Inclusive Education Technologies: Emerging Opportunities for People with Visual Impairments

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Abstract

Technology has become central to many activities of learning, ranging from its use in classroom education to work training, mastering a new hobby, or acquiring new skills of living. While digitally-enhanced learning tools can provide valuable access to information and personalised support, people with specific accessibility needs, such as low or no vision, can often be excluded from their use. This requires technology developers to build more inclusive designs and to offer learning experiences that can be shared by people with mixed-visual abilities. There is also scope to integrate DIY approaches and provide specialised teachers with the ability to design their own low cost educational tools, adapted to pedagogical objectives and to the variety of visual and cognitive abilities of their students. For researchers, this invites new challenges of how to best support technology adoption and its evaluation in often complex educational settings. This workshop seeks to bring together researchers and practitioners interested in accessibility and education to share best practices and lessons learnt for technology in this space; and to jointly discuss and develop future directions for the next generation design of inclusive and effective education technologies.

Author Keywords

Education, Visual Impairments, Accessibility, Inclusion

ACM Classification Keywords

K.3.1 [Computer Uses in Education]: Collaborative learning; K.4.2 [Computers and Society]: Social issues - Assistive technologies for persons with disabilities

Background

Technology offers opportunities for innovation that can transform educational environments by making the learning process more encompassing, more engaging, and more collaborative [18]. Today, there is an increasing acceptance of the use of digital content in diverse educational contexts, often in conjunction with technologies such as interactive whiteboards, tabletops or tablet computers to prepare, deliver and manage lessons [3]. However, while the debate on how novel interactive technologies should be shaped to maximise educational benefits is ongoing (e.g. [19]), many are heavily built on visual content and interactions (e.g. drag-and-drop gestures) that continue to pose significant challenges for people living with visual impairments (VI). Indeed, technology-enabled learning can shrink accessibility gaps by meeting the needs of all learners. Interestingly, interactive technologies can also provide specialised teachers with the possibility to design their own teaching tools that are adapted to the sensory and cognitive abilities of the students [13]. But if not carefully designed, they can also introduce potential barriers to effective educational experiences for people with VI, who, in practice, continue to rely on screen-readers, screen magnifiers, Braille displays and low-tech analog artefacts to access and engage with educational materials [5, 17, 20, 22, 31].

Learners with VI have complex needs that require appropriate provisions [1]. They have limited access to the curriculum via the visual medium, and accessing information via alternative mediums such as braille, large print, and text-to-speech is still often time-consuming or even impossible [15]. The linear presentation of information that typical accessible technologies enforce stands in contrast with graphical representations, such as maps and diagrams, and thus increases difficulties with conceptual and spatial understanding [8, 22]. A child with a severe VI is also likely to require additional support in developing social skills in educational environments [28]. These issues are further compounded by the fact that increasing numbers of learners with VI are now educated in mainstream rather than special schools, which usually takes the form of one or two learners in a class of up to thirty sighted peers [22, 25, 29, 30]. Classrooms are also especially challenging environments for evaluation, thus new methods need to be explored to evaluate the value of novel HCI techniques in educational contexts.

Traditionally, educators have adapted visual curriculum content, such as maps and graphs, using transcriptions and analog solutions, e.g. heat raised imagined and Braille displays [2, 31]. While useful, such methods can be time-consuming, necessitate purchasing expensive materials, and require expertise on-site educators lack. With the rise of novel interactive techniques, research has started to explore augmented haptic and tactile displays, tangible interactions, virtual reality, and sonification [2, 9, 14, 20, 21, 23, 26]. The increasing multisensory input and output capabilities of these interactive technologies on the one hand, and the limited uptake of novel assistive technologies in educational practice [5, 17, 31] on the other, highlight that designing and evaluating these technologies is a situated, complex and multifaceted process. This raises methodological and theoretical challenges which we want to begin to highlight and address with this workshop. As the next generation of educational technology arrives into modern classrooms and home studies, it is crucial that a variety of perspectives are considered and synthesised to deter-

mine how best to design, develop and evaluate accessible digitally-enhanced learning tools inclusive of people with vision impairments.

Workshop Goals and Topics

We take the approach that next generation of HCI technologies will have a significant role in learning for people with VI if the technology is designed and applied in a pedagogically appropriate way and rigorously developed and evaluated in the field. The workshop will be an opportunity for HCI researchers and practitioners in the areas of education and accessibility to share insights of methods and tools by discussing questions of interest from a variety of perspectives. Each potential perspective has its own section below with key research questions to think on during the workshop.

Novel Interaction Techniques

How do we use novel interaction techniques to maximise educational benefits for people with visual impairments? Researchers are developing increasingly novel interaction techniques that have the potential to support more engaging interactions (e.g. [8]) and off-the-shelf technologies offer more advanced multisensory input and output capabilities [6]. But little attention is given to how these existing techniques work for children with VI.

Individual Cognition and Perception

How do we leverage cognition and perception research to maximise educational benefits for people with visual impairments? Sensory substitution and cross-modal studies contribute to our understanding of how the visual parts of the brain process other information in the absence of visual input [7, 10], digital interactive tools that introduce novelty and stimulate activity can play a powerful role in creating new neural pathways to support learning processes [16, 27], and usability studies of cross-modal tools inform us about how to combine multisensory output to improve user experiences [24, 11].

Collaborative Learning and Inclusion

Learners with VI have been entering mainstream education in growing numbers, but the dearth of education research does not attend to their increasing presence. Likewise, accessibility research still tends to focus on individuals. How should technology-enhanced learning tools and environments be designed in such contexts to address the challenges they face in such settings? How do we design, develop and evaluate collaborative educational tools for learners with mixed abilities [22, 29]? How can we go beyond assistive technology that only focuses on mitigating a functional limitation in the context of collaborative learning?

Design Education and Training

Involving populations with special education needs in design is more complex due to the range of additional support they may have during the design process. At the same time, as with any form of participation in decision-making in society, people with visual impairments have had limited opportunities to influence technology design in the educational context [4]. How can we create more inclusive methods and co-design tools that help facilitate important dialogue both with learners with visual impairments, and relevant stakeholder groups? How can we provide specialised teachers with tools that are easy to adapt to the topic and audience?

Evaluation

Schools, classrooms and learning environments can be challenging contexts for evaluating technology [12], especially at scale. Thus, new ways need to be explored to assess the value of novel HCI techniques in educational contexts. How can we develop appropriate methods to help evaluate impact on teaching and learning practices? How can we negotiate between different evaluation criteria and

perspectives on desired outcomes of multiple stakeholders?

One of the main goals of this workshop is to bridge cross-disciplinary relationships between researchers and practitioners interested in interaction techniques, accessibility, education, collaborative UIs, and design. The aim is to build synergies for further development and advances at the intersection of technologies for visual impairments and education. Participants will thus benefit from networking, exchanging ideas, potential collaborations and discussions with researchers and practitioners doing related research in separate areas.

Organisers

Oussama Metatla is an EPSRC Research Fellow in the Department of Computer Science at the University of Bristol. His research interests include investigating multisensory technology and designing with and for people with visual impairments. He currently leads a project focusing on inclusive educational technology for mixed-ability groups in mainstream schools.

Christophe Jouffrais is a senior CNRS researcher at IRIT, Toulouse, France, with a background in Cognitive Science. His current research focuses on Interactive Technologies for visually impaired people and specialised teachers, with an emphasis on spatial cognition.

Marcos Serrano is assistant professor at the IRIT Lab, University of Toulouse, France. His research is dedicated to designing novel interaction techniques in the field of mobile and ubiquitous computing. His most recent work include map exploration techniques for visually impaired users.

Anja Thieme is a postdoctoral researcher in the Human Experience & Design (HXD) group at Microsoft Research Cambridge. Her research encompasses empathic and socially inclusive approaches to the design and study of digital technology for, and with, people with visual impairments. She has previously been involved in the organisation of seven workshops at CHI, CSCW & DIS.

Shaun Kane is an assistant professor in the Department of Computer Science at the University of Colorado Boulder. His research explores accessible input and interaction methods, with a focus on touch interaction and tangible computing.

Stacy Branham is a Lecturer and researcher at the University of Maryland, Baltimore County (UMBC). Her research explores the social dimensions of assistive technology (AT) design for people with disabilities, specifically how to create AT that promotes “interdependence” towards deep social integration and mixed-ability engagement.

Émeline Brulé is a PhD candidate in Media Studies in the Codesign Lab at Telecom ParisTech. Her research focuses on the various implications of the current development of wearables and on the design of interactive and hybrid maps for people living with visual impairments.

Cynthia Bennett is a PhD candidate in the department of Human Centered Design and Engineering (HCDE) at the University of Washington. Her dissertation work focuses on increasing the accessibility of design processes. She has been involved in several accessibility projects ranging from designing and testing accessible smartphone apps to bringing disability studies in conversation with HCI to think critically about and open up ways HCI researchers can orient to disability and accessibility.

Pre-Workshop Planning

We have already solicited expressions of interest from a number of researchers to serve as participants and pro-

gram committee members, as well as encourage their colleagues and graduate students to attend and present during the workshop. We will advertise the workshop broadly to the CHI audience to invite anyone interested in the link between visual impairments and education and their HCI research. A number of invitees have already confirmed their interest to be part of the workshop as participants and/or program committee members, including:

- Laura Benton, University College London, UK
- Anke Brock, ENAC Toulouse, France
- Pierre Dillenbourg, EPFL, Switzerland
- Emilie Giles, Open University, UK
- Tiago Guerreiro, University of Lisbon, Portugal
- Alex Hadwen-Bennett, Kings College London, UK
- Jonathan Lazar, Towson University, USA
- Charlotte Magnusson, Lund University, Sweden
- Marianna Obrist, University of Sussex, UK
- Michael Proulx, University of Bath, UK
- Sue Sentence, King?s College London, UK
- Danae Stanton Fraser, University of Bath, UK
- Tony Stockman, Queen Mary University, UK
- Janet van der Linden, Open University, UK

Beyond the multidisciplinary group of invitees above, we envision that the workshop audience will comprise of researchers and students whose work have close relevance to novel interaction techniques, accessibility, visual impairments and education. The goal of the workshop is to build bridges between theory and practice in areas of: interaction techniques, education/ pedagogy, collaborative UIs, and design. Before the workshop, we will invite position papers, review and notify participants. In order to reach a wide range of participants, we will also broadly advertise the workshop on social media to HCI researchers who are interested in learning more about educational technologies and visual impairments.

Workshop Structure

We are proposing a full day workshop that combines input from the participants from within their perspectives of research, together with focus group work and hands-on prototyping for critical reflection. The proposed structure is:

- Introduction and participants presentations: brief introduction of research + highlight one key area of interest to discuss at workshop
- Interactive panel discussions: Identification of key discussion themes from introductions. Nomination of a representative of each theme to lead discussion to identify wider issues.
- Break-out sessions and focus group activities: Participants break into self-selected groups to discuss and develop materials for one of the key themes. This may include:
  - Explorations of examples of research tools for design activities involving teachers, people with VI and other stakeholders, such as parents
  - Hands-on prototyping of education materials
  - Experience sharing of best practices and lessons learned about real-world deployments and evaluation of educational technology

- Wrap-up of Break-out session + documentation and reporting of key insights
- Workshop summaries, challenges, future directions, plans for joint actions/work

Post-Workshop Planning

We will summarise the discussions and the wide range of research presented at the workshop in a report to be published in an HCI journal or a magazine article (e.g., ACM Interaction). We will release a report in multiple formats and invite blog contributions on the subject to foster a community around these issues, themes and directions that emerge from the workshop. We have also built-in time during the workshop for discussing and planning further routes for dissemination and future work.

Call for Participation

This workshop aims at bringing together HCI researchers and practitioners to share knowledge into methods and tools in the areas of education and visual impairment. The one-day workshop will combine submissions presentations with focus groups and hands-on activities exploring key questions including, but not limited to the following:

1. How to better leverage the potential of interaction techniques to maximise educational benefits?
2. How to go beyond assistive technologies that only focus on mitigating a functional limitation?
3. How to provide specialised teachers with tools and methods that are easy to adapt to the topic and audience?
4. How to best evaluate appropriate methods to help evaluate impact on teaching and learning practices?

This workshop welcomes contributions in one or more of our perspectives on education and visual impairment: novel interaction techniques, individual cognition and perception, collaborative learning and inclusion, design and evaluation. We invite participants to submit 2-4 page position papers in the CHI extended abstracts format via the workshop website. Position papers will be reviewed by committee members based on relevance to the workshop and the potential for contributing to discussions. Accepted papers will be presented at the workshop. At least one author of each accepted position paper must attend the workshop and all participants must register for both the workshop and for at least one day of the conference.

Website

inclusiveeducation.tech

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