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Widening Participation Using Speech Recognition: Can it Deliver?
Liberated Learning Project

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ABSTRACT

Speech recognition technology is now being used to augment verbal delivery of lectures in three Australian higher education classrooms. The University of the Sunshine Coast, Murdoch University and Central TAFE are collaborating to widen participation within the classroom for students, particularly those with a disability. The technology has surmounted a barrier to equal participation for students with a disability without the need for invidualised augmentative assistance such as note takers or tape recording of lectures. This paper reports on outcomes of the implementation of the technology to date.

1. INTRODUCTION

The purpose of this research is to establish if students with disabilities exposed to speech recognition technology (SR) within the lecture theatre environment and who receive a transcript of the lecture perceive an improvement in academic integration. Access to lecture material for students with disabilities and the abilities of students to take notes were the impetus for developing SR in lectures as a mainstream teaching tool.

The **Liberated Learning Project** is a world-first, action research project, developing a speech recognition technology application for use in lecture theatres to remove barriers to participation for those students with disabilities, who for whatever reason, have difficulty in taking lecture notes. It is argued that incorporating speech recognition as an augmentative approach to student learning reduces reliance on intermediaries by improving the accuracy of information leading to enhanced comprehension of lecture material.

2. LIBERATED LEARNING PROJECT

The **Liberated Learning Project** (LLP) is aimed at developing and researching automated speech recognition technology to provide flexibility for students in the classroom, particularly for students with a disability. It does this by taking a product that has been produced (ViaVoice) specifically for dictation applications and developing it as a real time application.

Within the context of an international research consortium spearheaded by Saint Mary's University (Halifax, Canada), the University of the Sunshine Coast (USC) is pioneering and expanding the Liberated Learning concept in Australia. To undertake this task USC funding has been provided by the Department of Education Science and Training (DEST) to form an Australian collaboration team, which currently involves Murdoch University and Central TAFE in Western Australia. Other Universities are expected to join the project in the next few months.

3. OBJECTIVES OF THE PROJECT

- Implement the Liberated Learning concept in multiple Australian universities. Implementation has begun at Murdoch University and Central TAFE in West Australia with up to four additional universities being included in the project by the end of 2003.
- Research the impact of the Liberated Learning approach on various educational stakeholders, especially students with disabilities, Indigenous students and those from ESL students.
- Research and Develop the Liberated Learning model: continue groundbreaking working with consortium partners at an international level.
- Develop a **Training and Support Infrastructure** at the University of the Sunshine Coast to enable speech recognition (SR) technology to become a mainstream teaching tool in Australia.

At present there are more than 20 academics using the technology in lecturing environments at eight higher education institutions across the globe in programs as diverse as communication and cultural transitions, information technology for ESL students, politics, business, teaching Auslan (Australian sign language) and science. More than two thousand students were exposed to the technology during first semester, 2002 in Australia.

4. WHO BENEFITS FROM THE TECHNOLOGY?

In 2000, there were some 18,000 students in Australia who have identified as having a disability within the university sector. (DEST report 2000) Accessibility laws, including the *Disability Discrimination Act 1992*, positively affect efforts to expand use of the LLP concept. Finding innovative and cost effective interventions to comply with basic legal and societal obligations provides a challenge for all universities. In addition to fostering dependence on intermediary approaches, traditional support services consume vast resources. Volunteer and paid notetaking programs, sign language interpreting services, real-time transcription, stenography, and other intermediary based models are very expensive to operate. Thus, universities, TAFE colleges and schools continually seek viable alternatives that offer equal or better quality, increase student independence, increase student access, and simultaneously cost less. For example, one deaf student can require up to $20,000 of interpreting services in the course of an academic year. One stenographer/captionist (court report status) could cost over $60,000/year.

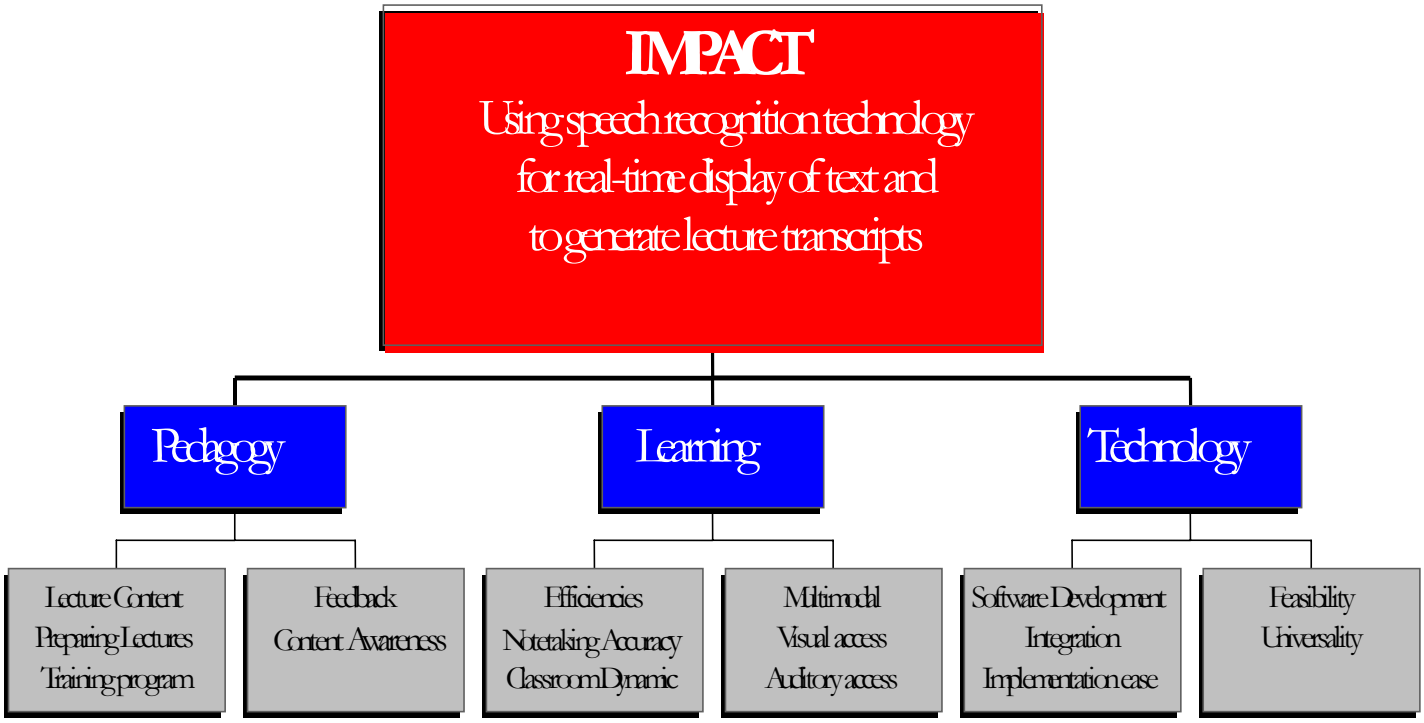
A demographic study of students with a disability, undertaken in Canada by Dr. Leitch in 1998, revealed approximately 7,000 students with a disability were attending the 47 universities surveyed by Canada's McLean's Magazine.

In the US, the sheer number of potential stakeholders exacerbates the need for creative innovation in accessibility. Many American Disability Act (ADA) analysts believe that this federal law covers more than 50 million people. Various summaries, including those issued by the National Institute on Disability and Rehabilitation Research, indicate that between 15% and 20% of any grouping of randomly selected people can be expected to have those impairments considered as disabilities under federal/state law (source: Louis Harris & Associates, 1994).

Out of the 677,100 higher education students who entered their First Year in 1999/00 in 172 institutions in the UK, 26,720 were known to have a disability.

5. IMPACT OF SPEECH RECOGNITION TECHNOLOGY

Diagram One: Pedagogical Impact



The Liberated Learning Project is grounded in a paradigm that promotes independence for students with disabilities, unlike conventional approaches to notetaking that have historically sustained a dependence on intermediaries. Furthermore, it is synergistic with universal design principles in that it potentially addresses macro level learning issues for a variety of stakeholders with varying needs. (Bain, Basson & Wald, 2002)

The introduction of voice recognition technology in classrooms is a major cultural shift for both academics and students as both groups can, and do, critically reflect on what has been said in the classroom. Students see the text, warts (errors) and all, displayed during the lecture, however academics are comfortable which this notion. It's another shift along a continuum of using tools in classrooms, from the days when chalk was used, to the use of overhead projectors, computers

using PowerPoint presentations to now using voice recognition to digitize speech and display it as text.

6. INTEGRATING SPEECH RECOGNITION INTO LECTURES

At the outset of this research it was believed that the most salient effects of speech recognition would derive from the delivery of the lecture. To date, the impact of speech recognition on lecture preparation and delivery seems to be relatively inconsequential for some academics, largely due to the insistence that speech recognition be absorbed within the lecture environment, rather than dominate it. In essence, academics tended to view speech recognition as a vehicle for the critical appraisal of their conventional teaching methods, and a means by which they could enhance, if necessary, components of the lecture style and content. An example is where academics have reviewed their lecturing style and now incorporate good pedagogical practice by repeating questions or answers provided by students during the lecture to enable the full context of the lecture to be captured.

Complementing the pedagogical advantages of using speech recognition technology there is a need to concentrate on the clarity of the spoken word in terms of improving the academic integration of students. In a study of distance education students undertaken by Raciti (1997) a number of elements arise in terms of the written communication, which has relevance to this project. Whilst the research has not been conducted within the Liberated Learning Project it does point to the importance for academics to ensure their delivery of lectures addresses a number of elements relating to clarity of presentation both in the lecture and in provision of the transcript. Findings of the testing of the clarity and conciseness category are shown.

Table 1.

Elements of the *clarity and conciseness* of written communication in rank order of importance:	**Elements of the *clarity and conciseness* of written communication NOT of importance:**
1. No punctuation errors	1. Absence of jargon or slang language
2. No unnecessary repetition	2. Absence of grammatical errors
3. No spelling errors	3. Clear sentences
4. Logical structure	4. Warm tone of message
5. No unexplained words	
6. Clear words	

Source: Raciti (1997)

As shown in the above table, students noted that variables in order of their importance in forming written communication were: no punctuation errors, no unnecessary repetition, no spelling errors, logical structure, no unexplained words and clear words. The absence of jargon or slang, language, absence of grammatical errors, use of clear sentences and a warm tone of message did not have a significant bearing on the perceptions of students.

If we examine a distance education model as a framework for the integration of speech recognition technology into the higher education sector, both academic and social systems intersect to improve the teaching and learning environment for students by integrating people with systems and tools.

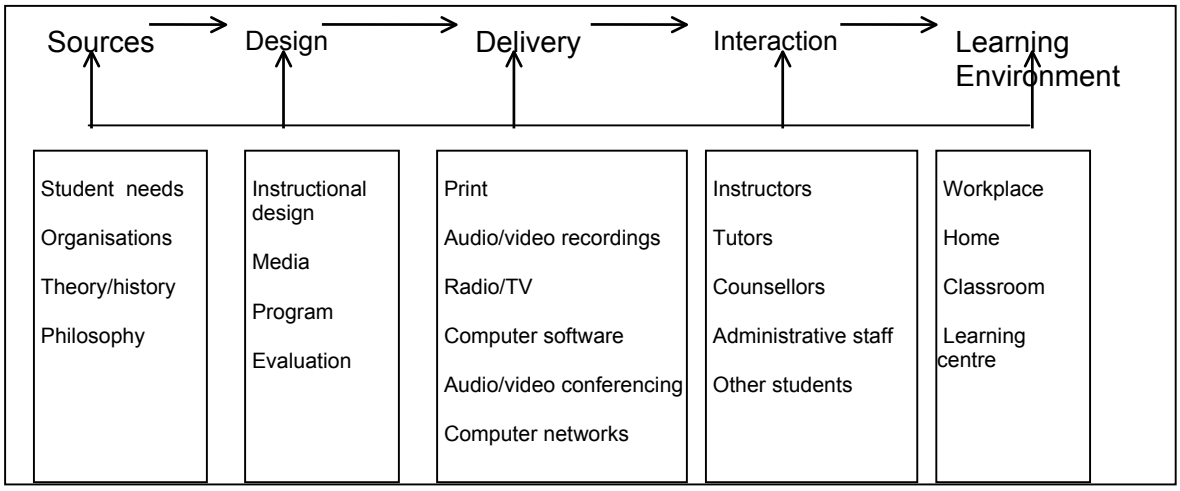
As already outlined there are increasing numbers of students who do not fit the traditional notion of a student and who require a change of practices within the higher education system to accommodate their needs and remove barriers to their participation. Speech recognition

technology can be integrated into the design process when developing courses as academics reduce the time taken to produce online or distance education content by using voice instead of typing. Instructional designers then improve on the written communication derived from the speech-generated script.

In terms of delivery the technology is an improvement on audio/visual recordings as students have access to an immediate, tangible, searchable and downloadable resource. Trials are currently underway to enable text of the lectures to be delivered in real-time across the web and to integrate multi-media into the displayed text.

Finally the technology allows the student to choose their learning environment beyond the traditional teaching model of the classroom. Moore and Kearsley (1996) in their model of distance education, identified computer networks and software as teaching delivery tools, such as that used in the Liberated Learning Project, as important components in the learning environment. For many students now, this is critical in maintaining an ability to continue enrolment until they develop the academic and social supports they require to successfully undertake a degree.

Model of Distance Education – Diagram two



Source: Moore and Kearsley 1996

7. FINDINGS FROM ACADEMIC INTERVIEWS

Academics are central to the delivery of this technology. The impact of SR on teaching experiences is key to understanding how well speech recognition can "adapt" to the lecture environment and how well lecturers, in turn, "adapt" to the challenges inherent in the technology. Although the primary goal is to deliver positive learning alternatives for students, the project is also obligated to provide academics with technology that extends pedagogical advantages without imposing excessive constraints upon, or critical changes to, their current methods of teaching.

Prior to the commencement of semester, academics are questioned about how they prepare and deliver lectures. These interviews serve as the foundation for understanding the nature and extent of change the technology might introduce to the academic's conventional pedagogical methods. As expected, each academic's method of lecture preparation and delivery is unique to individual teaching preferences, priorities, number of years teaching a particular unit and specific design of

the unit. Lecture preparation and delivery are also shaped, to some extent, by the discipline in which each academic specializes.

During interviews academics were asked to discuss what they perceived to be some of the pedagogical advantages generated by the use of speech recognition. In essence, academics view the use of speech recognition for the critical appraisal of the conventional teaching methods, as a means by which they could enhance, if necessary, components of their lecture style and content. The verbatim records of their lectures in particular seem to inspire in some academics, serious reflection of their work.

Researcher: *"So overall it's been a good experience for you?"*

"I've found it fascinating, it's made me think about what I'm doing a lot more which is always a positive sign and I think it actually forced me to think about how I was delivering the lectures and particularly the way in which I was preparing the lecture. I enjoyed it. I have no qualms about doing it again. I'm quite sure that next year it will be better because I'll be used to the technology, you know, the first bit was becoming comfortable again with the different technology and it takes a while to just be comfortable down the front, particularly when it was such a - it was a significant change from you know going away from overheads and now we're running totally on the computer and having the confidence it's going to work..". (Assoc Professor, Semester 1, 2002)

Secondly, a record of the lecture is viewed as a means of enhancing preparation for future lectures, research or development of material to be used on-line.

Thirdly, academics have reported that the technology compelled them to apply more structure and organization in the preparation of lectures, which for some was viewed as pedagogically beneficial. Another found that involvement in the project has taken all of his useable teaching materials and put them into PowerPoint presentations.

8. LEARNING IMPACT

8.1 The Role Of Note Taking

In addition to fostering dependence on intermediary approaches, traditional support services consume vast resources. Volunteer and paid note-taking programs, sign language interpreting services, real-time transcription, stenography, and other intermediary based models are very expensive to operate. Thus, universities, TAFE colleges and schools continually seek viable alternatives that offer equal or better quality, increase student independence, increase student access, and simultaneously cost less. For example, one deaf student can require up to $20,000 of interpreting services in the course of an academic year. One stenographer/captionist (court report status) could cost over $60,000/year. It is recognised that there is no intention to replace interpreters, however in regional and remote parts of Australia, universities and TAFE colleges are struggling to attract qualified interpreters, often leaving the student without equal access to the lecture.

Further, (DEST, 2000) reports that almost thirty percent of students withdraw from University, most of which occurs in the first semester of student enrolment. One of the reasons identified is the lack of preparation for studying at the tertiary level. Generally students are not taught how to take effective notes during lectures, so many students find themselves behind quite early in their first semester and become intimidated by the education process as it is different from their experiences at school. (Hartley & Marshall, 1974). For many students with a disability, taking

their own notes isn't an option, so we need to ensure that the information they are receiving is accurate and comprehensive.

It is recognized that students will learn material if they, themselves generate notes from the lecture as described by Beecher,

"There is growing evidence that note-taking combined with critical thinking facilitates retention and applications of the information. One study found that successful college students engaged in greater integrative processing during note taking, and that note taking itself "enhances organizational processing of lecture information." Other research shows that note taking is an effective learning strategy and that the amount of note taking is related to academic achievement. While most note-taking research continues to measure the impact of note-taking on recall as measured by tests, there is increasing emphasis on cognitive analyses that may have more explicit instructional implications in the near future" (Beecher, 1998)

As stated earlier, however, there are a significant number of students who, due to a disability are unable to take their own notes. For example students who are deaf, they watch a sign interpreter, blind students, with some types of mobility impairments, learning disabilities, or concentration difficulties due to ADHD or psychiatric illnesses; they have to rely on note-takers or someone taping the lecture. The literature also states that

"*The research findings on whether note-taking promotes encoding have been mixed. Hult et al. (1984), for example, found that note-taking does involve semantic encoding; but Henk and Stahl (1985) found that the process of taking notes in itself does little to enhance recall. They found, however, that reviewing notes clearly results in superior recall".* (Beecher, 1998)

It is clear that problems exist for some university students with both the immediate intake of lecture material and with note-taking for later study purposes. In particular, some students may initially find it difficult to understand new and different terminology used by lecturers. Having to rely on their auditory skills, they need to listen to and process large amounts of spoken text in lectures. Such students can find it difficult to distinguish between the main ideas and the supporting details. Moreover, while some lecturers use PowerPoint slides, the slides are usually in key word or phrase format. For many students with a learning disability, these slides can be cryptically concise, leaving the students wondering exactly what the slide was about. The result can be that the students misunderstand the verbal information, leading to frustration and, at times, withdrawal from the course.

As Putnam et al observes:

"Students with learning disabilities are often unable to identify the important information to note (Hughes & Suritsky, 1994); are unable to write fast enough to keep up with the lecturer (Suritsky, 1992); and, even when they do record notes, are frequently unable to make sense of their notes after the lecture (Suritsky, 1992), mostly because their notes are illegible. Difficulty taking notes presents a major problem for students' success in the general education classroom, especially in content area classes, where instructors often use their notes to develop tests, which in turn serve as the basis for grades." (Putnam, Deshler, & Schumaker, 1993).

To overcome these difficulties, speech recognition technology enables students with disabilities to compare the notes they themselves (or through an intermediary) have taken in the lecture against a transcript of the lecture, we move from incomplete notes of an intangible lecture, (as normally once it has been delivered the words are gone), to a tangible, downloadable, searchable

resource for students to compare their notes and use for revision. The technology also enables students who are visual learners to use the dual modality to enhance their learning experience.

By introducing SR technology into lecture theatres, students are able to **see** as well as **hear** the lecture, thus, the use of SR in the lecture theatre environment introduces discussions about how students learn both within the lecture theatre environment and during revision of the lecture. Academics generate between 8,000 to 10,000 words in a one hour lecture, yet we know from experience that even the best students will only note down approximately 800 words in the same time.

9. IMPACT ON STUDENTS

Students were asked to describe their first impressions of the digitized lecture and discuss how they engaged the technology. The table below shows the enrolment figures in subjects using the technology in Australia in semester one, 2002. First year courses have been targeted for implementation of the technology in an attempt to improve the retention rates of students with disabilities in particular. Students must log onto the website, read an information package about the project and then provide electronic consent to participate in the research prior to being provided access to the on-line transcripts.

Interviews were conducted with students with disabilities (SWD) at USC and at Murdoch University. The following table summarises the degree of interaction those students had with the LLP concept – use of the digitised screen during the lecture, and use of the Online Transcript after the lecture.

Enrolments for Semester One, 2002 - Table 2

Murdoch University **University of the Sunshine Coast**

Semester one 2002 **Semester one 2002**

Level of Course	No of Students	Level of Course	No of Students
First year core unit	500	First year Arts and Science unit	170
First year arts unit	103	First year core business unit	541
Second year arts unit	51	Third year science	20
		Intro subject for Internationals Students	16
		First year core business unit	481
Total	654		1228

Central TAFE in Western Australia will begin using the technology in Semester two, 2002.

Students with disabilities at USC and Murdoch University - Table three

STUDENTS WITH DISABILITIES	INTERACTION WITH SCREEN DISPLAY AND ONLINE TRANSCRIPT

Student A (Profoundly deaf)	▪ **Total dependence on digitised screen** – enables participation in whole lecture. ▪ **Intensive use of Online Transcript** – review of lecture, exam purposes. Enables independence in study habits.
Student C (Medical / Learning)	▪ **Frequent use of digitised screen** – checking missed parts of lecture. ▪ **Some use of Online Transcript** – for exam purposes.
Student D (ADHD / Learning)	▪ **Frequent use of digitised screen** – checking understanding, note-taking. ▪ **Intensive use of Online Transcript** – for exam purposes.
Student E (ADHD / Learning)	▪ **No use of digitised screen** – can't read text and listen to lecture (auditory learner – creates pictures in his mind). ▪ **Intensive use of Online Transcript** – depends on Transcript to review missed parts of lecture.
Student F (Medical / Learning)	▪ **No use of digitised screen** – finds it confusing to focus on more than one thing. ▪ **Some use of Online Transcript** – for exam purposes.
Student G (external) (ADHD)	▪ **Intends use of Online Transcript** – exam purposes.
Student H (Medical / Physical)	▪ **Frequent use of digitised screen** – checking understanding, vocabulary. ▪ **Some use of Online Transcript** – used for learning journal purposes.
Student I (Medical / Physical)	▪ **Little use of digitised screen** – only saw it for a short time on four occasions; high level of error. Would like to use in future. ▪ **One use of Online Transcript** – only one lecture posted. Would like to use in future.
Student J (Hard of hearing)	▪ **Little use of digitised screen** – high level of error, but would like to use more if accuracy improved. ▪ **One use of Online Transcript** – only one lecture posted. Would like to use in future.
Student K (Physical)	▪ **No use of digitised screen** – high level of error; comfortable with own listening and note-taking ability. ▪ **No use of Online Notes** – comfortable with own listening and note-taking ability.
Student L (Medical)	▪ **Little use of digitised screen** – high level of error; comfortable with own listening and note-taking ability. ▪ **No use of Online Notes** – comfortable with own listening and note-taking ability.

(Source:Wilkes, 2002)

Feedback gained from the students in initial interviews gives their impression of the SR concept:

- the digitised screen display enables the students to listen to the lecturer, and when they don't understand the meaning or an item of vocabulary, they can check on the screen;
- if the technology allows, the spoken lecture can be played at the same time as the written transcript, so that students can listen to and read the lecture as often as needed;

- the digitised screen and the online notes leave the students free to listen more carefully for main ideas and the overall organisation of ideas in the lecture – they know they can read the supporting details later in the online notes;
- students can compare their own note-taking to the screen, and use the screen to 'fill in' ideas/information/details they missed;
- the online notes can be used to check their understanding, to revise the content of the lecture, and to check their notes against the spoken transcript;

To gain further information on interaction with the screen display, the students were asked how and why they used or didn't use the digitised screen. Of those who answered they used the display for learning purposes, the reasons ranged from assisting them to cover the extra information around a key-word PowerPoint slide, confirming they had understood the lecturer, and checking to find information they had missed. As one student noted:

So basically until she has covered the whole all the topics on that particular (PowerPoint) frame, it's the same frame all the time type of thing. Ah, but then she does a lot of talking and that is where we get our notes from…Often, we can't get, but now we can get it… So, I'm a little bit slower on my writing, so I tend to look you know to make sure what she said and what I heard and if I'm on track…It helps me to confirm that what I'm hearing is actually what is being said…it helps me to confirm that what is being said - like what is on the screen - is what I have written down or whatever…What I hear, and what I see, and what I write. So it's a combination of the three, yeah. (Sara)

Yeah, I could check it on the screen… just when (the lecturers) keep going on. You're like I better get that down, and then she talks about something else that you need to know...and then you can...you'd miss it, but then you can look on the screen and go, 'Oh yeah, that was it,' do you know what I'm saying? (Shehara)

Finally, two students found the size, appearance, and moving script in the display attracted their attention:

Well it was pretty large and compelling. (Margaret)

Its hard not to (watch the screen), because they're flicking up on the screen in front of you, and also the slides are stationary most of the time; whereas this is moving. It's always changing, so you do tend to glance at it and because it catches your eye. (John)

The preferred learning modality of the students was another factor influencing whether their use or nonuse of the screen technology. As the LLP concept uses a screen display at the front of the lecture theatre, it might be expected that there be a positive correlation between a visual learning style and screen use for learning purposes. This was very much the case for one student who commented strongly on the influence of her visual learning style assisting her in interacting positively with the screen display.

...because I am a visual learner...first I have to see things before I can work them out, so I would say that might have some thing to do with it. It's my organizing problem. And the fact that I said I'm a bit slower...So I think the screen is good. I think I relate to all the visual things - I need to see it, because if I see it, I understand it, so I don't feel that I need to write. (Sara)

All students interviewed did their own note-taking in the lectures. When asked if they compared their notes to the digitized screen, positive replies included:

…if I don't understand on something I do…If I left out something or from my mistakes and I'm not too sure, then I do. Sometimes if I don't know where some information belongs...Because I might have forgotten, and I look there and oh yeah I didn't write that down. (Sara)

Student: Mmm once in a while, yeah if I missed something...Like four times in a lecture I'd miss something and I'd write something down...

Interviewer: So you weren't comparing what the lecturer said to the screen...you were comparing...?

Student: Yeah, if I got the right thing down. (Shehara)

There are, of course, some areas about which it is necessary to be cautious. Students report that levels of accuracy in the screen display have the potential to be distracting and misleading. Thus, extra care must be taken to ensure the efficient performance of the technology, and also the necessary training of the lecturers' voice models. This will give a higher level of accuracy in the screen display. A further point of caution, is that the development of listening and note-taking skills are extremely important for students in academic contexts. Care must be taken that these skills continue to be improved – they should be enhanced with the use of the SR, not replaced. Further research is necessary in these areas.

10. TECHNOLOGY IMPACT

After training in the use of voice recognition computers, faculty members, wearing cordless microphones, utilize automated speech recognition software (voice-to-text) in their lecture theatres. Their spoken lectures are digitized and simultaneously translated into text via speech recognition technology software, then displayed on a large screen in front of the lecture theatre.

Before Liberated Learning, no university in the world attempted to implement speech recognition in real classrooms with actual students and professors. Therefore, this world first initiative pioneered the baseline infrastructure, technological, and stakeholder requirements necessary for this technology to become more universally available.

The software can synchronize text and speech data to create bi-modal multimedia lecture notes, accessible in multiple formats via the internet - text, audio, or synchronous text and audio transcriptions.

Early on, the Liberated Learning team realized commercially available speech recognition software was not conducive to the classroom environment. As such, the Liberated Learning team created the first classroom speech recognition technology that would successfully digitize a spoken lecture and display output in readable form. Modifications include the need to use no punctuation; an algorithm utilizing naturally occurring pauses in speech causes the displayed text to move to a new line, creating automatic readability of text. Product development is now advanced to the point where it is now possible to gain a high level of accuracy in this setting. After the lecture has been delivered, the lecture is edited, punctuation is inserted, recognition errors are corrected and redundancies removed.

Building on this proof of concept application, the Liberated Learning team, working in collaboration with scientists from IBM Research, developed the next generation classroom speech recognition application - IBM NetScribe - that may potentially revolutionize the use of technology in learning environments.

IBM NetScribe can also to stream the text in real-time via the internet for remote access to lecture content. IBM Research also developed network architecture to enable the voice files to be accessed across a network instead of via the use of laptops, which we use at present. This would enable lecturers to access their voice files from any computer located on the network. This feature will reduce the infrastructure costs for universities to use the technology. More importantly, students (in or outside of the class) can receive the speech recognition digitized text on laptop (or PDA) clients and customize it based on personal learning preferences. Students would therefore have the ability to interact with the digitized text during class, creating personalized SR generation notes.

The ability of the software to be used concurrently by multiple speakers, known as speaker independent as opposed to the current requirement for each speaker to have their own dependent voice files. This feature will allow accurate digital capture of both text and voice of multiple speakers in a range of settings such as tutorials, interviews and seminars without the need to train individual speakers and use individual voice files for each participant.

Through the unique Joint Study Agreement, IBM and Liberated Learning are also developing IBM NetScribe as a tool for creating accessible learning material for distance learning applications. The software can automatically synchronize not only text and speech, but also video, slides, or other media into one file accessible through standard, freely available media players. Conventional approaches require all media types to be developed independently and painstakingly synchronized and integrated through costly and cumbersome tools. IBM NetScribe does this automatically.

The project uses a distinctive accuracy measurement instrument developed by Dr Ross Stuckless called the NTID Test of SR readability. Academics have found their levels of accuracy have fluctuated depending on the amount of training and preparation of material prior to the lecture. The more the technology is used the better the level of accuracy which has varied at levels of between 75% and 93%. Further research is currently underway to determine methods of reducing recognition errors.

11. CONCLUSION

The Liberated Learning Project offers a new and important direction in providing tangible material from the delivery of lectures. The technology has surmounted a barrier to equal participation for students with a disability in particular, within the lecture theatre environment without the need for individualized augmentative assistance such as note takers, tape recording of lectures, real-time transcription or sign interpreters as this technology can benefit all students as a mainstream teaching tool. As a unique and progressive learning medium, students now have the opportunity to take away a tangible, an additional searchable resource for use in comprehending lecture material.

Speech recognition challenges academics to move beyond their pedagogical conventions and disseminate knowledge in new and creative ways. Underlying all of these activities is a progression toward bridging the gaps in access to information within the lecture theatre and beyond. Academics have demonstrated an ability to achieve high rates of accuracy within the lecture environment, making the technology a viable option to assist students.

Students have used the technology to enhance their comprehension of lecture material during the lecture and through access to the online transcripts.

Speech recognition technology represents a cost effective method of providing support to students who have difficulty comprehending the content of lectures without intermediary support.

Introduction of this technology within a lecture environment will not assist all students, it is not meant to, it is being developed to remove barriers to participation within the lecture environment for those students who are unable to generate their own notes or who have difficulty comprehending the content of the lecture delivery.

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