

Preparation of assessment, learning and teaching materials for dyslexic students that benefit all students: presentation of results from an empirical study

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Introduction

The purpose of this paper is to present results from empirical research with dyslexic students in Higher Education that focuses on the impact of dyslexia on the study of computing. HESA (Higher Education Statistics Agency) statistics suggest that Computer Science is one of the subjects to which dyslexic students are attracted.

This study was motivated by the question as to whether there might be anything particular about the discipline of computer programming that makes it either beneficial or problematic for dyslexic students. In addition, we were also interested in dyslexic students' general experience of assessment, learning and teaching, as well as their views of proposed accessibility guidelines.

The Greek word 'dyslexia' means 'difficulty with words'. The British Dyslexia Association (2007) describes dyslexia as "a combination of abilities and difficulties that affect the learning process in one or more of reading, spelling and writing". Dyslexic students are a substantial and growing proportion of the overall student population, for whom learning materials should be made accessible. It is argued that good practice in approaches in assessment learning and teaching for disabled students is generally good practice for all students (Brown, Adams, 2006). Many of the adjustments, such as well prepared handouts, instructions given in writing as well as verbally, notes put on-line, and variety and flexibility in forms of assessment, are simply good teaching and learning practices from which all students can benefit.

Background to this Study

An outcome of previous work together with the Higher Education Academy (HEA) and others (see Powell et al, 2003, 2004) was the development of accessibility guidelines particularly relevant to dyslexic students. The accessibility guidelines were derived from existing guidelines (CITA, 1998; W3C, 1999; IMS, 2002; TechDis, 2002; Rainger, 2003) and were devised as follows:

Figure 1: Usability guidelines particularly relevant for dyslexic students (Powell et al, 2004)

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|-------|--|
| i) | Allow the user control of font size and style, background and text colours. |
| ii) | Avoid strongly coloured or patterned backgrounds. |
| iii) | Use clear structuring of text to form left justified paragraphs. |
| iv) | Use clear and concise language and easy to understand graphical cues. |
| v) | Design pages so that they can be read by a screen reader. |
| vi) | Allow the user to turn off any animated or timed elements. |
| vii) | Use consistent layouts and formats. |
| viii) | Provide context and orientation information. |
| ix) | Front-load information (i.e. indicate what a section contains at the beginning). |
| x) | Use white space so that the text does not look cluttered. |
| xi) | Place hyperlinks at the end of a piece of text instead of scattered throughout. |
| xii) | Provide a brief description of where a hyperlink will lead and why it is there. |

Data Collection Method

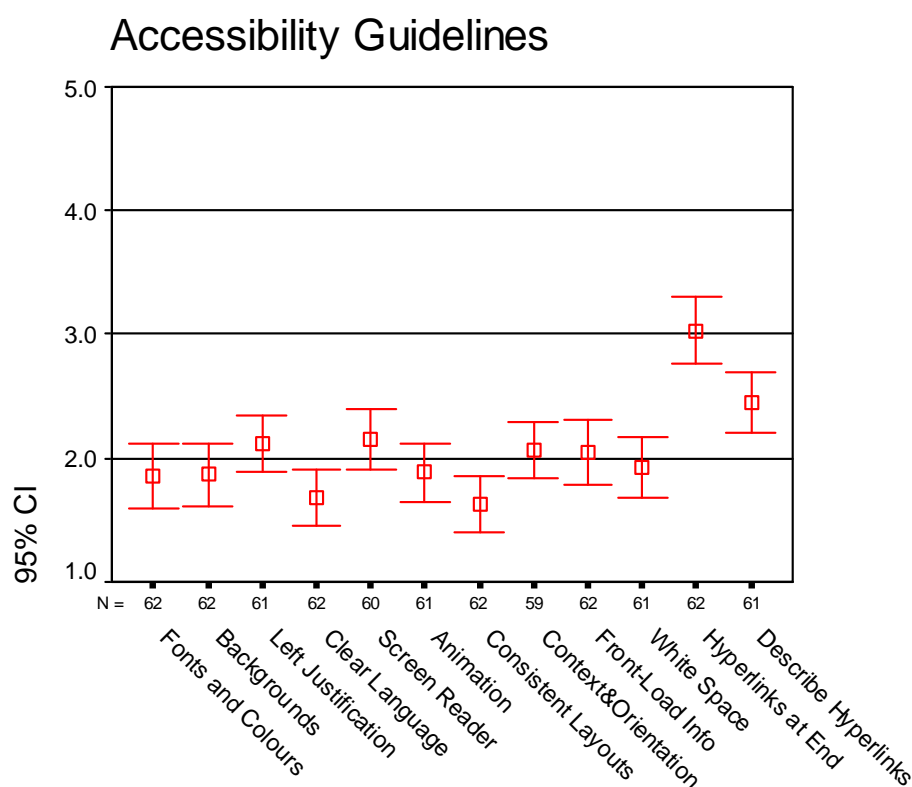
A questionnaire was devised based on the interview schedule from previous work (see above). The questionnaire contained open questions to enable dyslexic students to identify issues and express views important to them. The questionnaire was publicised widely and posted on the HEA website, distributed at a dyslexia discussion group and handed-out via personal contacts. A total of 63 responses were collected. The aim of the questionnaire was to understand the experience of dyslexic students learning computer programming; it also included general issues of presentation of on-line material, assessment, learning and teaching, and more specific issues associated with computer programming. Restrictions of space meant that only selected aspects of the findings, particularly relating to enhancing the learning and teaching environment for our students, are presented here. Further details can be obtained from the authors.

Discussion of Results

Accessibility Guidelines

Participants were asked to rate their agreement for each guideline (**Error! Reference source not found.**) on a Likert Scale, 1 strongly agree to 5 strongly disagree. Results are shown in figure 2.

Figure 2: Level of Agreement with Accessibility Guidelines, Means and 95% Confidence Intervals



Questionnaire responses show general agreement with all the accessibility guidelines. Exceptions are (xi) placing hyperlinks at the end, which the participants are generally neutral about and guideline (xii) describing hyperlinks, which is the next least popular. The remaining guidelines are all clustered about agreement, with perhaps some preference

within this towards (vii) consistent layout and (iv) clear language compared with (v) screen readers and (iii) left justification.

Experience of Assessment, Learning and Teaching

Regarding **lectures**, dyslexic students preferred receiving a good, clear set of notes prior to the lecture. Notes should be designed so that they can easily be annotated, as extensive note-taking was perceived as difficult by dyslexic students, particularly if the pace of the lecture is so fast that it prevents the information to be absorbed. The use of visual materials, such as diagrams and also examples was described as helpful. The students greatly appreciated just being able to access **on-line materials** and notes, especially if they are available around the clock and off-site in accessible formats. In addition, the respondents proposed including spatially organised text and visual materials, such as graphics, diagrams, tables and lists.

Interactive materials and materials that can be printed off were also appreciated. Further comments by the respondents about the contents of the on-line materials were for example “a good set of notes that stand independently of the lecture” and “contain worked examples with understandable solutions”. Some problems regarding on-line materials were mentioned such as contents, format and accessibility. Ideally, the contents should be clear and well structured, up-to-date and preferably more than just the lecture slides. The notes should be in text format rather than PDF, as the latter is less adaptable and harder to access with screen readers.

Practicals and Tutorials, as part of the course, were perceived as helpful, especially when they provided an opportunity to collaborate either formally or informally. Supportive staff and flexible access to computers were also mentioned as beneficial. Particularly, tutorials were seen as offering the opportunity to interact with tutors, ask questions and do practical work in the relaxed atmosphere of a small group. However, practicals can also expose weaknesses of the dyslexic student, which can be made worse by tutors who are not sympathetic to their difficulties. For example one tutor was quoted as saying “were you stoned when you did this homework?”

Assessments seemed to dominate the problematic responses, particularly long handwritten exams and the weight they carry in the marking scheme. Concern was also expressed over unrealistic assessment deadlines and the congestion of deadlines, as well as the clashes between coursework and revision.

Dyslexia and Programming

The majority of participants identified both difficulties and compensations regarding programming and dyslexia. The students identified as the main difficulties to learn programming, spelling and memory, followed by the time it took to learn programming, testing and debugging. Particularly debugging was identified as problematic, especially identifying one’s own mistakes, and there are also more likely to be errors in the code arising from the spelling and memory problems. Some respondents describe coping strategies such as “I have worked on developing strategies to check for errors. I also use numerical techniques to help me to minimise errors” or “I can use colour to help me break up sections”.

Interestingly, the majority of respondents described some sort of compensation associated with dyslexia. Some students mentioned how coping with dyslexia can be a good preparation for programming. A number of responses explained that some of the positive features of dyslexia, such as visualisation skills, can help to visualise a problem and therefore help to develop good problem solving skills.

Hence, strategies and coping skills that students have developed for dealing with dyslexia can translate into good programming practice and a methodical approach to programming.

Summary and Conclusions

The results from this questionnaire paint a picture of the experiences of dyslexic computer science students in higher education. Some conclusions, that can be drawn, concern students' general experience of assessment, learning and teaching, others are specific to the computer science discipline. Students expressed general agreement with the proposed accessibility guidelines (see **Error! Reference source not found.**), other suggestions emphasised the presentation of materials, such as the inclusion of visual content and spatially structured text. In general, the effect of dyslexia has been seen to be in the area of languages skills and also short term memory and organisation skills.

The respondents' comments indicate a strong connection being needed between lecture notes and on-line materials. Many dyslexic students describe it as problematic to make good quality notes from a lecture. Hence it was particularly important for the respondents to be able to access on-line materials that can be annotated before the lecture. In addition to this, the delivery of the material was also perceived as important. Mentioned in this context were the pace and quality of the lectures and the teaching style of the lecturers themselves. Assessments were found to be problematic, particularly long handwritten exams and congested deadlines for coursework. There was a preference towards practicals and coursework and away from exams. Practical aspects of the course, such as tutorials and programming, were found to be helpful, especially those that involved collaboration. The participants' experience of programming is mixed, as most of the participants find both difficulties and compensations associated with dyslexia. The degree and balance of difficulties and compensations were very varied, ranging from dyslexia having no effect to having an important effect.

Finally, it is important to be aware that the strengths and weaknesses of each individual dyslexic student are likely to be different. Hence, the areas where students may need support and the degree of support required will likewise be different.

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