Science Teaching through Computer Assisted Instruction: Research Findings and Insights

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Significance of the Study

The day may not be very far off when most Indian classrooms have a computer. Everyday teaching through computers can then become possible. However, educators, administrators, researchers and parents all have doubts about its real learning value. While no one denies the need for making every student computer literate, there are misgivings about the effectiveness of computers for teaching. We would like to see some evidence that computers in classrooms are more than expensive time-wasting toys; that use of computers for teaching enhances learning in demonstrable ways.

In western countries, a great deal of research has been conducted regarding the effects of the use of computers as a teaching tool on student achievement, attitudes, learning rate, retention, etc. (Cotton, 2001). In India, however, not much research or meta-analysis has been conducted in this field. It would indeed be worthwhile to find out if Computer Assisted Instruction (CAI) has the potential to bring about increased achievement in the Indian context, and how it compares to general classroom teaching.

Science is an important subject in the school curriculum that has two major problem areas that cause ineffective learning:

The Limitations of the Teacher: Most Science teachers have in-depth knowledge only in their chosen elective such as Physics, Chemistry or Biology that is required to teach fundamental concepts in the discipline, but they are hampered in teaching other branches which they must teach anyway. Many teachers are not adept at using quick sketches to explain certain content, or in drawing diagrams in Biology. Some do not possess a big enough knowledge-base to link scientific content with day-to-day examples. For effective teaching of Science, teachers need to collect ample background information, for which they may not have the resources, time, or inclination.

Lack of Audio-visual Aids: Teachers often need to carry several charts, equipment, specimens, etc., even for teaching a single topic effectively. However, often these materials are either unavailable or inaccessible; moreover, teachers do not have enough time between classes to procure and test it for its usability. Hence, most Science classes are limited to uninspiring, and sometimes, incomprehensible verbal lectures.

It is believed that computers can not only help overcome these problems, but the vastly greater potential of this technology as an effective teaching aid will cause a quantum leap in the quality of science teaching and learning.

However, in the past, new technology in teaching-learning has not always proved effective. Most science teaching material available for use by teachers was not able to accommodate the individual needs of the teacher. For example, educational films produced abroad did not match the local curriculum and were hard to understand due to different accents.

Today, general-purpose, easy-to-use software such as Microsoft PowerPoint® has become available. For the first time, *teachers* can easily modify and even produce their own CAI material based on the needs of their own classes.

We therefore need to study afresh the utility of the current generation of hardware and software in teaching-learning, and conduct research on what techniques are effective.

Procedure of the Study

I have trained several M.Ed. student-teachers to prepare CAI material for teaching of specific units of Science at the secondary level. They studied its efficacy in terms of student achievement, interest, and reactions. We chose Microsoft PowerPoint as the presentation medium for its ready availability, ease of learning, and because many teachers have learnt to use it. Several such presentations were developed, both in English and the regional language, Marathi, and tested in various schools. About a dozen such researches have been conducted since 1999. In this paper, I do a meta-analysis of the findings of these researches.

Over the years, my experience with preparation of presentations as also the observations of students and their reactions to the presentations led to the development of several useful techniques of teaching-learning that enhance the effectiveness of a presentation.

Some of these techniques are

1. Content analysis of previously learnt related content and a short initial quiz to jog students' memory

2. Use of advance organizers to provide students with "mental hooks" to attach new learning to

3. Use of principles derived from the theory of multiple intelligences

4. Use of visuals to complement the words

5. Use of interactivities such as "think-pair-share" exercises

6. Use of rhetorical questions, puzzles, quizzes, etc. to stimulate thinking

7. Use of hyperlinks to provide extra information on the topic, as well as to explain some basic concepts for students in need of extra assistance

8. Use of formative evaluation

9. Step-wise instructions and figures specifically targeted to improve diagram-drawing skills

10. Some of these features will be demonstrated through a PowerPoint Presentation.

Research Design

Single group and control/comparison group pretest-posttest designs were used. Efficacy of CAI was compared with regular classroom teaching, studying from the textbook, or from plain text files on the computer. Retention of content over time was also studied.

Findings of the Meta-analysis

◆ Students were given rating scales or rubrics to rate the usefulness of various features included in the presentation. Most students reacted very positively to these features.

◆ The response of students to CAI has been overwhelmingly positive.

◆ It led to greater inter-student interactions.

◆ 't' tests for comparison of pre and post-test means have revealed that CAI has in every case led to increased achievement.

◆ Its efficacy has never been found to be less than regular classroom teaching or regulated self-study from textbooks.

◆ In 92% cases, it has proved superior.

◆ While visually enhanced and non-enhanced presentations were equally effective in bringing about learning, the former led to better long-term retention.

◆ Differences were observed in the way girls viewed the presentations as compared to boys. Girls were far more systemic, followed a linear mode of viewing, and took much longer to view the presentations.

◆ Teachers who saw the presentations were keen on using them in their classrooms.

Insights Derived from the Meta-analysis

◆ 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 bad teaching, but can never replace good teachers. They can only enhance their effectiveness.

◆ These packages can be best used as visual aids to supplement classroom teaching (shown on a large T.V. or as LCD display.)

References

Cotton, K. Computer-Assisted Instruction, http://www.nwrel.org/scpd/sirs/5/cu10.html (Last Update: 31/8/01).