Computer Assisted Instruction (CAI): Development of Instructional Strategy for Biology Teaching

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Abstract:
Science is a systematic knowledge of our environment. Science education has become mandatory at all level of education from primary to higher education as recommended by University Grant Commission. The Indian Education Commission (1964-66) recommended to teach Physical and Biological Sciences from the primary level. Biology is one branch of Science which deals with natural phenomena and it develop scientific understanding, Attitude, Scientific Skills etc. National Policy on Education (1986) emphasized the need of achieving minimum levels of Learning at school level. This may help teachers in organizing meaningful teaching learning experiences and adopt innovative methods and approaches in teaching. Computer assisted Instruction (CAI) is a supplementary instructional strategy in effective teaching, in the same line CAI is also used in Biological Science teaching. In this paper, researcher elaborates use, utility and importance of CAI in Biology teaching.

Keywords: CAI, Biology, Photosynthesis, Macromedia Flash MX

Introduction

Computer plays an important role in different fields of Education. Nowadays, government provides good Infrastructural facilities like Smart Board, Computers, LCD Projector under the scheme of Information and Communication Technology in Schools (ICT in Schools) during the XI Five year Plan between 2007-2012 to promote ICT based learning (MHRD, 2010, b) and with the effort of teachers, teaching learning process makes effective and interesting. Use of Computer in the schools is more than expensive and entertaining toys; they evidenced that educational microcomputer use truly enhances learning in democratic way (Ranade, 2001).

According to Khirwadkar (1998), use of blackboard being augmented with lessons, prepare with the help of Computers. Computer Assisted instruction (CAI) add action to the information which students receive through one way process and help students to see the unseen, to test the theoretical concepts and to comprehend abstract ideals. CAI students had better attendance rates, showed higher motivation and cooperated better with peers.

Since the beginning of the human civilization human being have tried to understand the nature around them. This Nature comprises of plants and Animals. The Study of plants and Animals, their life and life Patterns is included in the content of Biology (Tomar, 2005). The role of Science is to find out reason behind different happening in the world and it is happened by Visualisation. In the same way Biology also require proper visualization of different concepts. Students learnt and understood concepts by proper visualisation and they remember the concept for longer period. Most of Indian Biology Classroom does not have that much strength as compare to other branches of Science. So teacher can teach student in better way by using Computer.
The potential benefits of Computer Assisted Instruction (CAI) cannot be underestimated in the contemporary world. Computer Assisted Instruction (CAI) plays very crucial role in teaching content effectively. A lot of studies were carried out on use of CAI in education mainly in the abroad country. But still there is requiring lot of attention needed on study of CAI in Indian context.

Place of Biology in School Curriculum

Instruction in Biology starts at the primary School level. Biology constitutes a significant component of the Science and studied by all Students till the middle school level. At the Secondary School level, Biology becomes a part of Science textbook. The process of channelization starts at the higher secondary level with a largely irreversible selection of future choice. Biology has two main branches: Botany and Zoology. Botany deals with the scientific study of Plants and Zoology deals with the Scientific Study of Animal. Other than these two branches, it comprises new branches Microbiology, Biotechnology, Pathology etc. Two main Branches of Biology: Botany and Zoology further divided into Morphology, Physiology, Ecology and Anatomy (Tomar, 2005). It comprises complicated terminologies, deeply study of different organisms, study of nano technology, molecular Biology, Genetics etc. and school teachers are also facing difficulty in teaching such kind of concepts. Of course teacher has good content knowledge but sometime they failure in express themselves and other problem is lack of adequate resources through which teacher teach biology in better way (Ahmed, 2009).

Objectives of Teaching Biology at Secondary and Higher Secondary level

As per Tomar (2005) and NCERT (2006) following are the objectives of teaching of Biology:

- know the facts and principles of science and its applications, consistent with the stage of cognitive development,
- acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge,
- relate to the natural environment, local as well as global, and appreciate the issues at the interface of science, technology and society,
- acquire the requisite theoretical knowledge and practical technological skills to enter the world of work,
- nurture the natural curiosity, aesthetic sense and creativity in science and technology,
- Imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment, and cultivate ‘scientific temper’-objectivity, critical thinking and freedom from fear and prejudice.

ICT has enormous potential to make education meaningful and utilisation of it in right direction makes education systematic and applicable in real life also. Many problems in Biology like visualisation, lack of linkage with real life may be minimized with the effective use of CAI.

Computer-assisted instruction (CAI)

Computer Assisted Instruction (CAI) is a program of instructional material presented by means of a computer or computer systems. Drill and practice software is generally called Computer-Assisted Instruction (Jurich, 2001 and Cotton, 2001). Computer-assisted instruction (CAI) is that in which teacher use computers at different times and spaces
according to the characteristics of the subject matter, the students and the available software and hardware. Most recent CAI software integrates features that encourage activities beyond the simple drill-and-practice, such as simulations, graphing and even modeling (Kara et al 2007, Jurich, 2001, Barot, 2009 and Yusuf, 2010).

According to Andrews (1992), CAI is tutorials (drill and practice — response oriented interaction), problem solving (laboratory and lecture exercises), simulation exercises (in lecture or laboratory settings), enrichment programs, remedial learning (continuous and repetitive), games (applications of problems or concepts) and testing (test banks with evaluation and analysis). According to Barot (2009) computer provides immediate feedback letting students know of their achievement.

Development of CAI

- **Identify Problem area**: Select the Unit area where students are having problems and there is really a requirement to develop CAI.
- **Design Specific Objectives**: After identifying the problem, design objectives related to the problem.
- **Develop CAI Programme**: After completion of the program material, it should be programmed through the Computer Software for converting it into CAI. Different software are used are Microsoft office Flash, Corel Draw, Page Maker and many other graphical software. Most commonly used software is PowerPoint. For the first time, teachers can easily modify and even produce their own CAI material based on the needs of their own classes. (Khirwadkar, 1998; Ranade, 2001; Andrews, 1992 and Barot, 2009).

CAI in Education

A great deal of research has been conducted during the 1970s, 1980s, and early 1990s on the effects of computer use on student achievement, attitudes, and other variables such as learning rate. This research covers a wide range of topics, from computerized learning activities which supplement conventional instruction, to computer programming, to computerized record keeping, to the development of databases, to writing using word processors, and other applications. The research on the effects of computer usage on a large number of outcome areas were conducted, including, mathematics, language, arts, reading, science, problem-solving skills, and health and social studies. Well-designed and implemented tutorial CAI, used as a supplement to traditional instruction, produces an educationally significant improvement in students’ final examination achievement (Cotton, 2001). When a teacher in the classroom applies this creative ability to use computers, enormous possibilities do exist for maximum learning. After studying more than 30 researches, Cotton (2001) concluded that compared to students receiving only traditional, teacher-direct instruction, students who had the teacher instruction supplemented by CAI were found to learn faster and had better retention rates. They also improved their attitudes toward school and their potential as learners.

Effectiveness of CAI with regard to different subjects likes Science, Mathematics; CAI was found effective in terms of students’ achievement at school level. It is worth nothing that CAI was effective not only for effective dimensions such as Attitude, Interest, and Behaviour pattern. Although large majority of the studies have reported that higher attitude in different subjects at the secondary level is needed but were mainly confined to the science subjects. Effective use of computer in education emphasized since last 30 years but
most of studies were carried out mainly in foreign countries and as demand of CAI accelerated in India, studies were carried out during 1990 in India also.

Khirwadkar (1998) developed software for Chemistry teaching and further studied effectiveness of CAI on student’s achievement. Ranade (2001) worked on Science teaching through CAI and concluded that thoughtfully designed CAI is indeed effective in bringing about learning, but when the teacher is really good, a few students prefer traditional face-to-face teaching to CAI. The packages when used in the self-learning/group learning mode can be a better alternative to ineffective teaching. Barot (2009) conducted research on effective use of CAI in Sanskrit. Likewise many studies on Science, Mathematics were carried out in India. But not a single study is carried out on Biology which signaled investigator to study effective use of CAI in Biology.

Benefits of effective use of CAI

- **Self-paced learning opportunities**: Learner can learn the content as per his capacity and can repeat the task if not understand by the learner (Barot, 2009; Yusuf, 2010 and Cotton, 2001).
- **Immediate feedback to the student and the instructor**: Immediate feedback motivates learner and give direction and if answer of students is wrong then it will help him to correct his mistake (Barot, 2009 and Khirwadkar, 1998).
- **Automatic adjustment to ability levels of students**: CAI programs design in such a way that it helps both brilliant students as well as slow learner. It is flexible as per user’s need (Andrews, 1998; Barot, 2009 and Ranade, 2001).
- **Continuous interaction**: Continuous interaction should be possible with CAI. (Khirwadkar, 1998; Barot, 2009).
- **Flexible time scheduling for the students and the instruction**: Programme have flexibility in terms of time, place and pace (Barot, 2009; Yusuf, 2010; Ranade, 2001; Kara, 2007 and Cotton, 2001).

Problems in teaching of Biology

After reviewing studies of Ranade (2001), Kara (2007) and Andrews (1992) it was elucidated that Biology subject has following major problem areas that cause ineffective learning:

- Students have serious misunderstanding about biochemical and genetics concepts, even concerning the basic scientific content related to biological inherence.
- Students face problems in genetics terminology, students may get confused because terms look and sound very similar.
- Sometime students do not understood the concept due to ineffective teaching in the classroom. In Indian classroom, most of the teachers adopt lecture methods. But concept of genetics and biochemistry are not easily understood by lecture method.
- Many teachers are not adept at using quick sketches to explain certain content, or in drawing diagram. Some do not possess a big enough knowledge-base to link scientific content with day to day life example.

After reviewing different research studies of Kara et al (2007), Jurich(2001), Barot(2009) and Yusuf (2010) on Computer Assisted Instruction, researcher mentioned following recommendations:

- CAI provides students with broad understanding of Biology and its utilisation in real life.
CAI familiarizes students with range of concept application in all walks of life and the computers’ potential as a controlling tool.

CAI should be introduced at the Higher Secondary level at the outset to be followed by the Computer literacy at Secondary and primary school levels.

Computer Education should be the part of school curriculum.

Computer literacy programme would enable student to become familiar with Computer and its potential as a versatile tool with application in all aspects of human endeavors.

Students are not ready to take biology because biology has so many branches and require lots of potential to do the things. To overcome such types of problems computer assisted instruction software packages and developed programs can be used and different videos related to content is easily available on the internet.

CAI in Biology


- Ensure that CAI Activities are integrated into curriculum.
- Do not overuse CAI
- Plan for use of CAI well adjusted to Infrastructure and Resources available
- Maximize Interactivity
- Allow Different rates of Progression in Class, but ensure that all students reach the Objectives
- Ensure students understand the scope and objectives of Assignments
- Be sure students understand the models presented on the screen
- Assess and Evaluate student Performance while using CAI

A computer enables repeated trials of experiments with considerable ease in a limited time, provides immediate feedback, allow stimulus, observation of graphical representation and offers a flexible environment that enable students to proceed with their own plans (Ahmed, 2009; Kara, 2007 and Andrews, 1992). Studies carried out by researchers on use of computer assisted instruction in biology found that most of the students of secondary and higher secondary level having problems in the molecular biology and in the area of genetics. And CAI is very helpful to minimize such problems. (Kara, 2007; Costa et al, 2008 and Ahmed, 2009). One example of using CAI for teaching concept of Photosynthesis at secondary and Higher secondary level which is showing as below:

Teaching of Photosynthesis with the help of CAI

Photosynthesis is probably the single most important process on the earth. This food-making process by plants creates the base of the food pyramid, by providing all living organisms with, energy, and perhaps most importantly, oxygen. Photosynthesis can be expressed using this simple equation:

\[
\text{Light energy} \\
\text{Chlorophyll} \\
\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{Food} + \text{O}_2 + \text{H}_2\text{O}
\]

Photosynthesis is a basic concept and student must understand basic concept properly otherwise it will create lots of confusion in future learning. In this regards CAI by the means
of Animation or Video on Photosynthesis helps students and teachers to understand concept easily. Most of Indian Biology Classroom does not have that much strength as compared to other branches of Science. So teacher can teach student in Better way by using Computer.

**Development and Implementation of CAI contains following two steps:**

1. **Develop CAI in form of Animation/ Video:**
   Animation or CAI is effectively created in different softwares like Macromedia Flash MX, Corel Draw or even in Microsoft office.

2. **Implementation of Program in Classroom**
   Computer system with Projector connection and other external devices like Speaker is mandatory of effective CAI implementation.

**Example of Implementation of CAI on Photosynthesis is given below in few steps**

   Home Page of the CAI on Photosynthesis containing Button for Start animation. Click the button to start Animation.

   ![Example of CAI implementation](image)

   Basic idea of Content of CAI is given as per the requirement teacher or student can click on it and went to that link.

   ![Example of CAI content](image)
After Clicking Definition of Photosynthesis it will show Definition of the Photosynthesis

**Definition of Photosynthesis**

*Photosynthesis is the process when organic compounds are synthesized from water and carbon dioxide in the presence of Sunlight and chlorophyll*

Definition is followed by the Procedure of Photosynthesis

**In the Leaf, Chlorophyll captures Sunlight and powers the reaction. Carbon Dioxide and Water combined and like this form Oxygen and Water**

In the Presence of Light energy collected from the sun, used by plants to combine carbon dioxide and water in the Chloroplast food source.
Photosynthesis process is only possible in the presence of light. So it is close in the night time.

All Process Stopped when sun come down (Night)
When Sun rise again in the morning then photosynthesis process is stated again.

*When the 'Sun' comes up again the combined molecules Oxygen come Outside the Leaf and Sugar come into further Proces.*

Final product of the photosynthesis is Sugar which is used by the Plant in further process and Oxygen Come out from the Stomata.
At last, CAI can explain whole process as a concluding remark.

Like this concepts of Biochemistry and Genetics can be taught effectively with the help of CAI. With the help of CAI and animation, lifelong learning is possible that is major goal of education. Students learnt basic concepts and through effective use of CAI, they will understand concept easily and it will help a lot in future.

Conclusion

After reviewing studies conducted on use of Computer Assisted Instruction and its effectiveness in different subjects, researcher concluded that CAI is also very useful for the achievement of students in biology subject. CAI can be used as the supplementary tool by the teachers to overcome the problems of Science like lack of visualisation and it may minimize constraint of education. CAI can never replace good Teaches but it complements them and helps in easier and faster learning of content.
References


