MULTIMEDIA IN DISTANCE LEARNING FOR TERTIARY STUDENTS WITH SPECIAL NEEDS

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ABSTRACT

Many exciting developments in computer technology offer some potential solutions to the physical needs of students with special needs. Distance learning via computer networks increases learning opportunities because it bypasses the physical difficulties some students may have in navigating around campus and the extra equipment that may need to be separately housed on campus. There is now quite an extensive range of adaptive devices that can be attached to an individual's computer to compensate for a specific disability. Assuming that these devices are in place, so those students with special needs can physically interface with the computer, we still need to look at their actual learning environment.

Typically, students with special needs suffer from lack of motivation and require much more time to complete a task in comparison with regular students. The process of coping with disabilities impacts on general energy levels resulting in early fatigue. To compensate, teaching needs to promote motivation, self-management and accommodate different timing needs.

In multimedia programs, a range of prompts in different media such as visual and audio can be provided to motivate and reinforce learning. The student can be provided with options to configure the interface in accordance with their special needs. The timing of the student's progress through the program can be tracked and adjusted to suit the individual student. This paper addresses the overall learning environment necessary for students having special needs. A general conceptual model is depicted outlining how a multimedia program can be designed for effective teaching and learning of tertiary students with mild learning difficulties.

KEYWORDS

Special education, interactive multimedia, teaching and learning strategies, distance learning, learning difficulties.

1. INTRODUCTION

Traditionally, special education has required a high teacher-to-student ratio, customised instructional materials, special equipment and training. However, in recent years, students with special needs have moved into the general stream of education. With the advent of technological advances, especially in adaptive devices to attach to computers, these students have become much more independent and capable of communicating through their computers, particularly via modems or on the Internet. In this paper we address the needs of students who are capable of tertiary study, but suffer from some learning difficulties.

Multimedia in education has the benefit of being able to support many modes of learning through graphics, sound and video clips in an interactive way. However, using multimedia in special education is not simply a matter of inserting these clips. It needs to be done within a learning structure. In addition, multimedia can provide a distance learning system that can address problems of funds, time and participation (Nguyen *et al* 1996). Flexible system delivery associated with educational computing technologies may improve the learning process in cost effective ways. This method can also increase access to educational opportunities for classified students and it can facilitate flexible participation for both the teachers and the students.

This paper describes the learning environment for special education. A model will be constructed based on the current infrastructure and philosophy in special education and the perceived benefits of multimedia to meet the needs of the students. Special considerations are suggested for the presentation of multimedia documents in the model.

2. TEACHING STRATEGIES IN SPECIAL EDUCATION

Special education has its own set of pedagogical principles and practices. Some of their teaching methods have also been valuable for regular students. The most obvious differences, when teaching students with learning difficulties are in timing and pacing needs. Students with learning difficulties may have psycho-motor, cognitive or sensory deficits. Teaching methods in special education have derived from six main theoretical models: medical, developmental, ecological, humanistic, cognitive and behaviourist. This section focuses on the most popular methods emanating from the cognitive and behaviourist theoretical models.

The cognitive model has had a strong influence on special education methods, particularly cognitive and metacognitive training methods (Cole and Chan 1990). The cognitive theories explain such processes as attention, perception, memory, conceptualisation, comprehension, reasoning, problem-solving and decision-making. Different cognitive theories provide different explanations of the underlying cognitive processes. The information processing theory (IPT) is the most popular cognitive theory applied in the area of computing and is used as a frame in artificial intelligence design (Ellis 1992). It provides an understanding of how sensory input is received, perceived, transformed, stored and retrieved. It is generally assumed that people with disabilities and learning problems have deficits in these cognitive processes.

The behaviourist model has greatly influenced the stimulus control and contingency management methods, precision teaching, mastery learning, direct instruction and computer-assisted instruction (CAI) methods. Stimulus events such as screen prompts and accurate feedback are used to control the behaviour of students (Cole and Chan 1990).

2.1 COGNITIVE AND METACOGNITIVE TRAINING METHOD

The development of metacognitive skills helps us to internally manage our own learning. This means that we need to become aware of how we learn best and how we can organise new material to achieve the best learning outcome. Generally, students with special needs have been described as passive learners (Torgeson 1990). Passive learners tend to attribute their successes or failures to forces over which they have little control (ability/luck), rather those they can control (effort/strategies). Poor metacognitive knowledge, metacognitive control or motivational problems can cause passive learning. The cognitive and metacognitive approach emphasises internal mental processes. The students need to have internal strategies to self-manage their learning. The value of having these strategies is so those students can motivate themselves, and use interpersonal skills to turn failure into success. Typically, in special education, the teacher takes the lead in promoting these metacognitive strategies by thinking out aloud about what strategic behaviours could be used. Students imitate this by speaking aloud to guide their own thinking processes. Overt speech is gradually faded to covert speech so that the strategy may be internalised by the student.

Self-monitoring and self-recording can also contribute to the development of metacognitive strategies that the students can internalise to use in all learning (Hallahan and Kauffman 1994). After self-monitoring, the students can self-record the target event. This systematic approach

to teaching metacognitive strategies has some similarities to the stimulus control approach. Because of its emphasis on a systematic approach it naturally lends itself to being embedded into either computer-assisted instruction or multimedia computer-assisted instruction.

There were gains when the software itself provided prompts to use metacognitive strategies to teach reading comprehension. The aim of the metacognitive training method is to gradually transfer control for learning over to the student so that they can use these same approaches in subsequent learning. These methods have effectively taught behavioural, academic and interpersonal skills (Green 1995). Frequent visual and auditory reinforcement and immediate feedback following an action reinforces learning and motivates further learning. A program can also prompt students to identify key sentences, generate imagery, self-questioning, question answering, previewing to activate prior knowledge, and formulate summaries. A question window with questions for the student to focus on can assist in promoting metacognitive strategies.

2.2 THE STIMULUS CONTROL METHOD

This method has had a profound impact on special education, but is seldom used in general education (Cole and Chan 1990). It manipulates antecedent events to encourage desired changes in learning or behaviour. The constant time delay (CTD) procedure is relatively simple to modify and highly effective. It has been used successfully with a wide range of disability types (Wolery *et al* 1992).

The initial series of trials in a CTD procedure contain a zero time delay. A task direction is given and the answer follows immediately. Subsequent trials use a fixed time interval for the control prompt. The best stimulus for the prompt for each set of tasks should be carefully selected at the design stage. Prompts can be gestural, verbal, pictorial, model actions or partially/ fully physical. The CTD procedure has been successfully applied in CAI. Edward *et* al (1995) has suggested that a variation of delay intervals and presentation screens at strategic points during skill acquisition could be the subject of future research.

3. THE LEARNING ENVIRONMENT

Let us assume that the knowledge to be taught has been selected and the course materials have been drafted. We now know *what* we will teach. The problem is, *how* will we teach it? At this stage, it is critical that the course materials be formulated to meet the student's special needs. The criteria for selecting teaching methods and strategies should be student-centred, rather than dependent upon the teacher's own preferred teaching methods.

The primary concern should be to determine the capacity of the classified student. The current scope of the student's skills and abilities needs to be identified. Then there are aspects of different learning styles, such as preferred stimuli and required adaptive devices for handicaps. These should be contemplated within the identified scope of the student's skills and abilities.

3.1 SKILLS AND ABILITIES

Analysis of the skills, abilities and learning style aspects will impact upon the instructional design for each stage of learning in the learning environment. For instance if the student has good visual perception, then he/she will be able to produce a meaningful visual conceptual map by the use of visual stimuli in the program. If the student at the beginning of the program selects different audio prompts, this can be useful if the student has sufficient sensitive auditory perception to recognise the meaning of these sounds.

Sensori-motor skills involve coordinating cognitive processes with movements of the body. They are used in most sporting activities, playing electronic games and operating machinery. Simple sensori-motor skills are involved in learning how to draw shapes or follow mazes. A sensori-motor task that is often used in laboratory studies of skills learning is to print the letters of the alphabet upside down, in the correct sequence. A more complex sensori-motor task would be to learn touch typing at a professional level. Two types of skills have been identified in studies of pilots flying aircraft. There are the physical motor skills of manipulating

the controls of the aircraft and the cognitive skills involved in encoding and interpreting air controllers' instructions, processing information about altitudes and consequently making decisions. Visual-spatial intelligence is perhaps more crucial than any other for learning using multimedia systems. This offers advantages to dyslexics who have typically suffered in text-oriented educational systems (Green 1995).

3.2 LEARNING STYLES

Learning style can be defined as the way in which a student learns best (Gaylord-Ross and Holvoet 1985). Learning strategies may be learned and developed. By contrast, learning styles are static and are relatively in-built features of the individual (Kezunovic 1995). Adaptive devices for handicaps are part of the classified student's learning style. There may be preferences for different temperature levels, lighting and noise in the learning environment. Different levels of motivation and interest will be present. Some learners are more analytical and can pick out embedded elements contained in information (field-independent). Others prefer to be given concrete examples (field-dependent) (Kezunovic 1995). The type of preferred stimuli, such as visual, auditory, kinaesthetic and tactile, to support each stage of learning and to use in individual feedback to the student, needs to be identified (Townsend and Townsend 1990).

3.3 STAGES OF LEARNING

The goals of general education are to teach so students perform well in the three main stages of learning, being the acquisition, practice and generalisation stages. At the acquisition stage the basic skills and facts are acquired. Having acquired this knowledge, the students need to be able to practise what they have learnt. The stage which many students have difficulty with is the generalisation stage. This is when they are required to transfer their newly acquired knowledge to other situations. They need to be able to apply what they have learned to real-life situations in the workforce and general community. The three main stages of learning can be further segmented into seven steps (Townsend and Townsend 1992).

Apprehending

The students are stimulated to select the main points from all the information given to them by the way that the lesson is presented to them. In this case, it is useful to highlight areas to accentuate main points, as well as presenting main facts in some sort of graphical form, such as a diagram or chart or acronym.

Acquisition

In the initial stage of learning, the students acquire facts and concepts. This information enters the short-term memory of the learner matched against other similar information and is coded for long-term storage. For example, if the goal of the lesson were to teach spelling of certain words, then an explanation of the rules of spelling would be given in the acquisition stage. Acquisition can be reinforced by a variety of presentation modes, such as speech, text, visuals and movement. At this stage, the students learn effectively by learning in small segments with frequent feedback from the tutor or program and by generating questions or problems from the learning materials. Testing can occur after every concept has been presented. This way errors can be corrected and the learning of incorrect responses can be diminished.

Retention

The new information is stored in long-term memory along with other similar information. At this stage the students have achieved a certain level of comprehension of the material.

Recall

The students can retrieve the information previously stored when requested to do so. To assist in this process, it is useful to have a short test and reminders or links to where the original information was gained.

Fluency

Drill and practice are vital to attain accuracy within a time frame. At this stage the students would be given an opportunity to become fluent in spelling the words in terms of rate and accuracy. CAI has a proven record in this area, because it is able to deliver self-paced lessons (Cole and Chan 1990). Also, students can be exposed to the content many times. Usually, teachers do not have time to repeat the content presentation for just those students.

Generalisation

Generalisation occurs when there are correct responses in settings other than the training setting. The students are able to retrieve all the similar information from long-term memory, analyse and synthesise it and apply it to a case study or real-life situation. For instance, in the spelling example, the students would be able to use the correctly spelt words in written tasks. Generally, it is useful if the students have direct manipulation of the materials. For example, they could be presented with a video showing a particular role play, then be encouraged to select from a series of video clips, one of which has the correct response to the role play. Students are encouraged to explore different paths to locate their answers using the non-linear capabilities of multimedia. Generalisation has been an especially difficult stage for students with intellectual disability or severe handicaps (Gaylord-Ross and Holvoet 1985). Target stimuli should be as close as possible to a naturally occurring stimulus. An audio prompt of the sound of a telephone ringing is a natural stimulus when teaching telephone techniques. Links to material previously seen and discussed can be made, thereby stimulating recall of prerequisite knowledge. Research indicates that multimedia computer-assisted instruction (MCAI) promotes a higher level of generalisation than traditional paper cases (Hsi and Agogino 1994).

Performance

The students can produce a summary or assignment to demonstrate that they have mastered all the previous steps.

Feedback

The students' performances are evaluated. The educator gives feedback about correct and incorrect responses to the students. The mode of feedback given should be customised to how the student best learns. If the student showed a preference for concrete examples, then feedback should be in this form.

4. MULTIMEDIA FOR SPECIAL EDUCATORS

Classified students often demonstrate undetected intelligences and skills when allowed to work with multimedia computer systems (Green 1995). Generally, multimedia in education has been described as student-centred, project-oriented and as amenable to collaborative learning. Interactive multimedia can be defined as the simultaneous use of data in different media forms, such as voice, video, text, graphics, animations, virtual reality (Buford 1994). The interactivity afforded by multimedia can facilitate more than one teaching method or strategy to optimise learning. Some overall benefits of multimedia software for classified students have been identified (Green 1995).

- They are highly motivated to engage in learning via a multimedia system.
- Properly designed software can assist them with cognitive and metacognitive strategies.
- Undetected intelligences and skills were identified when working with multimedia.
- There is an increase in self-esteem.
- Multi-sensory nature of MCAI facilitates learning.
- Motion and interactivity holds the student's attention.
- Software is consistent and eternally patient

Students with disabilities often have difficulty organising and retrieving information. They need to be shown techniques which will support retention and recall. One technique is to cluster similar material into small chunks. This assists in encoding information ready for storage in long-term memory. Another technique is to verbalise a word whilst viewing it (Hallahan and Kauffman 1994). Many researchers support the view that the use and delivery of multi-sensory information contributes to more effective learning. It is often said that we remember two-thirds of what we both see and hear. A combination of media, such as simultaneous audio-visual stimuli assists recall and leads to better retention.

Sound offers many possibilities. It can be a second or alternative channel of communication. It can be a stimulus. Narration can be used instead of long sections of on-screen text which can present difficulties for students with learning disabilities. Special sound effects can augment visual and narrative information. Interviews with experts in a field can stimulate interest in a subject. Speech can be used to explain technical information. Speech synthesis technology enables the computer to deliver verbal models. Prompts can be paired with printed words and graphics that appear on the screen (Cipani and Spooner 1994). Music is effective for setting the pace or prompting the user.

Multimedia together with digital video can support tutorials, drill and practice, facilitating sensori-motor skills and simulation all in the one program. A meta-analysis of 63 studies that used interactive video instruction reported a positive overall effect size for interactive video (IV). This was slightly higher than previous effect sizes reported for CAI. This result reinforces the belief that the ability of multimedia or IV to depict real-life situations has an added effect for learning outcomes. Further, students who have difficulty relating to a graphical representation of a situation may recognise the pertinent elements if presented in a realistic video format (Boone and Higgins 1992).

5. CONCEPTUAL MODEL OF MULTIMEDIA SYSTEM

It is necessary to have a conceptual model of how multimedia elements can assist in the stages of learning (Au 1995). Inevitably, the overall design of any multimedia system will reflect a philosophical viewpoint concerning cognitive development. But, there is nothing against combining elements from the various cognitive theories into the system (Ellis 1992).

Factors such as narrower life experiences and bias towards their disabilities could contribute towards a lower self-esteem and general motivation level for students with disabilities. Also a reliance on carers and specialised staff throughout their life may have resulted in less experience in self-management. Typically, tertiary education is geared towards the independent learner, so a degree of motivational tools/prompts and self-management tools need to be gradually introduced into the program. Uhran *et al* (1998) states that if study materials are not in a form that they can easily work with, then students with disabilities face an additional burden.

The multimedia designer needs to begin with an established framework from which to view the overall project. Experience with the capabilities of authoring programs is essential. Strategies specified by the special education consultant need to be integrated into the design. When the designer produces a multimedia document, there are many guidelines to consider. The multimedia document should use terms and metaphors that are familiar to the students. The overall multimedia document should be clear and consistent to prevent confusion and students need to know where they are in the program and, be able to exit easily.

The following model in Figure 1 shows a multimedia system for special education within a regular teaching setting. The classified students are assessed prior to receiving instruction through the multimedia system. This valuable information is provided by the special education consultant and has considerable influence on the design of the system. However, further screening via the start-up screen in the multimedia program, could also be appropriate. For instance, sound, visual and pacing requirements could be assessed and depending on the results, appropriate action is taken.

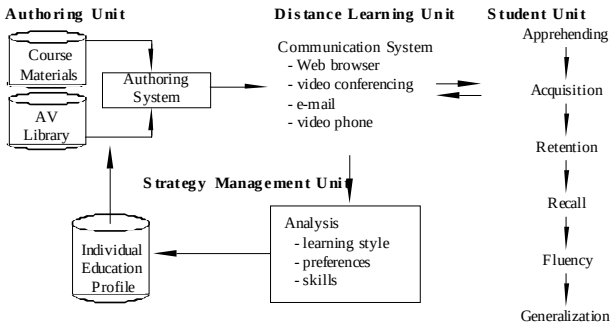

Figure 1: Conceptual model for interactive multimedia system

5.1 AUTHORING UNIT

Raw course materials and materials from the A.V. Library will be analysed and synthesised into draft course materials. The special education consultant selects the teaching strategy appropriate for the classified student's Individual education profile (IEP). The materials are restructured to incorporate the chosen strategy. Details of time delays and prompts for the CTD method would be annotated in the text. These course materials are forwarded to the multimedia designer for design and implementation into the multimedia system module. The designer will use effective multimedia techniques and artistic skills to manipulate the various media types.

5.2 DISTANCE LEARNING UNIT

The World Wide Web browser will deliver the formulated teaching materials. Video conferencing links can be set up between the educator and the students. The students can communicate with their peers and the regular educator through posting queries on the communications system and chat groups. Students can also synthesise their learning by sending their own summary of the lesson with text and relevant retrieved video clips back to the educator, as well as files containing results, graphs and case studies for marking and corrective feedback from the regular educator.

5.3 STUDENT UNIT

The classified student can choose prompts and pacing by selecting from a start-up menu:

Sound prompts **:** **correct / incorrect response**

Visual prompts **:** **type, size, colour**

Speed **:** **relaxed, medium, fast**

The classified student interacts with the multimedia program by responding to prompts, highlighting text, choosing images, typing notes to the screen and answering questions. Adaptive input devices, as prescribed by the special education consultant, interface with the multimedia system for input and output. Drill and practice and self-monitoring will be provided, where appropriate. The student can also create an audio or video clip and send it to the regular educator for analysis and corrective feedback.

5.4 STRATEGY MANAGEMENT UNIT

Information about timing and pacing as the student progresses through the program will be sent back to the Strategy Management Unit via the Communications System. During the interaction with the students, the regular educator can also evaluate outcomes such as satisfaction with the program. After evaluation, the regular educator will compare the progress against the student's IEP and expected learning outcomes and analyse it. This information will be sent to the Authoring Unit again to re-formulate the teaching materials.

6. CONCLUSION

Different teaching strategies were investigated and analysed to pinpoint their suitability for transfer into a computerised system. Stimulus control methods require precise timing and repetitive actions and suit the strong capabilities of the computer to provide precision and reiterative looping. Auditory and visual prompts can be inserted at strategic points to support these methods. Cognitive and metacognitive training methods are structured and can be implemented through multimedia.

Some learning skills and abilities were described. Motor skills and visual / auditory perceptive skills can be enhanced through multimedia. Alternative approaches in multimedia presentation may compensate for areas of skill deficits. Evidence was gathered about other benefits of multimedia for classified students. This information reinforced the belief that multimedia can have affective outcomes such as increased motivation and self-esteem. It also has potential to assist in retention and recall. On this foundation, a new conceptual model was constructed for special education in a regular educational setting using a multimedia system module for delivery of the learning material. Interaction between the regular teacher and classified student is supported through the communications system in the multimedia system module.

The purpose of the suggested model has been to address the pressures upon the regular education sector to meet the learning needs of classified students within reasonable budget parameters. The teaching strategies are contained within the multimedia program. This reduces the need for additional on-site specially-trained staff. Therefore, there is a reduction in recurring expenses. There is also a degree of self-instruction, self-assessment, self-monitoring and self-pacing in the multimedia system module. Interaction with the teacher is flexible. The demand on the teacher to be continuously present is less. Overall, once the support infrastructure is in place, distance learning offers a viable flexible alternative for teaching students with disabilities.

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