

**Πρόγραμμα Μεταπτυχιακών Σπουδών Εξειδίκευσης
Του Τμήματος Ελληνικής Φιλολογίας του Δημοκριτείου Πανεπιστημίου Θράκης**

σε συνεργασία με το

ΕΚΕΦΕ Δημόκριτος – Ινστιτούτο Πληροφορικής και Επικοινωνιών

με τίτλο «Εξειδίκευση στις Τ.Π.Ε. και Ειδική Αγωγή – Ψυχοπαιδαγωγική της ένταξης»

**«ΑΠΤΙΚΟΙ ΧΑΡΤΕΣ ΚΑΙ ΝΕΕΣ ΤΕΧΝΟΛΟΓΙΕΣ ΓΙΑ ΤΥΦΛΑ ΑΤΟΜΑ ΚΑΙ ΑΤΟΜΑ ΜΕ
ΠΡΟΒΛΗΜΑΤΑ ΟΡΑΣΗΣ»**

**«TACTILE MAPS AND NEW TECHNOLOGIES FOR BLIND AND PEOPLE WITH VISUAL
IMPAIRMENTS »**

της Γκανίδη Μαρίας

Μεταπτυχιακή διατριβή που υποβάλλεται

στην τριμελή επιτροπή για την απόκτηση του μεταπτυχιακού τίτλου του

Προγράμματος Μεταπτυχιακών Σπουδών Εξειδίκευσης

του Τ.Ε.Φ. – Δ.Π.Θ. σε συνεργασία με το Ε.Κ.Ε.Φ.Ε. Δημόκριτος – Ινστιτούτο Πληροφορικής και
Επικοινωνιών

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Εγκεκριμένο από την τριμελή επιτροπή:

- 1.ΔΡΙΓΚΑΣ ΑΘΑΝΑΣΙΟΣ- Διευθυντής Ερευνών στο Ι.Π.Τ. Ε.Κ.Ε.Φ.Ε. “ΔΗΜΟΚΡΙΤΟΣ”**
- 2.ΚΑΡΑΜΠΑΤΖΑΚΗ ΖΩΗ -Συνεργαζόμενη Ερευνήτρια στο Ι.Π.Τ. Ε.Κ.Ε.Φ.Ε. “ΔΗΜΟΚΡΙΤΟΣ”**
- 3.ΣΤΑΘΟΠΟΥΛΟΥ ΑΓΑΘΗ- Συνεργάτιδα Ερευνήτρια στο Ι.Π.Τ. Ε.Κ.Ε.Φ.Ε. “ΔΗΜΟΚΡΙΤΟΣ”**

Αθήνα 2019

ΠΕΡΙΛΗΨΗ

Μέχρι πρόσφατα το ιατρικό μοντέλο της αναπηρίας κυριαρχούσε, αλλά οι χρόνοι και οι απόψεις αλλάζουν, έτσι ώστε το μοντέλο της κοινωνικής ενσωμάτωσης να αποτελεί πλέον την κατευθυντήρια γραμμή. Επομένως είναι η ευρεία αποδοχή του κοινωνικού μοντέλου αναπηρίας που οδηγεί σε αυτές τις αλλαγές μαζί με τα εργαλεία της βοηθητικής τεχνολογίας που είναι τα φυσικά στοιχεία που επιτρέπουν την κοινωνική ένταξη. Στην παρούσα εργασία γίνεται μια προσπάθεια διερεύνησης της ελληνικής και διεθνούς βιβλιογραφίας αναφορικά με τον σχεδιασμό, τη χρήση και την αποτελεσματικότητα των απτικών χαρτών. Η συγκεκριμένη βιβλιογραφική έρευνα χωρίζεται σε τρία βασικά μέρη το καθένα από τα οποία χωρίζεται σε επιμέρους κεφάλαια. Στο πρώτο μέρος παρουσιάζεται η μέθοδος που ακολουθήθηκε κατά την εκπόνηση της βιβλιογραφικής αυτής εργασίας, οι πηγές αναζήτησης και τα κριτήρια αποκλεισμού. Παρατίθενται επίσης σε αυτό, οι ορισμοί βασικών εννοιών. Το δεύτερο μέρος της μελέτης καλύπτει η βιβλιογραφική ανασκόπηση περιλαμβάνοντας επιμέρους κεφάλαια. Στο δεύτερο κεφάλαιο παρουσιάζονται έρευνες που αφορούν το πεδίο της γεωγραφίας με έμφαση στη χρήση του χάρτη μέσω γνωστικών, νευρολογικών, συμπεριφορικών και κοινωνικών μοντέλων. Στο τρίτο κεφάλαιο παρατίθενται έρευνες που σχετίζονται με τη δομή, τη μορφή, τη λειτουργία των απτικών χαρτών και γενικότερα των επιμέρους εκείνων χαρακτηριστικών που πρέπει να ληφθούν υπόψη στα πλαίσια της δημιουργίας τους. Ακολουθεί τέλος, στο τέταρτο κεφάλαιο, μια σύντομη παρουσίαση των νέων τεχνολογιών που αφορούν τα τυφλά άτομα και τα άτομα με προβλήματα όρασης.

ABSTRACT

Until recently, the medical model of disability dominated, but times and views change so that the model of social inclusion is now the guideline. It is therefore the broad acceptance of the social model of disability that leads to these changes and assistive technology is the main tool that allows social inclusion. In this paper an attempt it is made to investigate Greek and international bibliography regarding the design, the use and the effectiveness of haptic maps. This bibliographic research is divided into three main parts, each of which is divided into sub-chapters. The first part describes the method followed, the search sources and the exclusion criteria. Definitions are also included in this part. The second part of the study covers the bibliographic review including sub-chapters. In the second chapter there are researches concerning the field of geography with emphasis on the use of the map through cognitive, neurological, behavioral and social models. In the third chapter there are researches related to the structure, form and operation of the haptic maps and, more generally, of the individual characteristics to be taken into account in their creation. Finally, in the fourth chapter, there is a brief presentation of the new technologies for blind and visually impaired people.

BIBΛΙΟΓΡΑΦΙΚΕΣ ΑΝΑΦΟΡΕΣ

Ahmetovic D., Gleason C., Kitani K., Takagi H., & Asakawa C., (2016) NavCog: Turn-by-turn smartphone navigation assistant for people with visual impairments or blindness. *In Proceedings of the 13th Web for All Conference*, 91–92

Ahmetovic, D., Manduchi, R., Coughlan, J. M., & Mascetti, S. (2017). Mind Your Crossings. *ACM Transactions on Accessible Computing*, 9(4), 1–25. doi:10.1145/3046790

Aitken, S. & Buultjens, M. (1992). *Vision for Doing: Assessing Functional Vision of Learners who are Multiply Disabled*. Edinburgh: Moray House Publications

Angin, P., Bhargava, B., & Helal, S. (2010). A Mobile-Cloud Collaborative Traffic Lights Detector for Blind Navigation. *Eleventh International Conference on Mobile Data Management*.doi:10.1109/mdm.2010.71

Auricchio, F., Greco, A., Alaimo, G., Giacometti, V., Marconi, S., & Mauri, V. (2017). 3D printing technology for buildings accessibility: the tactile map for MTE museum in Pavia, *Journal of Civil Engineering and Architecture*, 11, 736-747.

Baranski, P., Polanczyk, M., & Strumillo, P. (2010). A remote guidance system for the blind. *In Proceedings of the 2010 12th IEEE International Conference on e-Health Networking, Applications and Services*, 386-390

Bigham J. P., Jayant C., Miller A., White B., & Yeh T., (2010). “VizWiz::LocateIt - enabling blind people to locate objects in their environment,” *IEEE Conf. Comput. Vis. Pattern Recognition Workshops (CVPRW)*, 65–72.

Berla, E. & Murr, M. (1975). The effects of noise on the location of point symbols and tracking a line on a tactile pseudomap. *Journal of Special Education*, 9, 183–190.

Bohonos, S., Lee, A., Malik, A., Thai, C., & Manduchi, R. (2007). Universal real-time navigational assistance (URNA). *Proceedings of the 1st ACM SIGMOBILE International Workshop on Systems and*

Bourbakis, N. G., & Kavraki, D., (2001). An intelligent assistant for navigation of visually impaired people. *In Proceedings of the 2nd Annual IEEE International Symposium on Bioinformatics and Bioengineering*, 230-235

Casselis A., Green P., (1993). *Αντίληψη*. Αθήνα: Ελληνικά Γράμματα

Cattaneo, Z. & Vecchi, T. (2011). *Blind vision: the neuroscience of visual impairment*. Cambridge: MIT Press. [CrossRef](#)

Collins, D. F., Refshauge, K. M., & Gandevia, S. C. (2000). Sensory integration in the perception of movements at the human metacarpophalangeal joint. *Journal of Physiology*, 529, 505-515.

Connors, E. C., Chrastil, E. R., Sánchez, J., & Merabet, L. B. (2014). Virtual environments for the transfer of navigation skills in the blind: A comparison of directed instruction vs. video game based learning approaches. *Frontiers in Human Neuroscience*, 8. doi:10.3389/fnhum.2014.00223

Dear, M., Wilton R., Gaber S.L. & Takahashi, L. (1997). Seeing people differently: the sociospatial construction of disability, *Environment and Planning D: Society and Space*, 15, 455–480

Dey, I. (1993). *Qualitative Data Analysis: A User Friendly Guide for Social Scientists*. London: Routledge

Dias, M. B. (2010). Experiences with Lower-Cost Access to Tactile Graphics in India, *First Annual Symposium on Computing for Development*, 6-9

Drigas, A. S., Koukianakis, L. G., & Papagerasimou, Y. V. (2005). A system for e-inclusion for individuals with sight disabilities, *Mathematical methods and computational techniques in electrical engineering*, 146-150

Elger, G., & Furugren, B., (1998) SmartBO an ICT and computer based demonstration home for disabled, *Improving the quality of life for the European citizen Technology for Inclusive Design and Equality Assistive Technology Research Series, 4*, 392–395

Eriksson, Y., & Strucel, M. (1995). *Production of tactile graphics on swellpaper*. TPB, Swedish Library. Stockholm: AB PP Print

Faria, J., Lopes, S., Fernandes, H., & Martins, P. B. (2010). Electronic white cane for blind people navigation assistance, *World Automation Congress*, 1–7

Glesson, B. J. (1996). A geography for disabled people? *Mind and Body Spaces: Geographies of Illness, Impairment and Disability*, 98–118

Golledge, R. G. (1993). Geography and the disabled: a survey with special reference to visually impaired and blind populations, *Transactions of the Institute of British Geographers NS 21*, 404–411

Gual, J., Puyuelo, M., & Lloveras, J. (2013). Improving Tactile Map Usability through 3D Printing Techniques: An Experiment with New Tactile Symbols. *The Cartographic Journal, 52*(1), 51–57. doi:10.1179/1743277413y.0000000046

Gual, J., Puyuelo, M., & Lloveras, J. (2015). The effect of volumetric (3D) tactile symbols within inclusive tactile maps. *Applied Ergonomics, 48*, 1–10. doi:10.1016/j.apergo.2014.10.018

Hodapp, R. M. (2005). *Αναπτυξιακές θεωρίες και αναπηρία*, Αθήνα: Εκδόσεις Μεταίχμιο

Imrie, R. (1996). Ableist geographies, disablist spaces: towards a reconstruction of Golledge's, *Geography and the disabled, Transactions of the Institute of British Geographers NS 21*, 397–403

Jehoel, S., McCallum, D., Rowell, J., & Ungar, S. (2006). An empirical approach on the design of tactile maps and diagrams: The cognitive tactualization approach. *British Journal of Visual Impairment, 24*(2), 67–75. doi:10.1177/0264619606063402

Jehoel, S., Sowden, P. T., Ungar, S., & Sterr, A. (2009). Tactile Elevation Perception in Blind and Sighted Participants and Its Implications for Tactile Map Creation. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 51(2), 208–223. doi:10.1177/0018720809334918

Jehoel, S. (2017). *A series of psychological studies on the design of tactile maps*. Unpublished Doctoral Dissertation, University of Surrey, Guildford, UK

Johansson, R. S., & Vallbo, A. B. (1979). Tactile sensibility in the human hand: Relative and absolute densities of four types of mechanoreceptive units in glabrous skin. *Journal of Physiology*, 286, 283-300.

Johnson, K. O. (2001). The roles and functions of cutaneous mechanoreceptors. *Current Opinion in Neurobiology*, 11, 455-461

Kalbani, J. Al., Suwailam R. B., Yafai A. Al., Abri, D. Al., & Awadalla M. (2015). Bus detection system for blind people using RFID, *IEEE 8th GCC Conference & Exhibition*, 1–6

Kitchin, R., & Tate, N.J. (2013). *Conducting Research into Human Geography: Theory, Methodology and Practice*. New York: Routledge

Koutsoklenis, A., & Papadopoulos, K. (2014). Haptic cues used for outdoor wayfinding by individuals. *J. Vis. Impair. Blind.* 108(1), 43–53

Krishna, S., Bala, S., McDaniel, T., McGuire, S., & Panchanathan, S. (2010). VibroGlove. *Proceedings of the 28th of the International Conference Extended Abstracts on Human Factors in Computing Systems*. Doi:10.1145/1753846.1754031

Kulkarni, A., & Bhurchandi, K. (2015). Low cost E-book reading device for blind people, *IEEE international conference on computing communication control and automation (ICCUBEA)*, 516–520

Kulyukin, V., Gharpure, C., & Nicholson, J. (2005). RoboCart: toward robot-assisted navigation of grocery stores by the visually impaired. *In Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems*, Alberta, Canada

Kulyukin, V., Nicholson, J., Ross, D., Marston, J., & Gaunet, F. (2008). The blind leading the blind: Toward collaborative online route information management by individuals with visual impairments. *Proceedings of the AAI Social Information Processing Symposium*, Palo Alto, CA: AAI Press, 54–59

Kyudong, P., Taedong, G., & Hyo-Jeong, S. (2015). Toward accessible mobile application design: developing mobile application accessibility guidelines for people with visual impairment. *Proceedings of HCI Korea*, 31-38.

Lahav, O. & Mioduser, D. (2008). Haptic-feedback support for cognitive mapping of unknown spaces by people who are blind. *International Journal of Human-Computer Studies*, 66(1), 23–35. doi:10.1016/j.ijhcs.2007.08.001

Lawrence, M. & Lobben, A. (2011). The design of tactile thematic symbols. *Journal of Visual Impairment and Blindness*, 105(10), 681-691

Leydhecker, W. (1990). *Οφθαλμολογία*, έκδοση 21^η, Αθήνα: Ιατρικές Εκδόσεις Λίτσας

Λιβιεράτος, Ε. & Παπαδόπουλος, Κ. (2000). Χάρτης αφής του Πολεοδομικού Συγκροτήματος της Θεσσαλονίκης. Κατασκευάστηκε για το Αθλητικό Σωματείο Τυφλών “Πυρσός”. Θεσσαλονίκη, 2000

Lobben, A. & M. Lawrence. (2012). The use of environmental features on tactile maps by navigators who are blind. *The Professional Geographer*, 64(1), 95-108.

Lobben, A., Lawrence, M., & Pickett, R. (2014). The map effect. *Annals of the Association of American Geographers*, 104(1), 96-113

Martinez, M., Roitberg, A., Koester D., Schauerte, B. & Stiefelhagen, R. (2017). Using Technology Developed for Autonomous Cars to Help Navigate Blind People, *IEEE International Conference on Computer Vision Workshops (ICCVW)*, 1424 – 1432

Mason, H. (1997a). Anatomy and Physiology of the Eye. *Visual Impairment – Access to Education for Children and Young People*, 30-37

Neto, R. & Fonseca, N. (2014). Camera reading for blind people. *Procedia Technology*, 16 , 1200–1209

Olausson, H., Wessberg, J. & Kakuda, N. (2000). Tactile directional sensibility: Peripheral neural mechanisms in man. *Brain research*, 866, 178-187

Παπαδάτος, Ι. (2003) . Ψυχοφυσιολογία. Αθήνα: Εκδόσεις Καμπύλη,

Papadopoulos, K., Barouti, M., & Koustriava, E. (2018). Differences in Spatial Knowledge of Individuals With Blindness When Using Audiotactile Maps, Using Tactile Maps, and Walking. *Exceptional Children*, 84(3), 330–343. doi:10.1177/0014402918764300

Παπαδόπουλος, Κ. (2003). Βοηθήματα Προσανατολισμού και Κινητικότητας για τα Άτομα με Μειονέκτημα Όρασης - Χάρτες Αφής. *Επιστήμες της Αγωγής*, 3, 79-86

Parr, H. & Butler, R. (1999). New geographies of illness, impairment and disability, *Mind and Body Spaces: Geographies of Illness, Impairment and Disability*, 1–24

Pascolini, D. & Mariotti, S.P. (2010). Global Estimates of Visual Impairment, *British Journal Ophthalmology*, 96 (5), 614-618

Perkins, C. (2002). Cartography: progress in tactile mapping. *Progress in Human Geography*, 26(4), 521–530. doi:10.1191/0309132502ph383pr

Rowell, J. & Ungar, S. (2003). The World of Touch: Results of an International Survey of Tactile Maps and Symbols. *The Cartographic Journal*, 40(3), 259–263. doi:10.1179/000870403225012961

Rowell, J. & Ungar, S. (2003). Feeling your way - a tactile map user survey, *Proceedings of the 21st International Cartographic Conference (ICC)* , (pp. 652-659) Durban: The International Cartographic Association (ICA)

Siekierska, E., LaBelle, R., Brunet, L., McCurdy, B. Pulsifer, P., Rieger, M. K., & O'Neil L. (2003). Enhancing spatial learning and mobility training of visually impaired people: a technical paper on the Internet-based tactile and audio-tactile mapping. *The Canadian Geographer*, 47(4), 480-493. doi: 10.1111/j.0008-3658.2003.00037.x

Sheppard, L. & Aldrich F. K.(2001). Tactile graphics in school education: Perspectives from teachers. *Journal of Visual Impairment and Blindness*, 19(3), 93–97

Shoval, S., Borenstein, J., & Koren, Y. (1998). The NavBelt-a computerized travel aid for the blind based on mobile robotics technology. *IEEE Transactions on Biomedical Engineering*, 45(11), 1376–1386. doi:10.1109/10.725334

Slocum, T. (1999). *Thematic cartography and visualization*. Upper Saddle River, NJ: Prentice Hall

Stangl, A., Hsu, C.-L., & Yeh, T. (2015). Transcribing Across the Senses. *Proceedings of the 17th International ACM SIGACCESS Conference on Computers & Accessibility - ASSETS '15*. doi:10.1145/2700648.2809854

Tatham, A. (1989). Tactile mapping in the United Kingdom. *Proceedings of the 3th International symposium on maps and graphics for the visually handicapped people*, 22-26

Tinti, C., Adenzato, M., Tamietto, M., & Cornoldi, C. (2006). Visual Experience is not Necessary for Efficient Survey Spatial Cognition: Evidence from Blindness. *Quarterly Journal of Experimental Psychology*, 59(7), 1306–1328. doi:10.1080/17470210500214275

Tobin, M. J. (1994). *Assessing Visually Handicapped People: An Introduction to Test Procedures*. London: David Fulton Publishers

UN. 2006. UN Convention on the Rights of Persons with Disabilities

Wang, R. F. (2003). Spatial representations and spatial updating. *Psychology of Learning and Motivation*, 42, 109–155. doi:10.1016/S0079-7421(03)01004-1

Watanabe, T., Yamaguchi, T. & Nakagawa, M.(2012). Development of software for automatic creation of embossed graphs. *In International Conference on Computers for Handicapped Persons*, 174–181

Webster, A. & Roe, J. (1998). *Children with Visual Impairments*. London: Routledge

World Health Organization: International Statistical Classification of Diseases and Related Health Problems. 10th revision. Current version. Version for 2003. Chapter VII. H54. Blindness and low vision [[http:// www.who.int/classifications/icd/en/](http://www.who.int/classifications/icd/en/)]

WHO (World Health Organization). 2001. ICF International Classification of Functioning Disability and Health. Geneva: WHO.

Yuan, B. & Folmer, E. (2008). Blind hero. *Proceedings of the 10th International ACM SIGACCESS Conference on Computers and Accessibility - Assets '08*. doi:10.1145/1414471.1414503