# Chapter 2
# Interaction Design for Inclusive Learning

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## ABSTRACT

*The findings for a case study on improving interaction design for teaching visually impaired students, in an inclusive learning environment, are presented. The crux of the problem is the ability to draw and understand diagrams. The cognitive issues are often underestimated with insufficient attention being given to the use of metaphors, etc. and "one size fits all solutions" are often the norm. The findings of the original seed funded project, which was conducted by three universities in the United Kingdom, have led to design criteria and to an application for a large scale project, to produce generic tools and to enable "multi-modal" teaching and learning, with connotations for the support of people with cognitive as well as physical impairments, especially relevant with respect to an increasingly ageing European population.*

## INTRODUCTION

The work was motivated by the need to accommodate visually impaired students studying computer science at United Kingdom universities, the adequacies of disability legislation, and an academic interest in multi-modal interaction. The research was conducted at three universities in the UK over a period of a year.

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## 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. The 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 computing 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

### Methodology

The first activity required is knowledge acquisition. 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). Knowledge acquisition can be machine-aided or human-labour oriented.

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 approach in social science research. Once this shallow trawl of the domain has been done, the second phase requires that a more detailed task analysis is performed by the elicitor, focussing on the area of interest. The structure of the interview uses a teachback technique to traverse the domain and validate elicitor understanding with the result that the elicitor progressively refines the model of the expert's competence. This model is qualitatively drawn up and uses a mediating representation, Systemic Grammar Networks (SGNs) (Bliss, Monk, & Ogborn, 1983). These are a context free, qualitative representation, which can be used as a tool for the systems design, but their use does not imply the final application of any particular knowledge engineering software or methodology. SGNs have been used in many domains including oncology, printed circuit board (PCB) design, and fault diagnosis. The third phase of this approach is to validate the models drawn up from the expert with the wider expert community. The theoretical predictions of the model are presented to the initial community used in the first phase, and then to a further independent population, to check the appropriateness and validity of the model which has been created.

This knowledge acquisition methodology was adopted and tailored to the needs of the project. The first phase, the Broad and Shallow Survey, was achieved by arranging a telephone survey in conjunction the Royal National Institute for the Blind (RNIB) in London, and with a visually impaired student at the University of Ulster, to complete questionnaires specifically tailored to suit visually impaired interviewees. The second phase, a more detailed task analysis, was achieved through the design of semi-structured interviews with the visually impaired student expert at Ulster. Knowledge synthesis and analysis of survey and interview findings led to design criteria rather than the employment of SGNs which were not considered practical for visually impaired experts. Validation (and verification) was achieved by the evaluation of implemented criteria in exemplars