Make the makers' voices count: combining universal design and participatory ergonomics to create accessible makerspaces for individuals with (physical) disabilities

Anika Meyer[1] and Ina Fourie[2]

[1] Department of Information Science, University of Pretoria, Pretoria (South Africa)
[2] Department of Information Science, University of Pretoria, Pretoria (South Africa)

Corresponding author: Anika Meyer, anika.meyer@up.ac.za

Abstract

Introduction: The maker or Do-It-Yourself (DIY) movement, which facilitates maker-learning, has been flourishing globally in public, academic and school libraries. Makerspaces have been established to provide healthcare professionals (i.e. physicians, nurses and caregivers) with a creative, innovative and design space for healthcare innovation. For purposes of this paper blend-able makerspaces refer to makerspaces that support people with abilities and as far as possible, also with their disabilities and special needs. The focus will be on students in an academic medical library, but will also apply to other user and library types. Although there is a substantial body of Library and Information Science literature on makerspaces, these publications generally do not take into account the makers' 'voices' when designing blend-able spaces. Universal design and participatory (social) ergonomics can promote inclusive design for accessibility.
Objective: The purpose of this paper is to establish whether universal design and participatory ergonomics can enable a blend-able makerspace environment where individuals with (as well as without) physical disabilities can participate in the design of makerspaces. Health libraries might play a significant role in the establishment and support of such blend-able makerspaces.
Method: The paper is based on a pragmatic analysis of literature associated with universal design, participatory ergonomics and makerspaces to propose practical guidelines for health librarians.
Discussion: The following questions are addressed: can a makerspace facilitate special tools and services to foster maker-learning to assist students with physical disabilities?; how can makerspaces be designed to promote accessibility for students with physical disabilities?; and can principles of universal design and participatory ergonomics assist with inclusive design for individuals with physical disabilities?
Conclusion: The application of universal design and participatory ergonomic principles can offer health librarians practical guidelines for designing blend-able makerspaces to support individuals such as healthcare students with (and without) physical disabilities to co-learn, co-create and co-design innovative applications.

Key words: healthcare; makerspaces; participatory ergonomics; physical disabilities; universal design

Introduction

'Making is fundamental to what it means to be human. We must make, create, and express ourselves to feel whole',[1] and since 'everyone is a Maker, and our world is what we make it'.[2] Individuals make things out of curiosity, out of necessity or even out of an aspiration to make something tangible. The Maker movement, which facilitates maker education, continues to advance throughout various interconnected communities such as public, medical, academic and school libraries.[1] Maker education fosters a maker-learning culture within makerspaces to encourage students to tinker, design, and invent collaboratively with actual tools, technologies and materials in makerspaces.[3, 4] Makerspace literature hardly notes the significance of considering the needs of individuals with disabilities (sometimes referred to as individuals with special needs) when designing and facilitating makerspaces. As a result, makerspaces may seem inaccessible and uninviting for individuals with disabilities.[5]

A makerspace is a place where like-minded individuals come together to create, innovate, design and work on projects, share resources, tools and expertise as well as co-invent and co-learn.[6] Makerspaces can be seen as central resource spaces providing for various making practices, utilised in diverse contexts.[1] Medical makerspaces can also provide opportunities for innovation to healthcare professionals (i.e. physicians, nurses and caregivers) and their patients, as well as students in healthcare. The first dedicated medical makerspace in the world, known as the MakerNurse lab, was established last year in the United States.[7]

To argue the design of makerspaces in healthcare contexts that allow for the needs of individuals with disabilities this paper will focus on three aspects, namely: universal design, participatory ergonomics, and the involvement of people with and without disabilities. It covers the clarification of concepts, and practical guidelines applied to components of makerspaces, universal design and participatory ergonomics. In conclusion the role of health librarians is addressed. The focus will be on students in an academic medical library.

Purpose of paper

The purpose of this paper is to establish whether adherence to universal design and participatory ergonomic principles can enable a blend-able makerspace environment where individuals with (as well as without) physical disabilities can participate in the design of makerspaces. Questions addressed include:

- Can makerspaces facilitate the use of special tools and services to foster maker-learning to assist students with physical disabilities?
- Can principles of universal design and participatory ergonomics assist in establishing inclusive design to produce more accessible makerspaces for individuals with physical disabilities?
- What role can health librarians play in supporting the design of blend-able makerspaces?

Concept clarification

Disability

According to the World Health Organization (WHO)[8], 'disabilities is an umbrella term, covering impairments, activity limitations, and participation restrictions'. Furthermore, in the WHO's International Classification of Impairments manual,[9] disability can be defined as 'any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being'. This paper will focus on physical disabilities.

Makerspace

Maker Media[2] defines a makerspace as a 'learning environment rich with opportunities that serve as gathering points where communities of new and experienced makers connect to work on real and personally meaningful projects, informed by helpful mentors and expertise, using new technologies and traditional tools'.

Participatory ergonomics

'In participatory design (or co-design), users are also part of the design team, helping to come up with the requirements and features of the design'.[10]

Universal design

'Universal design encourages the design of space, products, and processes not just for the average user, but for people with a broad range of abilities, ages, reading levels, learning styles, languages, cultures, and other characteristics'.[10] Related terms include: design for all, inclusive design, and barrier-free design.[10]

Aspects to consider for transforming makerspaces into blend-able spaces

Britton[6] highlights that 'the beauty of the Maker movement, particularly in the library, is that there is no set list of equipment or programming required to make a space successful'. Hence, libraries are able to tailor their spaces to the needs and interests of their users as well as to the availability and accessibility of resources. Maker Media[2] notes that 'makerspace is our strongest effort to infuse schools with the spirit of the Maker movement, to re-energize education with the creativity, innovation, curiosity, motivation, technical know-how, and playfulness that characterize our maker community'. For that reason, Brady, Salasa, Nuriddina, Rodgersa and Subramaniama[5] explain that the prospective benefits to individuals are significant, but it is vital that the spaces, tools, services and facilities must be inclusive to deliver these benefits equally to everyone. Since, makerspaces foster innovation and promotes various benefits, 'these spaces and tools ultimately aim to encourage a more hands-on approach to learning, they unintentionally exclude some individuals from actively engaging in these new spaces'.[5] Studying the makerspace literature, one comes across several challenges associated with the practical implementation of a blend-able makerspace, such as budget limitations, finding a suitable space and location for hands-on learning, problems with the integration of technology, finding satisfactory and reasonably priced equipment, and finding the required resources, services, and tools.[11]

Designing a blend-able and accessible makerspace includes re-envisioning how the space will provide physical, intellectual and social access to individuals with all abilities and disabilities. Therefore, the typical components of makerspaces need to be aligned with principles of universal design and participatory ergonomics. These components include: physical space; equipment; tools, technologies and materials; staff, resources and services; and safety practices and training. For blend-able makerspaces not only the typical components, but especially meeting with the needs of individuals with disabilities are important. To guarantee that makerspaces are truthfully inclusive, guidelines must be implemented, and an array of various facilities, tools and materials for different abilities must be provided, as a result of asking the right questions from participating people.

Physical space as a makerspace component

The physical spaces facilitating makerspaces must be open and inviting, and catering for the needs of people with disabilities.

Examples of acknowledging universal design principles include: pathways, ramps and entrances should be wheelchair-accessible; all heights and levels of the space should be linked to an accessible path to all tools, technologies and materials; large-print signs, braille labels and high-contrast images should be provided all over the (maker)space, specially, for safety and guideline information; walkways should be wide and clear of obstacles (e.g. wires, laptop monitors, and 3D printers); safety processes, practice and policies should be modified and well-thought-out for students with mobility, visual or hearing impairments to facilitate maker-learning; all work surfaces and power cords should be adjusted and clearly marked to be accessible; enough meeting space for students with disabilities should be provided for brainstorming, prototyping and learning collaboratively with other students.

When working according to the principles of participatory ergonomics individuals with disabilities should be invited to assist in modifying the space. They can explain the type of tasks and social situations they will undertake with regard to their work or to enhance their learning performance. In addition, the sense of teamwork and participation in the design process can improve their commitment for a blend-able makerspace as a whole.

Equipment as a makerspace component
The equipment must provide the perfect fit between the students and their 'stuff'. This also applies to students with disabilities.

Examples of acknowledging universal design principles include positioning whiteboards and other tools for easy reachability from a seated position; equipping tables, seating and equipment with a push-button for easy adjustability to set the perfect height; allowing enough space under all work surfaces such as tables, cupboards and counters for wheelchair users; ensuring tables, cupboards and counters can easily be moved to free up space; and providing storage facilities that are easily accessible for all.

Working according to the principles of participatory ergonomics can help to address psychosocial factors in the workplace or learning environment where the makerspace is situated so that there is space for individuals to socially interact and to share an environment. Individuals with disabilities can assist in the modification of their equipment through addressing challenges and preferences regarding the needed equipment. For example, workstations should be adjustable, detachable and movable to allow the students to reconfigure the space for easy transferability between tools, equipment and other 'makers' to promote social inclusion. In addition, the University of Washington's students indicated that they preferred that the equipment should be positioned in the makerspaces and not in a different location for easy access and movability.[10]

Provision of tools, technologies and materials as a makerspace component
Tools, technologies and materials need to be inclusive for use by students with various abilities and disabilities.

The acknowledgement of universal design principles will depend on the specific tools, technologies and materials used - for example as needed by healthcare students. This can include health mobile applications and the use of suitable mobile assistive technology applications. Hand tools for example need to have raised, large and clear labels, as well as rubberised grips and plastic guards to protect the users from getting harmed. For electronic equipment safety gear should be promoted, described and labelled to cultivate a maker culture of safety comes first. Computers with specific assistive technologies should also be available. These can include alternative keyboards and mousses, screen readers, speech-to-text software, trackballs and note taking software.

As for participatory ergonomics, individuals with disabilities can partake in the selection of the tools, technologies and materials to support their making activities and projects according to their needs to cope and fully participate in spite of their disabilities.

Integrated assistance form library and information staff, resources and services as makerspace component
With regard to adherence to universal design principles library and information staff can produce an interconnected space for information and other resources based on the needs of users for such resources. They also need to supply access to resources and services that specifically meet with the needs of students and other users with disabilities regarding their 'maker' needs and not just the more conventional needs for information e.g. audio material and material in braille for users with visual disabilities. Within the spirit of makerspaces, library and information staff can also arrange for specific expertise to support the 'maker' needs such as computer, artisan and design expertise, workshops and skills training suitable for all abilities, for example, training students in utilising various hardware and software (e.g. CAD for 3D design) as assistive technologies for their daily routines.

Adhering to the principles of participatory ergonomics, individuals with disabilities can partake in an audit of information needs analysis to provide support regarding their collaboration, information seeking, social interaction and sense-making practices specifically with regard to the 'maker' needs of people with disabilities. For example, by having individuals with disabilities partake in surveys, interviews or group discussions to assist designers in the modification of makerspaces. Therefore, instead of just placing a ramp within your makerspaces, ask an individual in a wheelchair, walker, cane, or crutches to assist in co-designing the ramp.

Integration of safety practices and training into blend-able makerspaces as makerspace component
With regard to adherence to universal design principles there are several issues of importance. Training materials, guidelines and instructions to ensure safe practices must be available and accessible in various formats appropriate for users with disabilities. Safety labels and signs should be in high-contrast, large print and in braille. All safety equipment such as fire extinguishers and fire alarms, should be accessible by students using wheelchairs or who have limited physical functioning, dexterity or stamina. Visual and audio pointers should be provided for equipment and safety warnings. Makerspace staff, which should include specialised library and information technology staff, should be available to train and assist students with diverse abilities in the safe use of equipment.

Adhering to the principles of participatory ergonomics 'safety' teams can be formed to ensure that the needs of all people using a makerspace is considered in ensuring safety measures and guidelines. Such a team, apart from library and information staff should include people representing different groups of disabilities, healthcare professionals specialising in specific disabilities, faculty or supervisors of student projects, as well as staff from any units at the institution specialising in the needs of people with disabilities.

Role of health librarians

There are many opportunities to embrace the makerspace movement and the value it holds for academic (medical/healthcare) libraries and to get involved in ensuring blend-able makerspaces, which can support the needs of people with all types of abilities and disabilities. Regarding support for 'makers' with physical disabilities health librarians can:

- Systematically review the literature on support for people with disabilities in the health 'maker' contexts.
- Promote acknowledgement of universal design in the development of makerspaces, for example compiling guidelines on resources on universal design.
- Promote the importance of participatory ergonomics, especially in supporting the needs of people with disabilities as 'makers'.

There are many more opportunities for practical involvement that will be noted in the oral presentation, and follow-up work.

Conclusion

The application of principles of universal design and participatory ergonomics can offer health librarians practical guidelines for designing blend-able makerspaces to support individuals such as healthcare students and other users of libraries and makerspaces with (as well as without) physical disabilities to co-learn, co-create and co-design innovative applications.

References

1. Hatch M. The maker movement manifesto [Internet]. 1st ed. United States: McGraw-Hill Education; 2013 Sep 25 [cited 2016 Apr 11]. Available from: http://www.techshop.ws/images/0071821139%20Maker%20Movement%20Manifesto%20Sample%20Chapter.pdf
2. Maker Media. Makerspace Playbook. School edition [Internet]. United States: Maker Media, Inc.; 2013 Feb 27 [cited 2016 Apr 15]. 1–2 p. Available from: http://makered.org/wp-content/uploads/2014/09/Makerspace-Playbook-Feb-2013.pdf.
3. Kurti RS, Kurti DL, Fleming L. The Philosophy of educational makerspaces. Teacher Librarian. 2014;41(2):8-11.
4. Waters P. Makerspaces for students with special needs [Internet]. Maker Education. 2014 Oct 22 [cited 2016 Apr 11]. Available from: http://www.edutopia.org/blog/makerspaces-students-with-special-needs-patrick-waters.
5. Brady T, Salas C, Nuriddin A, Rodgers W, Subramaniam M. MakeAbility: Creating accessible makerspace events in a public library. Public Library Quarterly. 2014;33(4):330-347.
6. Britton L. The makings of maker spaces, part 1: Space for creation, not just consumption [Internet]. The Digital Shift. 2012 Oct 1 [cited 2016 Apr 13]. Available from: http://www.thedigitalshift.com/2012/10/public-services/the-makings-of-maker-spaces-part-1-space-for-creation-not-just-consumption/.
7. Robert Wood Johnson Foundation [Internet]. United States: Nation's first medical makerspace opens in Texas; 2015 Sep 25 [cited 2016 Apr 12]. Available from: http://www.rwjf.org/en/library/articles-and-news/2015/09/nations-first-medical-makerspace-opens.html.

8. WHO. World Health Organization [Internet]. Geneva: World Health Organization. Disabilities; 2016 Feb 27 [cited 2016 Apr 10]. Available from: http://www.who.int/topics/disabilities/en/.
9. WHO. World Health Organization. International classification of Impairments, disabilities, and handicaps: A manual of classification relating to the consequences of disease [Internet]. Geneva, Switzerland: World Health Organization; 1980 [cited 2016 Apr 10]. Available from: http://apps.who.int/iris/bitstream/10665/41003/1/9241541261_eng.pdf
10. University of Washington. Disabilities, Opportunities, Internetworking, and Technology (DO-IT) [Internet]. United States: University of Washington. Making a Makerspace? Guidelines for accessibility and universal design; 2015 Aug 3 [cited 2016 Apr 16]. Available from: http://www.washington.edu/doit/making-makerspace-guidelines-accessibility-and-universal-design.
11. Slatter D, Howard Z. A place to make, hack, and learn: Makerspaces in Australian public libraries. The Australian Library Journal. 2013 Nov 25;62(4):272-84.