

# Learning in an Inclusive Multi-Modal Environment

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## EXECUTIVE SUMMARY

*This paper examines recent research in interaction design for inclusive learning and the development of ideas for further research into building an environment facilitating inclusive multi-modal learning. In this paper, the authors give a summary of the findings of the original case study on improving interaction design for teaching visually impaired students. The paper then describes and discusses further work on evaluating current assistive technology products, with conclusions being drawn on future research.*

*Keywords:*     *Inclusivity, Interaction Design, Learning, Multi-modal, Visually Impaired*

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## INTRODUCTION

The findings arising from a case study on improving interaction design for teaching visually impaired students, in an inclusive learning environment, are presented. The original case study identified that a major problem for those with visual impairment when learning computer science (and probably any science or engineering discipline) is the need to draw and appreciate diagrams. The cognitive issues are often underestimated even for those with sight; a sighted person can look at a circuit diagram and see just as much as a blind person! It is important for everyone to have the circuit explained to them, particularly students, but understanding the essence of a diagram can be speeded up for those already familiar with the diagram and/or its constituent elements. The use of metaphors, orally supported, for assisting with location and navigation, etc. overcomes the “one size fits all solutions” that are often the norm. The findings of the original seed funded project led to the identification of design criteria and also led to an investigation into the feasibility of a large scale project. That project is to produce generic tools that create “multi-modal” teaching and learning courseware requiring both passive and active participation. By designing for the visually impaired, it has become apparent that the underlying functions usefully support those with aural, cognitive, physical and age-related impairments.

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In the next section, a summary of the findings of the original case study on improving interaction design for teaching visually impaired students is presented. In the section that follows, further work on evaluating current assistive technology products is described, leading to a discussion and conclusions being drawn on future research in the final section.

The objectives of this paper are:

- To outline the previous work (case study), summarising the findings which concentrated on usability.
- To describe the follow-up work that focused on the functionality of existing devices.
- To discuss the findings of the follow-up study and to draw conclusions for the direction of future research.

The work was motivated by the need to accommodate visually impaired students studying computer science at United Kingdom universities, and in so doing explore the adequacies of disability legislation, and enhance the authors' academic interest in multi-modal interaction. The research was conducted at three universities in the UK over a period of a year (Graham, Benest, & Nicholl, 2010).

## SETTING THE STAGE

Current interface design for teaching visually impaired students, even when SENDA (Special Educational Needs and Disabilities Act in mainland UK) or SENDO (Special Educational Needs and Disabilities Order in Northern Ireland) compliant, has often neglected the direct involvement of target users in determining the requirements specific for their needs. In particular, there is a lack of awareness of the cognitive issues for the spectrum of users deemed to be visually impaired. This research project, funded by the Higher Education Academy (HEA), aimed to determine and produce criteria for the design of interfaces, through the participation of target users from the outset, implementing these criteria in teaching exemplars in computer science at Ulster, and in electronics at York. An important constraint was that these criteria would be inclusive; usable by both sighted and partially sighted students as well as those with other impairments. Furthermore, inclusive design should not impede those without impairments, but potentially give greater variety to the ways in which they could learn or access information. This posed a considerable problem for both the exemplars at York for conveying electronic circuit diagrams and Ulster conveying Unified Modelling Language (UML) diagrams (Graham, Benest, & Nicholl, 2007b).

## CASE DESCRIPTION

The first activity required is knowledge acquisition, which can be machine-aided or human-labour oriented. Different authors present methodologies with varying stages of knowledge acquisition, but fundamentally they all involve: the identification and conceptualisation of requirements and problem characteristics, formalising these into some mediating representation scheme, implementation, and final testing and validation (Graham & Barrett, 1997). Johnson and Johnson's methodology (1987), enhanced by Graham (1990), proposes a three-stage knowledge acquisition process based around semi-structured interviews. The first phase is to perform a broad, but shallow survey of the domain. This allows the elicitor to become oriented with the domain, so that a more flexible approach can later be taken. This type of horizon broadening is a standard

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