Electronic Readings for Students with Reading Disabilities

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Prolog

This is a written version of a presentation made at the NERCOMP annual conference in Worcester, MA on March 18, 2002. It has been slightly modified to remove the short JAWS demo and some pre-planned adlibs. Since the actual presentation was made from outline notes, the exact text may vary.

Images in this document are described in the text so no descriptive link is necessary or provided.

Introduction

How many of you need some form of assistive technology to compensate for a physical disability?

Personally, I suffer from a visual disability that makes it difficult, almost impossible, for me to read a book or a computer screen. I can’t drive a car or even recognize faces at even a moderate distance.

Fortunately, I’ve found a form of assistive technology that permits me to do all these things and to live a life nearly the same as if I didn’t have a disability. That technology is called glasses.

In my case, there are alternative ways of making a computer screen readable other than using glasses. I could have used screen magnification software. I could have decided to go with a screen reader that would give me access to the text. I chose to go with glasses because of their functionality and flexibility. They were clearly the most effective way to give me access to the information that I needed. That simple principle, of finding the most effective technology to accomplish our objectives, was behind the project that I’m going to briefly describe today.
**Definition of problem**

For all the changes that have been made in technology and pedagogy in the last few decades, a college education still involves a lot of reading. At Amherst, which is a fairly traditional liberal arts college, our faculty assign enormous amounts of readings from books, journals, newspapers and just about anything else that has the written word on it. For most of our students, this doesn’t present a problem; except in the sheer volume. For some students however accessing this material can present significant difficulties. In the typical college or university environment, we are going to have to consider the problem of making written material available to three different groups of student dealing with different problems.

For the visually impaired, the problem is a sensory failure that makes accessing the printed word either difficult or impossible.

For those with mobility impairments, the problem is in the physical manipulation of the material.

For those with reading related learning disabilities the problem is in processing the visual information that is available to them.

In all three cases, once we get the material into a form that can be accessed, the reading impaired student is just as capable of understanding and manipulating the ideas as the rest of our students. And for all three groups, the most obvious method of increasing accessibility is to convert the written material into an audio format.

I should emphasize at this point that the conversion of reading material may not be the solution to all accessibility problems. For individuals with multiple disabilities, including hearing loss, or for individuals with certain types of learning disabilities, this approach may not be appropriate. Whenever you deal with issues of accessibility, flexibility is critical in providing service that is both useful for the student and manageable by the college.

**Current Solutions**

Most schools have depended on the use of audio tapes for providing access to written material for some time. There are a variety of ways of doing this, each with its own set of problems. I should add a caveat here that I don’t personally have much experience working with material on tape so I’ve had to rely on others, particularly members of the EASI list server, for information and verification.
**External Sources**

There are several sources of taped material, each with its own advantages and disadvantages. Books specifically recorded for readers with disabilities, such as those provided by Recordings for the Blind and Dyslexic or the National Library Service from the Library of Congress cover a significant amount of educational material. Commercial books-on-tape provides access to a good deal of popular material. These tapes have the advantage that the materials are fairly portable, are high quality and, if the recording has already been done, are available relatively quickly and at low cost.

There are, however, several problems with material presented in this format. The first is that a good deal of material is not available and although recordings can be made at request, this creates a significant time delay. We have found that about half of the material we need is not available. In addition there are format issues with Recordings for the Blind and Dyslexic and the NLS requiring special and incompatible players.

Probably even more severe, however, are problems basic to the audio tape format. Navigation can be difficult and locating a particular page, or worse, trying to return to a specific passage can be challenging. Some material, notable that from the Recordings from the Blind and Dyslexic, do include some simple tone indexing and some players are capable of playing at an accelerated rate without pitch distortion, but all the material is ultimately accessed in the sequential manner.

It should also be pointed out that students don’t actually read every word they’ve been assigned. There is no effective way to skim an audio tape. Random sampling of the text between periods of fast-forward is not the same thing as anybody who has ever tried to find a particular scene on a video tape is aware.

In addition, while the typical college student reads at about 250 to 350 words a minute and can, with work, increase that further, the typical tape would be recorded at about 150 to 160 words per minute. Even with a special player capability of playing at a higher rate without distortion, the student depending on tapes is at a significant time disadvantage relative to the student reading the printed material both because of the playing speed and, more importantly, the difficulties in efficiently navigating the material.

Another problem is the inability of the audio tape to help the user with spellings. If a student wants to extract a foreign word or a name or any term that they don’t already know, the audio tape gives them no help in determining how to correctly spell the word.

Audio tapes have a problem with the number of tapes involved. It is silly a bulky medium.

Currently there is some movement to providing material in the form of digital audio files. While these aren’t as bulky as tapes and permit faster navigation, they do not directly address most of the problems that we’ve identified.
Locally recorded material

In addition to the tapes you get from outside sources, it is possible to create tapes locally for material not otherwise available. This has its own problems. The most significant is quality control. Some of these problems are technical in nature, but many of the problems are related to the nature of the work. Not only do we lack the sophisticated recording studios available to outside sources, we also do not have the quality of readers they do. Students do not find this work enjoyable and that can be reflected in the recording quality. In fact the work is considered so unpleasant that we have problems finding enough student workers. Also, while we try to find readers who are familiar with the topic, this is not always possible and readers who are not up on the subject are likely to make mistakes, particularly in pronouncing specialized terms. In addition, reader fatigue or simple disinterest can come across on the tapes making them more tiring to listen to. And finally, locally produced tapes, since they are used by only a few or, more often, by just one student can be fairly expensive to produce.

Human Readers

I should mention that there is also the possibility of using live readers to help students with reading problems. This can be very flexible in that little lead time is involved and navigation through the material can be easy since the reader can respond to requests by the student. Beyond that, however, this has all the problems of locally produced tapes, plus potentially nightmarish scheduling problems. It also defeats our goal of making the student as independent as possible in the learning experience. At Amherst, we have provided readers when it seemed appropriate, but we regard this as desirable only in specialized situations.

What We are Trying to Do

Our current project involves shifting from the use of tape recordings to providing text in electronic format. The text is then rendered into speech using a commercial screen reader. We are currently working with JAWS from Freedom Scientific as our screen reader.

This is a collaborative effort between the Dean of Students Office which has primary responsibility for seeing that students with disabilities get the support they need and the Information Technology Department which is responsible for providing appropriate software, hardware and technical support.
Advantages

There are several very basic advantages to providing material in this format such as the fact that we no longer have to deal with all tapes and the screen reader can deal with most standard text formats.

The advantage most often mentioned by users is the increased ease in navigating the material. The screen reading software comes with various key combinations that permit the user to move about the document quickly and easily. For example, by using the alt-down arrow the user can go from paragraph to paragraph. By using this key combination after listening to the first sentence in each paragraph, the student can skim through material very quickly. In addition, the user can move either forward or backward through the text.

Additional features of the screen reader allow the user to hear a spelling of a particular word. As I mentioned before, this can be critical when working with specialized terms, names or foreign words.

And finally, the screen reader is fundamentally faster than an audio tape. While the tape is recorded at approximately 150 to 160 words per minute, experienced users of screen readers routinely work at 600 words per minute or more. This is significantly faster than most students can read.

Disadvantages

Unfortunately, there are drawbacks to the use of electronic text in this fashion. One obvious problem is that the student is tied to the computer and its screen reading software. In terms of portability, audio tapes have a clear advantage. I do know of one student who records the voice synthesizer so that he can have the material in both formats. I have also been told that the latest version of the Kurzweil product includes the ability to output the generated speech to an MP3 file.

Another disadvantage with screen reader software is that it may make mistakes in pronouncing certain words, particularly terms and names that it doesn’t know. For example, it gets my name wrong. While a reader, either live or recorded, can also make mistakes, it is likely that they would recognize the fact and either make some note of the problem or seek out the correct pronunciation before recording.

Related to this is the issue of the voice quality of the software. To the uninitiated, the voice is very mechanical sounding, even when options are set to increase inflection. While users report that they get use to the various voices provided, getting use to them and liking them are different. Several users report that for light reading, they prefer to use audio tapes for the improved quality of a real voice. However, for academic reading where the ability to navigate through the material is important, screen readers with electronic text have a clear advantage.
What was not clear to us when we started looking into providing electronic text was what the costs of doing so were likely to be relative to providing audio tapes and whether this solution would scale as the number of students supported increased. To try to determine the answers to these questions in the fall of 2001 we started a small pilot project to provide one student with electronic material.

**Mechanics of project**

**Copyright issues**

Before I get into the mechanics of the project, I should mention the bane of the existence to everyone who deals with electronic materials; copyright. For this project we have taken the position that material that the college or the student owns can be converted into electronic text without a copyright problem. We do insist that a copy of the material be purchased, either by the student or by the college prior to its conversion. We regard this reformatting of the information to be covered by “fair use.” However, I should be clear that, to the best of my knowledge, this policy has not been run by the college lawyers and I am personally unqualified to give legal advice nor is Amherst College providing you with any legal guidance.

**Scanning**

One advantage of this entire process is that it can be done almost entirely by student workers. In the fall semester we did, in fact, do much of the preparatory work for them. Starting this semester, however, we are passing most of this work to the students with the goal of eventually developing a team who will run the process completely and even train each new generation of workers. There is no requirement that the student workers have any experience with working with students with disabilities or dealing with assistive technologies.
The first phase of processing material involves scanning the text into the computer. For paperback books, we normally start by acquiring a copy and literally chopping off the spine to give us a collection of individual pages.

We then run these pages through a copier. This is done to standardize the type of paper being scanned since we find that our scanner’s document feeder can be a bit touchy when presented with odd paper sizes or textures. The copying also allows us to convert from double sided to single sides pages. We initially tried avoiding this step by scanning all the odd pages, turning the stack over, and then scanning all the even pages. We then shuffled the electronic images back into the correct order. It took us about five minutes to decide that was a mistake.

For hard cover books or sources that can’t be cut apart, we manually copy the text prior to scanning. While it would be possible to do this as part of the scanning process, we find it preferable to work out any copying problems before we start the scanning/OCR program. We are currently reconsidering our decision not to cut apart hard cover books. We may need to start making that decision on a case by case basis.
Once the text is in single sheet format, it is relatively simple to do the scanning. We work with an older Hewlett-Packard ScanJet with a document feeder.

![Figure 2 Scanning the Pages](image)

Unfortunately, the feeder tends to be a bit sensitive to jamming so we have to feed in larger works in bite size chunks. We use OmniPage 10 to run the scanner and do the optical character recognition (OCR). This allows us to correct a lot of mistakes very quickly in the process. However, the recognition is usually not perfect and more editing is required.
One of the options in OmniPage is to retain the basic formatting of the original document, what OmniPage calls “Retain font and paragraph”. From the point of view of the user this is largely unnecessary since Jaws does not usually provide much format information and the user rarely needs it. Rather we do this for the benefit of the student workers since it can be hard to stay oriented in completely unformatted text.

We save the resulting text as an MS Word file. This allows us to edit the file easily and also permits the user to annotate the file that they get from us. They can, in other words, "write in the book", something they couldn’t do with audio tapes.

Editing

The second phase involves editing the Word document that we got from the OCR program. Some of this involves simply correcting errors that slipped through the character recognition process, but we have found that there are usually fairly few such errors and often the user can spot them from context.

More time is spent in putting the document into a structure that is easy to use and understand by the student. While we suspect that we could give the file to the student in
fairly raw form, it’s fairly simple for us to make a few modifications that make the
document much more comprehensible when read. Consider the following examples.

Formatting: We use a standard page layout, font and font size. The user can’t tell but we
found that certain fonts and sizes were causing the screen reader to miss the ends of the
lines.

Page numbering: The typical output from the OCR program would include the page
number inserted into the middle of a line of text based on where the sentence wrapped to
a new page. We adopted a standardized format that involves adding word “page” and
enclosing the number in parenthesis, i.e., (page 8) for all page numbers. This lets the
student know when they had gone from one page to the next without causing problems in
reading comprehension. We also move the page number to the top of each page if the
source had them on the bottom.

Identification: This semester we have started adding standard bibliographic material to
the beginning of each document. This reassures the student that they are reading the
correct file and provides reference material that they may need later. We also feel that
scholarly standards call for crediting the source.

Illustrations: While these would seem to present a major problem, it has not turned out
that way. We find that the substance of most illustrations is, in fact, covered in the written
text. In addition, we did not want to get into the business of trying to interpret the
significance of an illustration by having our workers enter descriptive text. This is an area
where we feel it is the instructor’s responsibility to make sure the student gets the
important points the illustration is trying to make. We do, however, retain any captions –
moved to the bottom of the enclosing paragraph if necessary - so that the student will
know that there maybe something there they need to ask about.

The bigger problem with illustrations and especially maps may be text scattered
on the picture. The OCR software makes a gallant attempt to figure out what these words
are and it doing so create confusion in the final text output. This can force some clean up
activities to reverse the effects of an over-zealous software package. In some cases we
have blocked out graphic elements on a page prior to scanning.

Footnotes and Endnotes: These are the most challenging problems we’ve run into. After
consulting with our test student, the decision was made to move all bibliographic
citations to the end of the document leaving just a brief (footnote 8) reference in the
document. For substantive footnotes, it was decided to include them at the point in the
document where they were referenced as in (footnote 8: These dates . . ).

This last play seemed like a good solution to me when I first proposed it.
However, I would like to emphasize the need to remain flexible. Since coming up with
these rules I happened to read a book that included many pages that looked like this,
where the substantive footnote can take up almost two thirds of the page. Attempting to include these footnotes inside the body of the document would destroy the flow of the basic argument. Fortunately, we haven’t actually run into any documents that needed to be converted into electronic form that make more than minimal use of substantive footnotes. The point is that any rules are going to have to be constantly re-evaluated in light of actual experience.

We are still working on a set of guidelines for our student workers. This is a work in progress and constantly changing based on feedback from both users and workers.

**Organization of material**

Once the material has been prepared, it needs to be structured in a way that is easy for both the workers and the users to use. Our initial design for this involved creating a folder on a network drive that both the workers and the student had access to. This folder included a working subfolder that the workers used to edit the document. Once they were happy with the results, they moved the file to the top level and linked it to the syllabus that had already been prepared. The user would go to the network folder, open the syllabus, find the document needed and then use the link to get to the file.
For our test run last semester this worked reasonably well. We did run into one peculiarity in that opening the syllabus file by double clicking on it caused any attempts to edit the file to fail with a memory error. Opening Word first and then opening the syllabus from within Word avoided this problem. However, until I was able to figure this out, I was forced to create all the links myself.

By the end of the semester, however, a more significant problem became evident. The number of individual files that were needed for just the one course we were working with was creating a very cluttered environment. With multiple courses and multiple syllabi, the situation would get completely out of hand. This semester we will be using a more structured approach. The top level folder will contain only the syllabi for the various courses plus an accompanying folder for each course. The course folders will contain the individual files and within those folders will be working folders. Links will be created in the syllabi files to the files containing the readings. This greatly simplifies what the user has to deal with.
While this looks more complicated, for the user the addition of each course only adds two items to the list that they see and only one that they need worry about.

At the end of the semester we were confronted with the question of what to do with the material. We did not want to keep it in place in part because it would clutter the student’s interface and in part because of concerns about the copyright impact of leaving the material online. Given the work and expense in generating the files in the first place, we contemplated moving the material to a new location and using a bibliographic program to catalog it for future use. However the low number of students that we are supporting, and the variability of the material used in the typical Amherst course argued against putting a great deal of effort in it’s storage. The simple solution was to copy it to a zip disk and take it offline.

**Comparative analysis**

One thing that we were interested in looking at was how quickly our student scanners/editors could convert material into electronic form. This had direct implications for whether this approach scales well as the number of students needing the service increases.
Fortunately we had some basic information in the log files that the students maintained. Unfortunately, there was a fair amount of rounding error in the logs since they were being used primarily for pay purposes. They do, however, probably do a better job of representing actual working conditions than a more carefully run test.

What we were interested in looking at was the number of words per minute that could be converted from printed text to electronic text. By using wpm rather than page count we could avoid the issue of variable page sizes. It also made it easier to compare with audio format since we know that the rate at which audio material can be prepared is limited at the upper end by the rate at which the reader speaks. Fortunately finding the word count for each document is fairly simple with Word.

In general, results indicate that approximately 80 to 90 words per minute could be converted. This includes scanning, proof-reading and editing. I found this remarkably stable between all three students workers whose logs I examined. For reasons that are not clear a small number of documents were processed at much higher rates, in the 180 words per minute area. Why this happened is not clear since we saw this happened with two different student workers both of whom were normally working at the more standard rate. In addition, there was no obvious reason why this particular material would be any easier to scan and edit that any other. In fact, one of the fast documents was part of a larger work, the rest of which was processed at the more standard speed.

In order to get really dependable data, we would to have to go back and enforce more careful logging practices. We would also have to be more precise in factoring in preparatory activities for both scanned and recorded material. However, I think it’s fairly safe to say that we are probably talking about a process that takes no more than twice as long as making audio tapes and probably a lot less. Some back of the envelope calculations based on our experience making audio records indicate very similar rates of preparation.

It should be mentioned that unlike reading for recording, our student workers appear to enjoy the scanning and editing work. This greatly simplifies our life since finding workers has not been a problem. Nor have we had to hire expensive outside help as we did a few times when we weren’t able to find enough student readers.

**Future directions and alternatives**

There are several areas that we would like to look more closely at. First, we would like to start making greater use of existing electronic sources. The Frost Library at Amherst College is already encouraging faculty to look more closely at online resources for journal articles such as those that are available through JSTOR. Not only are they often accessible, they eliminate the need to worry about the difficulty and expense of getting copyright clearance.
We would like to see more book length texts becoming available. This is one area where we have not really done much searching. We are aware that depositories of texts in electronic form do exist, such as the Texas Text Exchange and Netlibrary.com, but we have not looked extensively at either. In addition some material in e-book form is now available through a variety of commercial sites, but as yet the amount of material still appears quite limited. Given the economies of scale in providing the same book in electronic form to a variety of users, centralizing this process would appear to make a lot of sense. However, if academic institutions do go down this route, we are going to have to address the issue of standardizing the format provided.

So far our experience with dealing with publishers directly has not been good. Last semester we could not find a single publisher who could, or would, provide a book in electronic form. On a more hopeful note, however, this semester we had our first success in getting a publisher-provided copy of a book, John Trimble’s *Writing with Style* from Prentice Hall. Unfortunately the instructor then dropped the book from the course.

As we increase the use of pre-existing electronic material, the role of the library in locating, providing and storing of the information will become more important. It would inefficient and redundant for departments such at IT or Dean of Students to attempt to deal with issue of locating and storing significant amount of material.

It does not appear that there is much to be gained up updating and upgrading our hardware and software. In particular, while our scanner is fairly old, the actually scanning was a trivial part of the process. In the long term, improvements in OCR software may significantly reduce the time involved in editing the text by reducing errors during character recognition, but I suspect that short term gains will be marginal.

And finally, as needed, we will continue to evaluate specialized software for students with reading disabilities. Products like Freedom Scientific’s WYNN and the Kurzweill 3000, in addition to screen reading, have features specifically designed to help individuals with reading related learning disabilities deal with written material. While it is possible to look for solutions that apply to most students, there is sufficient variation is disabilities to require a flexible approach to finding and providing solutions.

**Conclusion**

At this point we are very encouraged by the results we have seen. The process of creating the electronic readings is manageable and the resulting material is much more useful to the students than the audio tapes we originally provided. This semester we are having material available in electronic form a week to ten days ahead of when it’s needed which is certainly acceptable. Our student workers have required minimal supervision.

There is, however, some concern about how well this model will scale. At the moment the number of students that we have to support is fairly low and our test project was even more limited. When dealing with so few students, the potential variation from
semester to semester can be considerable. While I think it’s safe to say that providing study material in electronic form is the future, it’s not that clear how it will done or who is ultimately going to be responsible for providing it. Our hope is that publishers will increasingly come to view providing electronically accessible forms of their publications as a matter of routine.

Credits

Frances Tuleja – Associate Dean of Students
Lucia Cucu, Xin Zheng, Jade Tam, Gloria Yi – Student Scanners/Editors

Web References


National Library Service for Blind and Physically Handicapped: http://www.loc.gov/nls/

Recording for the Blind and Dyslexic: http://www.rfbd.org/

Texas Text Exchange: http://tte.tamu.edu/

EASI (Equal Access to Software and Information): http://www.rit.edu/~easi/

Netlibrary.com: http://www.netlibrary.com/

Bibliography