CAL in Computer Education and Training: Issues and Challenges

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Abstract

The applications of computers are growing rapidly, and expectations of this technology are growing at the same rate. One of the newest branches of computer application is Computer Aided Learning or CAL. Although computers and educational packages are generally in use today, Computer Aided Learning in the future will be even more essential and important. Today computers are used as a big, fast encyclopedia or data book, a tape recorder, type writer or video, but in the future CAL systems will contain smart adaptive trainers that will adapt themselves to learners' features and propose the best method of teaching. Again, we will have more remote learning and video conferencing instead of today's traditional classes. CAL now is a new idea, but as time goes by, it will become very important and wide-spread.

CAL is the interaction between a student and a computer system designed to help the student to learn. The CAL name is intended to emphasize 'learning' rather than just 'instruction'. In education, CAL shall be, when it is pedagogically and economically sound, to increase student learning and to broaden the range of learning opportunities. CAL includes drill and practice, tutorials, simulations, and microwares and also computer managed instruction.

In this paper we have emphasize on issues as basic objections to computerized education, challenges of CAL, good and bad practices in CAL software development and challenges for the teachers.

Keywords: Computer Aided Instruction (CAI), Intelligent CAL, Computer Based Instrction (CBI), ITS (Intelligent Tutorial System), CATAT.

Introduction

Mechanical machines always had certain limited areas within which they could operate, until computers arrived. Computers serve as extensions of human minds, abolishing many restrictions that once bound machines. Neither a mind nor a computer can carry people or materials or cut and shape metal. Both can, however, direct other machines to perform these actions. Computers share the power of the mind because they are directed by, and are completely dependent upon, the directions that intelligence and imagination give them. They follow these instructions slavishly. This ability to adhere to written or oral instructions differentiates computers from all other machines and is a very specific dominant attribute. These instructions are known as programs or softwares. Each instruction for a computer is a simple statement that a machine can read and interpret. One programming instruction can be joined with hundreds or thousands of others. Together they provide awesome power. They can command computers to carry out actions and ideas that are complex in nature and some of them that had never previously been contemplated outside the realm of pure human intelligence. However, without human programming, computers are useless. With it, however, they emulate the minds that guide them, but add two startling improvements: blinding speed and a massive memory. These additional attributes explain why computers can exceed the power of the minds behind them. Speed and memory, combined with the creativity of the human minds directing them, are the attributes that have enabled these machines to pervade and conquer the world with astonishing swiftness.

Education and technology worldwide is changing from standardization to cutomerization, from educator-centered or teacher centered to learner-centered and from memorization to understanding. Learners are expected to direct their own learning, pace their learning activities and to become life long learners.

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today, Computer Aided Learning in the future will be even more essential and important. Today computers are used as a big, fast encyclopedia or data book, a tape recorder, type writer or video, but in the future CAL systems will contain smart adaptive trainers that will adapt themselves to learners' features and propose the best method of teaching. Again, we will have more remote learning and video conferencing instead of today's traditional classes. CAL now is a new idea, but as time goes by, it will become very important and wide-spread.

The level of interaction between the learner and the computer is important. Increased levels of interaction should permit greater learning. For example, many educational programs are converting to a Windows interface because they assume that this interface is more "user-friendly" for the student but it is not the technology itself that makes a CBI (Computer Based Instruction) program an effective tool; it is the ability of the learner to interact with the learning situation. This is the measure of the effectiveness of any learning tool. Thus, two factors are important to remember: First, learner training in the technology can be as important as the technology itself; and second, anything a computer can do, a human can do. Unless the computer is more efficient than the alternative learning method, it lacks value as a learning tool.

Some of tools are given as:

1. Tutorials
2. Drill-and-Practice (Review)
3. Simulation
4. Games
5. Utility/Problem Solving
6. Multimedia and Hypermedia

1. Computer Aided Learning (CAL)

The CAL is same as CAI, but CAL emphasizes 'learning' while CAI emphasize on 'instruction'. It is the interaction between a student and a computer system designed to help the student to learn. Although computers and educational packages are generally in use today, Computer Aided Learning in the future will be even more essential and important. Today computers are used as a big, fast encyclopedia or data book, a tape recorder, type writer or video, but in the future CAL systems will contain smart adaptive trainers that will adapt themselves to learners' features and propose the best method of teaching. Again, we will have more remote learning and video conferencing instead of today's traditional classes. CAL now is a new idea, but as time goes by, it will become very important and wide-spread.

Authoring tools like Authorware Professional are becoming more powerful and can be used by people without the need to have any programming knowledge, i.e. they can be widely used by teachers to prepare their own courses. Of course, it is not clear whether they will really make use of these tools. How many of the teachers make use of their writing abilities to write their own textbooks? It is more realistic to see teachers willing to adapt existing CAI-courses to their own preferences, adding new materials to already developed courses. If we want to see teachers taking a more active role, we have to provide them with help in the design of the course, to ensure that the course really covers all-important concepts in the domain and achieves some goals. However, there is a significant shortage of tools for curricula development.

2. Basic Objections to Computerized Education

In recent years, several new technologies have been developed that were touted by their adherents as able to revitalize education. Teaching machines, audio-visual presentations, movies and videos were hailed as potential saviors that would bring a dynamic transformation into schools. Education withstood each of these intrusions and emerged virtually unchanged. The reaction to claims that any new technology can make a major upheaval may be greeted with amused disbelief and quickly dismissed by some authorities. They've heard this trite assertion before about these other novelties and nothing happened. Why expect this latest gimmick to upset a system that has shown itself to be inflexible for over a century?

This time, however, we are dealing with machines (computers) whose range and powers are unprecedented. Their unique qualities have enabled them to countless revolutionize in other fields. No previous invention has forced similar upheavals. Computers can bring excellent changes and modification in education what they have done elsewhere: they can bring a total revolution. Merely because other educational modifications have been unduly praised and have failed, is an ineffectual argument of practioners teachers to prove that no invention can ever revolutionize schools or add on the capabilities of teacher and living classrooms.

Even acknowledgment of the power and unique characteristics of computers does not ensure their immediate acceptance. Arguments against assigning a vital part in education to computers are manifold, such as-

1. How could a machine do what my teacher did for me in the class?
2. Machines will break down, and students will be left with nothing to do.
3. Computer programs always have bugs, and again the students will be left without material.
4. Computers can teach only certain facts, not the important higher-order thinking.
5. The cost of giving every student a computer is prohibitive.
6. A machine cannot make judgments that a human can make.
7. A machine cannot teach values.
8. A machine cannot develop natural, instant and frequent interaction among students.
9. A machine cannot give necessary emotional support and meaningful personal attention to students.
10. Pupils can waste their time if no teacher checks on them or available to them for assistance.
11. A school system with computers as teachers will turn out into automatons without warm and friendly human relationship.
12. Some students will be unable to use computers either through fright or incompetence and could not receive any education.
13. Computer-based instruction is not cost-effective.
14. Computers will replace teachers.

3. Intelligent CAL systems

In computer science, 'Artificial Intelligence' is an important subject and refers to that category of research which tried to give computers some abilities like a human brain, such as speech recognition, image understanding, and recognition, synthesizing, analyzing and decision making. (Burns-Capps ,1988) Successful implementation of an artificial intelligent system is always a very difficult engineering problem, because traditional and typical computers do not have any sign of intelligence.

3.1 Characteristics of an intelligent CAL system

A brief review on the characteristics of some implemented intelligent CAL systems will be helpful for understanding their features and abilities. Nakabashi et al introduced Computer Aided Learning Authoring Environment and Tele Education (CALAT), which is an intelligent tutoring system on the World Wide Web (WWW). Users via a typical web browser can access CALAT server, which has been installed on the CALAT server computer. CALAT is organized by a goal-sub goal scheme and has three types of courseware pages: explanation, exercise and simulation. (Nakabashi et al, 1997) Terauchi et al have discussed a system for learning Japanese sign language with three-dimensional placement of hand motions. This system has been designed for translation from Japanese to sign language and gets Japanese sentences as input and generates and shows sign language motion pictures on the screen. Generalizing of such a system could be very useful in the educating of hearing impaired people. (Terauchi et al, 1997) In recent years many attempts have focused on the distributed systems and because of Internet standardisation, many designers have selected this as the base platform. For instance Brusilovski et al have reported on a distributed intelligent system on the Web. The system is adaptive and can customize student features and is implemented in calculus teaching. (Brusilovski, 1997)

4. Challenges of Computer Assisted Learning (CAL)

1. Declining Teachers' Role

The idea of substituting CAL systems instead of teachers is not logical and rational. The human relationship between students and teachers can not be generated by a machine, even the most expert machine of the world. Besides this, even a Nobel Prize winner's lessons are not comparable to a good teacher. (Oblinger-Rush, 1997), but such a CD could be a good companion and complementary.

2. Wider Gap

CAL systems are expensive and need some platforms and peripherals for running, and these facilities are expensive too. Thus developing countries and less-wealthy education centres can not use them. Consequently, the gap between teaching qualities of those two categories will become wider. Nowadays, the Internet and rate of Internet use has generated such a gap too.

3. Poorer Social Behaviour

As mentioned above, group working is a necessary skill for every one in the work places. Some CAL facilities, for example video conferencing, will decrease students' in-class hours and will increase self-work hours. Therefore social relations and students' co-operation may decline. Sommerville (Sommerville, 1994) reported on such a problem in the behaviour of task-oriented computer programmers.

4. Losing Academic Traditions

Education has been used as a tool for training students for society. For three thousand years, students have not only been educated, but have also learned about good ethics and responsibility in schools and universities. (Oblinger-Rush, 1997). The majority of students directly or indirectly are affected by their teachers' behaviour and morals and repeat them. This prototyping procedure is not possible in excessive CAL-oriented methods.

5. CAL

CAL may be poor at developing teamwork skills, communication and interpersonal skills being a one-to-one system whereas these skills can be enhanced only in group. Recently some researchers have started to explore the area of collaborative learning, which has the potential of promoting these skills.

5. Good and Bad Practices in CAL Software Development

The following points can be measured in CAL software development:

1. The primary focus of CAL should be on material that truly aids learning. A surprising amount of learning material is vague in content.
2. Good CAL software requires a high quality of academic input from discipline specialists for its design.
3. Many CAL programs currently being developed are heavily influenced by the hardware and software limitations. Education is technology dominated.
4. CAL material should present text and graphic materials to learners in a coordinated manner and use the exercises and questioning techniques in a way that learners throughout active in the learning process.
5. A critical problem is the failure to realize the potential of the computer as an interactive medium. Poor software packages, even multimedia ones, display too much for students to read on the screen before doing anything.
6. Long messages should be avoided in a CAL program as it is found that students do not read them fully. Brevity and accuracy should be balanced to retain the context. Messages should appear at the same place to retain consistency.
7. Immediate feedback results in better retention of subject matter than delayed feedback.
8. CAL programs should allow students to exit the program at their will to avoid frustration.

6. Challenges for the Teachers

6.1 Individualizing Lessons

Even the best teacher finds it a monstrous difficulty to individualize lessons for each student in any classroom. Students are at different learning levels and dedicated teachers struggle continually to surmount this immense obstacle. When computers are used in today's classrooms, problems are intensified because at another level, the computer exists between teacher and individual student.

Theoretically, when using computers, teachers might assign different students to different parts of lessons depending on the progress of pupils. However, it requires that the teacher be able to analyze accurately the condition of the learning of thirty students on that particular day and know the intricacies of the computer lessons with uncanny thoroughness. Even if teachers had these skills, computer programs intended for only one class will lack many instructional steps demanded by the differing requirements of students. If teachers had different programs available, they still could not decide exactly what level of computer instruction was optimum for each student.

6.2: Matching Software to Curriculum

Teachers must choose a software program that they have decided will help them and supplement their instruction, while keeping their curriculum requirements always in the forefront. Programmers can create software that will satisfy the needs of the total curriculum, but only if computers are responsible for the complete education of students. If computers were instructing without a teacher, they would not be bound by predetermined limits of a software package intended for only one class. If a machine discovered that a student is missing information or skills that should have been learned four years earlier, it would return to that level. If it found a student or students ready to go to the next level, it would immediately provide the advanced material. It would integrate learning to a degree impossible today when computers are used only to augment the instruction of a teacher. Again, teachers waste their valuable resources trying to match software to curriculum because software programmers can do it more easily and more efficiently.

6.3: Scheduling Computer Time for Student

Teachers must try to accomplish what would be automatic if computers were responsible for teaching. If students have full access to a machine in computerized education, scheduling problems would vanish. However, providing an individual computer to every student in every classroom is impractical. Most teachers will not use them and the others will employ them only for a small duration/time.

6.4: Monitoring Use

Teachers must try to supervise how thirty pupils use their individual computers. Every teacher, who has thirty eyes operating independently of each other, finds this task is easy and may be a more apt term. For those who have only one pair of eyes and can focus on only one object at a time, it is more difficult and even impossible. Computers are better able to oversee their use by individual pupils than is a teacher. Software programmers could build monitoring into lessons. As a simple example, they could program machines to query students when a certain length of time had elapsed without interaction from the student. The machine would immediately set about solving the difficulty, whatever it might be. It could take appropriate remedial action if frivolous interactions took place. If necessary, programming could alert authorities. Each machine would be responsible for one student instead of one teacher trying to watch and supervise thirty students.

6.5: Providing Assistance and troubleshooting

A few teachers become adept in computer usage however, majority does not. People who use computers regularly are often ill equipped for troubleshooting. The computer could provide this help by being incorporated into the original programming. In complete computerized education, programmers will arrange for automatic feedback to them of problems and they will then make changes in programs to decrease constantly the difficulties students encounter. If more help was needed, students could reach outside experts at any time. Teachers are not prepared for new roles as computer experts or technical wizards. It is inefficient to put teachers into those positions, because it wastes their valuable time and gives them another useless burden. The need to assist students is increased further because software has to be written to manage the countless variations among teachers, interposed between pupils and programs.

7. Conclusion

Now-a days CAI/CAL is the thrust area of educational research. In developing countries like India, the potential features of CAI are unlimited. There is a need to explore this current are for the upliftment of the traditional teaching-learning process Recent advances in science and technology have enforced some changes in teaching methods. Contemporary CAL systems, which are results of a 30-year-old procedure of development, are popular, useful, and necessary tools for today's education. Multi media facilities, fast, cheap PCs and world wide networks make them powerful and available. In the future, CAL systems' development will continue. Besides this, expert CAL systems that will have intelligence attribute, will be practical and make teachers' duties lighter. Artificial intelligence is, and will be the key point in future CAL systems. Meanwhile, virtual reality and near-to-real simulators will have an important role in tomorrow's CAL. CAL is not the whole future of the education. However, as time goes by, CAL systems will become more essential, expert and not to be ignored. We discussed in details the disadvantaged of CAL, good and bad practices in CAL software development, teacher roles in computer enriched classrooms.

References

1. Atkinson R. C. and Wilson H.A. (1969). 'Computer Assisted Instruction', New York: Academic Press.
2. Frye C. H. (1969). 'CAI languages: Their capabilities and applications', In R. Atkinson and H. A. Wilson (ed) Computer Assisted Instruction.
3. Lawrence M. (1969). 'Some factors in the design of systems for computer assisted instruction', In R. Atkinson and H. A. Wilson (ed) Computer Assisted Instruction. New York: Academic Press.
4. Boyd, W. (1985). 'Computer-Assisted Instruction - Today and Tomorrow', Arizona Law Record, University of Arizona College of Law, Fall/Winter.
5. McCalla, G. (1987) 'The Promise of AI for Computer Assisted Learning', in Proceedings ICCAL in Post-Secondary Education "Learning in Future Education".
6. Stubenrauch, R. (1989) 'Touring a Hyper-CAI System, in Computer Assisted Learning',

Proceedings of the 2nd International Conference ICCAL'89, Dallas, May 1989, 'Lecture Notes In Computer Science 360', Springer, 541-551.
7. Stubenrauch, R. (1992) 'Aspects of CAI and Hypermedia', Ph.D. Thesis, Graz University of Technology, Graz.
8. Vassileva, J. (1994) A New Approach to Authoring of Adaptive Courseware for Engineering Domains, in Proceedings CALISCE'94, Paris, 241-248.
9. Burns H. L. and Capps C. G. (1988). Foundations of intelligent tutoring systems : An introduction. In M. Polson and J. Richardson (ed) Intelligent Tutoring Systems: An Introduction. Hillsdale : Lawrence Erlbaum Associated Publication
10. Nakabashi K., Maruyama M., Koike Y., Kato Y., Touhei H. and Fukuhara Y. (1997). Architecture of an intelligent tutoring system on the WWW. In B. De Boulay and R. Mizoguchi (ed) Artificial Intelligence in Education. Amsterdam : IOS Press
11. Terauchi M., Nishikawa M., Nagamachi M. and Osaki H. (1997). A system for learning Japanese sign language with 3D placement of hand motion based on case structure. In B. De Boulay and R. Mizoguchi (ed) Artificial Intelligence in Education. Amsterdam : IOS Press
12. Brusilovski P., Ritter S. and Schwarz E. (1997). Distributed intelligent tutoring on the web. In B. De Boulay and R. Mizoguchi (ed) Artificial Intelligence in Education. Amsterdam : IOS Press
13. Oblinger D. G. and Rush S. C. (1997). The Learning Revolution: The Challenge of Information Technology in the Academies. Bolto: Anker Publishing.
14. Sommerville I. (1994). Software Engineering. Harlow : Addison Wesley Terauchi M., Nishikawa M., Nagamachi M. and Osaki H. (1997). A system for learning Japanese sign language with 3D placement of hand motion based on case structure. In B. De Boulay and R. Mizoguchi (ed) Artificial Intelligence in Education. Amsterdam : IOS Press.