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Use of assistive technology by students with dyslexia in post-secondary education

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Abstract

Purpose. To identify the types and mix of technology (hardware and software) provided to post-secondary students with dyslexia under the UK's Disabled Student Allowance (DSA), and to determine the students' satisfaction with, and use of, the equipment provided and to examine their experiences with training.

Method. A telephone survey of 455 students with dyslexia who had received technology under the DSA from one equipment supplier was conducted over in the period September to December 2005. The survey obtained a mixture of quantitative data (responses to binary questions and selections from a five-point rating scale) and qualitative data (participants identifying positive and negative experiences with technology). In addition, the equipment supplier's database was used to determine the technology supplied to each of the participants.

Result. Technology provision is variable between students. The majority of students receive a recording device, text-to-speech software and concept mapping tools in addition to a standard computer system. Ninety percent of participants are satisfied or very satisfied with the hardware and the software that they receive. A total of 48.6% of participants received training, with 86.3% of those expressing satisfaction with the training they received. Of those that were offered training but elected not to receive it, the majority did so because they felt confident about their IT skills.

Conclusions. Students express satisfaction not only with the computer systems that they receive but also with the special-purpose software provided to support their studies. Significant numbers of students elect not to receive training and may, therefore, not be using their equipment to its best advantage.

Keywords: *Dyslexia, assistive technology, text-to-speech, scanners, concept mapping*

1. Introduction

Computer systems and software (both general- and special-purpose) are supplied to students in post-secondary education and studies (e.g. [1]) have shown that this is beneficial. In the United Kingdom students with disabilities receive the Disabled Students Allowance (DSA) [2] that is used to pay for equipment (including computer-systems, software, special-purpose hardware and other items such as specialist chairs, coloured overlays, wrist rests, etc.), training costs and specialist study support. The typical process of obtaining a DSA is as follows. Having applied to an appropriate funding body such as a local government authority, a student is advised to have a needs assessment, which is conducted by an approved assessment centre. The needs assessment identifies the equipment required by the student together with his/her support needs. The equipment is purchased by the funding body or student from one of a set of approved suppliers.

Dyslexia is '*a combination of abilities and difficulties that affect the learning process in one or more of reading, spelling and writing*' [3]. A significant proportion of students in receipt of a DSA have dyslexia and the proportion of students is rising. In 1994/95 there were 4860 supported students with dyslexia in a UK Higher Education population of 1,567,315 (0.31%), in 1999/2000 this had risen to 21,615 in a population of 1,856,335 (1.16%) and to 49,945 in 2,247,440 (2.22%) in 2003/2004 [4]. The support needs of students with dyslexia are variable between individuals and quite complex. Moreover, a significant number of students in receipt of the DSA are

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identified as being dyslexic shortly after they enter post-secondary education. This is in contrast to the vast majority of other disabled students (for example students with visual, hearing and physical impairments) whose needs are usually identified much earlier.

Students with dyslexia have variable and complex needs which are identified late in their academic careers. This study seeks to identify the mix of equipment recommended for such students and to obtain their perceptions of its utility and also to investigate the uptake of training. Detailed research questions are given in Section 1.3. The motivation for this work is that there are few comparable studies (see Section 1.2) and those that have been carried out sample significantly fewer dyslexic students. Those assessing and supporting students often have only anecdotal evidence concerning the provision of technology, its perceived value and the take up of training, and real data is required to support an informed debate on the support of students with dyslexia in higher education.

There have been two much smaller studies that have examined the relationship between students with dyslexia and their equipment. These are described in Section 1.2. Before considering theses studies a brief overview of the equipment provided to students with dyslexia is given in Section 1.1.

1.1 *Hardware and software*

A wide variety of computer-related hardware and software is supplied to students with dyslexia. In this sub-section we identify the equipment that is provided and classify it in four areas. The hardware and software used by participants in the study is given in Section 2.2.1. The classification of hardware and software is:

- General-purpose hardware. This is computer-related equipment that is not targeted at users with special requirements; it is used by the general population and will include items such as desktop and laptop computers.
- Special-purpose hardware. This equipment is standalone electronic equipment that is targeted at users with special requirements; it is assistive technology. Whilst it may be used by the general population, its primary use is by people with special requirements.
- General-purpose software. Software aimed at the general population (for example Microsoft Office).
- Special-purpose software. Software aimed primarily at people with dyslexia (assistive technology).

1.1.1 General-purpose hardware. A standard computer system (whether it be a desktop or laptop) is the basic equipment provided to students with dyslexia under the DSA. Indeed the participant selection criterion for the survey was that the student registered for a copy of Microsoft Office (for Microsoft Windows or Apple Macintosh operating systems), so all of the participants have access to such a system. Our classification includes standard peripherals such as a monitor, keyboard, mouse, printer etc.

Scanners are often provided to students with dyslexia. As noted below, they are supplied with Optical Character Recognition (OCR) software to convert the scanned image to text, often to be used in conjunction with text-to-speech software.

Some students with dyslexia are provided with Personal Digital Assistants (PDAs) to assist in diary keeping and general organisational tasks.

1.1.2 Special-purpose hardware. The special-purpose hardware supplied to students with dyslexia is usually in the form of standalone electronic devices. Whilst some of the hardware discussed below is designed for and used by the general population, the specific use to which the devices are put and their high incidence of use by the population of dyslexic students causes them to be classified as special-purpose hardware.

- Recording devices. Either minidisk or digital recorders used to record lectures and personal notes.
- Handheld spellcheckers. Used for checking handwritten work, providing definitions of words and as a thesaurus. Many of Fidler's [5] participants identified the last function as the most important.
- Scanning and reading pens. Scanning pens are used to capture text and transfer it to a computer. Reading pens pronounce and define the word by speech.
- Portable notetakers. Special-purpose notetakers (e.g. AlphaSmart) are used by some students to take notes in lectures.

1.1.3 General-purpose software. Most students with dyslexia will be provided with standard word processing software (such as Microsoft Word) and other standard packages (such as other applications within Microsoft Office).

Speech recognition software (such as Dragon NaturallySpeaking) is quite often used by students with dyslexia as means of inputting text into a computer system, thus overcoming difficulties with typing. Another approach to addressing difficulties with typing is to provide typing tutor programs such as Mavis Beacon or Kaz.

1.1.4 Special-purpose software. A variety of special-purpose software is used by students with dyslexia. Those most commonly used are:

- Text-to-speech systems. Such packages convert text held on a computer system to synthesised speech to assist in the reading and creation of documents. Such software is supplied with integrated talking dictionaries and some versions will support scanning and OCR. Examples of such software include TextHelp's Read and Write and Claro Software's ClaroRead. Fidler [5] provides a breakdown of his survey participants' use of TextHelp (Fidler does not specify which TextHelp product is used, we assume that it is Read and Write), the major uses are (with an indication of the proportion of the total students (53) who mention use of a feature): proof reading (60.4%); spell checking (30.2%); reading other texts (15.1%); grammar checking (7.5%); other uses (17.1%).
- CD-based talking dictionaries are also used by some students with dyslexia. These provide speech output from standard dictionaries. Some students use both talking dictionaries and text-to-speech systems that contain talking dictionaries. One possible reason for using a talking dictionary in addition to a text-to-speech system is that the speech produced by the talking dictionary is recorded human speech, rather than synthesised speech and users may prefer this.
- Concept mapping software is used by students with dyslexia to organise information. It can be used for notetaking, revision and the planning of reports and essays. Most concept mapping software supports the last of these by exporting information into standard word processors such as Microsoft Word. Examples of such software include Mind Manager and Inspiration.
- Word prediction and word banks may be used to assist students with dyslexia in typing and word selection. However, none of the 455 students included in the survey were provided with standalone software for this purpose. Some text-to-speech systems have support for this area, but it is not clear from the data if any of the survey's participants use this facility.

1.2 *Related work*

Fidler [5] presents the results of a paper-based questionnaire of 82 students and 10 follow-up, semi-structured interviews at Roehampton University. Fidler's goals were to evaluate equipment used by students with dyslexia and support services at the Roehampton University with the aim of enabling the support needs of students to be addressed. In addition Fidler also aimed 'to attempt to understand the link between learning styles and equipment' [5] but states that the results from this area were unclear. In the evaluation of the computer as a tool 91.25% of Fidler's participants indicate that a computer is an essential piece of equipment. Fidler notes that '[t]his is hardly surprising and one could argue that all students would reply in a similar fashion' [5]. Fidler's results are of interest in the way in which he reports the student satisfaction (on a five-point scale ('essential', 'very good', 'adequate', 'not very good' and 'not helpful/do not use') with a range of specialist software and hardware. On the whole, students are positive about their equipment provision, see Table I.

In addition, Fidler reports that 53.7% of his sample used a cassette recorder and 8.5% a minidisk recorder, noting that students were not particularly positive about these devices. 48.5% of the cassette recorder users stated its usefulness was adequate with 'a slightly more favourable response' [5] from minidisk users.

Cobham et al. [6] conducted two surveys (using paper-based questionnaires) of students who were supplied with equipment under the DSA in 1998 and 1999. Their survey was principally concerned with the process of assessment and was not confined to students with dyslexia; of the two surveys conducted 22 (47.8%) of the 46 in one survey and eight (38.1%) of the 21 in the other survey were identified as having dyslexia. The results show high levels of satisfaction with the assessment process and the equipment provided. When asked to identify the educational or technical aids that had the greatest impact on the participants' academic lives, of the 20 in the larger study who replied, 15 mentioned general items (principally general purpose computers but also specialist teaching support) and five mentioned specialist hardware and software.

Table I. A summary of the results of Fidler's survey of 82 students with dyslexia at Roehampton University [5].

Hardware device/ Software program	Percentage of 82 participants using the equipment	Proportion stating essential or very good
Scanner (with OCR)	'*nearly 70%*' (5)	74%
Text-to-speech	64.6%	64%
Talking dictionary	56.1%	76%
Mind mapping	Not stated	61%
Speech recognition	24.4%	45%
Handheld spellchecker	48.8%	83%

1.3 *Research questions addressed by this study*

- Equipment
  - What hardware and software is provided to students with dyslexia?
  - Is there a typical provision of equipment (i.e. do all students get the same mix of equipment)?
- Student perception
  - Are students positive about the equipment provided to them?
  - Are they as positive about the special-purpose equipment provided as general items such as a computer?
  - Do students use the equipment that is provided on a regular basis and is equipment abandoned?
- Training
  - What is the take up of the training?
  - Do students find the training useful?
  - Why might a student not accept the offer of free training?

2. Survey

2.1 *Survey procedure*

2.1.1 Participants. The participants were selected from the customer records of Microlink PC (UK) Ltd, a company that supplies hardware and software to students in receipt of a DSA. Microlink is based in the Southampton in the UK and the majority of its customers attend higher and further education establishments in the south of England. This also means that the majority of the participants will have had their needs assessment performed by 14 assessment centres – see Section 3.1 for a discussion of the implications of this. The customer records were used to randomly select 1000 candidate participants; the selection criterion was that the student had been in receipt of Microsoft Office. This criterion was used because it guaranteed that the student was using a computer and because the information was easy to access. A telephone interview was conducted with 475 of these students (the remainder could not be contacted) of which 455 were determined to be dyslexic based on the characteristics of the hardware and software that they received and comments made by the participants during questioning. Of the 475 students interviewed, all bar two completed the questionnaire; a completion rate of 99.6%.

2.1.2 Process. Interviews were conducted at the start of the 2005–2006 academic year by one of the authors and by telephone support staff employed by Microlink PC (UK) Ltd. The purpose of the survey was explained to the students, they were informed that the information they provided would be used anonymously and that their name would be entered into a draw to win a personal MP3 player.

2.1.3 Instrument. The questionnaire used was common to all participants and questions were asked in the same order. Early drafts of the questionnaire were based upon the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST version 2.0) [7]. However, in initial trials it was found to be more suited to the evaluation of a single assistive technology rather than the range of hardware and software equipment that we wished to survey. Moreover, the survey derived from QUEST took an average of 10 min to perform compared with the average of 8 min in the eventual questionnaire. Because one of the problems in conducting telephone interviews is the difficulty of presenting the participants with a list of options, participants were asked to highlight one item of hardware and software that they felt performed especially well and especially poorly. This technique allowed data to be gathered about the users' experiences whilst minimising possible confusion and time. The questions used are presented together with the results in Section 2.2.2.

2.2 *Results*

2.2.1 Hardware and software supplied to survey participants. The hardware and software used by the survey participants was extracted from the database of the company that supplied the equipment to the participants. The equipment supplied to survey participants is shown in Table II.

Scanners are provided with OCR software that converts the scanned image into text. However, there is an option to augment the basic functionality of the scanning software by providing additional software. This additional OCR software provides more sophisticated control over the character recognition especially with regard to images; examples of such software include Omnipage Pro and ABBYY FineReader. Alternatively, the student may be supplied with a version of text-to-speech software that integrates such sophisticated OCR scanning into the tool; examples include TextHelp's Read and Write Gold and Claro Software's ClaroRead Plus. Table III shows the provision of OCR software to the 347 students who received scanners.

It is interesting to note that only 11 of 347 scanner users were provided with the basic OCR software, all of which were provided with text-to-speech software without OCR capabilities. The vast majority of students were provided with more sophisticated scanning software. Of these, 26 were provided with

Table II. Equipment supplied to survey participants – data from Microlink PC (UK) Ltd database.

Hardware/Software	No. (455)	Percentage	Subtype	No. (455)	Percentage
General-purpose hardware					
Computer	455	100.0%	Desktop	296	65.1%
			Laptop	159	34.9%
Scanner	347	76.3%			
PDA	6	1.3%			
Special-purpose hardware					
Recording device	347	76.3%	Minidisk Recorder	215	47.3%
			Digital Recorder	132	29.0%
Handheld spellchecker	92	20.2%			
Scanning and reading pens	0	0.0%	*Note: three students comment later on the use of such pens, but they do not appear in the supplier's database.*		
Portable notetaker	1	0.0%			
General-purpose software					
Microsoft Office	455	100.0%			
Speech recognition	138	30.3%			
Typing tutor	128	28.1%			
Special-purpose software					
Text-to-speech software	363	79.8%			
Talking dictionary	165	36.3%			
Concept mapping	350	76.9%			

Table III. Provision of software to those provided with scanners (the percentage is represents the number of participants in a category as a proportion of students who received a scanner (347)).

Scanning software	No	Percentage
No additional software (as included with scanner only)	11	3.2%
Additional OCR software (no text-to-speech with OCR capabilities)	300	86.4%
Text-to-speech with inbuilt OCR (no additional OCR software)	10	2.9%
Additional OCR software and text-to-speech with OCR capabilities	26	7.5%

Table IV. The combinations of software provided to the participants in the survey.

	CM and SR	CM and not SR	not CM and SR	not CM and not SR
TtS and TD	45 (9.9%)	97 (21.3%)	4 (0.9%)	12 (2.6%)
TtS and not TD	53 (11.7%)	124 (27.3%)	7 (1.5%)	20 (4.4%)
not TtS and TD	1 (0.2%)	5 (1.1%)	0 (0.0%)	1 (0.2%)
not TtS and not TD	9 (2.0%)	16 (3.5%)	19 (4.2%)	42 (9.2%)

CM, concept mapping; SR, speech recognition; TtS, text-to-speech; TD, talking dictionaries. Each entry in the table is the logical combination of the row and column headers. For example, top right hand entry is 'TtS and TD and not CM and not SR' which represents the 12 students who were provided with text-to-speech and a talking dictionary but who were not provided with concept mapping or speech recognition software.

both additional OCR software and text-to-speech software with sophisticated text-to-speech; this will result in a duplication of function with regard to OCR scanning, but the enhanced text-to-speech software has additional features not included in the standard text-to-speech software in addition to enhanced OCR capabilities. Thus the apparent duplication of facilities might be explained by a student's need for the additional features.

It is also interesting to examine the combinations in which the three items of special purpose software and speech recognition are recommended to students with dyslexia. This is shown in Table IV.

The majority of students (70.2%) are provided with both text-to-speech and concept mapping software. Of this group, the majority are not provided with a talking dictionary (55.5%) and not provided with speech recognition (69.3%). The proportion of students provided with all four software packages is 9.9% of the group surveyed and 9.2% receive none of these packages.

2.2.2 Survey data. Of the 455 participants, 222 were male (48.8%) and 233 female (51.2%). The questions and the responses to them are given in Table V.

In addition to being asked the questions shown in Table V, participants were encouraged to elaborate on their answers. Comments that give further information are identified in Table VI.

The participants in this survey are generally very positive about their provision under the DSA. Participants are not only positive (91.0% quite or

Table V. Answers to survey questions.

Question						
1. Did you use any software programs before your assessment e.g. word-processing and the internet?	Yes 395 (86.8%)	No 60 (13.2%)				
2. Did you use specialised software programs such as text-to-speech or screen reading to support your study needs before your assessment?	Yes 51 (11.2%)	No 404 (88.8%)				
3. How satisfied are you with the equipment you have received? (*Note that the term 'equipment' used here is synonymous with 'hardware' as used in the rest of the paper and the concept of 'equipment' as opposed to 'software' was explained to the students during the interview*).	Not satisfied at all 1 (0.2%)	Not very satisfied 14 (3.1%)	More or less satisfied 26 (5.7%)	Quite satisfied 94 (20.7%)	Very satisfied 320 (70.3%)	
4. How often do you use your equipment?	Not at all 1 (0.2%)	Occasionally 5 (1.1%)	Sometimes 16 (3.5%)	Often 132 (29.0%)	Always 301 (66.2%)	
5. How easy is it to use? (Hardware)	Very difficult 1 (0.2%)	Difficult 6 (1.3%)	Moderately easy 66 (14.5%)	Easy 156 (34.3%)	Very easy 226 (49.7%)	
6. Was there one particular piece of equipment which failed to meet your needs?	Yes 145 (31.9%)	No 310 (68.1%)				
7. Was there one particular piece of equipment which exceeded your expectations?	Yes 210 (46.2%)	No 245 (53.8%)				
8. How satisfied are you with the software programs you have received?	Not satisfied at all 0 (0.0%)	Not very satisfied 5 (1.1%)	More or less satisfied 35 (7.7%)	Quite satisfied 137 (30.1%)	Very satisfied 276 (60.7%)	Not Applicable 2 (0.4%)
9. How often do you use your software programs?	Not at all 5 (1.1%)	Occasionally 19 (4.2%)	Sometimes 56 (12.3%)	Often 185 (40.7%)	Always 190 (41.7%)	
10. How easy are they to use? (Software Programs)	Very difficult 1 (0.2%)	Difficult 13 (2.9%)	Moderately easy 98 (21.5%)	Easy 152 (33.4%)	Very Easy 189 (41.6%)	Not Applicable 2 (0.4%)
11. Was there one particular software program which failed to meet your needs?	Yes 124 (27.3%)	No 331 (72.7%)				
12. Was there one particular software program which exceeded your expectations?	Yes 272 (59.8%)	No 183 (40.2%)				
13. Have you purchased or received any additional equipment or software programs since your original assessment?	Yes 85 (18.7%)	No 370 (81.3%)				

(*continued*)

Table V. (*Continued*).

Question						
14. Did you receive any training on the equipment and software programs?	Yes 213 (46.8%)	No 242 (53.2%)				
15. How satisfied are you with the length of time it took for you to receive your equipment and software programs?	Not satisfied at all 6 (1.3%)	Not very satisfied 24 (5.3%)	More or less satisfied 56 (12.3%)	Quite satisfied 155 (34.1%)	Very satisfied 212 (46.6%)	Not Applicable 2 (0.4%)
16. How satisfied were you with the service you received from the supplier?	Not satisfied at all 2 (0.4%)	Not very satisfied 18 (4.0%)	More or less satisfied 31 (6.8%)	Quite satisfied 136 (29.9%)	Very satisfied 261 (57.4%)	Not Applicable 7 (1.5%)
17. If you have received maintenance on your equipment, how satisfied were you with the service? *The second set of percentages present the proportion of participants who did not choose not applicable.*	Not satisfied at all 5 (1.1%) *(3.8%)*	Not very satisfied 18 (4.0%) *(13.8%)*	More or less satisfied 16 (3.5%) *(12.2%)*	Quite satisfied 30 (6.6%) *(22.9%)*	Very satisfied 62 (13.6%) *(47.3%)*	Not Applicable 324 (71.2%)
18. Finally, would you be happy to be part of a short follow-up survey later in the year?	Yes 403 (88.6%)	No 52 (11.4%)				

very satisfied) about the hardware they received (largely general purpose computer systems), but also the special purpose software (90.8% quite or very satisfied).

On the whole participants had received their equipment 1 year before the survey took place and levels of use were high with 95.2% of participants' using their hardware and 82.4% of participants' using their software either 'often' or 'always'. This would appear to indicate that the abandonment rates for the hardware and software are relatively low and contrast with more general statistics concerning the use of assistive technology (AT), i.e. 'in spite of the increased variety and availability of AT approximately 30% of obtained ATs are discarded within a year' [8]. However, it should be noted that our questions pertain to the use of all hardware and all software and will not, therefore, indicate the abandonment of one element of a student's provision if he/she uses other equipment regularly.

Participants were positive about the ease of use of hardware (84% of participants' stating easy or very easy) and software (75% stating easy or very easy). Of course, the survey does not explore how the students used their systems. A student may find it easy to use a piece of hardware or software, but he/she may not be using it to its full potential.

The number of participants' identifying hardware device as exceeding their expectations (46.2%) exceeded the number who identified a hardware device as failing to meet their needs (31.7%). A number of participants (45.2% of those commenting 'positively') indicated that 'everything' exceeded their expectations. When specific equipment was mentioned, the majority mention general-purpose computing equipment (15.6% of those surveyed commenting 'negatively' and 16.7% commenting 'positively' – the figures account for 64.5% of the 'negative' comments that could be classified and 66.1% of the 'positive' comments that mentioned a specific piece of equipment.). Special-purpose equipment was mentioned much less often (7.7% 'negative' and 8.4% 'positive'). The fact that general-purpose hardware is mentioned more often should not be a surprise; every student received a computer and peripherals. As indicated by Table VII over one fifth of the students received no special-purpose hardware, and of those that received special-purpose hardware participants' received a maximum of two pieces of equipment, but only 17.4% receive both a recording device and a handheld spell checker.

Given the numbers that received them it is not surprising that the recording devices were the

Table VI. Comments made by participants in response to questions in the survey.

Question	No.	Further information
1. Did you use any software programs before your assessment e.g. word-processing and the internet?	117 (25.7%)	Had used general office software (word processors etc) and the Internet
2. Did you use specialised software programs such as text-to-speech or screen reading to support your study needs before your assessment?	35 (7.7%)	Used or knew about: concept mapping (11), speech recognition (7) text-to-speech (4)
6. Was there one particular piece of equipment which failed to meet your needs?	145 (31.7%)	The answers identify both general purpose computing equipment (71 participants) and equipment specified to specially address problems caused by dyslexia (39 participants). The comments from a further 35 participants could not be classified. The numbers identifying problems with special-purpose equipment are (percentages indicate the proportion of students commenting that were identified as receiving the equipment in Table II): • Recording devices (34 [9.8%]) • Scanning pens (3) *As noted in Section 2.2.1 there was no record of scanning or reading pens being provided to any participants from the Microlink PC (UK) Ltd sales records.* • Spell checker (1 [1.1%]) • PDA (1 [16.7%]) The numbers identifying problems with general purpose equipment are (percentages indicate the proportion of students commenting that were identified as receiving the equipment in Table II): • Printers and printer cartridges (25 [unknown]) • Computer (17 [3.7%]) • Scanners (17 [4.9%]) • Monitor (4 [0.9%]) • Mouse and/or keyboard (4 [0.9%]) • Headset for speech recognition (3 [2.2%]) • Chair (1 [unknown])
7. Was there one particular piece of equipment which exceeded your expectations?	210 (46.2%)	These can be split into general-purpose computing equipment (76) and special purpose equipment for addressing the needs of students with dyslexia (39). In addition, 95 participants (45.2% of those commenting) indicated that 'everything' exceeded their expectations. We take this to include the computer, its peripherals and the software. (Percentages indicate the proportion of students commenting that were identified as receiving the equipment in Table II). Special-purpose equipment • Recording devices (33 [9.5%]) • Spell checkers (5 [5.4%]) • Portable notetaker (1 [100%]) General-purpose equipment • Scanners (37 [10.7%]) • Printers (23 [unknown]) • Monitor (12 [2.7%]) • Mouse and/or keyboard (3 [0.7%]) • Headset for speech recognition (1 [0.7%])
11. Was there one particular software program which failed to meet your needs?	124 (27.3%)	See Table VIII.
12. Was there one particular software program which exceeded your expectations?	272 (59.7%)	See Table VIII.
13. Have you purchased or received any additional equipment or software programs since your original assessment?	85 (18.7%)	The additional equipment obtained by the participants is given below. In addition a further 39 participants (8.6%) specifically commented that they did not require any further hardware or software. • Software specific to course (18) • Digital camera (7) • USB pen drive (5)

(*continued*)

Table VI. (*Continued*).

Question	No.	Further information
		• Printer (4) • Scanner (3) • Monitor and speakers (3) • Laptop (3) • Speech recognition (2) • PDA and iPod (2) • Others (38)
14. Did you receive any training on the equipment and software programs?	413 (90.8%)	The comments were classified into the following groups. The percentages reflect the proportion of those that expressed a comment. • Found it beneficial to study need (170 [41.2%]) • Offered but declined because student felt confident (101 [24.5%]) • Offered but not taken up due to time constraints, etc (59 [14.3%]) • Not offered or arranged (56 [13.5%]) • Did not benefit from training (27 [6.5%]) In addition, some participants made the following comments in addition to those classified above Were trained, but wanted more (18 [4.4%]) Training sessions were too long (13 [3.1%])
15. How satisfied are you with the length of time it took for you to receive your equipment and software programs?	162 (35.6%)	Of these 90 participants stated the timescale. There were 72 general and unclassified comments concerning the process and its time scales. The following timescales were indicated, percentages given a as proportion of the students who stated a timescale. • Quick, under 8 weeks (65 [72.3%]) • 2–4 months (14 [15.6%]) • 5–7 months (4 [4.4%]) • 8–10 months (4 [4.4%]) • 11 months + (3 [3.3%])
16. How satisfied were you with the service you received from the supplier?	103 (22.6%)	Of these 17 participants simply commented to say they had no contact or issues with the suppliers of the remaining 86 participants, 53 (61.6%) commented favourably and 33 (38.4%) made doubtful or negative comments.
17. If you have received maintenance on your equipment, how satisfied were you with the service?	266 (58.5%)	Of these 147 stated that maintenance was not needed. Of the remaining 119 participants, six identified virus issues as being the problem and the remaining 113 comments were unclear. This issue is further discussed below.

No., number (percentage) of 455 making a comment in response to the question.

most commented on piece of special-purpose hardware. Of those that received it, 9.8% commented 'negatively' and 9.5% 'positively'. This result is at odds with the perception of software packages (see Table VIII) where 'positive' comments always outweigh 'negative' comments and perhaps indicates that for some students recorders are of little use; a result that is consistent with Fidler's findings – see Section 1.2. Hoogan and Dooley note that students found recorders useful as they '*allow[ed] recordings to be broken into easily navigable structures*' [9]. However, they also note the ability of students to cope with different speaking rates varied from student to student and some students found noises such as background hiss distracting.

Table VII. Numbers receiving special-purpose hardware.

	Recording device	
	Yes	No
Handheld spellchecker		
Yes	79 (17.4%)	13 (2.9%)
No	268 (58.9%)	95 (20.9%)

'Yes' indicates that equipment was supplied, 'No' indicates that equipment was not supplied (column for recording device, row for spell checker). The intersection of the row and column indicate the numbers receiving the combination, e.g. 79 (17.4%) receive both a recording device and a handheld spell checker.

Nearly 60% of participants identified one software program as exceeding their expectations, with a little less than 30% identifying a software program that

Table VIII. Participants identifying 'one particular software program which' exceeded their expectations and failed to meet their needs (%age shows the proportion of participants responding who received that software).

	Exceeding expectations		Failing to meet needs	
Software	Number	% age	Number	% age
All comments	*272*	*59.7%*	*124*	*27.3%*
Speech recognition	41	29.7%	28	20.3%
Text-to-speech	98	27.0%	33	9.1%
Concept mapping	82	23.4%	31	8.9%
Talking dictionary	19	12.7%	12	7.3%
Typing tutor	8	6.3%	6	4.7%
Microsoft Office	21	4.6%	0	0.0%
Other	3	N/A	14	N/A

failed to meet their needs. The software identified is given in Table VIII. 'Positive' comments outweigh 'negative' comments for all software. Speech recognition has the highest proportion of both 'positive' and 'negative' comments; perhaps indicating that it works very well for some students and not for others. This may be dependent on the characteristics of the student; their patience in training and learning to use the software; and, of course, for those who responded 'positively', their expectations for this software may have been low to start with. The result is consistent with Koester's study [10] that indicates that people with severe physical impairments that preclude many other means of entering text are not completely happy with speech recognition. Koester reports text entry speeds of '3.5 to 32.2 [words per minute]... with recognition accuracy ranging from 72% to 94% and satisfaction scores of 28 to 89 on a scale of 0 to 100' [10].

There are almost three 'positive' comments about text-to-speech for each 'negative' comment. There has been some debate as to the value of text-to-speech software when coupled with a scanner when it is found to be distracting for people with moderately severe reading difficulties [11] and perhaps this is supported by the almost 10% of students who express 'negative' comments. However, it is clear that it is well received by most students to whom it is provided.

Relatively few students (18.7%) received additional hardware or software. Of these very few obtained equipment that could be said to be addressing problems associated with dyslexia; although two students requested the addition of speech recognition software and a further two an iPod and a PDA.

Participants had a mixed attitude to training, just under half received training (46.8%); a figure that is consistent with Fidler's 45% [5] and not inconsistent with MacLachlin's 1994 finding of 35% [12]. The majority of those who received training (86.3%) found it to be beneficial. Almost one quarter of those surveyed turned down the opportunity for training because they felt confident about their IT skills. Indeed in reading through the transcription of the participants' comments, one notes the surprise and sometimes disdain exhibited by the students to the suggestion that they would need to be trained to use a computer and software programs. It seems that very many students believe that the training is designed to develop basic IT skills, which they believe they already possess, rather than developing skills in the use of systems to support their educational activities. The issue of a relatively low take-up of training has been around for some time. In 1998 Hall and Tinklin stated 'simply providing students with computers and suitable software is not enough in itself. Students who receive computers need training and ongoing technical support' [13] and Cobham et al. [6] note that training levels are unsatisfactory.

Very few students commented negatively on their relations with their supplier of equipment with regard to delivery (4.4% 'not at all satisfied' or 'not very satisfied') and maintenance of the equipment (17.6% of those who raised maintenance issues were 'not at all satisfied' or 'not very satisfied'). As noted in Section 2.2.3, the vast majority of maintenance issues pertain to general purpose hardware and software and in the year preceding this study only 4.2% of maintenance queries pertained to special-purpose software.

Finally, it should be noted that a significant number of students commented very positively about the effect of the hardware and software on the studies. As Jutai notes 'assistive technologies may produce distinct and predictable impacts on users' feelings related to quality of life' [14] and there are a number of examples including: 'it has really built up my confidence and helped my grades'; 'it has been absolutely brilliant having all the equipment as it has been really helpful'; and 'before I received the equipment I felt I would spend my life struggling and end up in a dead end job with no prospects, this has made such a difference'.

2.2.3 Maintenance and support issues. As noted above, the comments given about the need for maintenance were not generally clear enough to classify. In order to investigate this issue further the Microlink PC (UK) Ltd technical support database was examined to determine the type of maintenance and support issues raised by customers. The period used was 1 September 2004 to 31 August 2005 (i.e. the period immediately prior to the running of the telephone survey, which will include the period of time in which the survey participants were using their equipment). There were 214 technical enquires and these were classified as shown in Table IX.

It is clear from this data that very few of the enquiries deal with specialist hardware and software.

Table IX. Technical enquiries made to Microlink PC (UK) Ltd in period 1 September 2004 to 31 August 2005.

Type of enquiry	Percentage (of 214)
Laptop hardware	32.7%
Peripherals	22.4%
Desktop hardware	19.6%
Operating system	13.6%
Courseware and other non-assistive software	6.6%
Specialist assistive software	4.2%
Other	0.9%

3. Discussion

3.1 *Answers to research questions*

There appears (quite rightly given the disparate needs of students with dyslexia) to be no standard combination of hardware and software given to students. However, Tables II and Tables IV indicate that the most typical student receives a scanner, a recording device, concept mapping and text-to-speech software.

Participants are very positive about the provision of equipment and are only slightly less positive about the provision of special purpose software than the general-purpose hardware supplied to them. This is an important finding because it indicates that students are really very positive about the software provision and is counter to the rather sceptical view that students like to receive DSA funds because they get a free computer and that the special-purpose software is little appreciated.

Those students that are trained have a good perception of training. However, a significant number of students are not trained and much of this is due to the students' perceptions of their own IT competence.

3.2 *Limitations of the study*

The study is limited in three respects.

Firstly, the identification of the participants as being students with dyslexia is based on the equipment they received and comments made. Participants are all in receipt of a DSA so they have been assessed as having a disability. A participant is thought to have dyslexia when he/she is in receipt of concept mapping software, text-to-speech software, speech recognition software and/or a talking dictionary. This accounts for 90.8% of the participants (see Table IV), the remainder all receive a scanner and a recording device; provision that is indicative of dyslexia. Whilst the survey questions did not ask participants for the reason for their receipt of a DSA award, many participants volunteered their dyslexia as the reason. No participant, identified as having dyslexia based on their equipment provision, gave a counter indication.

Secondly, the study is confined to one equipment supplier and whilst this does not introduce bias (because the equipment supplier does not specify the equipment), the location of the supplier tends to favour higher education establishments in the Southern England, being regularly used by around 14 assessment centres. Therefore, there is no way of knowing how typical or atypical the equipment supplied to the students is over the whole of the UK.

Thirdly, the record of the equipment supplied is limited to that directly supplied to the participant by Microlink PC (UK) Ltd and does not include equipment that a participant may have obtained by other means. It is clear that participants have access to other equipment; three are owners of scanning pens none of which were supplied by Mircolink and 18.7% of participants own to purchasing additional software and hardware, although little of this equipment seems related to their dyslexia. It is not possible to estimate the extent by which participants have added to their portfolio of equipment.

3.3 *Areas for future research*

Whilst the survey results are interesting in that they present what equipment is received by students and their perception of it, the survey fails to address a number of key questions.

- Do students receive the hardware and software that is most appropriate to their needs?
- How do students actually use the systems that are provided for them?
- Are they using these systems to their full potential?
- A large proportion of students choose not to be trained, would training improve their benefits from the equipment supplied?

These questions can only be addressed by an in-depth study of individual students over the course of a programme of study.

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