

EDUCATIONAL TECHNOLOGY AND ICT

Dr. Sarita Anand

Department of Education, Vinaya Bhavana

Visva-Bharati, Santiniketan

Week-10

Lecture-48

Module-48: Computer Assisted Instruction (CAI)

Hello dear learners, welcome to SWAYAM-NPTEL course on Educational Technology and ICT. I am Dr. Sarita Anand, your course coordinator from Department of Education, Vinaya Bhavana, Visva-Bharati, Santiniketan, West Bengal, India. Today, we will talk about the module 48 on Computer Assisted Instruction, CAI. This is the lecture 48 and before going to the topic, we will go through the course concepts covered. Earlier we had discussed about the institutions and professional development of teacher's part 2, where CPD its concept and need we had discussed and we have seen the 50 hours guidelines of CPD and also talked about the NPST 223.

We have seen the evolution of the teacher training program for the in-service teachers like academic staff college to HRDC and now MMTTP and CPD programs organized by HRDCs and MMTTP and also we had visited the website of MMTTP Malaviya Mission Teacher Training Program. Now, we will talk about the CAI. The concept of CAI refers to the instructional approach that utilizes computers to facilitate or support the learning. By its own name Computer Assisted Instructions you can understand that it utilizes the computers. This method represents an advancement over teaching machines and is significantly more evolved than the programmed textbooks in fostering

individualized and self-directed learning experience. The main advantage of CAI, we call it CAI over teaching machines is its ability to handle a greater workload, execute multiple functions simultaneously and accommodate an unlimited number of learners. Consequently, CAI is recognized as more sophisticated and modern instructional technology compared to teaching machines and program learning. According to Hilgard and Bower in 1977 emphasize these distinctions stating that computer assisted instruction

has now taken so many dimensions that it can no longer be considered as a simple derivative of teaching machine or the kind of program learning that Skinner introduced.

The integration of computers into education has profoundly transformed instructional methodologies across various domains. In another definition given by Bhatt and Sharma in 1992, CAI is defined as an interactive process involving a learner, a computer-generated display, and an input mechanism designed to facilitate educational outcomes. So, these definitions highlight CAI as the interaction between the student and the computer mirror or the screen—the tutorial model where a teacher engages directly with an individual learner. The computer presents instructional materials designed for the students' needs, and the student actively engages with the content.

The system evaluates the student's responses to determine the next phase of instruction, ensuring a structured and goal-oriented learning experience. Bhatt and Sharma in 1992 defined CAI as an instructional method where a learner interacts purposefully with a computer system equipped with instructional software. This interaction enables the learner to progress at their own pace and according to their abilities, ultimately achieving the intended learning objective, similarly as we see in programmed learning. At present, CAI refers to the use of computers as instructional tools to facilitate learning. It involves the integration of multimedia elements like text, graphics, audio, video, and animation to deliver educational content in an interactive manner.

So, CAI is designed to supplement or replace traditional teaching methods by providing learners with personalized, self-paced, and adaptive instruction. So, it is written that it replaces teaching methods, but for what? To make classroom teaching interactive, but it definitely cannot replace the role of the teacher. Basic assumptions of CAI. If we talk about computer-assisted instruction or design, it is designed to facilitate self-directed and individualized learning and I have prepared elements like instruction for multiple learners, automated tracking of performance, and diverse instructional methods.

It provides the opportunity for the three kind of things which we will discuss that the instruction for multiple learners simultaneously. With the help of this CAI, we can provide the instruction, the instructional material, the content to the large number of learners and the automated tracking of learner performance. learners when we have given the instruction to the learners with the help of CAI, then they are going through it or not they are learning they are reading or not we can monitor or record the learner's responses their difficulties and performance level. The system tracks how each learner interacts with the presented

material or given material, identifying areas of struggle, learning process. This automated data collection aids in planning further instruction, ensuring that learner receive appropriate support to enhance their learning outcomes.

Thus, the second core assumption of CAI is its capability to systematically and accurately document the learner's performance for instructional improvement which is not 100 percent possible in our traditional teaching learning process because phase to phase interaction is there and we cannot take care of all such kind of things which can be mechanically completed with the help of CAI. The third one is Diverse Instructional Methods and Techniques. CAI operates on the principle that a single instructional method is insufficient for addressing the diverse learning needs of the students. So, different subject and topics requires, worried approaches and learners benefit from choosing instructional methods and align with their learning styles and cognitive abilities.

So, different type of learner can be accommodated with the available different type of methods of teaching and the support system. So, CAI supports the range of teaching strategies enabling learners to engage with the content in a way that maximizes the comprehension and retention of the given content. Hence, its third fundamental assumption is the necessarily for multiple instructional methods and approaches to accommodate diverse learners effectively given by Meyer. So, in short, we can elaborate the characteristics of CAI.

That it is focusing on the interactivity, immediate feedback, personalization, multimedia integration, flexibility and assessment and tracking. These are the core features of the any computer assisted instruction and we will go one by one with the help of those characteristics. Need not to explain because you all knowing about the interactive, the content given through different module will be interactive for the learners their assessment can be tracked by the teachers that they have given or not what kind of performance they are going to giving and the immediate feedback can be given by the system generated responses. For the correct answers or the mistakes, the personalized learning, learning experiences can be designed for the individual needs' multimedia and like video animation or simulation can be attached with the content and the flexibility. Learners are the the most important part of the CAI is that anytime anywhere they can learn and supporting self-paced learning through the CAI.

Now, technologies engaged or used in the computer assisted instruction is the hardware, the software and the courseware. These you all are aware with the terms hardware, the

software and the third one is the courseware which has the forms of instructional content used in CAI. Subject matter expert, instructional designers and educational psychologist collaborate to develop structured learning materials which are then translated into the software programs for computer-based instruction. So, this kind of technologies are involved to prepare the computer assisted instruction for the learner. Now, we can go through the evolution or developmental phases of the CAI, how we developed in early developments from 1950s to 60s.

It was the beginning phase and started from the use of computer for education in military training and mathematical computers. Then comes the PLATO the Program Logic for Automated Teaching and Operation in 1960, one of the first CAI systems at the University of Illinois and then IBM Teaching Machines by B. F. Skinner learning machine and used program instructional method which you have already learned like Linear Programming. Then the second phase is 1970s to 80s and the personal computers and interactive learning came; the rise of personal computer PCs and the logo programming of language came by the Papert in 1980s introduced the constructivist learning for children and the CBT computer-based training emerged in the corporate and technical education. Then in third phase in 1990s to 2000 internet and digital learning, the scenario has been changed and the advent of CD and CD-ROM and early internet led to interactive multimedia for CAI software, web-based learning environment created, LMS like blackboard were evolved and smart classroom with digital whiteboard, simulation, animations, improved instructions.

and the fourth one is the 2010 to present era, present time Artificial Intelligence and adaptive learning era. This AI driven intelligence tutoring systems provide real time learning analytics MOOCs are available for offer free and open education worldwide concept of OERs gamification, virtual reality enhances the engagement on the different training program like in field of medical. Now, the types or modes of CAI in different types of Computers Assisted Instructions are there like practice work support, informational instruction, educational games, simulation-based instruction, intelligent tutoring systems, learning management assistance, drill and practice, tutorial instruction and problem-solving instruction.

We will go for one by one shortly information instruction this provides the learner with the quick access to the stored information the computer functions as an interactive database responding to the student's query with relevant answer while the instruction is minimal it supports concept acquisition and acknowledge enhancements. So, learner can expose their topic independently and following and inquiry based or discovery approach and they can

learn. For example, Wikipedia or Google search and educational database like Britannica kids provide students with instant access to the stored information on the various topic and in a classroom use a history student researching on the resonance can type queries into educational portal receiving detailed answer without direct interaction with the teacher. So, this is about the information instruction system through CAI.

The next one is Drill and Practice, CAI offers reinforcement exercise for memorizing like different quizzes or spelling drills. It gives a structured drill practice program that enforce previously learned materials. Student receive immediate feedback, connecting mistakes instantly they can get and the advanced system adjust difficulty based on the student performance ensuring progressive skill development. For example, in a math practice session, the computer displays the multiplication problems, evaluate responses and provide the reinforcement or remediation as needed, which we have discussed in previous lectures of linear programming and your branching programming. and this works in a similar way.

For example, Duolingo for language learning or mathematics for arithmetic practices and Khan academy exercises and the classroom uses student can use the math app receive the immediate feedback and if answer is wrong, they can provide with the hint and extra practice and before moving on the next step, they can learn that where they have done the mistake. The tutorial instructions this tutorial made a step-by-step instruction modules for the new topic allows the computer as an act as a virtual tutor guiding the student through lesson step by step. These programs deliver explanations example exercises assessments while tracking student's progress. If a student master a concept and the program advance to the next topic otherwise it provides remedial instruction.

Tutorials are commonly used for the subjects like, mathematics, physics and language learning and it is similar to your branching programming. Coursera, Udemy and Khan Academy tutorials are working like that and a student can learn by their own. For example, in classroom Newton's law watches an interactive tutorial explaining concept animations followed by quizzes and guide them through the learning process. So, this kind of tutorial instructions are kind of CAI. The fourth one is educational games.

The educational games are for the design for the engaging students through the interactive and simulating challenges educational games and these are having the objectives into game play for the students. Unlike the traditional academic exercises these games enhance the motivation problem solving and skills and cognitive development. They serve as a valuable tool for the reinforcing concept and rewarding the students achievement. And for example,

the Minecraft education edition is having the teaching problem solving and creativity level and prodigy math game and brain POP games etc. are the example of this kind of educational games, type of CAI. And if for example, in a class a geography teacher uses an online game where student must build civilizations based on real world geography and resources, then they can play with this these above-mentioned games and they can learn about the topic.

Then comes the simulation-based instructions. These simulations create a virtual environment, and we know that they are used to save students from risk-taking practices. This program is particularly useful in the fields of medicine, engineering, and aviation. By participating in simulated experiments or decision-making exercises, students develop critical thinking and practical skills in a controlled or artificial setting. So, PhET interactive simulations for science and math, flight simulators for pilot training, and virtual labs like Labster, etc., fall under this kind of computer-assisted instruction. I request you all to please go through the PhET. Interactive simulations, they have wonderful simulations on physics.

I have gone through them and found them very useful for learners in the fields of physics and mathematics. A biology student uses a virtual lab to experiment with chemical reactions, testing different outcomes safely before performing them in a physical lab. So, this can be utilized and falls under CAI related to simulations. The sixth one is problem-solving instruction. This focuses on developing students' analytical and logical thinking abilities, as well as decision-making skills.

Rather than providing direct answers, problem-solving programs encourage learners to explore strategies for arriving at solutions. One of the most well-known tools for problem-solving education is LOGO. This is a programming language developed based on Piagetian learning theories, and LOGO is the precursor to Scratch for coding. Microsoft Excel for data analysis falls under the problem-solving type of CAI, where computer science teachers or science students are challenged to create animations or stories through Scratch. Earlier, in a previous lecture, I mentioned that Scratch is very useful for developing logical thinking skills in school students. Practical work supports CAI programs, supplementing laboratory and hands-on activities by offering virtual demonstrations, interactions, and experiments. Students can use computer-based simulations to gain familiarity with procedures and concepts.

So, they can use the example of virtual reality and the next one is learning management assistance. The CAI where they can learn about the student progress administration test

and the customizing the learning material based on the individual need. It plays important role in the special education and how we can see and adapt the learning experiences for students with disabilities. Moreover, assistance teachers and parents in the monitoring academic performance and planning interventions effectively for the special children. Google Classroom, Moodle, Blackboard, AI powered platforms like Smart Sparrow are the example of this kind of learning management system or assistance where the teacher can utilize the platform or the LMS for the learners.

A teacher tracks the students progress on LMS and assign personalized quizzes based on the performance and communicates feedback to the learners and their parents also because not all the platforms are providing the access for the parents, but few are giving the opportunity. And the ninth the last one is the ITS. Intelligent Tutoring System, AI driven program that adopt the students learning styles and it is the the AI driven platform which is using the AI algorithm to track learning progress and suggest improvement for the learners. The Carnegie Learning's MATHai is the example of that AI driven tutorial system and it helps the student to master the algebra and other math topic by adopting their learning pace and providing hints offering real time feedback and teachers use this for the individualized instruction.

And I have given this screenshot of Carnegie Learning's MATHai you are requested to go through the website and you will find that is very useful platform for the learners as well as the teachers. The second example is AutoTutor this is also using the AI tutor developed by the researchers at the University of Memphis. AutoTutor engages students in conversational dialogue to teach the complex topic like physics, computer science and critical thinking. So, if you try to AutoTutor Which it self shows that this is the made for the math and physics learning exam practice for 5 to 12 years students.

So, this is for the school going learners, I also suggest that you go through this platform because without going or searching the platforms you cannot understand about the CAI in a practical world. So, I have mentioned these two examples. Now, the advantages of the CAI we already know that it providing personalized learning, increased engagement, flexible access immediate feedback and scalability. These are the features which have we have already discussed, but definitely if they are having advantages also having the challenges and limitations like high cost is the issue. One of our participants of this course has mentioned that many of the apps or the software which I have told that is not cost effective.

Definitely every app or software is not cost effective, but they are having their free version. So, I request you all that at least you can go through the free version of those apps or softwares and the potential safety risk definitely if you are using the electronic devices or computer definitely, they are having some hazards regarding the security or the damage the equipment or harm by the other people. So, these are the limitation also the quality educational software is lacking and if they are available, we are not aware this is the limitation. And if I am telling you about the different apps or the website of the CAI and you are not using or at least you are not opening or signing in then definitely this is the challenge of the CAI. The hardware maintenance issues.

Each system has the malfunctioning here also and repairing may difficult to the lack of technical experts and disrupting the students learning process. Those lack of supervision and discipline. If we are talking about any kind of digital education the either it is CAI or SWAYAM or any other DIKSHA like platform whichever you talk if the supervision is not their discipline is not there. So, learner may be led to the issue of lack of the indiscipline may be truancy or insufficient time management and you are going to study, but in the name of study you are doing something else. So, monotony and fatigue prolonged interaction with the computers through typing or using input devices can in become tedious and exhaustive task for the learners.

Unlike human instructors, computers cannot yet fully support natural speech or handwriting interaction. So, these are the limitations, also incompatibility with traditional educational structures. Many times, the teachers are hesitant or they are not interested in using this kind of facility or group-based interactions. So, this is the limitation. Lack of human interaction CAIs are machine-oriented learning. So, definitely, it cannot replace the emotional support of the teacher, warmth, and personal engagement provided by the human teacher. So, it is crucial for effective learning, but anyhow, for the masses or large-scale, which I have mentioned, the scalability allows us to go for CAI.

Now, the conclusion: we can conclude that CAI has emerged as a transformative tool in modern education, integrating technology to enhance teaching and learning by offering individualized, interactive, and self-paced learning. Different modes of CAI, such as informational instruction, drill and practice, tutorials, educational games, simulation, problem-solving, practical work support, and learning management systems, provide diverse opportunities for learners to acquire knowledge, develop skills, and enhance cognitive abilities. The integration of intelligent tutoring systems (ITS) within CAI has

further revolutionized learning by adapting to individual student needs through AI-driven personalization.

The ability of CAI to cater to diverse learning styles, offer immediate feedback, and enable self-directed learning makes it an invaluable asset to blended and digital learning models. So, I have given a few references for your further reading; please go through them and keep learning.

Thank you.