A review of interactive technologies in learning

Attiq Ahmed Khan

Department of Computer Science and IT
University of Lahore, Gujrat Campus
Gujrat, Pakistan
attiqahmedkhan@gmail.com

Zunaira Ilyas Bhutta

Department of Computer Science and IT
University of Lahore, Gujrat Campus
Gujrat, Pakistan
zunaira.ilyas@gmail.com

Abstract— Technology will continue to have an important impact at all stages of life and in every field. Human-Computer Interaction is a recognized field of research in Education. The use of computers in the teaching and learning process is investigated by many researches and nowadays, due the available diversity of interactive computing devices, technology-enhanced learning is becoming popular in classrooms. The nature of learning is changing significantly as more and more technologies are assimilated into students' lives. The way teachers engage with their students during class by using interactive learning technologies and after class e.g. use of online assessment tools is very different from the 'chalk and talk' model of the past. In this paper we present a review on learning technologies, the most serious obstructions and benefits of HCI in education are characterized by the type of technologies which are also discussed in this review.

Keywords- hci and education, technology in pedagogy, technology in andragogy, enriching education system with technology.

I. INTRODUCTION

Human-computer interaction (HCI) was emerged in 1980s, as specialty area in computer science focusing human factors engineering and cognitive science. As its name depicts, it deals with understanding of how people use computer technology. How new computing devices and systems are designed which can enhance human experience, performance and satisfaction [1].

Technology has always had a troublesome time entering into the classroom. We can see advance technology in different facilities like medicine, transport system etc [2]. We are using fully automated cars which was not possible few years ago. But education system is slow in adopting latest technology. Following are some techniques and ideas for a technology rich education system.

II. TECHNOLOGIES OF LEARNING

Learning technologies are the technologies used to increase efficiency of learning and teaching. Learning technologies include different communication, information and related technologies helping to improve learning cycle [3]. Various learning technologies are used for teaching. Utilization of all these learning technologies is based upon three general functions of learning i.e.:

1. Content Delivery
2. Engagement
3. Assessment

A. Content Delivery

In content delivery technique, the knowledge\content is delivered in the form of text, audio, video or images. This delivery method is like one way communication. The content is delivered without receiving any feedback. [4]

B. Engagement

Engagement method of learning focuses on interaction of students beyond listening or watching. Engagement can be defined as an activity that requires students to do something with information like comparing, creating links between different information and questioning [5]. Students are engaged in reasoning and are encouraged to give feedback, thus increasing learning ability.

C. Assesment

According to [6] "Assessment is the process of gathering and discussing information from multiple and diverse sources in order to develop a deep understanding of what students know, understand, and can do with their knowledge as a result of their educational experiences."

Thus in assessment different tactics are used to determine the learning and understanding of students. The assessment can be formative or summative [7]. Formative assessment determines student learning during the learning process. This can be in the form of in-class activates, surveys and quizzes. Summative assessment evaluates the student learning at end of unit or course. These assessments include exams, presentations, portfolios and projects. Table 1 shows different learning technologies using one of these learning methods.

TABLE I. TECHNOLIGIES USING LEARING FUNCTIONS

Content Delivery	Engagement	Assessment
Computer Assisted Instruction	Computer Assisted Instruction	Computer Assisted Instruction
Moodle		Moodle
Tangible Learning objects	Tangible Learning objects	
Paper Centric learning Ecology	Paper Centric learning Ecology	
Shared Screen	Shared Screen	
Electronic Whiteboard	Electronic Whiteboard	
Proactive displays	Proactive displays	
Vocal sticky notes	Vocal sticky notes	Poll Everywhere Audience Response System
		Digital Pen for exams
	Reflect Table	

III. INTRODUCTION OF TECHNOLOGIES

A. Tangible learning objects

Tangible learning objects play an important role in development of a child. Children learn by exploring new things. Objects in real life has more impact than handling these similar objects on screen [8].

If these tangible objects become recognizable by computer, then we can teach different specifications of that particle object. For example if a children grabs a lion in her hand and shows it to computer.

Computer will display habitat of lion with its roar and an image. This will help her to remember sound and shape of line.

Figure 1. TANGIBLE LEARNING OBJECTS

Fig. 1 shows an alarm clock is attached with bar code. Computer recognizes the code and shows the picture of clock and sound which can be heard. Thus enabling child to connect sound with object in her memory [9]. This technique is suitable for content delivery method and interactive method, as child is able to interact with objects and get information of these specific objects. Following shows the pros and cons of this technique:

TABLE II. BENEFITS AND LIMITATIONS OF TANGIBLE OBJECTS

Advantages	Disadvantages
Better understanding of objects	Expensive
Can add new object easily	Hardware Issues
Interactive Learning	
Small Learning curve	

B. Electronic white board

Fractions are fundamental topic in mathematics. Students find it difficult to understand it. To help students learn fractions Fraction Sketch is introduced which is based on electronic white board system. It allows teachers to sketch shapes that are commonly used to teach fractions, including rectangles, circles and number lines. Teachers can manipulate these objects, divide and recombine them in ways that are useful for teaching both simple and advanced topics. Fig 2 shows how an interactive white board is used to explain fractions [10].

Figure 2. ELECTRONIC WHITEBOARD

Electronic whiteboard technology uses content delivery and engagement method of learning, it enable teachers to use student centric learning method. Student centric learning focuses on learning of student rather than on content and what teachers are doing [11].

C. Refelect table

When students are engaged in any group learning activity, some balance in participation is needed to make sure all members of the group achieve desired learning gains. When the learning activity requires discussion, such as co-construction of knowledge or collaborative problem solving, then balance in verbal participation becomes important [12].

Reflect is an interactive ambient awareness table that uses embedded microphones to listen to the conversation taking place around it, and uses multi-color LEDs to display a visualization of that conversation. By filtering out sounds coming from different sides, table can detect which member of the group is speaking at each point. This is done without needing to wear any additional device such as a head-mounted microphone or label, allowing for natural use of the table. The LEDs are

covered with a frosted glass. Fig. 3. The display shows members of the group, their levels of participation. Indicating how much they have spoken during the collaboration. The simple and low-resolution display makes it possible for users to perceive and understand the visualization without extending too much cognitive effort that could otherwise be used for the task. [13]

Figure 3. AMBIENT AWARENESS TABLE

Reflect table emphasis on engagement method of learning. Progress of every participant is easily observed. Following are the advantages and disadvantages of reflect table:

TABLE III. BENEFITS AND LIMITS OF REFLECT TABLE

Advantages	Disadvantages
Budget Friendly	Only for small groups
Small Learning curve	Hardware Issues
Interactive Learning	Cannot be used in noisy environment
Less distraction because of least details	Easily fooled as a student can speak without logic to increase participation

D. Shared Screen

Now a day's electronic presentation is very common. Most commercial slide ware tools demonstrate a teaching philosophy wherein the presentation is a one-way communication. With the help of these tools an instructor delivers information to students.

Aside from this, a contending educational philosophy is picking up endorsement by teachers, where students have an active role [14]. To facilitate this new approach shared screen system uses hand held computer and laptops operated by students to enable a higher degree of student involvement and a stronger student-instructor interaction in classrooms.

Students can highlight any line from presentation hence making it easy to tell instructor where he is facing difficulty in understanding properly [15].

Shared screen serves two purposes first is the traditional support for a teacher to explain content well (content delivery) and second, it enables to give their feedback on the spot. Student can easily point out the exact location

where he\she is facing problem (engagement). Following table depicts the advantages and disadvantages of using shared screen:

TABLE IV. BENEFITS AND LIMITATIONS OF SHARED SCREEN

Advantages	Disadvantages
Suitable for large class	More Expensive
Compatible with student tablets and computers	
Small learning curve	
Interactive Learning	

E. Paper Centric Learning Ecology

Traditional paper is being used in a huge variety of learning contexts. This is due to the many inherent advantages of paper over digital documents.

For example, paper equally serves for reading a text, annotating an excerpt, for sketching in a learning group, for writing a note and passing it to someone else or for integrating information from books and web pages [16].

Figure 4. PAPER CENTRIC LEARNING ECOLOGY

If we integrate these papers with computer this can save these notes for long time and it will become easy to share these with other people so increasing efficiency of learning or any other task. [17]

Fig. 4 shows an electronic paper prototype. These papers can be used to adopt the content delivery method of teaching; instructor can easily engage students to write the respective notes and answers on these electronic papers.

TABLE V. BENEFITS AND LIMITATIONS OF PAPER CENTRIC LEERING ECOLOGY

Advantages	Disadvantages
Easy to understand its functionality	Limited capability of storing information on each paper
Can save information for long time as compared to traditional paper	Requires larger space to save as compared to digital documents
Interactive Learning	
Inexpensive	

F. Proactive displays

Academic seminars provide a platform for people to present their work, learn about others' work, and interact with one another [18]. But, opportunities for interaction are unevenly distributed among the attendees. With the help of proactive displays attendees easily disclose about their experience and interests.

Computer displays are coupled with the sensors that sense and then respond to the nearby people.

There are two types of applications which are used in proactive displays:
a. auto ID Speaker
b. Ticket to Talk.

In auto ID Speaker application, name, association and photograph of a person asking a question is shown on display. Where as in Ticket to talk, image of user and his interest is displayed when he approaches the display[17].

These proactive displays can be used to achieve successful outcomes in larger class rooms. This will help to understand each participant in class. The instructor can easily become aware of students' attributes. This can be used to increase the engagement of students. Following table shows some advantages and limitations of this technique:

TABLE VI.   BENEFITS AND LIMITATIONS OF PROACTIVE DISPLAYS

Advantages	Disadvantages
Low hardware maintenance	Time consuming, Have to add data for every participant
Better content delivery	Steep learning curve
Interactive Learning	Connectivity issues

G. CAI

Computer-assisted instruction assures a better learning environment in education. It refers to instruction or remediation presented on a computer. They enhance teacher instruction in several ways. They permit students to advance at their own pace and work individually or solve problem in a group [19].

In CAI, computer works as a "tutor" that examines a student's efforts in attempting a question. The tutor program is aware about the mistaken concepts of the people regarding a particular problem and observes a student wriggling into one of these traps.

Subsequently, it suggests advice tailored to specific needs of a student. Thus CAI can be used to implement all the three general functions of learning i.e. interactive learning, engagement and assessment.

Another indirect but most important educational advantage of deliberate learning is to reproduce mechanical thinking, the learner gains capability of distinguishing between what mechanical thinking is and what it is not [19]. Following table shows some pros and cons of using this technology:

TABLE VII.   BENEFITS AND LIMITATIONS OF COMPUTER ASSISTED PROGRAMS

Advantages	Disadvantages
Can adapt to the abilities and preferences of student	Hardware capability issues
Allows pupil to control their own learning process.	Not budget friendly
Can provide immediate feedback.	Requires intensive technical support
CAI is non-judgmental and predictable.	Steep learning curve

IV.   CONCLUSION

This paper shows that several solutions may be considered in the design of friendly and efficient education system. These technologies will help in establishment of an education system which will encourage students to learn, will help them in understanding concepts well and will give opportunities to examiners in evaluating their pupils on scientific basis.

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