (ICSLP-94)*, 2019-2022.

Shaw, R., Laplante, P.A., Salinas, J., & Riccone, R. (1996). *A Multimedia Speech Learning System for the Hearing-impaired*. Multimedia Tools and Applications. 3(1). 55-70. Springer Netherlands.

Sik, L., C., Tilinger, A., Szabo, J., Pall, A., & Lanyi, Z. (2000), *User interface design question in developing multimedia software for handicapped children*. University of Veszprem, Colour and Multimedia Laboratory, Hungary.

Sousa, K., & Furtado, E. (2005). *From Usability Tasks to Usable User Interfaces*. 26-27 September. University of Fortaleza (UNIFOR), Poland.

Spencer, D. (2004). *What is Usability?* University of Melbourne, Melbourne. pp 108-115.

Sung H. L. & Elizabeth B. (1999). *Screen design guidelines for motivation in interactive multimedia instruction:a survey and framework for designers*. Educational Technology Vol. 39, pp 19-26

Treviranus, J. (2000). Expanding the digital media in more human directions. Presented at the *Towards the Digital Media Institute*, March 11. University of Toronto: Knowledge Media Design Institute Lecture Series.

UNDP. (2008). *Statistic of PWD in Malaysia*. Retrieved on 15/6/09 from <http://www.undp.org.my/11-12-2008-towards-accessible-public-transportation-in-penang>.

Wald, M. (2002). Hearing disability and technology. In P. Lawrie, S. Allan & S. Jane (2002). *Access All Areas: Disability, technology and learning*. Joint Information System Committee. TechDis and the Association for Learning Technology.

Wang, P. (2008), *Issues of Online Course Design*. Cardiff University, United Kingdom.

Wiberg, C. (2001). From ease of use to fun of use: Usability evaluations guidelines for testing entertainment web sites. In *Proceedings of Conference on Affective Human Factors Design*, CAHD, Singapore.

Wiberg, C. (2005). Fun in the home: Guidelines for evaluating interactive entertainment on the web. In *Proceedings of 12th International Conference on Human-computer Interaction*. Las Vegas, USA.

Wickens, C. D., Gordon, S. E., & Liu, Y. (1998). *An introduction to human factors engineering*. Addison-Wesley Educational Publishers Inc. USA

Wolf, M.J. (1999). *The entertainment economy*. London. Penguin Books. *Malaysian Online Journal of Instructional Technology (MOJIT)* Vol. 3, No.1, pp 85-95

Zurina, M., & Mohamed, R. E. K. (2009). *Adaptive user interface design in multimedia courseware*. August 27. Faculty of Information Science & Technology, Universiti Kebangsaan Malaysia, Selangor, Malaysia.