Seminar on Computer Assisted Learning

Organized by

The NSF Research Committee on Science Education

Venue : NSF Auditorium

Date : Friday, 04th, July 2003

Time : 9.00 a.m. to 4.45 p.m.

Sponsored by

CINTEC

Council for Information Technology

Telecommunications Regulatory Commission

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Programme

9.00 a.m.	Registration	
9.30 a.m.	Welcome Address	Chairman/Director, NSF
9.35 a.m.	Introductory Remarks	Dr Sunethra Karunaratne Chairperson/RC
9.40 a.m.	Use of Computers in distance learning	Prof. Uma Coomaraswamy Open University, Sri Lanka
10.40 a.m.	**Discussion**	
10.50	**Tea**	
11.05 a.m.	Computer Applications in Chemistry Teaching	Prof. H. M. N. Bandara University of Peradeniya
11.35 a.m.	**Discussion**	
11.45 a.m.	Computer Assisted Programme for Teaching selected topics in A/L Chemistry	Mrs M W S K Wijethilake Nugawela Central College
12.10 noon	**Discussion**	

12.15 p.m	Computer-based Interactive Physics Teaching	Prof. Laksman Dissanayake University of Peradeniya
1.15 p.m	**Discussion**	
1.25 p.m	Lunch	
1.55 p.m.	Trends in Information Technology Education	Dr Kithsiri Liyanage University of Peradeniya
2.30 p.m.	**Discussion**	
2.40 p.m.	Preparation of a computer-based self study guide for GCE A/L biology	Mrs S S Senadheera Peradeniya Central College
3.05 p.m.	**Discussion**	
3.10 p.m.	**Tea**	
3.25 p .m	Use of Computers to aid Science Teaching	Mr M G R Kumarasiri / NIE
3.55 p.m.	**Discussion**	
4.00 p.m.	Development of a study package for astronomy education	Mrs K P K Koralagama Sri Lanka Planetarium
4.25 p.m.	**Discussion**	
4.30 p.m.	Final Summing up	Dr D.A. Ponniah

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USE OF COMPUTERS IN DISTANCE LEARNING

by
Professor Uma Coomaraswamy
Vice-Chancellor, The Open University of Sri Lanka

at the Seminar on "Computer Assisted Learning"
National Science Foundation on July 4, 2003

Summary

Distance Learning imposes strains arising from isolation. The system gives learners the responsibility to manage their own progress with the support and guidance of tutors. Learning system, particularly materials, themselves are an important aspect of providing support to Open and Distance learners and of promoting their interaction with those materials and where possible with their tutor/instructor/other learners.

The number of new technologies introduced in distance learning over the last few years or so have expanded rapidly. The convergence of communication information, media and educational technologies brings together the interactive benefits of traditional face to face education and the freedom from geographic and time constraints offered by multimedia distance education.

Use of computers in distance learning in this context will be discussed under

Computer assisted learning,
Computer mediated communication,
Computer based learning,
Web-based learning, and
Audio-graphic teleconferencing

The Open University of Sri Lanka is exploring a number of different delivery and student support system using new technologies.

The broad directions in which the University is advancing are

- multimedia instruction through CD-ROMs.
- Internet to play an increasingly central role in the university's functioning right from student admission, registration, program delivery, counseling and assignments to final examination and certification.
- Regional and study centres to transform themselves to house multimedia centres (telecentres) offering information and communication terminals to students.

This will be discussed using demonstration packages prepared inhouse.

Computer Applications in Chemistry

Prof. H M N Bandara
Dept. of Chemistry
University of Peradeniya

There has been a remarkable development in the fields of computer and information technology during the last two decades. The impact of this development is felt by the human society at all social levels. It has introduced new dimensions to all scientific disciplines and new methodologies in the learning and teaching process have emerged. Although it is hardly possible for an individual to keep abreast with and master all these techniques, we as the members of the teaching community must be at least aware of such developments and strive to make use of them wherever possible.

Internet, today, is almost a boundless resource of scientific information and its use must be encouraged in the teaching of Chemistry in schools and in the universities. Besides, computers can be used in a multitude of other applications such as data acquisition and data processing, molecular modeling, drug design, simulations and instrument control, to name a few.

Software packages which are useful in the teaching of chemistry are available, however, good packages are expensive and the cheaper ones are not very useful. With some knowledge in programming, it is possible to develop highly effective computer programs that can be used for the teaching of chemistry to advanced level students. This is particularly useful in teaching units such as those on atomic structure, where abstract concepts have to be introduced. However, one has to be careful not oversimplify basic concepts using simulations, models or animations because there is a possibility of misconceptions being introduced to the students.

Computer Assisted Programme for Teaching selected Topics in A/L Chemistry Syllabus

Mrs M W S K Wijethilake
Nugawela Central College

When students begin to learn chemistry in A/L classes, it is important to have a firm foundation on the basic concepts of the subject . The general chemistry section of the A/L chemistry syllabus starts introducing the basic concepts. Without proper understanding of these concepts students may face with difficulties in grasping more complex facts later on.

First few lessons in the syllabus contain abstract concepts, that cannot be experimented. Therefore students face more difficulties in understanding them.

In considering these factors it is important to use a new technology as a new teaching approach. Programmes have been written in QBasic programming language. to introduce the following topics.

. 1.Orbital shape

2. Orbital overlap _ These tropics introduce in forth unit under bonding section.

3. Hybridization _ This is introduce in organic chemistry section.

Orbital overlap can be represented by using two methods. They are

Contour diagrams and polar plots.

Polar plots are used to draw the shapes of the orbitals in these programmes.

These programmes are used to teach these topics to students in my school. Students performance was significantly improved by these computer programs. With little extra effort, we can write such programmes to improve our teaching procedure.

COMPUTER-BASED INTERACTIVE PHYSICS TEACHING

Prof. M.A.K. Lakshman Dissanayake

Department of Physics, University of Peradeniya & Board of Study in Science Education, Postgraduate Institute of Science, University of Peradeniya

Several independent research studies (Halloun and Hestenes, 1985) have shown that most students could complete and pass an entire course on Physics at a major university but still have very little understanding of the basic concepts in Physics. Students' misconceptions are deeply rooted, and developed over a very long period of time, and consist of incorrectly interpreted personal experiences and observations. Physics education research has shown that, because of these deeply held misconceptions, students' understanding and hence appreciation of very basic Physics concepts cannot be greatly improved by traditional instruction. However, the quantification and analysis of student misconceptions has led to the development of more effective "interactive" methods of instruction based on the constructivist model of student thinking and learning. There is considerable evidence to show that these interactive learning techniques are far superior to traditional teaching methods for improving students' understanding of basic scientific concepts in both the secondary and the tertiary levels.

Computer-based, interactive methods can be used very effectively for teaching Physical concepts. They can be performed either as Interactive Lecture Demonstrations (ILDs) to a large audience or as computer-aided hands-on experiments by students. However, it should be emphasized that, these methods do not necessarily guarantee improved understanding of scientific concepts unless they are carefully designed as student-centred learning strategies that encourage active participation of the student in the learning process.

To create an active learning environment inside the classroom, the instructor's facilitating technique should accommodate a diverse range of student learning styles and encourage students to interactively engage in the learning process. Such a learning technique should provide ample opportunities to constantly challenge students' misconceptions of vary basic scientific concepts. In an active learning environment, the instructor ceases to be the source of all knowledge but rather assumes the role of a facilitator who guides the student through the learning process. With the instructor as the guide, they are presented with numerous opportunities to predict, experiment, observe, discuss, explain, and exchange ideas with their peers and with the instructor. They are encouraged to work in teams or groups and participate in various activities such as interactive computer-based experiments, interactive lecture demonstrations performed by the instructors, interactive computer simulations, and interactive problem solving. These activities should be carefully prepared so that they always simulate the students to think, predict, observe, compare and reason.

Trends in Information and Communication Technology in Education

Kithsiri M. Liyanage
Director, Information Technology Center
University of Peradeniya

The role of technology in shaping educational technologies is very significant. Information and Communication Technology (ICT) stands out as the key technology that could significantly contribute to the development of educational technologies.

Education involves creation and use of knowledge directly link to information, its manipulation and exchange. As such, there isn't any modern technology comparable to information and communication technology that has tremendous implications on education. In fact ICT has enabled undreamed possibilities for interactions between students, schools, teachers and parents over any distance. As a result ICT has become one of the most attractive and potential technologies that could be used to transform education today.

The potential of ICT for the development of educational technology could vary from country to country. This is so because in assessing the potential of ICT to improve the quality of education is determined by many factors such as socio-economic status, pressing national needs, long and short term development strategies and technological status of the country. Specially economical and technological status of a country will be key-determining factors of the country's capabilities to use ICT for the enhancement of educational activities successfully.

Several trends in ICT have contributed to the current developments in educational technologies world over with varying degree of success. Among many, technologies such as the Internet, Multi-media technology, wireless communications and electronic and software built together: embedded systems are at the forefront in this respect.

New developments and improvements in ICT will continue to appear frequently. Availability of more and more power packed hardware, flexible and intelligent software, broadband connectivity, smart storage, ubiquitous computing, multi-media applications etc. at an ever reducing cost would be a result of them. In education, emerging applications developed

around communication and multi-media technologies would receive widespread attention. Some of such applications are, tele-immersion, virtual laboratories and digital libraries.

Importance of reforming the education system to keep abreast of global developments in education sector is beyond doubts. In order to bring in necessary reforms, inevitability and importance of ICT are clearly understood. However, in Sri Lanka, amid weak economic situation, inadequate social awareness & preparedness and lacking implementation capacity, introducing reforms would be a challenging task that should be under taken according to a properly done plan.

Incorporation of ICT to create technology enhanced educational environment involves many more than making equipment available. Equipment forms the tip of the iceberg and all other aspects are remain below the water surface. Addressing all these aspects in crucial for success of creating a technology enhanced education environment.

PREPERATION OF A COMPUTER-BASED SELF-STUDY GUIDE FOR GCE A/L BIOLOGY"

Mrs S S Senadheera, Peradeniya Central College

A computer based self-guided study package on "Molecular Genetics and its applications" was developed for G.C.E. (Advanced Level) Biology students. Subject material included was based on the UNIT 5 (Genetics) of G.C.E. Advanced Level Biology syllabus. This section of the syllabus was specially selected to overcome the difficulties experienced by the students mainly due to the scarcity of study materials in this area.

In the preparation of the package, information was drawn from various textbooks, the Internet and several encyclopedias. Complicated sections of the subject were presented in the form of animation. Question papers, written notes and animations were prepared using Authorware package of computer software, which is widely used to develop educational packages. Coral-Xara package of computer software was used for diagrams. Exercises and the question papers were prepared in such a way that the students are involved in the process of self-evaluation.

Impact of the study package in understanding the specified subject area was assessed by an evaluation test using twenty-four Advanced Level students (Grade 13). An experimental group and a control group of students were taught the subject area with and without the assistance of the package. Test scores were subjected to a statistical analysis using a T-test. Results showed that the self-guided study package positively affects the students' performance. Discussions carried out with the teachers and the students further concluded that the package greatly assists in teaching the related unit of the subject.

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The Research committee on Science Education
National Science Foundation
04th July 2003

Use of Computers to aid Science Teaching
(M G R Kumarasiri)

Present Context/Practice in Science Education:

- Is Science taught to students?
- Can Science really be taught to students by teachers?
- Should Science be learned by students?
- Are Teachers to facilitate Science learning of the students?
- Are Students to learn Science or remember Science to re-produce at the examinations?

What should be the composition of the science curriculum?

- How much Science Concepts/Theories
- How much Science Processes/Applications
- Or Concepts/Theories and Processes/Applications as separate subjects

What are the learning/teaching methodologies used in Science education:

- Involvement in possible practical in the laboratories
- Observation of phenomena/Processes
- .....(Areas not covered under the above means).

Do we need any technology to learn/teach Science?

- What are the areas cannot be learned/taught by well accepted traditional means
- What are the areas better learned through technology
- What are the Appropriate technologies (HW, SW, Audio/Video, Interactive ness)
- What is the Cost of the technology (HW, SW, Capital cost, Running Cost, Internet/telephone/OFF-line-Online)
- Relevance of Technology (Local needs, Curriculum, Language Barriers)

(Demonstration of exemplar learning/teaching aid on Photosynthesis)

Will e-learning solve the problem?

e –learning (originating from electronic learning)

- Internet Mediated Learning
- On-line Computer Assisted learning
- Any possible connection with technology Mediated learning
- Real e-learning not yet even existing (perhaps change fundamentally all learning.

(Will there be a situation of e-Science?)

Issues

Challenges (in Srilankan education system)

- Is actual learning required in Science to go through the examinations
- How can we make/acquire suitable software for our educational environment
- Do we need to develop such software
- How can we attract other software which are less examination supportive

Constraints

- Non availability of appropriate Educational software
- Very high Cost of production if it is done indigenously
- Cannot be retained SW development experts in Gov. Institutes
- Private sector do not invest on production of software as Srilankan market is small

Methodologies in Science Learning/Teaching should be justified from the perspectives of the Science and not from the perspective of Computer Technology/IT/ICT only.

DEVELOPMENT OF A STUDY PACKAGE FOR ASTRONOMY EDUCATION

Mrs K P K Koralagama – Sri Lanka Planetarium

The entire package developed takes almost 3 hours to be presented to a group of viewers. Therefore I propose to discuss its content in brief during my talk. I propose to make a visual presentation of only, what I feel, are the salient features of the package during this presentation.

The development of a study package for astronomy education consists of six chapters. The first chapter is the introduction and the other five are subject materials. They cover the following areas;

In the second chapter of this project, the author emphasizes the historical development of astronomy; what many individual astronomers have contributed, often, over a long period of time, to the development of new ideas about the universe, how the cumulative nature of discoveries in astronomy have continued, right up to the present time, as the principal means of progress in astronomy and how the heliocentric revolution was completed and, furthermore, it describes the Newton's law of motion, his law of gravitation, and Kepler's laws of planetary motions.

The third chapter focuses on the sky, astronomical measurements and telescopes. This chapter helps understand how someone can describe where exactly some body is in the sky. It describes ways of specifying the location of a celestial object (the altitude-azimuth system and the equatorial coordinate system), how the earth's seasonal changes occur, what parallax is, etc. and how telescopes work; their types, and their specific functions, advantages & disadvantages.

The next chapter touches on outlines of our solar system and describes the main properties Jovian planets & terrestrial planets , the surface of the sun, motion of the sun, surface of planets, layers of the planets & the sun, the moon, the earth and solar system debris (asteroids, meteoroids comets).

The fifth chapter describes current ideas about the formation of stars from interstellar clouds, about the lives of stars between their births & their death and white dwarfs, neutron stars and black holes that represent the final stages in the evolution of stars, star classifications, a few famous star constellations, the great nebula in Orion and constellations of the Zodiac

The final chapter explores the observation that permits observers to see ever deeper back into time. This chapter describes galaxies as they are today–near us both in space and in time, cosmology, the evolution of the universe, extra planetary systems and the search for life.

Workshop on Computer Assisted Learning

Organized by

The NSF Research Committee on Science Education

Programme

Venue : **NSF Auditorium**
Date : **Wednesday, 28th January 2004**
Time : **9.00 a.m. to 4.30 p.m.**

9.00 a.m.	Registration	
9.15 a.m.	Lighting of traditional oil lamp	
9.20 a.m.	Welcome Address	Prof. Ranjan Ramasamy Chairman, NSF
9.25 a.m.	Introductory Remarks	Dr Sunethra Karunaratne Chairperson/RC
9.30 a.m.	Future prospects of CAL : Sri Lankan Perspectives	Prof. V.K. Samaranayake University of Colombo School of Computing
10.10 a.m.	**Discussion**	
10.20 a.m.	**Tea**	
10.35 a.m.	CAL in Tertiary Science Education – The Indian experience	Dr Abhai Man Singh Former Director-South Campus University of Delhi
12.35 p.m.	**Discussion**	
12.45 p.m.	**Lunch**	
1.30 p.m.	CAL in Secondary Science Education The Indian experience	Dr Kamlesh Mittal NCERT, New Delhi
3.30 p.m.	**Discussion**	
3.40 p.m.	Re-shaping National Education with Learning Technologies	Dr P. Kumarawadu SLIIT
3.55 p.m.	Educational Software for Senior Secondary Science Education	Mr D.A. Jayalal Chief Project Officer, NIE
4.25 p.m.	**Discussion**	
4.30 p.m.	Final summing up	Dr D.A. Ponniah Warden – St. Thomas College

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An Approach to Computer Assisted Learning of Science at the University Level

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*Former Director South Campus and Professor of Physics

ABSTRACT

The invention of the tiny transistor in 1948 (W.H.Brattain) and imagination of J.S.Kilby that transistor, resistor and capacitor can be fabricated on the same semiconductor chip and successful laboratory demonstration of the first integrated circuit mircrochip in 1958 has given birth to the electronics and digital revolution. The present day computers are only the most recent manifestation. The convergence of the capabilities of modern computers with telecommunication has further revolutionized the technology for information communication and storage (popularly called information technology IT). As a result, any computer on a network today can access information stored in any other networked computer anywhere else in the globe (Internet). It comes as a no surprise that this phenomenal technological change has been so rapid that the society has not yet been able to fully understand and absorb it and its implication in different spheres of life. The empirical observed trend in 1960 by Gordon Moore (cofounder of Intel) that number of transistors on a silicon chip had doubled every 18 to 24 months popularly known as Moore's law has proved to be a reality in the past four decades resulting into more powerful computers at reduced prices. This has made possible to explore the application of this technology in various fields even in developing nations. One of the most important application is teaching and learning process. This is because education armed with knowledge and skill is the currency of the today's technology oriented world. The potential of IT in improving the teaching and learning process of age old class room education has yet to be fully exploited.

Conventionally the class room teaching is supported by text books and/or lecture notes. However, the need for supplementing class room teaching by audio and video especially for better understanding of the basic principles in science started almost forty years back by using video recording and projectors. This suffered from the draw back that the storage and text media were different and only one could be used at a time. The digitization of text, audio and video signals has made it possible to store all the information on the same disc- hard disc of computer or Compact Disc (CD) and it can be retrieved by a computer. **The e-learning (computer assisted learning) program employs multimedia presentation of a subject i.e. includes text, audio, video and simulation. These techniques result in better visualization of the subject and hence retention and understanding of the subject is expected to be better.**

The information stored in a computer can be accessed by another computer (student's) if the two computers are connected in a network with appropriate software

and hard ware. The two or more computers can be networked either by intranet (with in an organization) or Internet (globally). The information stored in a floppy disc or CD can be accessed by a stand alone computer with required hardware and software. The e-learning especially through internet has revolutionized the learning because:

i. It concentrates on learning around student and not the age old concept of class room i.e. technology suits the students need not the student suiting to technology requirement (pace and style of class room teacher).
ii. It focuses learning on the strength and needs of the individual learner rather than on the teacher.
iii. Self paced learning so that learners can learn at the rate they prefer.
iv. Provides convenient access to learning any time at any place.
v. Encourage learners to browse for information through hyperlinks to sites on the world wise web.
vi. Develop technical abilities to use the Internet.
vii. Encourage students to take responsibility for their learning and builds self knowledge and self-confidence.

Seeing the importance of e-learning in imparting education formal-computer assisted learning along with class room teaching and distant education sector, initiatives were taken world wide to promote e-learning. Different Governments as well as International bodies have also initiated programs in this direction. The first to initiate programs in a big way was USA under the National Education Technology Plan of the US Department of Education. The teaching materials for primary, secondary and university level have been developed and several of these are available on the web, although many of them can not be downloaded. Europe has also prepared an Action Plan for e-learning involving 30 countries and a budget of over Euro 850 million (from 1st January 2000 until 31st December 2006. The main objective of the program is to create a Europe of knowledge, providing a better response to the major challenges of this new century:

i. to promote life long learning
ii. to encourage access to education for all and
iii. to help people acquire recognized qualifications and skills.

The initiative in India has been in for all the three levels primary, secondary and tertiary (university level), we shall concentrate at the University level. The e-learning requires some basic infrastructure facilities. The infrastructure requirement for Internet connectivity is expensive, while the hardware/ software requirements for the preparation of multimedia Compact Disc (CD) is definitely not that simple as a computer to retrieve the information stored in the CD. The development of learning material (Content) is the most difficult part whether it has to be placed for Internet/Intranet access or to make CD. The content can be digitized by using software tools/packages available commercially or from open source. The content has to be subject and topic specific requiring the inputs from the experts in the subject and topic. This provides a module/educational software

package for a subject. Apart from text and audio the content should incorporate video, simulation, quizzes etc. so that it can have right impact on the learner. Obviously educational software packages cannot be developed at all the institutions or small IT companies because of hardware, software- infrastructure and professionals, along with the subject experts are not available at one place. The major thrust so far in different organizations has been on CAL for software (IT), technical and professional education. However, the initiative on science education has now started for example the project entitled "Developing Web Based Intelligent Interactive Tutoring (Web IIT)-IIT Delhi aims at developing web based intelligent interactive tutoring system for four basic subjects- Physics, Chemistry, Mathematics and IT.

The University level education and training in science starts from teaching courses in specific areas leading to Bachelors and Masters degree, as well as research in a specialized area leading to a doctorate degree. In science apart from theory the experiments constitute an essential part of teaching. In research availability of scientific journals is as important as the basic infrastructure facilities. The possibility and importance of developing computer controlled conventional laboratory experiments in physics is briefly discussed. The CAL at the University level should encompass all these aspects.

In conventional Universities different Government Organization have joined hands to provide internet and intranet connectivity to all the Universities of India. The road map for this is briefly presented. **The major emphasis is to mitigate the problem faced by the Universities in procuring research journals. The way this problem is being tackled is briefly discussed.** As aid to classroom teaching, to begin with, instructors are taking recourse to those web site of different Universities across the globe in which the developed teaching material conforms to their style of teaching this is explained by some examples. The need of a teacher in making better understanding of the learning material in a web is elaborated by practically demonstrating a relevant educational web site of an American University.

The computer assisted learning has revolutionalized the distance education and Indra Gandhi National Open University (IGNOU) has taken big initiative in developing software packages CD for various computer courses. The organization and presentation of these teaching materials will be demonstrated. The other major responsibility of IGNOU is the development of educational material and software packages for different courses. To begin with the TV programs in science developed by IGNOU have been converted to multimedia CD (DVD), a couple of such CD's will be demonstrated. The availability of different educational materials at IGNOU will be handed out.

Another aspect covered in the talk is the finding of collaborative web based sharing of teaching a particular course between Institute of Informatics and Communication and Brighton University U.K. The advantages of regional collaboration in CAL of science are pointed out.

Computer Assisted Learning in Secondary Science Education
An Indian Experience

Summary

The basic aim of any form of education is to gain knowledge and use it effectively. School computing started in India in early eighties with the launching of the Government of India's project Computer Literacy and Studies in Schools (CLASS). The role of Information Technology (IT) in Education has been well recognised in Government of India's IT Policy (1998) and a promotional campaign Operational Knowledge proposes to universalise IT and IT-enabled education as a tool for transaction of curriculum at all levels of education. Computers have become an integral part of the curriculum. These can be effectively used in education be it for Computer Assisted Learning (CAL)/ Computer Based Learning (CBL) or Computer Assisted Teaching (CAT). However all these together are better termed as Computer Based Instruction (CBI)/ Computer Assisted Instruction (CAI). CAI has been shown to be effective and in many ways, provides an enjoyable learning experience. It is an interactive, self-paced medium that helps maintain the interest of the learner. A number of Indian Examination Boards have introduced Information Technology (IT) as a subject at the secondary and senior secondary levels. The computer teacher cannot impart computer-aided education, in the long run, therefore, all teachers should be able to handle the technology and integrate it into the teaching learning process. The IT-enabled education uses the computer and communication technologies as tools.

Different initiatives have been taken up by different organisation to achieve above objectives. These include framing of the appropriate IT-derived curriculum, training of teachers, pre-service and in-service both, to adopt the computer oriented technologies and methodologies to impart IT-enabled education and above all , there must be development of appropriate software packages for CAL to be used by the schools for effective transaction of the curriculum. Development of software for CAL three things must be known,

- It is a curriculum development process.
- The development team should be able to establish the relationship between the goals of the curriculum and capabilities of the technology.
- The product should help achieve these goals.

If integrated meaningfully CAL will have positive impact on student learning of fundamental science concepts and reasoning skills.

National Council of Educational Research and Training, an apex organisation for School Education has taken up the initiative to integrate ICT in school system and efforts are being made in the area of Curriculum framework, training of teachers and development of curriculum based multimedia software for schools in different science subjects.

Dr (Mrs) Kamlesh Mittal
Reader
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New Delhi