CHAPTER-I

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1.0 INTRODUCTION

Education is the only mean through which a society adjusts with its needs. Therefore, a society can never exist without education. Through education, the members of a society learn the skills to enrich, transmit and transform cultural heritage as well as to enhance existing social and scientific knowledge for the continuous advancement of the society. Teaching learning process has been inseparable to human being since ancient times. Leaders of human thoughts have endorsed memorable words about education, knowledge and learning. An educational system is explicitly based on the quest, what to teach and how to teach. “What to teach” means the learning material. The continuum of learning material swings from linguistic to scientific knowledge. The choice of contents and subject from the multifarious branches of knowledge is subjected to social needs.

According to Johnson and Dalen (1988)\(^1\) there are certain moments in human history when it seems that all human activities and social organizations have been directed towards the extension of knowledge. They further say that human endeavours to explore the universe and foster social, cultural and economic needs resulted in a widespread educational system on the global purview. Every society, every culture and every nation is in a race to build up its educational system on profound bases of knowledge, learning and expertise. Today, a nation with superior educational system is superior and dominant.

1.1 SCIENCE IN SCHOOL CURRICULUM

Science occupies a unique position in the school curriculum. Biology is central to many science related courses such as medicine, pharmacy, agriculture, nursing, biochemistry and so on. It is obvious that no student intended to study these disciplines can do without biology. These factors, among others, have drawn attention of researchers and curriculum planners towards biology as a subject in the school curriculum. In spite of the importance and popularity of biology among students, performance at senior secondary school level had been poor. The desire to know the causes of the poor performance in biology has been the focus of researchers for some time now. It has been observed that poor performance in the sciences is caused by the poor quality of science teachers, overcrowded classrooms, and lack of suitable and adequate science equipment, among others (Abdullahi, 1982). Students perform poorly in biology because the laboratories are ill-equipped and the biology syllabus is over loaded (Ajayi, 1998).

The potential benefits of Computer Assisted Instruction (CAI) cannot be underestimated in the contemporary world. There is a plethora of established findings on the instructional value of computer, particularly in advanced countries. There are now several CAI packages on different subjects. It is obvious that the current trend in research all over the world is the use of computer facilities and resources to enhance students’ learning. This may be the reason why Handelsman, Ebert-May, Beichner, Bruns, Chang, et al (2004) opined that “many exercises that depart from traditional method are now readily accessible on the web”, even though teachers do not use these facilities. They further showed that the interactive approaches to lecturing significantly enhance

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learning.

1.2 ICT IN EDUCATION

The use of information and communication technologies in education makes teaching-learning process effective and interesting. To know the impact of ICT in education, we need to know two basic things: ICT, and education.

The Information and Communication Technologies (ICT) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer, and network hardware and software, satellite system and so on, as well as the various services and applications associated with them, such as video conferencing and distance learning.\(^5\) When such technologies are used for educational purposes, namely to support and improve the learning of students and to develop learning environments, ICT can be considered as a subfield of Educational Technology.

Education encompasses specific skills related to teaching and learning, and also something less tangible but more profound: the imparting of knowledge, positive judgement and well-developed wisdom. Education has as one of its fundamental aspects the imparting of culture from generation to generation. Education means ‘to draw out’ facilitating realization of self-potential and latent talents of an individual. It is an application of pedagogy, a body of theoretical and applied research relating to teaching and learning and draws on many disciplines such as psychology, philosophy, computer science, linguistics, neuroscience, sociology and anthropology.\(^6\)

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\(^5\) [http://searchcio-midmarket.techtarget.com/sDefinition/0,,sid183_gec928405,00.html](http://searchcio-midmarket.techtarget.com/sDefinition/0,,sid183_gec928405,00.html)

1.2.1 ICT AND LEARNING

In view of ICT, education can be classified in three main categories- E-Learning, Blended Learning, and Distance Learning.

A. E-Learning

Electronic learning or e-learning is a general term used to refer to computer-enhanced learning. It is commonly associated with the field of advanced learning technology (ALT), which deals with both the technologies and associated methodologies in learning using network and/or multimedia technologies. It is also known as online learning. Distance education provided the base for e-learning’s development. E-learning can be “on demand”. It overcomes timing, attendance and travel difficulties.

B. Blended Learning

Blended Learning is the combination of multiple approaches to learning. It is usually used to define a situation where different delivery methods are combined together to deliver a particular course. These methods may include a mixture of face-to-face classrooms, self-paced learning and online classrooms as shown in Fig. 1:

![Fig. 1.1: Blended Learning](image)

a) **Face to Face Learning**


Face to face learning refers to learning that occurs in a traditional classroom setting where a faculty member delivers instruction to a group of learners. This could include lectures, workshops, presentations, tutoring, conference and much more.

b) **Self Paced Learning**

Self paced learning provides the flexibility to learn according to the availability of learners’ own time and pace, it occurs in a variety of ways such as: reading specific chapters from textbook, studying course material presented through web-based or CD-based course, attending pre-recorded classes or sessions, reading articles referred by faculty member, working on assignments & projects, and searching & browsing the internet.

c) **Online Collaborative Learning**

Online collaboration involves interaction between learners and faculty members through the web; this interaction can occur in one of the following modes:

- Synchronous interaction
- Asynchronous interaction

Synchronous, means “at the same time”, it involves interacting with a faculty member and other learners via the Web in real time using technologies such as virtual classrooms and/or chat rooms. On the other hand, Asynchronous means “not at the same time”; it enables learners to interact with their colleagues and faculty member at their own convenience; such as interacting through e-mail.⁹

**C. Distance Learning**

It is a type of education, where students work on their own at home or at the office and communicate with faculty and other students via e-mail, electronic forums, video conferencing, chat rooms, instant messaging and other forms of computer-based communication.¹⁰ It is also known as open learning.

⁹[http://lyon.chin.gc.ca/>../module3/m03t04p01_e.asp?af=1](http://lyon.chin.gc.ca/>../module3/m03t04p01_e.asp?af=1)

Most distance learning programs include a computer based training (CBT) system and communications tools to produce a virtual classroom. Because the Internet and World Wide Web are accessible from virtually all computer platforms, they serve as the foundation for many distance learning systems.

**ICT needs in education**

ICT needs for successful nationwide institutes computerization program can be described as a hierarchy, as shown in Fig.1.2.\(^{11}\)

![Fig. 1.2: Pyramid of ICT needs in education](http://www.htk.tlu.ee/TLG/strategy/masterplan2)

The first visible part of the pyramid shows the ICT needs in education and corresponding second visible part of the pyramid hints what are required to fulfill corresponding ICT needs.

- Access to modern and stable ICT infrastructure by all teachers and students.
- Multifunctional, licensed software tools and services for educational use (including Virtual Learning Environments and Content Management Systems).
- ICT skills of students and staff.
- Integration of ICT into curriculum that provides valid goals, content and methods for using ICT in institute.
- Management of the ICT innovation at the institute, district, state and national level.

\(^{11}\)http://www.htk.tlu.ee/TLG/strategy/masterplan2
The hierarchy of ICT needs shown by the pyramid does not imply that the low-level needs (ICT infrastructure and software) should be completely satisfied before high-level needs could be addressed. Suggested approach is to deal with all levels at once, in the systematic, integrated and coordinated manner.

**Relationship between different kinds of ICT use in learning**

The relationship between different kinds of ICT use in learning is shown in Fig.1.3. It shows that ICT skills for IT jobs, derived from a partial subset of those needed for enhanced living and employment opportunities; and ICT skills for enhanced living and employment opportunities is derived from subset of those ICT skills which are needed for learning in all curriculum areas.¹²

![Diagram showing the relationship between different kinds of ICT use in learning](http://www.educ.utas.edu.au/.../thesis/html/design.htm)

**Fig. 1.3: Relationship between different kinds of ICT use in learning**

**Stages of teaching and learning**

Teaching and learning process is always going together; we cannot consider these two as separate and independent activities. In fact, these are similar as two sides of the same coin, interconnected and interrelated. The process of teaching and learning in institutes around the world can be divided into four main stages. These four stages are shown in Fig. 1.4.¹³

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Fig. 1.4 Model of stages of teaching and learning using ICT

<table>
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<th>Stage 1</th>
<th>Discovering ICT tools</th>
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<td>Stage 2</td>
<td>Learning how to use ICT tools</td>
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<td>Stage 3</td>
<td>Understanding how and when to use ICT tools to achieve particular purposes</td>
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<td>Stage 4</td>
<td>Specializing in the use of ICT tools</td>
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**Stage 1 - Discovering ICT tools:**
This stage focuses on discovery of new ICT tools by teachers and students. This is linked with the emerging approach in ICT development.

**Stage 2 – Learning how to use ICT tools:**
This stage emphasizes on learning the use of new ICT tools. It involves the use of general or particular applications of ICT.

**Stage 3 – Understanding how and when to use ICT tools:**
It focuses on understanding how and when to use ICT tools to achieve a particular purpose, such as in completing a given project. This stage indicates the ability to recognize situations where ICT will be helpful, choosing the most appropriate tools for a particular task, and using these tools in combination to solve real problems.

**Stage 4 – Specializing in the use of ICT tools:**
The fourth and last stage involves specializing in the use of ICT tools. This requires deep knowledge about using ICT tools. In this stage, students study ICT as a subject to become specialists. Such study concerns vocational or professional education rather than general education.
Key points about successful pedagogical strategies utilizing ICTs for teaching and learning

1. **Teachers remain central to the learning process**
   A shift in the role of a teacher utilizing ICTs to that of a facilitator does not obviate the need for teachers to serve as leaders in the classroom; traditional teacher leadership skills and practices are still important (especially those related to lesson planning, preparation and follow-up).

2. **Lesson planning is crucial when using ICTs**
   Teacher lesson planning is vital when using ICTs; where little planning has occurred, research shows that student work is often unfocused and can result in lower attainment.

3. **Introducing technology alone will not change the teaching and learning process**
   The existence of ICTs does not transform teacher practices in and of itself. However, ICTs can enable teachers to transform their teacher practices, given a set of enabling conditions. Teachers’ pedagogical practices and reasoning influence their uses of ICT, and the nature of teacher ICT use impacts student achievement.

4. **ICTs seen as tools to help teachers create more ‘learner-centric’ learning environments**
   Research consensus holds that the most effective uses of ICT are those in which the teacher, aided by ICTs, can challenge pupils’ understanding and thinking, either through whole-class discussions and individual/small group work using ICTs. ICTs are seen as important tools to enable and support the move from traditional ‘teacher-centric’ teaching styles to more ‘learner-centric’ methods.

5. **ICTs can be used to support change and to support/extend existing teaching practices**
   Pedagogical practices of teachers using ICT can range from only small enhancements of teaching practices using what are essentially traditional methods, to more fundamental changes in their approach to teaching. ICTs can
be used to reinforce existing pedagogical practices as well as to change the way teachers and students interact.

6. **Using ICTs as tools for information presentation is of mixed effectiveness**

   The use of ICTs as presentation tools (through overhead and LCD projectors, television, electronic whiteboards, guided “web-tours” etc., where students simultaneously view the same resources on computer screens) is seen to be of mixed effectiveness. While it may promote class understanding of and discussion about difficult concepts (especially through the display of simulations), such uses of ICTs can reinforce traditional pedagogical practices and divert focus from the content of what is being discussed or displayed to the tool being utilized.

**Impact of ICTs on learning environment**

It has been argued that ICT is a mediator of learning as a component of the learning environment. While it is difficult to measure and directly demonstrate the impact of ICTs in schools on learning, it is possible to suggest possible impacts by connecting ICT as a mediator with well researched theories of learning and strategies for providing learning opportunities. The Committee on Developments in the Science of Learning completed such an exercise and stated that “several groups have reviewed the literature on technology and learning and concluded that it has great potential to enhance student achievement and teacher learning, but only if it is used appropriately”\(^{14}\)

It is generally agreed that in education the unique instructional characteristics of computers needs to be exploited.

There are four distinct characteristics of computer technology which have clear implications for using computers in the classroom: logical programming, interactive control, graphics and audio output, and information processing. There are many ways in

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which these characteristics could be used and have been shown to support students and teachers in improving learning outcomes and increasing productivity. The degree to which each of these should be applied will depend on an array of variables such as the developmental age and personal characteristics of the student, the characteristics of the learning environment, and the nature of the curriculum content.

**ICTs help students in investigating reality and building knowledge**

ICT allows students to investigate more thoroughly the real world. They can more readily access information sources outside the classroom and can use tools to analyse and interpret such information. Information may be accessed through online systems or through data logging systems. The technologies allow them to receive feedback, refine their understanding, build new knowledge and transfer from school to non-school settings. In the past this has been difficult to provide in schools due to logistical constraints and the amount of material to be covered all of which can now be addressed with ICT support.

**ICTs help in active learning and authentic assessment**

In many classroom situations it is difficult to allow students to be sufficiently active as participants. Typically students are often passive, spending a lot of time on listening or reading.

It is well known that students are more likely to be interested and attentive and will achieve a wider range of learning outcomes if they remain active and learn by doing. Their engagement with the curriculum will increase as they are afforded opportunities to

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create their own information and represent their own ideas (Riel, 1998). Computer software can be used to provide students with learning experiences where they are interacting with the computer system. Alternatively the software may support activities where they interact with other people either in person or online (Riel, 1998). In all these cases the student has more influence on the learning processes and the activities can be more responsive to the needs of the student. This better facilitates the development of conceptual frameworks by students to assist in deeper levels of learning (Committee on Developments in the Science of Learning, 2000; Réginald Grégoire inc. et al., 1996). The use of online systems to support active learning through providing forums for feedback and reflection have been shown to promote greater depth of explanations by students of varying ability (Committee on Developments in the Science of Learning, 2000). Where assessment emanates from active learning it is termed authentic. The use of ICT often encourages active learning and results in more authentic assessment.

**Role of ICTs in increasing learner independence**

Computer systems are increasingly being used to provide learning experiences when and where they are needed. This provides students with greater independence not only in terms of when and where they learn but also what they learn. It is not necessary for all students to do the same thing at the same time. Teachers may provide students with access to software allowing students to select different learning experiences.

The class does not have to be treated as one group. Individuals or groups of students may consider learning topics independently of the teacher (Reginald Gregoire inc. et al., 1996).

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This is often discussed in terms of lifelong learning, learner-driven learning or project-based learning (Riel, 1998). ICT tools can be used to create records of thoughts and support reflection and assessment of progress (Committee on Developments in the Science of Learning, 2000).

**Role of ICT in strengthening independent learning**

ICT is an essential tool in the modern classroom; it can engage pupils on a number of levels and make the job of the teacher considerably easier. However, the use of ICT does not necessarily ensure good learning. There could even be a situation where the class is quiet and engrossed in their computer/web-based activity, but getting no lasting benefit from the activity. All activities, ICT or not, should challenge pupils thinking at a high level and try to make them better learners.

It is impossible to separate engagement, from getting pupils to think at a high level and making them into independent learners - they are all linked. As pupils learn best when they are interested, involved and appropriately challenged. This is hardly a revelation, but it is easy to forget the third clause in that sentence. Some of the ICT going on in History classrooms is exciting and captures the imagination for a short time, but does not involve a level of complexity and challenge students mentally. If learning is to be effective then interest, involvement and challenge all need to be addressed. With this in mind Vygotsky\(^{18}\) and Piaget\(^{19}\), came up with nine rules of Engagement:

1. Activities have a clear purpose and relevance.
2. New knowledge is related to old.


3. Presentation is varied.
4. Activities generate curiosity.
5. Pupils ask questions and try new ideas.
6. Pupils see their achievements and progress.
7. Pupils analyse their thinking/learning.
8. Pupils gain satisfaction and enjoyment from their work.
9. Pupils get a positive image of themselves as learners.

ICT activities can include these elements of learning, but they need to be thought about carefully and planned into any activity. The interactive and multimedia nature of modern computer systems has provided the opportunity for software developers to create increasingly more stimulating features. Many studies have found that students like to use computers and are likely to develop more positive attitudes towards their learning and themselves when they use computers. Computer systems do provide opportunity to create a wide range of interesting learning experiences. This is likely to help to maintain student interest and interest a wider range of students (Cradler & Bridgforth, 2002).

The interactive and multimedia features within software can be used to help students grapple with concepts and ideas. Students can more readily be provided with similar information and experiences within a variety of contexts.

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1.2.2. Challenges in Integrating ICTs in Education

“Technology by itself is not the answer to educational problems. The power of technology will come from its combination with serious educational reform. Schools must first rethink their mission and structure, starting with the needs of students and a set of instructional principles, before they can understand the ways in which technology can help them”. (Means & Olson 1994)\textsuperscript{22}

While considering the opportunities associated with ICT-enhanced education it can be said that ICT-enhanced education is better than a simple education, but there are many challenges, which hamper the exploration and exploitation of its opportunities. In view of integrating ICTs in education have following key challenges:

A. ICT Infrastructure

The main challenge for ICT-enhanced education is the availability of information and communication technologies infrastructure. Before any ICT-based program is launched, policymakers and planners must ensure the availability of the followings: appropriate rooms or buildings to house the technology, computers as well as affordable Internet service for online learning, and availability of electricity and telephony. In developing countries large areas are still without a reliable supply of electricity and the nearest telephones are miles away.

B. Language and Content

English is the dominant language of the Internet. An estimated 80% of online content is in English.\textsuperscript{23} A large proportion of the educational software produced in the


world market is in English. For developing countries in the Asia-Pacific where English language proficiency is not high, especially outside metropolitan areas, this represents a serious barrier in maximizing the educational benefits of the World Wide Web. Even in countries such as Philippines, Malaysia, Singapore, and India where English is a second language; it is desirable that teaching and learning materials, preferably be developed in the local languages.

C. Teachers with ICT Skills

Lack of teachers equipped with ICT skills is another problem for the use of ICT in education. The institutes where ICT is going to be integrated in education, first of all their teachers must be well trained about ICT tools in education. Before going to teach students, teachers must know about how and when to use ICT tools to achieve particular purposes.

D. Change Management

Managing the change is one of the biggest problems, as teachers don’t want to accept change easily. Change management issues must be addressed as new work practices, new ways of processing and performing tasks are introduced.

In general a large number of teachers in educational institutes are non ICT proficient, and resist to change.

Research has shown that the strategy of adding technology to the already existing activities in institutes and in the classroom, without changing habitual teaching practices, does not produce good results in student learning. The reason for this is due to the fact that the vast majority of teachers are not proficient users of technology, especially computer technology. A number of studies have shown that most teachers consider the two main obstacles in using technology in pedagogical practices to be a lack of resources

E. Leadership

Integrating ICT in education is not an easy task, as it requires a wide range of support including higher management, and teachers. Therefore it is necessary to properly convince them for their support, and for this task a leader is required.

Leadership is necessary before, during and after project implementation. Before the project is initiated, leadership is needed in order to explain the model, the concept and create awareness; during the project, leadership is needed to manage change and support the project; and after the project, it is needed to pledge the required adaptability and flexibility of the initiative.

The present age is the age of technology, whereby technology plays a key role in daily lives; this also includes the education system. There are endless possibilities with the integration of ICT in the education system. The teaching community is able to reach remote areas and learners are able to access qualitative learning environment from anywhere and at anytime. It is important that teachers or trainers should be made to adopt technology in their teaching styles to provide pedagogical and educational gains to the learners. One of the important blessings of ICT in instructional technologies is Computer Assisted Instruction.

1.3.0 COMPUTER ASSISTED INSTRUCTION

In the words of Dr. A. P. J. Abdul Kalam, “The competitiveness is powered by knowledge power. Knowledge power is powered by innovation. Innovation is powered by science and technology and technology is powered by resource investment”.

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26 The Hindu, Friday, December 9, 2005
The computer is one of the most important and outstanding inventions that has made an increasing and powerful impact on the working methods of research and development in the field of science and technology and has revolutionized everyday social life in the advanced countries of the world. Computers are being used in the areas of transportation, communication, national defence, food material production, scientific research and education.

Historically, computer-aided instruction, which is also called computer-assisted instruction (CAI), has roots in Pressey’s 1925 multiple-choice machine and the punch-board device, which foreshadowed the network-supported tutorials of today. Pressey’s multiple-choice machine presented instruction, tested the user, waited for an answer, provided immediate feedback, and recorded each attempt as data. In 1950, Crowder developed a process for the U.S. Air Force in which a CAI program presented some content as text, tested the user, provided some feedback, and then branched to corrective instruction or new information based on supplied responses. Branching was thought to be an advance on Pressey’s multiple-choice machine. In 1954 at the University of Pittsburgh, Psychologist B. F. Skinner demonstrated a teaching machine for ‘‘reinforcing,’’ not just teaching, spelling and arithmetic with a machine. The user may access auditory material, listen to a passage as often as necessary then transcribe it. The machine then reveals the correct text. He may listen to the passage again to discover the sources of any error.

Developers applied principles of data transmission and reinforcement theory to a variety of educational situations. Skinner used reinforcement theory to downplay the role of punishment in changing behaviour. Instead, he was convinced that behaviour could be altered by simply using positive and negative types of reinforcement. Positive reinforcers presented rewards (good grade or congratulatory comment) after the user achieved a desired behaviour. Negative reinforcers remove aversive stimuli after the user failed to

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achieve a desired behaviour. Crowder\textsuperscript{29} applied these ideas to “intrinsic programming” so that a user’s responses determined the material to be presented next. The main advantage of intrinsic programming was that it did not waste the time of the fast learner with unnecessary repetition. Its disadvantage was that it required a large amount of content to present even a relatively small amount of material\textsuperscript{30}.

Later, CAI researchers S. M. Alessi and S. R. Trollip, (1991)\textsuperscript{31}, M. J. Hannafin, and K. L. Peck,(1998)\textsuperscript{32} observed that algorithms for teaching with CAI had to incorporate both the physical programming or authoring to run the computer program and the instructional programming required to learn from the program.

1.3.1 Types of computer Assisted Instruction

Computers are being increasingly employed for classroom instruction as also for individualized and distance education. It can be done in one of the many different modes of instruction, some of them are;


In the tutorial mode, information is presented in small units followed by a question. The student’s response is analysed by the computer and an appropriate feedback is provided. This is similar to programmed instruction. As in programmed instruction the information may be given in a linear fashion or in branched pathways.

In the drill and practice mode, the learner is provided a number of graded examples on the concepts and principles learnt earlier. The idea is to develop proficiency and fluency through doing. All the correct responses are reinforced and the incorrect responses are diagnosed and corrected. The computer continues the drill until mastery is achieved by the learner.

In the simulation mode, the learner is presented with scaled down simulated situations bearing correspondence with the real situations. Simulations are made to avoid risk, save money and conserve time. Simulation of an aeroplane in flight, an experiment on titration, a nuclear reaction, collision of two bodies etc. are good examples of the simulation mode.

In the discovery mode, the inductive approach to teaching and learning is followed. The learner is encouraged to proceed through trial and error approach, i.e. by solving a given problem, realizing where and how he/she went wrong, trying again and finally solving the complex problem.

In the gaming mode, the learner is engaged in playing opposite the computer or opposite another learner. The extent of learning depends upon the type of the game. Games on spelling, names of places and general knowledge are some examples of the gaming mode.
1.3.2 Advantages of CAI

Contemporary CAI is either downloaded from an Internet site and run locally, or it is shipped on DVD with a colourful reader and links to a companion website. Some CAI programs even run interactively online. The main advantages of developing CAI include-

- one-to-one interaction.
- great motivator.
- freedom to experiment with different options.
- instantaneous response/immediate feedback to the answers elicited.
- self pacing - allow students to proceed at their own pace.
- helps teacher - can devote more time to individual students.
- privacy helps the shy and slow learner to learn.
- individual attention.
- learn more and more rapidly.
- multimedia helps to understand difficult concepts through multi sensory approach.
- self directed learning – students can decide when, where, and what to learn.

1.3.3 Limitations of CAI

CAI have its own limitations like-

- learner may feel overwhelmed by the information and resources available.
- over use of multimedia may divert the attention from the content.
- learning becomes too mechanical.
- lack of infrastructure.
- non availability of good CAI packages.

CAI is not yet a mature field. While various CAI models exist, not all CAI programs offer all the benefits of CAI. Sometimes what is theoretically advocated is not implemented in practice (either due to lack of knowledge or technological unfeasibility).
Sometimes, the effective or good practices are not easy to identify. Continuous research will help to advance the field of CAI. One important research area is that of development of CAI based instructional modules. Development of suitable instruction module may overcome several limitations of CAI.

1.4.0 INSTRUCTIONAL MODULE

A module is self-contained, self-pacing and self learning by nature, but a teacher has a positive role to play in its use. A module contains three coordinate basic elements of instruction- a) objectives b) learning activities and c) evaluation. It is in these characters that the module differ from other instructional materials, either do not have all the three elements i.e. Objectives, learning activities and evaluation or if they do have, then the elements themselves are not co-ordinate. The philosophy behind instructional modules is based on the generally accepted fact that each learner is unique and is different from others in background experience, inherent qualities, habits and learning styles and as such should be allowed to grow and develop to the fullest potential. Modular approach is an attempt to make the instruction individualized so that the student learn at his own pace according to his interest, capabilities and capacities (UNESCO Handbook 1978). Modular approach appears to be an effective and economical way of developing specific knowledge and skills with minimum of teacher’s direction and supervision.

The modules can be prepared in different forms. They can be in written form or in the form of slides, tapes, pictures etc. One of the unique characteristics of the modules is that they can be subdivided into smaller module units to meet the needs of each individual student or group of students. In other words they can be designed for individual or group study or both. Since a module often consist of self-contained modular units, its component can be used singly or in combination with others in accordance with the varied needs and interests of the students. One of the important characteristics of a module is that they are meant for self study and self-evaluation by a student or a group of students.
1.4.1 Essential features of a module

- It should be self-contained. The module should be self-contained so as to enable the learner to achieve the objectives with minimum assistance from the teacher and without the need for using extraneous materials. The presentation of learning activities, pre tests, formative tests, post tests, assignments, answer keys etc. should be provided in the module.
- The objectives and learning activities should be properly sequenced.
- The learning activities should make the best use of local community resources.
- The subject matter should be correct, concise and presented in an interesting manner.
- It should provide opportunities for the learner to interact with other students and the community.
- It should be interesting to the learner.

Structural characteristics

- A module is a self-contained and self-sufficient unit.
- A module is designed to consist of sub modular units which by themselves are independent but linked together.
- A module is built for any type of learning strategy in or outside the classroom.
- A module is built on a block of time and each sub modular unit for an optimum learner engaged time.
- A module contains a test based on specific learning outcome of learning for all the sub modular units for summative evaluation.
Functional characteristics

- If a module is written adopting a self learning approach they should function as a self pacing device also.
- A sub modular unit could be used by the teacher or the learner for specific purpose, such as, attaining master remedial learning.
- Modules could be used for formative or summative evaluation.
- A module could function as a meaningful and useful reference material for the learner as he has personally worked on it and developed competencies.
- The curriculum developer could use the modules for developing different courses of study, as they are not only independent units, but also contain sub modular units which are also self-sufficient and self-contained.

1.4.2 Components of a module

The UGC Curriculum Development Committee in Education (1988) specified five very important components for a module viz. Objectives, content specification, teaching strategies, evaluation and reading materials.

A hand book on Developing Instructional modules for Teacher’s Directions’ by UNESCO (1998) specified the components of a module as follows:

**Title:** The title of the module should be clear and concise.

**Introduction:** The introduction should give the background and rationale of the module as well as target population for whom the module has been developed.

**Overview:** The overview introduces the learner to the theme of the module, its purpose, structure, organization and uses. It should give an overall impression of the module and its content.
**Instructions to the users:** This component should include clear instructions to the learners as to how this should proceed and what he has to do after each step or stage. This is an important component of the module as it would help the learner in self-learning. Most of the instructions are related to the different components of the module such as how to take pre-test, formative test, summative test and how to undertake learning activities etc. can be given in this section. Some of the specific instructions related to evaluation and learning activities can also be given at the appropriate stage.

**Pre test:** The pre test is taken by the learner at the beginning. This helps to find out the level of knowledge and skills that the learner already has. This helps the learner to find for himself the entry points in the module. If the ability of the learner is up to the criterion reference or to standard fixed by the teacher or the module developer, he may be advised to skip the module and go on to the next one. But if the achievement is below the expected level, he is asked to study the module.

**Objectives:** The instructional objectives of the module should be clearly stated. They should specify the expected learning outcomes in terms of behaviours. A behavioural objective should be stated clearly and precisely so that the learner would know what the learning outcome of a given activity will be.

**Learning activities:** Learning activity should be provided in a planned and sequenced manner. These activities enable the learners to develop behaviour in a pre-determined direction. The following are some of the principles, which should be kept in mind while developing the learning activities:

1. The learning activities should be planned on the basis of the entry behaviour of the learners. Entry behaviour means the previous knowledge of the learner of the instructional objectives.
2. The learning activities should be based on the needs of the learner.
3. The learning activities should be based on the terminal behaviour i.e., the ultimate outcomes of the learning activities.
4. The learning activities should provide for individual differences. The activities should provide for freedom and flexibility in the learning process.
5. The learning activities should be properly graded so that the learner proceeds step by step in the order of difficulty.

6. The learning activities should be of different types using different media and methodology.

7. The methodology used in learning activities should promote imagination, divergent thinking and creative innovative behaviour on the part of the learners.

8. The learning activities should provide maximum interaction between the learner and the module.

9. The learning activities should be varied enough to cater the students’ interests, abilities and learning styles.

10. The learning activities should provide the learner with enough knowledge of his progress.

**Formative tests:** Formative tests are given at the end of each learning unit or learning activity. The formative test helps the learner to know whether he has achieved the expected behavioural outcomes. If he has not reached the expected mastery level he should go through the learning activities again in consultation with the teacher.

**Summative test:** The summative evaluation is done with the help of a post test. The post test helps in knowing how well the learner has attained the expected learning outcomes. In some modules the pre-tests and the post tests are the same but it is advisable to have two parallel versions of the same test.

**1.4.3 Development of a module**

At the heart of any instructional system lies the self paced instructional module. The speed of adoption of self-paced learning modules as suggested by Cross (1976) looks more revolutionary than evolutionary. Novak (1973)\(^{33}\) observes “the use of some form of modular instruction is probably the fastest growing trend in the history of

western education” The survey of Cross (1976)\(^3\) showed that almost three fourths of the community colleges in London reported some use of self paced learning modules.

According to Sharma (1988)\(^5\), the following are the steps, which can be used for developing a module.

- Identify the target group.
- Identify learning needs of the group.
- Decide terminal behaviour.
- Identify entry behaviour.
- Assessment of entry behaviour through pre test.
- Teaching frames including objectives, learning activities, formative evaluation and summative evaluation.
- Try out of the module.
- Revision and finalization of the module.

Authors differ in their views on the development of the module. But there are certain common steps for module development.

According to Govind (1975)\(^6\), like many of the instructional systems and strategies in current use, module invariably include programmed instruction as a major component in them which as its essential feature of the development process, adopt some common procedures such as specification of instructional objectives in behavioural terms, analysis of task involved, field testing and revision arrangement of in-built feedback to learners and evaluation, as shown in fig. 1.5.


\(^6\)Govind, P. (1975) Development of a programmed text on educational evaluation and measurement and experimentally studying its effectiveness as instructional material for B.Ed students. Doctoral Thesis, Centre of Advanced study in education, M.S. University, Baroda
Fig. 1.5: Module developmental process-I
The process of development of module can be observed in a more elaborated way as in fig. 1.6.

**Fig. 1.6: Module developmental process-II**
Educationists developed several modules observing the different steps. Different phases adopted by the researchers can be listed under three headings i.e., Planning stage, Drafting stage and Revising stage.

UNESCO experts have also suggested three stages for the development of modules. They are:

- Planning stage
- Drafting stage and
- Revising stage

Planning stage:

In this the target group is identified. Where the module is to be administered should also be decided at this stage, i.e., in formal classroom or out of class situation. The social and physical environments, problems of daily life, work experience, development of skills, etc., of the target population should also be assessed in this phase.

Drafting stage:

Modules are drafted at this stage. Objectives of the module should be formulated first. Learning experiences which are conducive in achieving these objectives are also to be selected. The modules should be formulated in such a way that students can go through the module on their own or with the minimum help of the teachers.

The first of the components suggested by UNESCO (1998) for the development of modules is as follows:

1. Introduction (Background and rationale)
2. Overview
3. Instructions to the learners
4. Objectives
5. Learning activities
6. Tests, evaluation and feedback at the pre-test stage, the formative stage and the concluding stage (summative evaluation).
**Revising stage:**

In this stage modifications or revision of modules is done. This revision is dealt with addition, or deletion of objectives and assessment items, sequencing, content organization and revision of language. These modules are then used in an initial try-out for further modifications.

From the try-out performance the adequacy of the draft modules in terms of readability, difficulty level and content organization can be checked and necessary modifications can be attempted. The adequacy of test items can also be checked and learning activities and sequences of instructions can again be revised. Then the modules are ready for experimentation.

**1.4.4 Advantages of modules**

Modular strategy appears to be an effective and economical way of developing specific knowledge and skills with the minimum of teacher’s direction and supervision. Following are the advantages to the students, teachers and institutions.

I. Advantages to the students:

- Students can progress at their own rate, because they have full control on their rate of study.
- Student can himself decide whether he has learnt the subject matter fully.
- He must be involved in the learning process by which his commitment to the task is enhanced.
- It helps to develop a sense of responsibility for one’s own learning.
- Students are not forced to cover materials which are already familiar to them.
- A large pool of modules will permit students to explore portions of the subjects of particular interest without having to enroll in a full course containing topics not relevant to their needs.
- Some modules can be checked out and studied at home.
- The consequences of failure are reduced. Each student can master each module completely before proceeding to the next.
II. Advantages to the teachers:

- The use of modules provides an opportunity for organizing numerous sequences of experience to reflect special interests of the teacher.
- The modular approach provides a way of assessing the student’s progress in learning.
- Modules reduce the routine aspects of instruction, leaving the teacher free to engage in personal contact with the student.
- The independent nature of self instructional units facilitates the updating of study material without major revisions.
- Modules can serve as models for teachers who wish to develop their own materials using their own individuality.
- Self instructional units can be exchanged between institutions.

Therefore several CAI based self instruction modules should be developed in various subjects for effective and efficient self learning by the students.
NEED OF THE STUDY:-

Researchers have employed varying research methods in an attempt to understand the role that computer technology can and does play in the education of children.

Consequently, there are a number of differing lines of research that have been conducted, and many of the lines of inquiry may overlap with others. This has resulted in a large amount of research, but so varied in method and treatment that at times is difficult to categorize. There are areas for which there is little, if any, information available, meaning that there is much that we do not yet know about the effects of this technology on student learning. Because there are a variety of ways in which technology has been used in the past and a variety of ways it is being used today in education. It is important to consider each line of research individually in an attempt to sort out the status of what is known and what research is yet to teach us.

Educational technology offers solution to many problems of modern educational system. To tackle one of these problem in form of ‘individual differences’ among students self instructional material/module or multimedia package is one of the best solution. The use of multimedia in teaching and their integration in the classroom has remained almost completely unexplored. So with the intention of developing module and testing its effectiveness the investigator has selected self instruction module development as the topic for research.

2.0 STATEMENT OF THE PROBLEM

DEVELOPMENT AND VALIDATION OF COMPUTER ASSISTED INSTRUCTION MODULE IN LEARNING BIOLOGY

Operational Definition of the terms used:-

*Development:* To construct.
Validation of Computer Assisted Instruction module: Validation of CAI module was done in two ways

- By taking expert’s views using ‘CAI module assessment tool’ (developed by the investigator).
- Another criterion for validation of module used was 90/90 criterion i.e. if at least 90% students scored 90% or more. To achieve this criterion required improvements were made in the module.

Computer assisted instruction: Instructions provided with the help of computer using multimedia approach, for self learning.

Biology: Study of living organisms.

3.0 OBJECTIVES OF THE STUDY:

i. To develop computer assisted instruction module in Biology for class XII.
ii. To assess the validation of computer assisted instruction module.
iii. To compare the achievement of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.
iv. To compare the achievement of the students on the basis of sex with respect to computer assisted instruction and conventional teaching in the subject of Biology.
v. To compare the achievement of the students on the basis of intelligence with respect to computer assisted instruction and conventional teaching in the subject of Biology.

   a. High Intelligence
   b. Average
   c. Below average

vi. To compare the achievement of the students on the basis of different learning objectives with respect to computer assisted instruction and conventional teaching in the subject of Biology.
a. Knowledge
b. Comprehension
c. Application

vii. To study the users’ reaction towards computer assisted instruction.
viii. To compare the retention of the students in Genetics in control and experimental group.

4.0 HYPOTHESES OF THE STUDY:

i. There is no significant difference in the mean achievement score of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.

ii. There is no significant difference in the mean achievement score of the students on the basis of sex with respect to computer assisted instruction and conventional teaching in the subject of Biology.

iii. There is no significant difference in the mean achievement score of the students on the basis of their intelligence level with respect to computer assisted instruction and conventional teaching in the subject of Biology.

   (i) High Intelligence
   (ii) Average
   (iii) Below average

iv. There is no significant difference in the mean achievement score of the students in different learning objectives with respect to computer assisted instruction and conventional teaching in the subject of Biology.

   (i) Knowledge
   (ii) Comprehension
   (iii) Application
v. There is no significant difference in the mean retention score of the students with respect to computer assisted instruction and conventional teaching in the subject of Biology.

**Delimitations:**

(i) The study was delimited to the students of class XII only.
(ii) The study was delimited to the subject of Biology.
(iii) The content (Unit-Genetics) of the class XII Biology was according to C.B.S.E curriculum.
(iv) The sample for the present study was delimited to 50 students of class XII studying in two English medium schools of Sonepat.