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Designing accessible learning materials for learners with disabilities and learning difficulties

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What do designers of learning materials need to consider in designing learning materials which may be used by learners who have physical, intellectual, vision, hearing, psychological or neurological disabilities, such as low literacy and numeracy levels? How can these materials be made more accessible for such learners? This article explains how the Open Training and Education Network has addressed this issue.

The Open Training and Education Network (OTEN) in New South Wales currently has a student population of around 27,000, enrolled in various courses in both vocational and pre-vocational areas. Because many of these courses do not require attendance at formal classes, there is a strong tendency for learners with disabilities and learning difficulties to enrol in OTEN. Instructional Designers work on developing course materials for these learners, together with teachers who are responsible for the delivery of these courses. Staff from Student Support in OTEN assist students with disabilities and/or learning difficulties (including aboriginal students and those with non-English speaking backgrounds, or NESB). These OTEN staff members recently met at a forum to discuss issues in developing courses to assist these students. The outcome of this forum is the list of recommendations, summarised in the Appendix.

The students

The number of students in OTEN who have identified themselves as having a disability or impairment is 1,279, of whom approximately two thirds are being serviced by staff from Student Support. The disability/learning difficulty breakdown follows.

Disability	Enrolments	Receiving support
Physical	730	420
Intellectual	66	66
Learning	49	49
Vision	90	90
Hearing	150	120
Psychiatric	88	38
Neurological and other	106	80
Totals	**1279**	**863**

The largest number of these students tend to be concentrated in:

Pre-vocational courses:

- CAFE (Certificate of Adult Foundation Education - the next step after literacy)
- CGE (Certificate of General Education - Year 8 to 10 secondary school equivalent)
- Matriculation (TAFE HSC)

Vocational courses:

- Environmental courses: mainly Aboriginal learners, who may have learning difficulties
- Child Studies: mainly Aboriginal learners
- Business courses: mainly learners with hearing disabilities.

The recommendations

These are based on the experience of teacher/consultants who deal on a daily basis with OTEN learners who have these disabilities and learning difficulties. Metacognitive strategies for learners with disabilities are dealt with in MacMillan(1986), particularly in the section entitled, *Research on learning and cognition* (page 696 and following). Many of the recommendations in the literature for learners with various disabilities apply to classroom learning, and integration into classes (see, for example, Sterling, 1994, Baine, 1982). However, this article discusses recommendations which apply to the development of learning materials since OTEN delivers most courses using a print component.

1. Disk

Ensuring that learning materials are available on disk is essential for visually impaired learners. Most blind students now use computer based synthetic speech output as their primary means of accessing print. Students who are severely dyslexic and who therefore cannot access print may also manage well with a synthetic speech output program. Students with learning difficulties find that reading materials on screen seems to help them focus on what they are reading. Additionally, learners who require large print are able to work from a computer screen after changing the font style and size to one that is most appropriate to their individual needs.

Students who have a physical disability that limits fine motor control find that accessing learning materials via a computer is essential for their independence as learners. Several occasional papers on adaptive technologies for learners with disabilities are available from OTEN (Downie, 1993a, 1993b, 1995, and in press).

2. Language use

It seems rather obvious that all text should be written in plain English, but some vocational areas tend to bog down in difficult language. Students do need to learn the technical vocabulary appropriate to their chosen field, but this can be defined in plain English. For some learners, it is difficult to pick up technical language after one read, so designers should consider giving a variety of vocabulary building activities and practice in the use of technical language in self assessment activities throughout the text, preferably relating to the job the students are working in, or seeking. In some courses, language appropriate to the purpose may be different to what one might consider formal, written language. Some course writers have great difficulty writing in informal, conversational style: they see the print component as a textbook, rather than conducting a 'learning conversation' (see Baath, 1982). The challenge is to write in different registers for different purposes. Of course, for NESB learners, conversational English can also present a problem, so this must be carefully considered.

Learners with reading difficulties will profit from use of diagrams and clear layout with a reduced amount of text to highlight important concepts and navigate through materials.

3. Assessment

With the increasing implementation of competency based courses in vocational areas, course development teams need to carefully consider how outcomes should be measured. In many curricula, assessment events and criteria have already been specified, but in others they need to be

specified by the course team in the planning phase. The following questions need to be considered: how is the learner going to use these skills on the job, and therefore how should they be measured? Can the broadest range of learners achieve them, or does the assessment criterion need to be changed? Consider oral work as well as written. Also acknowledge collaborative learning, as well as competitive (See Bryant et al, 1995 for using assistive technology to accomplish this; Goor et al, 1993 on how to do it). Many writers feel that group assessment is cheating, but on the job, many tasks are accomplished by groups.

If possible, provide alternative options to cater for different learning styles and consider the geographic restrictions of learners, such as prisoners and those with physical disabilities. In one course, learners are required to walk around a block and draw a map of a block in their local area. Prisoners were having difficulties with this! A well-constructed learner profile which includes possible minorities before the course is developed could alleviate these problems, leading to greater creativity in the planning and design of the course. There is sometimes difficulty in determining the difference between assessment for diagnostic purposes, and summative assessment. This should be clearly specified at the planning stage, so that course writers are clear about the purpose of each of the assessment items. In many of the pre-vocational courses, learners have not studied for a long time, and may not have been successful in their previous attempts at learning. Thus it is essential not to make the first assessment task too difficult, or too time consuming so learners can build up their confidence as they progress. Many mature-age NESB students aren't familiar with the system and current teaching methods, as well as lacking study skills. People involved in the delivery should also consider their role in building the confidence of students: delivery staff should be included in the design of the course. Disabilities Services (1994) has written a report for the Department of Employment, Education and Training on reasonable adjustment to competency assessment mechanisms for people with disabilities, giving examples of how this might be done (see p.47, section 4.3). One of the most important points the report makes is that (p.32) there are very different disabilities and different degrees of disability. Their summary states, (p.34) the differences within the group classified as 'people with disabilities' are actually more extreme than any differences between the group and other members of the population.

Quirk (1994) discusses issues in language and literacy affecting competency based assessment (see p.36 for a summary). He also mentions a number of projects which are related to this issue, and are ongoing at the moment (pages 33-35).

4. Print materials

Designers should consider the consistency of font style and size. Use broad fonts (eg Arial, Helvetica or Universal) rather than narrower ones, which are more difficult to read. Consider how headings and text fonts interact: some designers prefer sans serif for headings, serif for text (Times is a serif font, Helvetica is a sans serif). Avoid the temptation of using too many fonts, as this can become very confusing!

Always give an overview of the learning, either in decision trees, concept or mental maps, or flow charts. This allows learners to build a mental map of what is coming, and fit it into a structure. The words mind map® have been registered as a trademark by Tony Buzan, and ideas about how to use mental maps may be gained from his book (Buzan, 1993) Ensure the structure of the materials is clear: some readers may have had the experience of checking back through a long discursive text to work out where it has come from, and where it is going as it meanders through byways. Remember that learners with physical difficulties have trouble with the physical task of frequent page turning. Some learners with neurological impairment have difficulty with diagrams, as do others with visual and intellectual disabilities, so alternate formats are helpful.

Consider how learners are going to navigate through the materials. Flag learning outcomes or objectives so learners can easily find them; cut down on referring backwards and forwards through the materials where possible. Some learners with physical disabilities have trouble with large volumes of print materials requiring them to frequently find different pages.

Use practical and concrete examples of why things are done: why these things are taught, and how they will help the learner on the job. Such explanations also assist the learner's motivation: if you know why you are learning it can be easier to learn. Use graphics and diagrams plentifully to explain concepts. However, text should be able to stand alone: learners with vision impairment need a verbal explanation as well. If the diagram is essential, simplify it so it can be generated as a raised line drawing.

Where activities or assignments require learners to walk around a block of houses, or to have a look at a library, a ground plan should be provided (for example, a typical library ground plan) for learners who have difficulty with walking or are geographically restricted. If the ground plan is what the learners need to generate, and therefore you can't provide them with it, then give a picture of a typical block with shops or houses on for them to use.

Learners with hearing impairment miss information from radio and TV programs which don't have subtitles. Learners with literacy gaps miss written information. So when you need to refer to current affairs, or

background information from newspapers, magazines or TV programs, give this information where it is referred to (or ask the students to refer to it, giving references).

Make sure that you check the learner's understanding of the print explanation: learners with hearing impairment and literacy gaps tend to assume they have understood, but may not learn in sufficient depth to be able to use the information later. This can also apply to all other learners. It may seem obvious, but it is very important. Simplify content, and repeat in different ways, but make sure the repetition does not become boring for those who understand it the first time. State the concept, give information on how to learn it, then give the conclusion, stating the concept again. Consider emphasising the structure graphically within the text, using different fonts and / or sizes for section headings to those used in the text. For instance, OTEN uses Helvetica 18 pitch for A (or main) headings, Helvetica 14 pitch for B (or secondary) headings, with appropriate spacing, and Palatino for text. As already mentioned, use cues to assist the learner in recognising and using the structure. Use summaries at regular points throughout a topic, preferably in different ways to the text: diagram, flow chart, table. Better still, ask the learner to summarise, giving a structure, then ask them to check against the answer (on the next page only if it's not already visible while they are doing the exercise). Give positive and negative examples, to illustrate what does and does not belong to a concept, for instance, democracy: this is a very abstract and elusive concept for some learners who don't have the wealth of background information that the teacher has. Often writers overestimate the knowledge and experience of the learner.

5. Video

Use videos as supplements, rather than to replace parts of the course. Remember that videos are linear, and it's more difficult to revisit sections than it is to turn back the pages of a print resource (for most learners). Students need to ask themselves questions beforehand, and revise key concepts after viewing. Try asking learners to formulate their own questions beforehand. Learners can rewind the video, particularly if they are experienced in this area. However, many learners with disabilities tend to be more frightened about using technology than learners without disabilities. Subtitles are better than signing, as more people with hearing disabilities can understand them: ensure all essential videos are subtitled. Hofmeister (1992) gives guidelines on developing instructional video for a diverse group of learners.

6. Audiotapes and video voice overs

Make sure the voice is deep and slow, but don't use male voices only, as female learners will feel left out. Learners with neurological disabilities often have difficulty with visual presentation because their visual memory

may be 'scrambled': they may have trouble extracting meaning from text and graphics. However they have less difficulty with aural comprehension. So an audiotape is easier for them to understand.

7. Computers

Many learners learn better with computers, particularly those with intellectual disabilities. Computer programs which provide multi-sensory information are extremely motivating (see EJ497680, author not stated, for a literature review and Okolo, 1993 for a retrospective view of CBI). They also provide a means of teaching learners who have limited or no reading skills. However, the information is limited by what's on the screen. Learners may feel safer because they can go back and retrieve information. Multimedia on computer taps several modalities at once, but navigation through the material needs to be carefully considered. Also ensure that the learner has access to the required computer: it is very frustrating finding out after you start that you don't have access to essential equipment. Remember that some epileptics have difficulty with the flickering screen on the computer. For a significant number of individuals with acquired brain injury (for example, through car accidents), a computer can provide practice in interaction with less boredom than, for instance, repeated practice in mathematical examples from a textbook.

8. Learning to learn and bridging

Learning skills should be taught as part of the content in the course. Also consider whether some learners need basic bridging skills to acquire content in particular areas: in electrical courses, there may be a need to revise algebraic concepts for the mathematics content in the course, for instance.

Conclusion

The purpose of OTEN flexible learning materials is to develop independent, autonomous learners, so there is some concern that spoon feeding learners might lead to them relying on the materials, rather than becoming independent. However materials at the start of a course, and in pre-vocational courses, need to support learners to a greater degree. This support could be gradually withdrawn as the course proceeds. In OTEN, learners may enter some courses at any point, having started with a face-to-face course, so a basic minimum of good instructional design should always be present. This will assist all learners in the course, not only those with disabilities and learning difficulties.

Remember too that not all learners with disabilities will necessarily identify themselves: learners with partial hearing impairment and reading difficulties in particular tend to shy away from defining themselves as possessing a disability. Some learners have experienced patronising treatment in previous contexts, and may wish to try independence. It's

difficult to give blanket recommendations for all learners, as you will notice from the recommendations. Strategies which assist some learners will need to be carefully considered for others, for instance, diagrams and learners with vision impairment. However, careful consideration of the needs of all learners will result in more accessible, quality resources which meet the needs of all learners.

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Appendix: Recommendations for designing accessible learning materials

	Recommendation	Student group
1. Disk	All material should be available on disk.	All learners, particularly with vision impairment or physical disabilities and specific learning disabilities.
2. Language use	All text should be written in plain English. Consider giving practice in the use of technical language in the self assessment activities. Also, consider language appropriate to the purpose: different registers are acceptable for different purposes. Use key and go words to highlight important concepts and navigate through materials.	All learners, particularly learners with reading difficulties, such as NESB (English as a second language), specific reading disability. Aboriginal learners or those with intellectual disabilities and hearing impairment.
3. Assessment	Consider how outcomes are measured: can the broadest range of students achieve them or does the assessment criterion need to be changed? Consider oral work as well as written. Also acknowledge collaborative learning as well as competitive: it's not cheating. Provide alternative options, to cater for different learning styles and restrictions (prisoners physical disabilities).	All learners, particularly learners with reading difficulties, such as NESB, specific reading disability, Aboriginal, prisoners, or learners with physical disabilities or vision impairment. This may help the isolating effects of any disability.
	The first assignment should not be too difficult, and preferably not receive a mark or be part of the final mark for the subject/module.	All learners, particularly learners with reading difficulties, Aboriginal, prisoners, NESB, or learners with intellectual disabilities.
4. Print material design	Text font, style and size Font size should be 12, including tables, and font style and size should be consistent. Use broad fonts (eg Ariel, Helvetica or Universal) rather than narrower ones.	All learners, particularly learners with vision impairment.
	An overview of the learning should be given either in decision trees, concept or mental maps, flow charts (but remember some learners have difficulty with graphics, so these	All learners, particularly learners with learning difficulties, physical or neurological disabilities and NESB learners.

	should not be stand alone). Make sure the content is in small chunks. Ensure the structure of the materials is clear.	
	Use lots of graphics and diagrams, however text should be able to stand alone (don't use only a diagram to explain a concept: use text and the diagram). If the diagram is essential, simplify so it can be generated as a raised line drawing.	Aboriginal, NESB and learners with reading difficulties, those with neurological disabilities or vision impairment.
	Where activities or assignments require students to (for instance) walk around a block of houses, or to have a look at a library, a ground plan should be provided (for example, a typical library ground plan) for students who have difficulty.	Geographically isolated, prisoners, learners with physical or vision impairment.
	Navigation through the materials should be considered: flag learning objectives/outcomes so learners can easily find them; cut down on referring backwards and forwards through the materials where possible.	All learners, particularly NESB, those with neurological disabilities or vision impairment.
	Background information given, where referred to, as learners with hearing impairment miss information from radio and TV which doesn't have subtitles, and literacy learners miss written information.	All learners, particularly literacy, hearing and neurological disabilities. This can help develop a contextual 'map'.
	Reading for understanding: make sure that understanding of the print explanation is checked. Learners with literacy gaps or hearing impairment tend to assume they have understood, but may not learn in sufficient depth. Learners may also be unwilling to admit they have not understood.	All learners, particularly with reading difficulties, hearing and neurological disabilities.
	Simplify content and repeat in different ways, but make sure the repetition does not become boring for those who understand it the first time. State the concept, give information on how to learn it, then give the conclusion, stating the concept again. Consider emphasising the structure graphically, using different section headings to text.	Learners with learning or neurological disabilities or those with hearing impairment.

	Use cues to assist the student in recognising and using the structure. Use summaries at regular points throughout a topic, preferably in different ways to the text: diagram, flow chart, table. Give positive and negative examples to illustrate what does and does not belong to a concept, for instance democracy.	All learners, particularly those with learning and neurological disabilities.
5. Video	Use videos as supplements rather than to replace parts of the course. Remember that videos are linear and it's difficult to revisit sections, so prepare questions beforehand and revise key concepts after viewing.	All learners, particularly those with vision impairment.
	Subtitles are better than signing, as more people with hearing impairment can understand them: ensure all essential videos are subtitled.	Learners with hearing impairment.
6. Audiotapes	Make sure the voice is deep and slow, but don't use male voices only. Use as alternate presentation of content to print.	Learners with hearing impairment, or vision impairment learners with neurological disability.
7. Computers	Learners with intellectual disabilities learn better with computers. They find them motivating. The information is limited by what's on the screen. They may feel safer because they can go back and retrieve information. Multimedia on computer also taps several modalities at once.	Learners with learning or neurological disabilities
8. Learning to learn	Learning skills should be taught as part of the content in the subject. Some students need basic bridging skills to acquire content in particular subject areas.	All learners, particularly NESB, Aboriginals, those with reading disabilities, neurological, or learning disabilities or hearing impairment.

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