# BRINGING ICT TO TEACH SCIENCE EDUCATION FOR STUDENTS WITH LEARNING DIFFICULTIES

By

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*ABSTRACT*

*The purpose of the following study was to examine the impact of Information and Communication Technology (ICT) in Science classrooms of students with Learning Disabilities. Teachers were positive about the learning benefits and design of the Science curriculum. Students were more critical but still positive about these features. Learning Science has both Cognitive and affective implications for students with LD. From a constructivist perspective, the process of learning is viewed as an active construction of knowledge rather than a passive reception of information. ICT provides cognitively engaging and motivating instructional tools for individualizing the mode of delivery, developing special tutors, using metaphors as instructions, Cross curricular Connections in science, thus reducing the cognitive load on working memory and motivating the students to stay on the same task.*

*Keywords: Science, Learning, Disability (LD), Cognitive Load, Information and Communication Technology.*

## INTRODUCTION

The main focus of this article is to figure out how to use words and pictures to foster meaningful learning. Meaningful learning is reflected in the ability to apply what was taught to new situations. This paper will help the quality of science teaching for students suffering from LD using ICT. As Holachan, et al. (1994) stated, despite calls for making science beneficial for all, very little effort has been made to make Science available to students with disabilities.

### Students with Learning Disabilities

LD is a neurological disorder that affects the brains ability to receive process, store and respond to information. The term learning disability is used to describe the seemingly unexplained difficulty a person of at least average intelligence has in acquiring basic academic skills. LD is not a single disorder.

LD is a neurological based problem with processing information. These affect one or more process of input (taking in), integrating (organizing, sequencing, remembering) and output (expression) of the information.

The problem associated with Learning disabilities interfere with one or more of the following: learning, reading, writing or understanding math and may affect a person's ability to speak, listen, recall or organize information, difficulty with study skills, self control, self-esteem, memory and attention. (Mercer, 1997).

For example LD students may find it difficult to read text books and taking notes in the class. These children lack in coherent written work, vocabulary and taking test. Since most of the teachers rely on lecture method, written notes, examinations and text books as the main source of teaching, most of these children are unable to manage. Research proves that LD students are weak in solving basic math problems; this gives a deficit that could obstruct their progress in science (Goldman, Pellegrino & Mertz, 1988). Such deficiencies at least in mathematical skills are largely due to delayed learning. Therefore the skills and reasoning strategies of students with LD have been found to be largely the same as normal students, but they occur at later ages.

The major problem of LD students is that most of the energy is wasted in simple tasks, so less cognitive energy is available for the development of skills required in science. They too often have very low self esteem and low motivation because of their past experiences in their classrooms. So classroom environment plays a vital role in the development of children with learning disabilities.

### Science Education and LD

Science subject is both cognitive and affective in nature, (Lawson, 1994; Simpson, Koballa, Oliver, & Crawley, 1994). Science has both hands-on and minds-on practice. As Aldridge (1992) said "Science is needed by everyone and everyone (including those with LD) is capable of learning and enjoying science". However with the existing traditional practices such as lecture method, rote learning, and teacher as the only Source, it is difficult to make science interesting to the students with Learning disabilities. Science develops in interaction and not in isolation. In traditional schools there is no chance for anyone to interact with the teacher since it is highly teacher oriented are not child oriented. In this context how information and communication technology could be used to deliver Science education and make science more appealing to students is discussed.

The two main areas where the teacher should focus is reducing Cognitive load on working memory and motivating the students to stay on the same task. Keeping the above two factors in mind, how information and communication technology could be used to deliver science education and make science more appealing to students with LD terms this paper.

### Role of Information and Communication Technology

The computer technology not only improved the quality of Computer applications in education, but also provided a basis for understanding human cognition. The Communication Technology provides students with interesting and motivating learning experiences that would help the students to stay on the same task. Using information and communication technology the researchers can facilitate the teaching of science to students with LD through special tutors, using metaphors, and cross curricular connections in science. Knowledge engineering is the term often used to describe the process of capturing human expertise, developing a problem –solving framework, and eventually making the knowledge available to others through a computer based expert system (Hofmeister, A. M & Lubke, M. M. (1988).

#### *Developing Special Tutors*

In a normal classroom individual attention is not possible for all children. With information in communication technology it is possible to develop special tutors to provide higher cognitive level learning experience on an individual basis. Special tutors give the instruction in small steps for problem solving and allow them to work independently (Bos & Vaughn, 1994).

#### *Metaphor Videos*

Metaphor is a technique where videos of real world problem are used as metaphors to provide a macro context for students to give a meaningful understanding of the topic they learn (cognition and technology Group at Vanderbilt, CTGV (1990). The videos help students resist problem situation and overcome the knowledge (White head, 1929). The visual representation of concepts and relationships through videos is useful to teach students with learning problems (Hofmeister, Engelmann, and Carnine, 1989). The images can be given slowly and by allowing the students to see one by one through which we can allow the LD students to learn at their own pace.

#### *Cross Curricular Connections in Science*

Integrating Science with other subjects has both Cognitive and affective implications because this will demand the use of both the right and left brain hemispheres (Fortuner, 1990). The multiple ways of presentation make them think beyond boundaries of subject matter. This gives them easy access to the physical and social world (Cuffaro, 1984, p565). These mind mapping Videos will help them to understand better, since they can integrate science with other subjects. By doing this a certain amount of cognitive load will be reduced on them. Instead of opening up a different memory location this will go and link with the existing knowledge of the learner.

### Cognitive Load

Let us look into what is happening while we use information and communication technology in learning, that is, a learning situation in which words and pictures are presented. A potential problem is that the processing demands evoked by the learning task may exceed the processing capacity of the cognitive system- a situation we call cognitive overload. The three kinds of cognitive demands, are essential processing, incidental processing and representational holding.

Essential processing refers to cognitive processes that are required for making sense of the presented material, such as the five core processes in the cognitive theory of computer learning- selecting words, selecting images, organizing words, organising images and integrating.

Incidental processing refers to cognitive processes that are not required for making sense of the presented material but are primed by the design of the learning task. For example adding music to a video may increase the amount of incidental processing to the extent that the learner spend some cognitive capacity to processing the music.

Representational holding deals with the cognitive processes aimed at holding a mental representation in working memory over a period of time. For example a particular concept is there in one slide and a verbal description of it is there in another slide, but only one slide can appear on the screen at one time. In this case the learner must hold a representation of the concept in working memory while reading the verbal description in working memory while viewing the illustration.

### Ways of Reducing Cognitive load on Working Memory

In fact there are nine ways to reduce the Cognitive Load in Information and communication technology. Students suffering from LD face difficulties in doing mental operations if there are more variables. To learn science at higher grade level more number of skills is required. Computers functions like a external human memory, and reduce cognitive load on working memory (champagne and klopfer, 1984, Kumar, White and Helgeson, 1994 a)

*Overload: Segmentation*

Suppose a student was seeing an animation that explains the formation of Rainbows, he goes to the site and clicks on the entry for Rainbow. Here some of the slides are selected to be processed as words in the verbal channel and some slides are in visual channel. If the information is rich, the students finds it difficult to organize the words with a verbal model and integrate it. Before the next segment starts, this cuts the time needed for deeper thinking and processing. This situation takes to Cognitive Over load in which the available cognitive ability is not enough to meet the requirements.

Sweeler (1999) referred to this situation as one in which the presented matter has high intrinsic load and is complex. The possible way to allow the learners to digest is presenting one by one and then reproducing it.

*Solution*

The solution to this overload is reducing the time between two slides in the presentation, which was less. So the presentation should be divided into small segments. The learner can select the word and image for that slide and have enough time to organize, place and to integrate the words and images. Mayer and Chandler (2001, Experiment 2) broke a narrow animation which explains the formation of Rainbow into 15 segments. Students will understand if it is a learner controlled segment.

In a physics problem solving experiment Staver (1986) found that the performance level of students increased as the number of independent variables was decreased, leading one to believe that the amount of memory space required to think while solving a problem has direct effect on the outcome. In this area the information and communication technologies have a lot to offer in aiding their working memory through interactive computer tasks. Here the role of input devices such as induction pen helps in reducing the human computer interaction at the Cognitive-psychology –computer-technology interface (Kumar, Helgeson, and White, 1994)

### Motivating Students to Stay on the Same Task

ICT are excellent motivational tools for LD children. By Jackson (1988) it is known that give immediate feedback to students about their performance and play a vital role and motivate students to stay on task and complete their assignment. In a study, Kumar, et al. (1994a) noticed that the time taken for the chemistry problem solvers using technology, was significant higher than others using traditional paper and pencil method. For LD children lack of attention is always deficit. For them, any teaching methods which gives pleasure and encouragement are beneficial. If the LD children are using technology as their tools they will be more cognitively engaged (Goldenberg, Russell, and Carter, 1984).

## Conclusion

A few ways in which Information and Communication Technology could be used to facilitate the teaching of science to students with LD from that of rote practice to higher level thinking have been presented in this paper. They include developing Special tutor, Metaphor videos and Cross curricular connections with other subjects, reducing cognitive load on working memory and motivating students to stay on the same task.

The ICT classrooms create more positive interaction between teachers and the LD students. Individual attention is possible for the teachers since they find more time to spend. The role of the teacher may change from knowledge source to that of an "Idea Coach" (Songer, 1989, p. 38).

The teachers should be well versed with the technology to deal with LD children, for that, teachers' education programme should provide these experiences to the teachers. ICT provides a powerful tool for getting students with LD actively engaged in learning science. If once the LD children are allowed to use these methods, then they have quick access to various resources and tools for combining those resources. They can spend less time looking for answers and information, and have more time on analyzing, reflecting, developing and understanding.

Science educators, researchers and ICT specialists should sit together and develop these types of modules for science education to teach LD students (Egelston-Dodd, 1995). They should put their complete efforts to make effective ICT tools for making science both cognitively and affectively appealing to LD students. More and more research and development efforts are required to take this task with a great concern for making science education available to students with LD. It will be worthwhile if a separate section in the education sector, works for LD students to solve their problem, and after all the highest function of education is to transform the society.

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