Educational Technology

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Contents

Chapter 1

Educational technology

Educational technology is the effective use of technological tools in learning. As a concept, it concerns an array of tools, such as media, machines and networking hardware, as well as considering theoretical perspectives for their effective application.[1][2]

Educational technology is not restricted to high technology.[3] Nonetheless, electronic educational technology has become an important part of society today.[4] Modern educational technology includes (and is broadly synonymous with) e-learning, instructional technology, information and communication technology (ICT) in education, EdTech, learning technology, multimedia learning, technology-enhanced learning (TEL), computer-based instruction (CBI), computer managed instruction, computer-based training (CBT), computer-assisted instruction or computer-aided instruction (CAI), internet-based training (IBT), flexible learning, web-based training (WBT), online education, virtual education, personal learning environments, networked learning, virtual learning environments (VLE) (which are also called learning platforms), m-learning, and digital education. These labels have been variously used and understood, and conflate to the broad domain of educational technology and e-learning.[5] These alternative descriptive terms are all more restrictive than "educational technology" in that they individually emphasize a particular digitization approach, component or delivery method. For example, m-learning *emphasizes* mobility, but is otherwise indistinguishable *in principle* from educational technology.

Theoretical perspectives and scientific testing may influence instructional design. The application of theories of human behavior to educational technology derives input from instructional theory, learning theory, educational psychology, media psychology and human performance technology.

Educational technology includes numerous types of media that deliver text, audio, images, animation, and streaming video, and includes technology applications and processes such as audio or video tape, satellite TV, CD-ROM, and computer-based learning, as well as local intranet/extranet and web-based learning. Information and communication systems, whether freestanding or based on either local networks or the Internet in networked learning, underlie many e-learning processes.[6]

Educational technology and e-learning can occur in or out of the classroom. It can be self-paced, asynchronous learning or may be instructor-led, synchronous learning. It is suited to distance learning and in conjunction with face-to-face teaching, which is termed blended learning. Educational technology is used by learners and educators in homes, schools (both K-12 and higher education), businesses, and other settings.

1.1 Definition

Richey defined educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources".[1] The Association for Educational Communications and Technology (AECT) denoted instructional technology as "the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning."[2][7][8] As such, educational technology refers to all valid and reliable applied education science, such as equipment, as well as processes and procedures, that are derived from scientific research, and in a given context may refer to theoretical, algorithmic or heuristic processes: it does not necessarily imply physical technology.

1.1.1 Scope

Educational technology thus refers to the use of both physical hardware and educational theoretics. It encompasses several domains, including learning theory, computer-based training, online learning, and, where mobile technologies are used, m-learning. Accordingly, there are several discrete aspects to describing the intellectual and technical development of educational technology:

- educational technology as the **theory and practice of educational approaches** to learning

- educational technology as **technological tools and media** that assist in the communication of knowledge, and its development and exchange

- educational technology for **learning system management** (LMS), such as tools for student and curriculum management, and education management information systems (EMIS)

- educational technology itself as an **educational subject**; such courses may be called "Computer Studies" or "Information and Communication Technology (ICT)"

1.1.2   Related terms
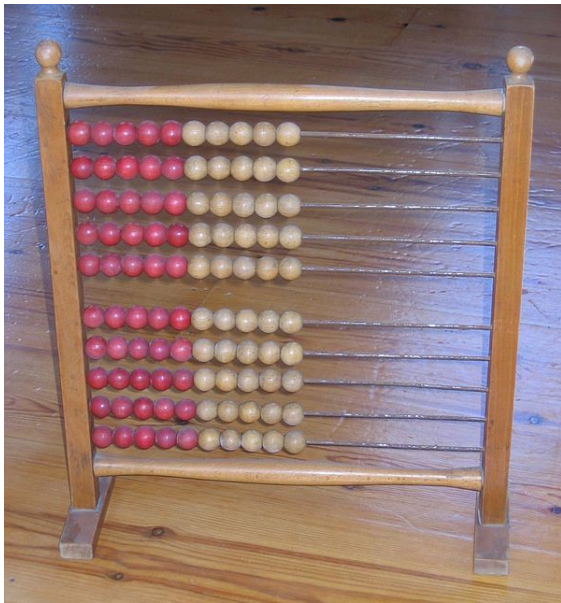
Early 19th century abacus used in a Danish elementary school.

Educational technology is an inclusive term for the tools that technologically or electronically support learning and teaching. Educational technology is not restricted to high technology.[3] However, modern electronic educational technology has become an important part of society today.[4] Technology Depending on whether a particular aspect, component or delivery method is given emphasis, a wide array of similar or overlapping terms has been used. As such, educational technology encompasses e-learning, instructional technology, information and communication technology (ICT) in education, EdTech, learning technology, multimedia learning, technology-enhanced learning (TEL), computer-based instruction (CBI), computer managed instruction, computer-based training (CBT), computer-assisted instruction or computer-aided instruction (CAI),[9] internet-based training (IBT), flexible learning, web-based training (WBT), online education, digital educational collaboration, distributed learning, computer-mediated communication, cyber-learning,

and multi-modal instruction, virtual education, personal learning environments, networked learning, virtual learning environments (VLE) (which are also called learning platforms), m-learning, and digital education.

Every one of these numerous terms has had its advocates, who point up particular potential distinctions. In practice, as technology has advanced, the particular "narrowly defined" aspect that was initially emphasized has blended into the general field of educational technology and e-learning.[5] As an example, "virtual learning" in a narrowly defined semantic sense implies entering the environmental simulation within a virtual world,[10][11] for example in treating posttraumatic stress disorder (PTSD).[12][13] In practice, a "virtual education course" refers to any instructional course in which all, or at least a significant portion, is delivered by the Internet. "Virtual" is used in that broader way to describe a course that not taught in a classroom face-to-face but through a substitute mode that can conceptually be associated "virtually" with classroom teaching, which means that people do not have to go to the physical classroom to learn. Accordingly, virtual education refers to a form of distance learning in which course content is delivered by various methods such as course management applications, multimedia resources, and videoconferencing. Students and instructors communicate via these technologies.[14]

Bernard Luskin, an educational technology pioneer, advocated that the "e" of e-learning should be interpreted to mean "exciting, energetic, enthusiastic, emotional, extended, excellent, and educational" in addition to "electronic." This broad interpretation focuses on new applications and developments, as well as learning theory and media psychology.[15] Parks suggested that the "e" should refer to "everything, everyone, engaging, easy".[16]

1.2   History

Main article: Educational software

The historical foundations of devising means to help

19th century classroom, Auckland

people learn in ways that are easier, faster, surer, or

less expensive than previous means can be traced back to the emergence of very early tools, such as paintings on cave walls.[17][18] Various types of abacus have been used. Writing slates and blackboards have been used for at least a millennium.[19] From their introduction, books and pamphlets have held a prominent role in education. From the early twentieth century, duplicating machines such as the mimeograph and Gestetner stencil devices were used to produce short copy runs (typically 10–50 copies) for classroom or home use. The use of media for instructional purposes is generally traced back to the first decade of the 20th century[20] with the introduction of educational films (1900s) and Sidney Pressey's mechanical teaching machines (1920s). The first all multiple choice, large scale assessment was the Army Alpha, used to assess the intelligence and more specifically the aptitudes of World War I military recruits. Further large-scale use of technologies was employed in training soldiers during and after WWII using films and other mediated materials, such as overhead projectors. The concept of hypertext is traced to Bush's description of memex in 1945.
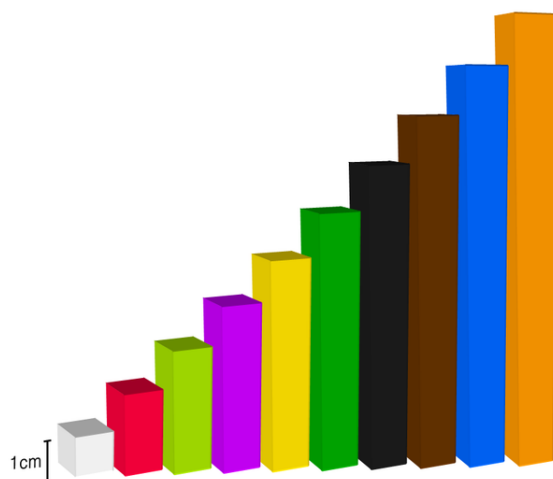
Cuisenaire rods

Slide projectors came into widespread use during the 1950s and were widely used in educational institutional settings. Cuisenaire rods were devised in the 1920s and saw widespread use from the late 1950s.

In 1960, the University of Illinois initiated a classroom system based in linked computer terminals where students could access informational resources on a particular course while listening to the lectures that were recorded via some form of remotely linked device like a television or audio device.[21]

In the early 1960s, Stanford University psychology professors Patrick Suppes and Richard C. Atkinson experimented with using computers to teach math and reading to young children in elementary schools in East Palo Alto, California. Stanford's Education Program for Gifted Youth is descended from those early experiments. In 1963, Bernard Luskin installed the first computer in a community college for instruction. Working with Stan-

ford and others he helped develop computer-assisted instruction. Working with the Rand Corporation, Luskin's landmark UCLA dissertation in 1970 analyzed obstacles to computer-assisted instruction.

Artistic portrait of Ivan Illich by Amano1.

In 1971, Ivan Illich published a hugely influential book called, Deschooling Society, in which he envisioned "learning webs" as a model for people to network the learning they needed. The 1970s and 1980s saw notable contributions in computer-based learning by Murray Turoff and Starr Roxanne Hiltz at the New Jersey Institute of Technology[22] as well as developments at the University of Guelph in Canada.[23] In 1976, Bernard Luskin launched Coastline Community College as a "college without walls" using television station KOCE-TV as a vehicle. In the UK the Council for Educational Technology supported the use of educational technology, in particular administering the government's National Development Programme in Computer Aided Learning[24] (1973–77) and the Microelectronics Education Programme (1980–86).

By the mid-1980s, accessing course content become possible at many college libraries. In computer-based training (CBT) or computer-based learning (CBL), the learning interaction was between the student and computer drills or micro-world simulations.

Digitized communication and networking in education started in the mid-1980s. Educational institutions began to take advantage of the new medium by offering distance learning courses using computer networking for information. Early e-learning systems, based on computer-based learning/training often replicated autocratic teaching styles whereby the role of the e-learning system was assumed to be for transferring knowledge, as opposed to systems developed later based on computer

supported collaborative learning (CSCL), which encouraged the shared development of knowledge.

Videoconferencing was an important forerunner to the educational technologies known today. This work was especially popular with Museum Education. Even in recent years, videoconferencing has risen in popularity to reach over 20,000 students across the United States and Canada in 2008-2009. Disadvantages of this form of educational technology are readily apparent: image and sound quality is often grainy or pixilated; videoconferencing requires setting up a type of mini-television studio within the museum for broadcast, space becomes an issue; and specialised equipment is required for both the provider and the participant.[25]

The Open University in Britain[23] and the University of British Columbia (where Web CT, now incorporated into Blackboard Inc., was first developed) began a revolution of using the Internet to deliver learning,[26] making heavy use of web-based training, online distance learning and online discussion between students.[27] Practitioners such as Harasim (1995)[28] put heavy emphasis on the use of learning networks.

Cassandra B. Whyte researched about the ever-increasing role that computers would play in higher education. This evolution, which includes computer-supported collaborative learning in addition to data management, has been realized.[29]

With the advent of World Wide Web in the 1990s, teachers embarked on the method using emerging technologies to employ multi-object oriented sites, which are text-based online virtual reality systems, to create course websites along with simple sets of instructions for its students.

In 1993, Graziadei described an online computer-delivered lecture, tutorial and assessment project using electronic mail. By 1994, the first online high school had been founded. In 1997, Graziadei described criteria for evaluating products and developing technology-based courses include being portable, replicable, scalable, affordable, and having a high probability of long-term cost-effectiveness.[30]

By 1994, CALCampus presented its first online curriculum. CALCampus is where concepts of online-based school first originated, this allowed to progress real-time classroom instructions and Quantum Link classrooms.[31] With the drastic shift of Internet functionality, multimedia began introducing new schemes of communication; through the invention of webcams, educators can simply record lessons live and upload them on the website page. There are currently wide varieties of online education that are reachable for colleges, universities and K-12 students. In fact, the National Center for Education Statistics estimate the number of K-12 students enrolled in online distance learning programs increased by 65 percent from 2002 to 2005. This form of high learning allowed for greater flexibility by easing the communication between teacher and student, now teachers received quick lecture feedbacks from their students.

Online education is rapidly increasing and is becoming as viable an alternative as traditional classrooms. According to a 2008 study conducted by the U.S Department of Education, during the 2006-2007 academic year about 66% of postsecondary public and private schools participating in student financial aid programs offered some distance learning courses; records show 77% of enrollment in for-credit courses with an online component.[32] In 2008, the Council of Europe passed a statement endorsing e-learning's potential to drive equality and education improvements across the EU.[33]

Today, the prevailing paradigm is computer-mediated communication (CMC), where the primary interaction is between learners and instructors, mediated by the computer. CBT/CBL usually means individualized (self-study) learning, while CMC involves educator/tutor facilitation and requires scenarization of flexible learning activities. In addition, modern ICT provides education with tools for sustaining learning communities and associated knowledge management tasks.

Students growing up in this digital age have extensive exposure to a variety of media.[34][35] Major high-tech companies such as Google, Verizon, Microsoft are funding schools to provide them the ability to teach their students through technology, which may lead to improved student performance.

1.3 Theory

Main articles: Educational psychology, E-learning (theory), Learning theory (education) and Educational philosophies

Various pedagogical perspectives or learning theories may be considered in designing and interacting with educational technology. E-learning theory examines these approaches. These theoretical perspectives are grouped into three main theoretical schools or philosophical frameworks: behaviorism, cognitivism and constructivism.

1.3.1 Behaviorism

This theoretical framework was developed in the early 20th century based on animal learning experiments by Ivan Pavlov, Edward Thorndike, Edward C. Tolman, Clark L. Hull, and B.F. Skinner. Many psychologists used these results to develop theories of human learning, but modern educators generally see behaviorism as one aspect of a holistic synthesis.

B.F. Skinner wrote extensively on improvements of teaching based on his functional analysis of verbal behavior[36] and wrote "The Technology of Teaching",[37][38]

an attempt to dispel the myths underlying contemporary education as well as promote his system he called programmed instruction. Ogden Lindsley developed a learning system, named Celeration, that was based on behavior analysis but that substantially differed from Keller's and Skinner's models.

1.3.2 Cognitivism

Cognitive science underwent significant change in the 1960s and 1970s. While retaining the empirical framework of behaviorism, cognitive psychology theories look beyond behavior to explain brain-based learning by considering how human memory works to promote learning. The Atkinson-Shiffrin memory model and Baddeley's working memory model were established as theoretical frameworks. Computer Science and Information Technology have had a major influence on Cognitive Science theory. The Cognitive concepts of working memory (formerly known as short term memory) and long term memory have been facilitated by research and technology from the field of Computer Science. Another major influence on the field of Cognitive Science is Noam Chomsky. Today researchers are concentrating on topics like cognitive load, information processing and media psychology. These theoretical perspectives influence instructional design.[39]

1.3.3 Constructivism

Educational psychologists distinguish between several types of constructivism: individual (or psychological) constructivism, such as Piaget's theory of cognitive development, and social constructivism. This form of constructivism has a primary focus on how learners construct their own meaning from new information, as they interact with reality and with other learners who bring different perspectives. Constructivist learning environments require students to use their prior knowledge and experiences to formulate new, related, and/or adaptive concepts in learning. Under this framework the role of the teacher becomes that of a facilitator, providing guidance so that learners can construct their own knowledge. Constructivist educators must make sure that the prior learning experiences are appropriate and related to the concepts being taught. Jonassen (1997) suggests "well-structured" learning environments are useful for novice learners and that "ill-structured" environments are only useful for more advanced learners. Educators utilizing a constructivist perspective may emphasize an active learning environment that may incorporate learner centered problem based learning, project-based learning, and inquiry-based learning, ideally involving real-world scenarios, in which students are actively engaged in critical thinking activities.

1.4 Practice

Main article: Instructional design

The extent to which e-learning assists or replaces other learning and teaching approaches is variable, ranging on a continuum from none to fully online distance learning.[40][41] A variety of descriptive terms have been employed (somewhat inconsistently) to categorize the extent to which technology is used. For example, 'hybrid learning' or 'blended learning' may refer to classroom aids and laptops, or may refer to approaches in which traditional classroom time is reduced but not eliminated, and is replaced with some online learning.[42][43][44] 'Distributed learning' may describe either the e-learning component of a hybrid approach, or fully online distance learning environments.[40]

1.4.1 Synchronous and asynchronous

E-learning may either be synchronous or asynchronous. Synchronous learning occurs in real-time, with all participants interacting at the same time, while asynchronous learning is self-paced and allows participants to engage in the exchange of ideas or information without the dependency of other participants' involvement at the same time.

Synchronous learning refers to the exchange of ideas and information with one or more participants during the same period. Examples are face-to-face discussion, online real-time live teacher instruction and feedback, Skype conversations, and chat rooms or virtual classrooms where everyone is online and working collaboratively at the same time.

Asynchronous learning may use technologies such as email, blogs, wikis, and discussion boards, as well as web-supported textbooks,[45] hypertext documents, audio[46] video courses, and social networking using web 2.0. At the professional educational level, training may include virtual operating rooms.Asynchronous learning is particularly beneficial for students who have health problems or have child care responsibilities and regularly leaving the home to attend lectures is difficult. They have the opportunity to complete their work in a low stress environment and within a more flexible timeframe.[27] In *asynchronous* online courses, students proceed at their own pace. If they need to listen to a lecture a second time, or think about a question for a while, they may do so without fearing that they will hold back the rest of the class. Through online courses, students can earn their diplomas more quickly, or repeat failed courses without the embarrassment of being in a class with younger students. Students have access to an incredible variety of enrichment courses in online learning, and can participate in college courses, internships, sports, or work and still graduate with their class.

1.4.2   Linear learning

Computer-based training (CBT) refers to self-paced learning activities delivered on a computer or handheld device such as a tablet or smartphone. CBT initially delivered content via CD-ROM, and typically presented content linearly, much like reading an online book or manual. For this reason, CBT is often used to teach static processes, such as using software or completing mathematical equations. Computer-based training is conceptually similar to web-based training (WBT), the primary difference being that WBTs are delivered via Internet using a web browser.

Assessing learning in a CBT is often by assessments that can be easily scored by a computer such as multiple choice questions, drag-and-drop, radio button, simulation or other interactive means. Assessments are easily scored and recorded via online software, providing immediate end-user feedback and completion status. Users are often able to print completion records in the form of certificates.

CBTs provide learning stimulus beyond traditional learning methodology from textbook, manual, or classroom-based instruction. For example, CBTs offer user-friendly solutions for satisfying continuing education requirements. CBTs can be a good alternative to printed learning materials since rich media, including videos or animations, can be embedded to enhance the learning.

However, CBTs pose some learning challenges. Typically, the creation of effective CBTs requires enormous resources. The software for developing CBTs (such as Flash or Adobe Director) is often more complex than a subject matter expert or teacher is able to use. In addition, the lack of human interaction can limit both the type of content that can be presented and the type of assessment that can be performed. Many learning organizations are beginning to use smaller CBT/WBT activities as part of a broader online learning program which may include online discussion or other interactive elements.

1.4.3   Collaborative learning

Computer-supported collaborative learning (CSCL) uses instructional methods designed to encourage or require students to work together on learning tasks. CSCL is similar in concept to the terminology, "e-learning 2.0" and "networked collaborative learning" (NCL).[47]

Collaborative learning is distinguishable from the traditional approach to instruction in which the instructor is the principal source of knowledge and skills. For example, the neologism "e-learning 1.0" refers to the direct transfer method in computer-based learning and training systems (CBL). In contrast to the linear delivery of content, often directly from the instructor's material, CSCL uses blogs, wikis, and cloud-based document portals (such as Google Docs and Dropbox). With techno-

logical Web 2.0 advances, sharing information between multiple people in a network has become much easier and use has increased.[48]:1 One of the main reasons for its usage states that it is "a breeding ground for creative and engaging educational endeavors."[48]:2

Using Web 2.0 social tools in the classroom allows for students and teachers to work collaboratively, discuss ideas, and promote information. According to Sendall (2008),[49] blogs, wikis, and social networking skills are found to be significantly useful in the classroom. After initial instruction on using the tools, students reported an increase in knowledge and comfort level for using Web 2.0 tools. The collaborative tools prepare students with technology skills necessary in today's workforce.

Locus of control remains an important consideration in successful engagement of e-learners. According to the work of Cassandra B. Whyte, the continuing attention to aspects of motivation and success in regard to e-learning should be kept in context and concert with other educational efforts. Information about motivational tendencies can help educators, psychologists, and technologists develop insights to help students perform better academically.[50]

Classroom 2.0

Classroom 2.0 refers to online multi-user virtual environments (MUVEs) that connect schools across geographical frontiers. Known as "eTwinning", computer-supported collaborative learning (CSCL) allows learners in one school to communicate with learners in another that they would not get to know otherwise,[51][52][53] enhancing educational outcomes and cultural integration. Examples of classroom 2.0 applications are Blogger and Skype.[54]

E-learning 2.0

Main article: Computer-supported collaborative learning

E-learning 2.0 is a type of computer-supported collaborative learning (CSCL) system that developed with the emergence of Web 2.0.[55][56] From an e-learning 2.0 perspective, conventional e-learning systems were based on instructional packets, which were delivered to students using assignments. Assignments were evaluated by the teacher. In contrast, the new e-learning places increased emphasis on social learning and use of social software such as blogs, wikis, podcasts and virtual worlds such as *Second Life*.[57] This phenomenon has been referred to as Long Tail Learning[58]

E-learning 2.0, in contrast to e-learning systems not based on CSCL, assumes that knowledge (as meaning and understanding) is socially constructed. Learning takes place through conversations about content and grounded inter-

action about problems and actions. Advocates of social learning claim that one of the best ways to learn something is to teach it to others.[58]

In addition to virtual classroom environments, social networks have become an important part of E-learning 2.0. Social networks have been used to foster online learning communities around subjects as diverse as test preparation and language education.[59] Mobile Assisted Language Learning (MALL) is the use of handheld computers or cell phones to assist in language learning. Traditional educators may not promote social networking unless they are communicating with their own colleagues.[60]

1.5 Media
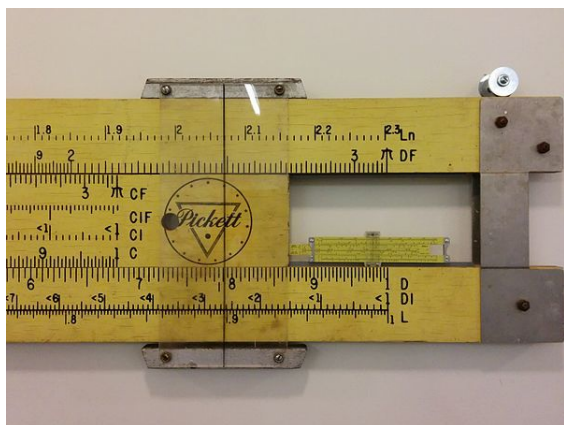
A 2.5m teaching slide rule compared to a normal sized model

Educational media and tools can be used for:

- task structuring support: help with how to do a task (procedures and processes),

- access to knowledge bases (help user find information needed)

- alternate forms of knowledge representation (multiple representations of knowledge, e.g. video, audio, text, image, data)

Numerous types of physical technology are currently used:[61] digital cameras, video cameras, interactive whiteboard tools, document cameras, electronic media, and LCD projectors. Combinations of these techniques include blogs, collaborative software, ePortfolios, and virtual classrooms.

1.5.1 Audio and video

Radio offers a synchronous educational vehicle, while streaming audio over the internet with webcasts and pod-

casts can be asynchronous. Classroom microphones, often wireless, can enable learners and educators to interact more clearly.

Video technology[62] has included VHS tapes and DVDs, as well as on-demand and synchronous methods with digital video via server or web-based options such as streamed video from YouTube, Teacher Tube, Skype, Adobe Connect, and webcams. Telecommuting can connect with speakers and other experts.

Interactive digital video games are being used at K-12 and higher education institutions.[63]

Podcasting allows anybody to publish files to the Internet where individuals can subscribe and receive new files from people by a subscription.[64]

1.5.2 Computers, tablets and mobile devices

Teaching and learning online

Computers and tablets enable learners and educators to access websites as well as programs such as Microsoft Word, PowerPoint, PDF files, and images. Many mobile devices support m-learning.

Mobile devices such as clickers and smartphones can be used for interactive feedback.[65] Mobile learning can provide performance support for checking the time, setting reminders, retrieving worksheets, and instruction manuals.[66][67]

OpenCourseWare (OCW) gives free public access to information used in undergraduate and graduate programs. Participating institutions are MIT[68][69] and Harvard, Princeton, Stanford, University of Pennsylvania, and University of Michigan.[70]

1.5.3 Social networks

Group webpages, blogs, and wikis allow learners and educators to post thoughts, ideas, and comments on a website in an interactive learning environment.[71] Social net-

working sites are virtual communities for people interested in a particular subject or just to "hang out" together. Members communicate by voice, chat, instant message, video conference, and blogs, and the service typically provides a way for members to contact friends of other members.[72] The National School Boards Association found that 96% of students with online access have used social networking technologies, and more than 50% talk online specifically about schoolwork. These statistics support the likelihood of being able to bring these technologies into our classrooms and find successful teaching methods to employ their use in an educational setting. Social networking inherently encourages collaboration and engagement.[73] Social networking can be used as a motivational tool to promote self-efficacy amongst students. In a study by Bowers-Campbell (2008) Facebook was used as an academic motivation tool for students in a developmental reading course.[74] Group members may respond and interact with other members.[75] Student interaction is at the core of constructivist learning environments and Social Net-working Sites provide a platform for building collaborative learning communities. By their very nature they are relationship-centred and promote shared experiences. With the emphasis on user-generated-content, some experts are concerned about the traditional roles of scholarly expertise and the reliability of digital content. Students still have to be educated and assessed within a framework that adheres to guidelines for quality. Every student has his or her own learning requirements, and a Web 2.0 educational framework provides enough resources, learning styles, communication tools and flexibility to accommodate this diversity.[74]

Social networking is important for educators themselves. On the social media website Twitter, there are daily chats and informational sharing between educators that are labelled (hashtag) "#edtech". Postings take place throughout the day and educators are linked internationally through the Internet. This learning network is shared globally.[76]

1.5.4   Webcams

Webcams and webcasting have enabled creation of virtual classrooms and virtual learning environment.[77]

1.5.5   Whiteboards

Interactive whiteboards and smartboards allow learners and instructors to write on the touch screen. The screen markup can be on either a blank whiteboard or any computer screen content. Depending on permission settings, this visual learning can be interactive and participatory, including writing and manipulating images on the interactive whiteboard.

1.5.6   Screencasting

Screencasting allows users to share their screens directly from their browser and make the video available online so that other viewers can stream the video directly.[78] The presenter thus has the ability to show their ideas and flow of thoughts rather than simply explain them as simple text content. In combination with audio and video, the educator can mimic the one-on-one experience of the classroom and deliver clear, complete instructions. Learners have an ability to pause and rewind, to review at their own pace, something a classroom cannot always offer.

1.5.7   Virtual classroom

Main articles: Virtual Learning Environment and MUVE

A Virtual Learning Environment (VLE), also known as a learning platform, simulates a virtual classroom or meetings by simultaneously mixing several communication technologies. For example, web conferencing software such as GoToTraining, WebEx Training or Adobe Connect enables students and instructors to communicate with each other via webcam, microphone, and real-time chatting in a group setting. Participants can raise hands, answer polls or take tests. Students are able to whiteboard and screencast when given rights by the instructor, who sets permission levels for text notes, microphone rights and mouse control.

A virtual classroom provides the opportunity for students to receive direct instruction from a qualified teacher in an interactive environment. Learners can have direct and immediate access to their instructor for instant feedback and direction. The virtual classroom provides a structured schedule of classes, which can be helpful for students who may find the freedom of asynchronous learning to be overwhelming. In addition, the virtual classroom provides a social learning environment that replicates the traditional "brick and mortar" classroom. Most virtual classroom applications provide a recording feature. Each class is recorded and stored on a server, which allows for instant playback of any class over the course of the school year. This can be extremely useful for students to review material and concepts for an upcoming exam. This provides students with the opportunity to watch any class that they may have missed, so that they do not fall behind. Parents and auditors have the conceptual ability to monitor any classroom to ensure that they are satisfied with the education the learner is receiving.

In higher education especially, the increasing tendency is to create a virtual learning environment (VLE) (which is sometimes combined with a Management Information System (MIS) to create a Managed Learning Environment) in which all aspects of a course are handled through a consistent user interface throughout the institution. A growing number of physical universities, as well as newer

online-only colleges, have begun to offer a select set of academic degree and certificate programs via the Internet at a wide range of levels and in a wide range of disciplines. While some programs require students to attend some campus classes or orientations, many are delivered completely online. In addition, several universities offer online student support services, such as online advising and registration, e-counseling, online textbook purchases, student governments and student newspapers.

Augmented reality (AR) provides students and teachers the opportunity to create layers of digital information, that includes both virtual world and real world elements, to interact with in real time. There are already a variety of apps which offer a lot of variations and possibilities.

1.5.8 Learning management system

Main article: Learning management system

A learning management system[79] (LMS) is software used for delivering, tracking and managing training and education. For example, an LMS tracks attendance, time on task, and student progress. Educators can post announcements, grade assignments, check on course activity, and participate in class discussions. Students can submit their work, read and respond to discussion questions, and take quizzes.[71] An LMS may allow teachers, administrators, students, and permitted additional parties (such as parents if appropriate) to track various metrics. LMSs range from systems for managing training/educational records to software for distributing courses over the Internet and offering features for online collaboration. The creation and maintenance of comprehensive learning content requires substantial initial and ongoing investments of human labor. Effective translation into other languages and cultural contexts requires even more investment by knowledgeable personnel.[80]

Internet-based learning management systems include Canvas, Blackboard Inc. and Moodle. These types of LMS allow educators to run a learning system partially or fully online, asynchronously or synchronously. Blackboard can be used for K-12 education, Higher Education, Business, and Government collaboration.[81] Moodle is a free-to-download Open Source Course Management System that provides blended learning opportunities as well as platforms for distance learning courses.[82] Eliademy is a free cloud based Course Management System that provides blended learning opportunities as well as platforms for distance learning courses.[83]

Learning content management system

A learning content management system (LCMS) is software for author content (courses, reusable content objects). An LCMS may be solely dedicated to producing and publishing content that is hosted on an LMS,

or it can host the content itself. The Aviation Industry Computer-Based Training Committee (AICC) specification provides support for content that is hosted separately from the LMS.

A recent trend in LCMSs is to address this issue through crowdsourcing (cf.SlideWiki[84]).

Computer-aided assessment

Computer-aided assessment (e-assessment) ranges from automated multiple-choice tests to more sophisticated systems. With some systems, feedback can be geared towards a student's specific mistakes or the computer can navigate the student through a series of questions adapting to what the student appears to have learned or not learned.

The best examples follow a formative assessment structure and are called "Online Formative Assessment". This involves making an initial formative assessment by sifting out the incorrect answers. The author of the assessment/teacher will then explain what the pupil should have done with each question. It will then give the pupil at least one practice at each slight variation of sifted out questions. This is the formative learning stage. The next stage is to make a summative assessment by a new set of questions only covering the topics previously taught.

Learning design is the type of activity enabled by software that supports sequences of activities that can be both adaptive and collaborative. The IMS Learning Design specification is intended as a standard format for learning designs, and IMS LD Level A is supported in LAMS V2.elearning and has been replacing the traditional settings due to its cost effectiveness.

Electronic performance support system

An electronic performance support system (EPSS) is, according to Barry Raybould, "a computer-based system that improves worker productivity by providing on-the-job access to integrated information, advice, and learning experiences".[85] Gloria Gery defines it as "an integrated electronic environment that is available to and easily accessible by each employee and is structured to provide immediate, individualized on-line access to the full range of information, software, guidance, advice and assistance, data, images, tools, and assessment and monitoring systems to permit job performance with minimal support and intervention by others."[86][87]

Student data systems have a significant impact on education and students.[88] Over-the-counter data (OTCD) refers to a design approach which involves embedding labels, supplemental documentation, and a help system and making key package/display and content decisions.[89]

1.5.9 Learning objects

Main article: Learning object

Content

Content is a core component of e-learning and includes issues such as pedagogy and learning object re-use. While there are a number of means of achieving a rich and interactive elearning platform, one option is using a design architecture composed of the "Five Types of Content in eLearning" (Clark, Mayer, 2007).[90]

Content normally comes in one of five forms:

- Fact - unique data (e.g. symbols for Excel formula, or the parts that make up a learning objective)

- Concept - a category that includes multiple examples (e.g. Excel formulas, or the various types/theories of Instructional Design)

- Process - a flow of events or activities (e.g. how a spreadsheet works, or the five phases in ADDIE)

- Procedure - step-by-step task (e.g. entering a formula into a spreadsheet, or the steps that should be followed within a phase in ADDIE)

- Strategic Principle - task performed by adapting guidelines (e.g. doing a financial projection in a spreadsheet, or using a framework for designing learning environments)

Pedagogical elements

Pedagogical elements are defined as structures or units of educational material. They are the educational content that is to be delivered. These units are independent of format, meaning that although the unit may be delivered in various ways, the pedagogical structures themselves are **not** the textbook, web page, video conference, Podcast, lesson, assignment, multiple choice question, quiz, discussion group or a case study, all of which are possible methods of delivery.

Learning objects standards

Much effort has been put into the technical reuse of electronically based teaching materials and in particular creating or re-using learning objects. These are self-contained units that are properly tagged with keywords, or other metadata, and often stored in an XML file format. Creating a course requires putting together a sequence of learning objects. There are both proprietary and open, non-commercial and commercial, peer-reviewed repositories of learning objects such as the Merlot repository.

Sharable Content Object Reference Model (SCORM) is a collection of standards and specifications that applies to certain web-based e-learning. Other specifications such as Schools Framework allow for the transporting of learning objects, or for categorizing metadata (LOM).

1.6 Settings

1.6.1 Preschool

Various forms of electronic media are a feature of preschool life.[91] Although parents report a positive experience, the impact of such use has not been systematically assessed.[91]

The age when a given child might start using a particular technology such as a cellphone or computer might depend on matching a technological resource to the recipient's developmental capabilities, such as the age-anticipated stages labeled by Swiss psychologist, Jean Piaget.[92] Parameters, such as age-appropriateness, coherence with sought-after values, and concurrent entertainment and educational aspects, have been suggested for choosing media.[93]

1.6.2 K–12

Teacher showing primary school students how to work a program at a primary school in Santa Fe, Mexico City.

E-learning is utilized by public K–12 schools in the United States as well as private schools. Some e-learning environments take place in a traditional classroom, others allow students to attend classes from home or other locations. There are several states that are utilizing virtual school platforms for e-learning across the country that continue to increase. Virtual school enables students to log into synchronous learning or asynchronous learning courses anywhere there is an internet connection.

E-learning is increasingly being utilized by students who may not want to go to traditional brick and mortar schools due to severe allergies or other medical issues, fear of school violence and school bullying and students

whose parents would like to homeschool but do not feel qualified.[94] Online schools create a haven for students to receive a quality education while almost completely avoiding these common problems. Online charter schools also often are not limited by location, income level or class size in the way brick and mortar charter schools are.[95]

E-learning also has been rising as a supplement to the traditional classroom. Students with special talents or interests outside of the available curricula use e-learning to advance their skills or exceed grade restrictions.[96] Some online institutions connect students with instructors via web conference technology to form a digital classroom.

National private schools are also available online. These provide the benefits of e-learning to students in states where charter online schools are not available. They also may allow students greater flexibility and exemption from state testing.

Virtual education in K-12 schooling often refers to virtual schools, and in higher education to virtual universities. Virtual schools are "cybercharter schools"[97] with innovative administrative models and course delivery technology.[97]

1.6.3 Higher education

Enrollments for fully online learning increased by an average of 12–14 percent annually between 2004 and 2009, compared with an average of approximately 2 per cent increase per year in enrollments overall.[98][99] Almost a quarter of all students in post-secondary education were taking fully online courses in 2008.[98] In 2009, 44 percent of post-secondary students in the USA were taking some or all of their courses online, this figure is projected to rise to 81 percent by 2014.[100]

Although a large proportion of for-profit higher education institutions now offer online classes, only about half of private, non-profit schools do so. Private institutions may become more involved with on-line presentations as the costs decrease. Properly trained staff must also be hired to work with students online.[101] These staff members need to understand the content area, and also be highly trained in the use of the computer and Internet. Online education is rapidly increasing, and online doctoral programs have even developed at leading research universities.[102]

Although massive open online courses (MOOCs) may have limitations that preclude them from fully replacing college education,[103] such programs have significantly expanded. MIT, Stanford and Princeton University offer classes to a global audience, but not for college credit.[104] University-level programs, like edX founded by Massachusetts Institute of Technology and Harvard University, offer wide range of disciplines at no charge. MOOCs have not had a significant impact on higher ed-

ucation and declined after the initial expansion, but are expected to remain in some form.[105]

Private organizations also offer classes, such as Udacity, with free computer science classes, and Khan Academy, with over 3,900 free micro-lectures available via YouTube. There already is at least one counterstream to MOOC; Distributed open collaborative course or DOCC challenges the role of the Instructor, the hierarchy, the role of money and role of massiveness. DOCC recognizes that the pursuit of knowledge may be achieved better by not using a centralized singular syllabus, that expertise is distributed throughout all the participants in a learning activity, and does not just reside with one or two individuals.[106]

University of the People (UoPeople; www.UoPeople. edu) is the world's first non-profit, tuition-free, accredited online university dedicated to opening access to higher education globally. Using open-source technology, Open Educational Resources, peer-to-peer learning, and the assistance of academic volunteers, UoPeople is especially designed to provide access to college studies for qualified individuals, despite financial, geographic or societal constraints.

Coursera, an online-enrollment platform, is now offering education for millions of people around the world. A certification is consigned by Coursera for students who are able to complete an adequate performance in the course. Free online courses are administered by the website- fields like computer science, medicine, networks and social sciences are accessibly offered to pursuing students. The lectures are recorded into series of short videos discussing different topics and assignments in a weekly basis.

This virtual curriculum complement the curriculum taught in the traditional education setting by providing equality for all students, despite disability, and geographical location and socioeconomic status.

According to *Fortune* magazine, over a million people worldwide have enrolled in free online courses.[107]

1.6.4 Corporate and professional

E-learning has now been adopted and used by various companies to inform and educate both their employees and customers. Companies with large and spread out distribution chains use it to educate their sales staff about the latest product developments without the need of organizing physical onsite courses. Compliance has also been a big field of growth with banks using it to keep their staff's CPD levels up. Another area of growth is staff development, where employees can learn valuable workplace skills.

1.6.5   Public health

There is an important need for recent, reliable, and high-quality health information to be made available to the public as well as in summarized form for public health providers.[108] Providers have indicated the need for automatic notification of the latest research, a single searchable portal of information, and access to Grey literature.[109] The Maternal and Child Health (MCH) Library is funded by the U.S. Maternal and Child Health Bureau to screen the latest research and develop automatic notifications to providers through the MCH Alert. Another application in public health is the development of MHealth (use of mobile telecommunication and multimedia into global public health). MHealth has been used to promote prenatal and newborn services, with positive outcomes. In addition, "Health systems have implemented mHealth programs to facilitate emergency medical responses, point-of-care support, health promotion and data collection." [110] In low and middle income countries, MHealth is most frequently used as one-way text messages or phone reminders to promote treatment adherence and gather data.[111]

1.6.6   ADHD

There has also been a growing interest in e-learning as a beneficial educational method for students with Attention Deficit Hyperactivity Disorder (ADHD). With the growing popularity in e-learning among K-12 and higher education, the opportunity to take online classes is becoming increasingly important for students of all ages.[112] However, students with ADHD and special needs face different learning demands compared to the typical developing learner. This is especially significant considering the dramatic rise in ADHD diagnoses in the last decade among both children and adults.[113] Compared to the traditional face-to-face classroom, e-learning and virtual classrooms require a higher level of executive functions, which is the primary deficit associated with ADHD.[114]

Lorraine Wolf [115] lists 12 executive function skills necessary for students to succeed in postsecondary education: plan, set goals, organize, initiate, sustain attention/effort, flexibility, monitor, use feedback, structure, manage time, manage materials, and follow through. These skills, along with strong independent and self-regulated learning, are especially pronounced in the online environment and as many ADHD students suffer from a deficit in one or more of these executive functions, this presents a significant challenge and accessibility barrier to the current e-learning approach.[116][117]

Some have noted that current e-learning models are moving towards applying a constructivism learning theory [118] that emphasizes a learner-centered environment [119] and postulates that everyone has the ability to construct their own knowledge and meaning through a process of problem solving and discovery.[120] However, some

principles of constructivism may not be appropriate for ADHD learners; these principles include active learning, self-monitoring, motivation, and strong focus.[118]

Despite the limitations, students with special needs, including ADHD, have expressed an overall enthusiasm for e-learning and have identified a number e-learning benefits, including: availability of online course notes, materials and additional resources; the ability to work at an independent pace and spend extra time spent formulating thoughtful responses in class discussions; help in understanding course lecture/content; ability to review lectures multiple times; and enhanced access to and communication with the course instructor.[116][121]

1.6.7   Disabilities

Design of e-learning platforms to enable access has received attention from several directions, including the World Wide Web Consortium's Web Accessibility Initiative (WAI). WAI provides universal formatting standards for websites so they can remain accessible to people with disabilities. For example, developing or adopting e-learning material can enable accessibility for people with visual impairment.[122][123] The Perkins School for the Blind offers learning resources tailored for the visually impaired, including webcasts, webinars, downloadable science activities, and an online library that has access to over 40,000 resource materials on blindness and deaf blindness.

1.7   Benefits

Benefits of incorporating technology into learning may include:

- Improved open access to education, including access to full degree programs[124]

- Better integration for non-full-time students, particularly in continuing education,[124]

- Improved interactions between students and instructors,[125]

- Provision of tools to enable students to independently solve problems,[125]

- Acquisition of technological skills through practice with tools and computers.

- No age-based restrictions on difficulty level, i.e. students can go at their own pace.

- Defray travel costs .

- Easy-to-access course materials . Course material on a website allows learners to engage in

asynchronous learning and study at a time and location they prefer and to obtain the study material very quickly.[126]

- Student motivation. According to James Kulik, who studies the effectiveness of computers used for instruction, students usually learn more in less time when receiving computer-based instruction and they like classes more and develop more positive attitudes toward computers in computer-based classes.[127] Teachers must be aware of their students' motivators in order to successfully implement technology into the classroom.[128] Students are more motivated to learn when they are interested in the subject matter, which can be enhanced by using technologies in the classroom and targeting the need for screens and digital material [129] that they have been stimulated by outside of the classroom.

- In 2010, 70.3% of American family households had access to the internet.[130] In 2013, according to Canadian Radio Television and Telecommunications Commission Canada, 79% of homes have access to the internet.[131] Students can access and engage with numerous online resources at home.

- Using online resources such as Khan Academy or TED Talks can help students spend more time on specific aspects of what they may be learning in school, but at home. These online resources have added the opportunity to take learning outside of the classroom and into any atmosphere that has an internet connection. These online lessons allow for students who might need extra help to understand materials outside of the classroom. These tutorials can focus on small concepts of large ideas taught in class, or the other way around. Schools like MIT have even made their course materials free online so that anybody can access them.[132] Although some aspects of a classroom setting are missed by using these resources, they are helpful tools to add additional support to the educational system.

- Wide participation. Learning material can be used for long distance learning and are accessible to a wider audience.[133]

- Improved student writing . It is convenient for students to edit their written work on word processors, which can, in turn, improve the quality of their writing. According to some studies, the students are better at critiquing and editing written work that is exchanged over a computer network with students they know.[126]

- Effective technologies use many evidence-based strategies (e.g. adaptive content, frequent testing, immediate feedback, etc.), as do effective teachers.[134] It is important for teachers to embrace technology in order to gain these benefits so they can address the needs of their digital natives [135]

- The Internet has unlocked a world of opportunity for students. Information and ideas that were previously out of reach are a click away. Students of all ages can connect, share, and learn on a global scale.

- Using computers or other forms of technology can give students practice on core content and skills while the teacher can work with others, conduct assessments, or perform other tasks.[134]

- Studies completed in "computer intensive" settings found increases in student-centric, cooperative and higher order learning, students writing skills, problem solving, and using technology.[136] In addition, positive attitudes toward technology as a learning tool by parents, students and teachers are also improved.

- As indicated by the Society for Human Resource Management (SHRM),[137] employers' perspectives of online education have enhanced in the course of the last five to 10 years. More than 50% of human resource managers SHRM surveyed for an August 2010 report said that if two candidates with the same level of experience were applying for a job, it would not have any kind of effect whether the candidate's obtained degree was acquired through an online or a traditional school. Seventy-nine percent said they had employed a candidate with an online degree in the past 12 months. However 66% said candidates who get degrees online were not seen as positively as a job applicant with traditional degrees.[137]

1.8 Disadvantages

Many states spend large sums of money on technology. However, no state looks at technology return on investment (ROI) to connect expenditures on technology with improved student outcomes.[138]

New technologies are frequently accompanied by unrealistic hype and promise regarding their transformative power to change education for the better or in allowing better educational opportunities to reach the masses. Examples include silent film, broadcast radio, and television, none of which have maintained much of a foothold in the daily practices of mainstream, formal education.[139] Technology, in and of itself, does not necessarily result in fundamental improvements to educational practice.[140] The focus needs to be on the learner's interaction with technology—not the technology itself. It needs to be recognized as "ecological" rather than "additive" or "subtractive". In this ecological change, one significant change will create total change.[141]

According to Branford, Brown, and Cocking, (2000) "technology does not guarantee effective learning" and inappropriate use of technology can even hinder it [142] A University of Washington study of infant vocabulary

shows that it is slipping due to educational baby DVDs. Published in the Journal of Pediatrics, a 2007 University of Washington study on the vocabulary of babies surveyed over 1,000 parents in Washington and Minnesota. The study found that for every one hour that babies 8–16 months of age watched DVDs and Videos they knew 6-8 fewer of 90 common baby words than the babies that did not watch them. Andrew Meltzoff, a surveyor in this study states that the result makes sense, that if the baby's 'alert time' is spent in front of DVDs and TV, instead of with people speaking, the babies are not going to get the same linguistic experience. Dr. Dimitri Chistakis, another surveyor reported that the evidence is mounting that baby DVDs are of no value and may be harmful.[143][144][145][146]

Electronic devices such as cellphones and computers facilitate rapid access to a stream of sources, each of which may receive cursory attention. Michel Rich, an associate professor at Harvard Medical School and executive director of the center on Media and Child Health in Boston, said of the digital generation, "Their brains are rewarded not for staying on task, but for jumping to the next thing. The worry is we're raising a generation of kids in front of screens whose brains are going to be wired differently." [147] Students have always faced distractions; computers and cellphones are a particular challenge because the stream of data can interfere with focusing and learning. Although these technologies affect adults too, young people may be more influenced by it as their developing brains can easily become habituated to switching tasks and become unaccustomed to sustaining attention.[147] Too much information, coming too rapidly, can overwhelm thinking.[148]

Adaptive instructional materials tailor questions to each student's ability and calculate their scores, but this encourages students to work individually rather than socially or collaboratively (Kruse, 2013). Social relationships are important but high-tech environments may compromise the balance of trust, care and respect between teacher and student [149]

Massively Open Online Courses (MOOCs), although quite popular in discussions of technology and education in developed countries (more so in US), are not a major concern in most developing or low-income countries. One of the stated goals of MOOCs is to provide less fortunate populations (i.e., in developing countries) an opportunity to experience courses with US-style content and structure. However, research shows only 3% of the registrants are from low-income countries and although many courses have thousands of registered students only 5-10% of them complete the course [150] MOOCs also implies that certain curriculum and teaching methods are superior and this could eventually wash over (or possibly washing out) local educational institutions, cultural norms and educational traditions [151]

1.8.1   Everest effect

"The learning environment is a complex system where the interplay and interactions of many things impact the outcome of learning."[152] When computers are brought into an educational setting just because they are there, the entire pedagogical setting of the classroom changes. This is known as the "Everest Effect", which leads to more "technology-driven" teaching," where the entire meaning of an activity changes without adequate research validation." This leads to unclear learning objectives and standards that are not met by the end of a lesson. If classroom technology continues to monopolize an activity, the students involved begin to develop the sense that "life would scarcely be thinkable without technology."[153] This concept goes along with Postman's claim that "it is more important for learners to reflect on the implications and consequences of process of information gathering, than it is to simply acquire the skills to generate, receive, gather and distribute information in easier and faster ways".[140]

1.8.2   Over-stimulation

In addition to the change in classroom environment, technology is also "rapidly and profoundly altering our brains."[154] High exposure levels stimulate brain cell alteration and release neurotransmitters, which causes the strengthening of new neural pathways and the weakening the old ones. This leads to heightened stress levels on the brain that, at first, boost energy levels, but, over time, actually augment memory,impair cognition, lead to depression, alter the neural circuitry of the hippocampus, amygdala and prefrontal cortex. These are the brain regions that control mood and thought. If continued to be unchecked, even more underlying structures of the brain could be altered.[155] Dr. Rich of Harvard Medical School believed that "downtime to the brain is what sleep is to the body. But kids are in a constant mode of stimulation.[156] There are also concerns that this over-stimulation due to technology begins too young. When children are exposed before the age of seven, important developmental tasks may be delayed and bad learning habits might develop, which could lead to poor motivation. In turn, this "deprives children of the exploration and play that they need to develop." [157]

1.8.3   Sociocultural criticism

Phantom objectivity

Leo Marx identifies the word "technology" itself as problematic,[158] susceptible to reification and "phantom objectivity", which conceals its fundamental nature as something that is only valuable insofar as it benefits the human condition. Technology ultimately comes down to affecting the relations between people, but this notion is obfuscated when technology is treated as an ab-

stract notion devoid of good and evil. Langdon Winner makes a similar point by arguing that the underdevelopment of the philosophy of technology leaves us with an overly simplistic reduction in our discourse to the supposedly dichotomous notions of the "making" versus the "uses" of new technologies, and that a narrow focus on "use" leads us to believe that all technologies are neutral in moral standing.[159] These critiques would have us ask not, "How do we maximize the role or advancement of technology in education?", but, rather, "What are the social and human consequences of adopting any particular technology?"

Cultural impact

Winner [159] argues that it is useful to view technology as a "form of life" that not only aids human activity, but also represents a powerful force in reshaping that activity and its meaning. For example, the use of robots in the industrial workplace may increase productivity, but they also radically change the process of production itself, thereby redefining what is meant by "work" in such a setting. In education, standardized testing has arguably redefined the notions of learning and assessment. We rarely explicitly reflect on how strange a notion it is that a number between, say, 0 and 100 could accurately reflect a person's knowledge about the world. According to Winner, the recurring patterns in everyday life tend to become an unconscious process that we learn to take for granted. Winner writes,

> By far the greatest latitude of choice exists the very first time a particular instrument, system, or technique is introduced. Because choices tend to become strongly fixed in material equipment, economic investment, and social habit, the original flexibility vanishes for all practical purposes once the initial commitments are made. In that sense technological innovations are similar to legislative acts or political foundings that establish a framework for public order that will endure over many generations. *(p. 29)*

Seymour Papert (p. 32) points out a good example of a (bad) choice that has become strongly fixed in social habit and material equipment: our "choice" to use the QWERTY keyboard.[160] The QWERTY arrangement of letters on the keyboard was originally chosen, not because it was the most efficient for typing, but because early typewriters were prone to jam when adjacent keys were struck in quick succession. Now that typing has become a digital process, this is no longer an issue, but the QWERTY arrangement lives on as a social habit, one that is very difficult to change. This example illustrates that when adopting new technologies, as Winner warns us, there may be only one best chance to "get it right." This is also an exam-

ple where the unintended consequences could, perhaps, have been foreseen.

Neil Postman endorsed the notion that technology impacts human cultures, including the culture of classrooms, and that this is a consideration even more important than considering the efficiency of a new technology as a tool for teaching.[161] Regarding the computer's impact on education, Postman writes (p. 19):

> What we need to consider about the computer has nothing to do with its efficiency as a teaching tool. We need to know in what ways it is altering our conception of learning, and how in conjunction with television, it undermines the old idea of school.

Digital divide

Main article: Digital divide

The concept of the digital divide is a gap between those who have access to digital technologies and those who do not.[162] Access may be associated with age, gender, socio-economic status, education, income, ethnicity, and geography.[162][163]

1.9 Teacher training

Teachers have gaps in understanding the appropriate uses of technology in a learning environment.[164] Similar to learning a new task or trade, special training is vital to ensuring the effective integration of classroom technology. The current school curriculum tends to guide teachers in training students to be autonomous problem solvers.[163] This has become a significant barrier to effective training because the traditional methods of teaching have clashed with what is now expected in the present workplace. Today's students in the workplace are increasingly being asked to work in teams, drawing on different sets of expertise, and collaborating to solve problem.[163] These experiences are not highly centered on in the traditional classroom, but are twenty-first century skills that can be attained through the incorporation and engagement with technology.[165] Changes in instruction and use of technology can also promote a higher level of learning among students with different types of intelligence.[166] Please see the presentation on Ted Talks by Sir Kenneth Robinson where he discusses the ways in which schools kill creativity.[167] Therefore, since technology is not the end goal of education, but rather a means by which it can be accomplished, educators must have a good grasp of the technology being used and its advantages over more traditional methods. If there is a lack in either of these areas, technology will be seen as a hindrance and not a benefit to the goals of teaching.

The evolving nature of technology may unsettle teachers who may experience themselves as perpetual novices.[168] Marc Prensky discusses the idea that teachers are digital immigrants, and students are digital natives. Teachers must continuously work at learning this new technological language, whereas students were born into retrieving information, problem solving, and communicating with this technology.[169] The ways in which teachers are taught to use technology is also outdated because the primary focus of training is on computer literacy, rather than the deeper, more essential understanding and mastery of technology for information processing, communication, and problem solving.[168] New resources have to be designed and distributed whenever the technological platform has been changed. However, finding quality materials to support classroom objectives after such changes is often difficult. Random professional development days are inadequate.[168] Learning is an ongoing process, which takes time and a strong commitment among the community of educators.[168]

Teachers may not feel the need to change the traditional education system because it has been successful in the past.[163] This does not necessarily mean it is the right way to teach for the current and future generations. However, learning styles and the methods of collecting information have evolved, and "students often feel locked out of the worlds described in their textbooks through the depersonalized and abstract prose used to describe them".[163] Even though technology can provide a more personalized, yet collaborative, and creative, yet informative, approach to learning, it may be difficult to motivate the use of these contemporary approaches among teachers who have been in the field for a number of years.

1.10 Assessment

There are two distinct issues of assessment. First, there is the issue of assessing learning technologies and the learning outcomes they support. Second, there is the issue of using technologies for the purposes of assessing students.

Assessment *of* technology

There is a great deal of apprehension associated with assessing the effectiveness of technology in the classroom and its development of information-age skills. This is because information-age skills, also commonly referred to as twenty-first-century literacies, are relatively new to the field of education.[170] According to the New Media Consortium, these include "the set of abilities and skills where aural, visual, and digital literacy overlap".[163] Jenkins modifies this definition by acknowledging them as building on the foundation of traditional literacy, research skills, technical skills and critical-analysis skills taught in the classroom.[163]

Assessment *with* technology

Technology for assessment is used in many countries,

and an example is the Organization for Economic Cooperation and Development's Program for International Student Assessment (PISA) test. PISA is for 15 year olds and it is held in 70 countries every three years. This exam will be next held in 2015, and it will include adaptive components to evaluate hard-to-measure skills such as collaborative problem solving. However, critics state that when learning is data driven it threatens the essence of schooling and turns them into factories.[171] Technology is pushed into the learning environment as a tool for assessment but it is an initiative for-profit business. Although computers have started to assess student abilities, it is far from the skills that teachers have acquired over years of experience and have done for decades. Those who oppose the use of technology in education believe that instead of invest

1.11 Expenditure

The worldwide e-learning industry is economically significant, and was estimated in 2000 to be over $48 billion according to conservative estimates.[172] Commercial growth has been brisk.[173] For example, in 2013 Lynda took in $103 million of growth equity from Accel Partners and Spectrum Equity.[174] In 2014, the worldwide commercial market activity was estimated at $6 billion venture capital over the past five years,[173]:38 with self-paced learning generating $35.6 billion in 2011.[173]:4 North American e-learning generated $23.3 billion in revenue in 2013, with a 9% growth rate in cloud based authoring tools and learning platforms.[173]:19

The top ten publicly traded e-learning companies are Adobe, Oracle, BlackBoard, Desire2Learn, Articulate, Lynda, Tribal, iSpring, Kineo, and Skillsoft. These commercial vendors offer an array of products and services.

Developments in internet and multimedia technologies are the basic enabler of e-learning, with consulting, content, technologies, services and support being identified as the five key sectors of the e-learning industry.[175]

E-learning expenditures differ within and between countries. Finland, Norway, Belgium and Korea appear to have comparatively effective programs.[176]

1.12 Careers

Main articles: Educational technologist and Educational psychologist

Educational technologists and psychologists apply basic educational and psychological research into an evidence-based applied science (or a technology) of learning or instruction. These professions typically require a graduate degree (Master's, Doctorate, Ph.D., or D.Phil.) in a

field related to educational psychology, educational media, experimental psychology, cognitive psychology or, more purely, in the fields of Educational, Instructional or Human Performance Technology or Instructional Systems Design. The transformation of educational technology from a cottage industry to a profession is discussed by Shurville et al.[177]

1.13 See also

- ADDIE Model
- Andragogy / Heutagogy
- Assistive technology
- Blended learning
- Computerized adaptive testing
- Content management system
- Distance education
- Distance learning
- E-assessment
- Edsurge
- Educational animation
- Educational psychology
- Educational research
- Educational technology category page
- g-learning
- Information and communication technologies in education
- Information mapping
- Instructional design
- Instructional theory
- Intelligent tutoring system
- Interactive geometry software
- Learning theory (education)
- M-learning
- Matching Person & Technology Model
- Mind map
- Online learning community
- SCORM
- TechChange

- Technological Pedagogical Content Knowledge
- Technology integration
- Usability testing
- Virtual school / Virtual university
- Virtual world language learning
- Washington County Closed-Circuit Educational Television Project
- Web-based simulation
- University of the People

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1.15 Further reading

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- Courts, B., & Tucker, J. (2012). Using Technology To Create A Dynamic Classroom Experience. Journal of College Teaching & Learning (TLC), 9(2), 121-128.

- Jacoy, Christine, and David DiBiase. "Plagiarism by Adult Learners Online: A Case Study in Detection and Remediation." IRRODL The International Review of Research in Open and Distance Learning. 2006. Web. 17 Mar. 2011.

1.16 External links

- Digital Media and Learning. The John D. and Catherine T. MacArthur Foundation

- The FITS Foundation - Framework for ICT Technical Support

- UNESCO Guide To Measuring Information And Communication Technologies (ICT) In Education

- Top Learning Management System Software

Chapter 2

Learning theory (education)

A classroom in Norway. Learning also takes places in many other settings.

Learning theories are conceptual frameworks describing how information is absorbed, processed, and retained during learning. Cognitive, emotional, and environmental influences, as well as prior experience, all play a part in how understanding, or a world view, is acquired or changed, and knowledge and skills retained.[1][2]

Behaviorists look at learning as an aspect of conditioning and will advocate a system of rewards and targets in education. Educators who embrace cognitive theory believe that the definition of learning as a change in behavior is too narrow and prefer to study the learner rather than their environment, and in particular the complexities of human memory. Those who advocate constructivism believe that a learner's ability to learn relies to a large extent on what he already knows and understands, and that the acquisition of knowledge should be an individually tailored process of construction. Transformative learning theory focuses upon the often-necessary change that is required in a learner's preconceptions and world view.

Outside the realm of educational psychology, techniques to directly observe the functioning of the brain during the learning process, such as event-related potential and functional magnetic resonance imaging, are used in educational neuroscience. As of 2012, such studies are beginning to support a theory of multiple intelligences, where learning is seen as the interaction between dozens of different functional areas in the brain, each with their own individual strengths and weaknesses in any particular human learner.

2.1 Educational psychology

Main article: Educational psychology

2.1.1 Behavior analysis

Main article: Behaviorism
Main article: Applied behavior analysis

The term "behaviorism" was coined by John Watson (1878–1959). Watson believed that theorizing thoughts, intentions or other subjective experiences was unscientific and insisted that psychology must focus on measurable behaviors.[3] Behaviorism has since become one of three domains of behavior analysis, the other two being the Experimental Analysis of Behavior, and Applied Behavior Analysis.

Methodological behaviorism is based on the theory of treating public events, or observable behavior. Skinner introduced another type of behaviorism called Radical behaviorism, or the Conceptual Analysis of Behavior, which is based on the theory of treating private events; for example, thinking and feeling. Radical behaviorism forms the conceptual piece of behavior analysis.

In behavior analysis, learning is the acquisition of a new behavior through conditioning and social learning.

Learning and conditioning

There are three types of conditioning and learning:

- Classical conditioning, where the behavior becomes a reflex response to an antecedent stimulus.

- Operant conditioning, where an antecedent stimuli is followed by a consequence of the behavior through a reward (reinforcement) or a punishment.

- Social learning theory, where an observation of behavior is followed by modeling.

Classical conditioning was noticed by Ivan Pavlov when he saw that if dogs come to associate the delivery of food with a white lab coat or with the ringing of a bell, they will produce saliva, even when there is no sight or smell of food. Classical conditioning regards this form of learning to be the same whether in dogs or in humans.[4] Operant conditioning reinforces this behavior with a reward or a punishment. A reward increases the likelihood of the behavior recurring, a punishment decreases its likelihood.[5] Social learning theory observes behavior and is followed with modeling.

These three learning theories form the basis of Applied behavior analysis, the application of behavior analysis, which uses analyzed antecedents, functional analysis, replacement behavior strategies, and often data collection and reinforcement to change behavior. The old practice was called behavior modification, which only used *assumed* antecedents and consequences to change behavior without acknowledging the conceptual analysis; analyzing the function of behavior and teaching new behaviors that would serve the same function was never relevant in behavior modification.

Behaviorists view the learning process as a change in behavior, and will arrange the environment to elicit desired responses through such devices as behavioral objectives, Competency-based learning, and skill development and training.[6] Educational approaches such as Early Intensive Behavioral Intervention, curriculum-based measurement, and direct instruction have emerged from this model.[7]

2.1.2 Cognitivism

Main article: Cognitivism (psychology)

Cognitive theories grew out of Gestalt psychology, developed in Germany in the early 1900s and brought to America in the 1920s. The German word *gestalt* is roughly equivalent to the English *configuration* or *pattern* and emphasizes the whole of human experience.[8] Over the years, the Gestalt psychologists provided demonstrations and described principles to explain the way we organize our sensations into perceptions.[9]

Gestalt psychologists criticize behaviorists for being too dependent on overt behavior to explain learning. They propose looking at the patterns rather than isolated events.[10] Gestalt views of learning have been incorporated into what have come to be labeled *cognitive theories*. Two key assumptions underlie this cognitive approach: that the memory system is an active organized processor of information and that prior knowledge plays an important role in learning. Cognitive theories look beyond behavior to consider how human memory works

to promote learning, and an understanding of short term memory and long term memory is important to educators influenced by cognitive theory.[11] They view learning as an internal mental process (including insight, information processing, memory and perception) where the educator focuses on building intelligence and cognitive development.[6] The individual learner is more important than the environment.

Once memory theories like the Atkinson-Shiffrin memory model[12] and Baddeley's working memory model[13] were established as a theoretical framework in cognitive psychology, new cognitive frameworks of learning began to emerge during the 1970s, 80s, and 90s. Today, researchers are concentrating on topics like cognitive load and information processing theory. These theories of learning play a role in influencing instructional design.[14] Cognitive theory is used to explain such topics as social role acquisition, intelligence and memory as related to age.

2.1.3 Constructivism

Main article: Constructivism (learning theory)

Built on the work of Jean Piaget and Jerome Bruner, constructivism emphasizes the importance of the active involvement of learners in constructing knowledge for themselves, and building new ideas or concepts based upon current knowledge and past experience. It asks why students do not learn deeply by listening to a teacher, or reading from a textbook. To design effective teaching environments, it believes, one needs a good understanding of what children already know when they come into the classroom. The curriculum should be designed in a way that builds on what the pupil already knows and is allowed to develop with them.[15] Begin with complex problems and teach basic skills while solving these problems.[16] This requires an understanding of children's cognitive development, and constructivism draws heavily on psychological studies of cognitive development.

The learning theories of John Dewey, Maria Montessori, and David Kolb serve as the foundation of constructivist learning theory.[17] Constructivism has many varieties: Active learning, discovery learning, and knowledge building are three, but all versions promote a student's free exploration within a given framework or structure.[18] The teacher acts as a facilitator who encourages students to discover principles for themselves and to construct knowledge by working to solve realistic problems.

2.1.4 Transformative learning theory

Main article: Transformative learning

Transformative learning theory seeks to explain how hu-

mans revise and reinterpret meaning.[19] Transformative learning is the cognitive process of effecting change in a frame of reference.[20] A frame of reference defines our view of the world. The emotions are often involved.[21] Adults have a tendency to reject any ideas that do not correspond to their particular values, associations and concepts.[20]

Our frames of reference are composed of two dimensions: habits of mind and points of view.[20] Habits of mind, such as ethnocentrism, are harder to change than points of view. Habits of mind influence our point of view and the resulting thoughts or feelings associated with them, but points of view may change over time as a result of influences such as reflection, appropriation and feedback.[20] Transformative learning takes place by discussing with others the "reasons presented in support of competing interpretations, by critically examining evidence, arguments, and alternative points of view."[20] When circumstances permit, transformative learners move toward a frame of reference that is more inclusive, discriminating, self-reflective, and integrative of experience.[20]

2.2   Educational neuroscience

Main article: Educational neuroscience

American Universities such as Harvard, Johns Hopkins, University of Southern California and others, in the first decade of the twenty-first century, began offering majors and degrees dedicated to educational neuroscience or neuroeducation. Such studies seek to link an understanding of brain processes with classroom instruction and experiences.[22] Neuroeducation seeks to analyze the biological changes that take place in the brain as new information is processed. It looks at what environmental, emotional and social situations are best in order for new information to be retained and stored in the brain via the linking of neurons, rather than allowing the dendrites to be reabsorbed and the information lost. The 1990s were designated "The Decade of the Brain," and advances took place in neuroscience at an especially rapid pace. The three dominant methods for measuring brain activities are: event-related potential, functional magnetic resonance imaging and magnetoencephalography (MEG).[23]

The integration and application to education of what we know about the brain was strengthened in 2000 when the American Federation of Teachers stated: "It is vital that we identify what science tells us about how people learn in order to improve the education curriculum."[24] What is exciting about this new field in education is that modern brain imaging techniques now make it possible, in some sense, to watch the brain as it learns, and the question then arises: can the results of neuro-scientific studies of brains as they are learning usefully inform practice in this

area?[25] Although the field of neuroscience is young, it is expected that with new technologies and ways of observing learning, the paradigms of what students need and how students learn best will be further refined with actual scientific evidence. In particular, students who may have learning disabilities will be taught with strategies that are more informed.

2.2.1   A brain-based theory of learning

The differences of opinion and theory in psychology indicate that the learning process is not yet understood. Neuroscience shows that the brain can be modelled not with a central processor where "intelligence" lies, but in having perhaps 70 functional areas. Mental activity requires several areas to work together. What appear as different types of intelligence result from different combinations of well-developed functional areas. Learning is a process by which neurons join by developing the synapses between them. Knowledge is arranged hierarchically, with new knowledge being linked to existing neural networks.

2.3   Multiple intelligences

Main article: Theory of multiple intelligences

The existence of multiple intelligences is proposed by psychologist Howard Gardner, who suggests that different kinds of intelligence exists in human beings.[26] It is a theory that has been fashionable in continuous professional development (CPD) training courses for teachers.

2.4   Multimedia learning

A multimedia classroom at Islington College, in the United Kingdom

Main article: Multimedia learning

Multimedia learning refers to the use of visual and auditory teaching materials that may include video, computer

and other information technology. Multimedia learning theory focuses on the principles that determine the effective use of multimedia in learning, with emphasis on using both the visual and auditory channels for information processing.

The auditory channel deals with information that is heard, and the visual channel processes information that is seen. The visual channel holds less information than the auditory channel. If both the visual and auditory channels are presented with information, more knowledge is retained. However, if too much information is delivered it is inadequately processed, and long term memory is not acquired. Multimedia learning seeks to give instructors the ability to stimulate both the visual and auditory channels of the learner, resulting in better progress.[27]

2.5 Other learning theories

Other learning theories have also been developed for more specific purposes. For example, andragogy is the art and science to help adults learn. Connectivism is a recent theory of networked learning which focuses on learning as making connections. The Learning as a Network (LaaN) theory builds upon connectivism, complexity theory, and double-loop learning. It starts from the learner and views learning as the continuous creation of a personal knowledge network (PKN).[28]

2.5.1 Learning style theory

Main article: Learning styles

Learning style theory proposes that individuals learn in different ways, that there are four distinct learning styles – feeling, watching, thinking and doing – and that knowledge of a learner's preferred learning style will lead to faster and more satisfactory improvement.[29]

2.5.2 Informal and post-modern theories

In theories that make use of cognitive restructuring, an informal curriculum promotes the use of prior knowledge to help students gain a broad understanding of concepts.[30] New knowledge cannot be told to students, it believes, but rather the students' current knowledge must be challenged. In this way, students will adjust their ideas to more closely resemble actual theories or concepts.[30] By using this method students gain the broad understanding they're taught and later are more willing to learn and keep the specifics of the concept or theory. This theory further aligns with the idea that teaching the concepts and the language of a subject should be split into multiple steps.[31]

Other informal learning theories look at the sources of

motivation for learning. Intrinsic motivation may create a more self-regulated learner,[32] yet schools undermine intrinsic motivation. Critics argue that the average student learning in isolation performs significantly less well than those learning with collaboration and mediation.[33] Students learn through talk, discussion, and argumentation.[34][35]

2.6 Philosophical anthropology

Main article: Philosophical anthropology

Every well-constructed theory of education has at its center a philosophical anthropology.[36]

2.7 Criticism of learning theory

Critics of learning theories that seek to displace traditional educational practices claim that there is no need for such theories; that the attempt to comprehend the process of learning through the construction of theories creates problems and inhibits personal freedom.[37][38]

2.8 See also

- Andragogical learning theory
- Cognitivism (learning theory)
- Constructivism (learning theory)
- Cultural-historical psychology
- Instructional theory
- Instructional design
- Kinesthetic learning
- Learning by teaching
- Science, technology, society and environment education
- Connectivism (learning theory)
- Evidence-based education

About accelerating the learning process

- cognitive acceleration
- spaced repetition
- incremental reading

About the mechanisms of memory and learning

- neural networks in the brain

- sleep and learning

- latent learning

- memory consolidation

- short-term memory versus working memory

- long-term memory

- declarative memory versus procedural memory

- the cerebellum and motor learning

About learning theories related to classroom learning

- Contemporary Educational Psychology/Chapter 2: The Learning Process

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2.11 External links

- Social Science Research Network. How to Become an Expert Law Teacher by Understanding the Neurobiology of Learning

- ERIC Digest. How People Learn (and What Technology Might Have To Do with It)

- Instructional Design Learning theories

- Learning theories Wiki Learning theories

Chapter 3

Information and communications technology

Information and communications technology (**ICT**) is often used as an extended synonym for information technology (IT), but is a more specific term that stresses the role of unified communications[1] and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information.[2]

The term *ICT* is also used to refer to the convergence of audio-visual and telephone networks with computer networks through a single cabling or link system. There are large economic incentives (huge cost savings due to elimination of the telephone network) to merge the telephone network with the computer network system using a single unified system of cabling, signal distribution and management.

3.1 History of the term

The phrase *Information and Communication Technology* has been used by academic researchers since the 1980s,[3] and the term *ICT* became popular after it was used in a report to the UK government by Dennis Stevenson in 1997[4] and in the revised National Curriculum for England, Wales and Northern Ireland in 2000. But in 2012, the Royal Society recommended that the term *ICT* should no longer be used in British schools "as it has attracted too many negative connotations",[5] and with effect from 2014 the National Curriculum was changed to use the word *computing* reflecting the addition of computer programming to the curriculum.[6] A leading group of universities consider ICT to be a soft subject and advise students against studying A-level ICT, preferring instead A-level Computer Science.[7]

3.2 Global costs of IT

The money spent on IT worldwide has been most recently estimated as US $3.5 trillion and is currently growing at 5% per year – doubling every 15 years. The 2014 IT budget of US federal government is nearly $82 billion.[8] IT costs, as a percentage of corporate revenue, have grown 50% since 2002, putting a strain on IT budgets. When looking at current companies' IT budgets, 75% are recurrent costs, used to "keep the lights on" in the IT department, and 25% are cost of new initiatives for technology development.[9]

The average IT budget has the following breakdown:[9]

- 31% personnel costs (internal)
- 29% software costs (external/purchasing category)
- 26% hardware costs (external/purchasing category)
- 14% costs of external service providers (external/services).

3.3 ICT Development Index

The ICT Development Index compares the level of ICT use and access across the world.[10]

3.4 The WSIS Process and ICT development goals

On 21 December 2001, the United Nations General Assembly approved Resolution 56/183, endorsing the holding of the World Summit on the Information Society (WSIS) to discuss the opportunities and challenges facing today's information society.[11] According to this resolution, the General Assembly related the Summit to the United Nations Millennium Declaration's goal of implementing ICT to achieve Millennium Development

Goals. It also emphasized a multi-stakeholder approach to achieve these goals, using all stakeholders including civil society and the private sector, in addition to governments.

3.5 See also

- Cloud computing

- Cognitive infocommunications

- DICOM

- Digital divide

- Example of Information and communication technologies for education

- Global e-Schools and Communities Initiative

- Hospital information system

- ICT Development Index

- Infocommunications

- Information Age

- Information and communication technologies for development

- Information and communication technologies for environmental sustainability

- Market information systems

- Mobile Web

- Picture archiving and communication system

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Chapter 4

Educational software

Educational software is computer software, the primary purpose of which is teaching or self-learning.

4.1 History

4.1.1 1940s - 1970s

The use of computer hardware and software in education and training dates to the early 1940s, when American researchers developed flight simulators which used analog computers to generate simulated onboard instrument data. One such system was the type19 synthetic radar trainer, built in 1943. From these early attempts in the WWII era through the mid-1970s, educational software was directly tied to the hardware, usually mainframe computers, on which it ran. Pioneering educational computer systems in this era included the PLATO system (1960), developed at the University of Illinois, and TICCIT (1969). In 1963, IBM had established a partnership with Stanford University's Institute for Mathematical Studies in the Social Sciences (IMSSS), directed by Patrick Suppes, to develop the first comprehensive CAI elementary school curriculum which was implemented on a large scale in schools in both California and Mississippi.[1] In 1967 Computer Curriculum Corporation (CCC, now Pearson Education Technologies[2]) was formed to market to schools the materials developed through the IBM partnership. Early terminals that ran educational systems cost over $10,000, putting them out of reach of most institutions. Some programming languages from this period, particularly BASIC (1963), and LOGO (1967) can also be considered educational, as they were specifically targeted to students and novice computer users. The PLATO IV system, released in 1972, supported many features which later became standard in educational software running on home computers. Its features included bitmap graphics, primitive sound generation, and support for non-keyboard input devices, including the touchscreen.

4.1.2 1970s – 1980s

The arrival of the personal computer, with the Altair 8800 in 1975, changed the field of software in general, with specific implications for educational software. Whereas users prior to 1975 were dependent upon university or government owned mainframe computers with timesharing, users after this shift could create and use software for computers in homes and schools, computers available for less than $2000. By the early 1980s, the availability of personal computers including the Apple II (1977), Commodore PET (1977), Commodore VIC-20 (1980), and Commodore 64 (1982) allowed for the creation of companies and nonprofits which specialized in educational software. Brøderbund and The Learning Company are key companies from this period, and MECC, the Minnesota Educational Computing Consortium, a key non-profit software developer. These and other companies designed a range of titles for personal computers, with the bulk of the software initially developed for the Apple II.

4.1.3 1990s

Major developments in educational software in the early and mid-1990s were made possible by advances in computer hardware. Multimedia graphics and sound were increasingly used in educational programs. CD-ROMs became the preferred method for content delivery with several digital encyclopedias released as Multimedia application CD-ROMs. With the spread of the internet in the second half of the 1990s, new methods of educational software delivery appeared. In the history of virtual learning environments, the 1990s were a time of growth for educational software systems, primarily due to the advent of the affordable computer and of the Internet. Today Higher Education institutions use virtual learning environments like Blackboard Inc. to provide greater accessibility to learners.

4.2 Types

4.2.1 Courseware

Courseware is a term that combines the words 'course' with 'software'. Its meaning originally was used to describe additional educational material intended as kits for teachers or trainers or as tutorials for students, usually packaged for use with a computer. The term's meaning and usage has expanded and can refer to the entire course and any additional material when used in reference an online or 'computer formatted' classroom. Many companies are using the term to describe the entire "package" consisting of one 'class' or 'course' bundled together with the various lessons, tests, and other material needed. The courseware itself can be in different formats, some are only available online such as html pages, while others can be downloaded in pdf files or other types of document files. Many forms of educational technology are now being blended with term courseware. Most leading educational companies solicit or include courseware with their training packages.

4.2.2 Study aids

Software to help with learning and organization of study material. Similar to having a tutor to assist with studying. StudyX flash card maker is a great example, and includes millions of subjects and can be customized for almost any learning.

4.2.3 Classroom aids

See also: Interactive whiteboard

Some educational software is designed for use in school classrooms. Typically such software may be projected onto a large whiteboard at the front of the class and/or run simultaneously on a network of desktop computers in a classroom. This type of software is often called classroom management software. While teachers often choose to use educational software from other categories in their IT suites (e.g. reference works, children's software), a whole category of educational software has grown up specifically intended to assist classroom teaching. Branding has been less strong in this category than in those oriented towards home users. Software titles are often very specialized and produced by various manufacturers, including many established educational book publishers.

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4.2.4 Assessment software

With the impact of environmental damage and the need for institutions to become "paperless",[3] more educa-

tional institutions are seeking alternative ways of assessment and testing, which has always traditionally been known to use up vasts amount of paper. *Assessment software* refers to software with a primary purpose of assessing and testing students in a virtual environment. Assessment software allows students to complete tests and examinations using a computer, usually networked. The software then scores each test transcript and outputs results for each student. Assessment software is available in various delivery methods, the most popular being self-hosted software, online software and hand-held voting systems. Proprietary software and open-source software systems are available. While technically falling into the *Courseware* category (see above), Skill evaluation lab is an example for Computer-based assessment software with PPA-2 (Plan, Prove, Assess) methodology to create and conduct computer based online examination. Moodle is an example of open-source software with an assessment component that is gaining popularity. Other popular international assessment systems include QuestionMark, EvaluNet *XT* and QuestBase.

4.2.5 Reference software

Main article: Reference software

Many publishers of print dictionaries and encyclopedias have been involved in the production of educational reference software since the mid-1990s. They were joined in the reference software market by both startup companies and established software publishers, most notably Microsoft.

The first commercial reference software products were reformulations of existing content into CD-ROM editions, often supplemented with new multimedia content, including compressed video and sound. More recent products made use of internet technologies, to supplement CD-ROM products, then, more recently, to replace them entirely.

Wikipedia and its offspins (such as Wiktionary) marked a new departure in educational reference software. Previously, encyclopedias and dictionaries had compiled their contents on the basis of invited and closed teams of specialists. The Wiki concept has allowed for the development of collaborative reference works through open cooperation incorporating experts and non-experts.

4.2.6 Custom platforms

Some manufacturers regarded normal personal computers as an inappropriate platform for learning software for younger children and produced custom child-friendly pieces of hardware instead. The hardware and software is generally combined into a single product, such as a child laptop-lookalike. The laptop keyboard for younger

children follows an alphabetic order and the qwerty order for the older ones. The most well-known example are Leapfrog products. These include imaginatively designed hand-held consoles with a variety of pluggable educational game cartridges and book-like electronic devices into which a variety of electronic books can be loaded. These products are more portable than general laptop computers, but have a much more limited range of purposes, concentrating on literacy.

4.2.7 Corporate training and tertiary education

Earlier educational software for the important corporate and tertiary education markets was designed to run on a single desktop computer (or an equivalent user device). The history of such software is usefully summarized in the *SCORM 2004 2nd edition Overview* (section 1.3), unfortunately, however, without precise dates. In the years immediately following 2000, planners decided to switch to server-based applications with a high degree of standardization. This means that educational software runs primarily on servers which may be hundreds or thousands of miles from the actual user. The user only receives tiny pieces of a learning module or test, fed over the internet one by one. The server software decides on what learning material to distribute, collects results and displays progress to teaching staff. Another way of expressing this change is to say that educational software morphed into an online educational service. US Governmental endorsements and approval systems ensured the rapid switch to the new way of managing and distributing learning material.

See also:

- SCORM

- Virtual learning environment, LMS (learning management system)

- Web-based training

4.2.8 Specific educational purposes

There are highly specific niche markets for educational software, including:

- teacher tools and classroom management software

(remote control and monitoring software, filetransfer software, document camera and presenter, free tools,...)

- Driving test software

- Interactive geometry software
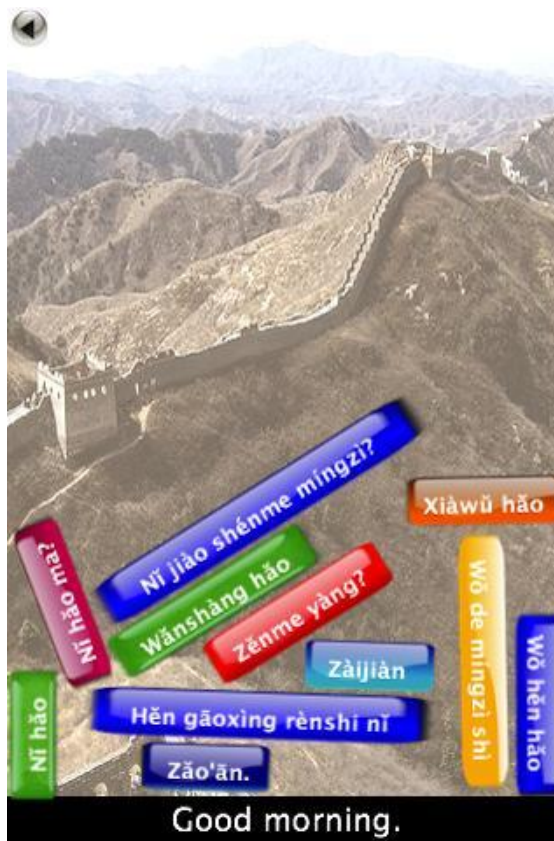
Educational software for learning Standard Chinese using Pinyin.

- Language learning software (KVerbos or English in a Flash, for example)

- Mind Mapping Software such as MindGenius which provides a focal point for discussion, helps make classes more interactive, and assists students with studying, essays and projects.

- Notetaking

- Software for enabling simulated dissection of human and animal bodies (used in medical and veterinary college courses)[4]

- Spelling tutor software

- Typing tutors (KTouch, Mario Teaches Typing, TypingWeb, Ratatype or Mavis Beacon, for example)

- Medical and healthcare educational software

- Apps or applications (Gojimo for example) created for educational purposes that are installed on mobile devices and provide information on a specific subject.

4.2.9 Operating systems

While mainstream operating systems are designed for general usages, and are more or less customized for education only by the application sets added to them, a variety of software manufacturers, especially Linux distributions, have sought to provide integrated platforms for specifically education. Among the most popular are Sugar, aimed primarily at preschool and elementary grades; DoudouLinux (www.doudoulinux.org) - a system targeting young children; Edubuntu, foremost targeted to middle and secondary grades; and, UberStudent, designed for the academic success of higher education and college-bound secondary students. In addition, Portos, designed by Cornell University, is a complete educational operating system designed to teach programming.[5]

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4.4 See also

- Adaptive learning
- Computer-assisted language learning
- Educational game
- Educational technology
- Educational entertainment *Edutainment*
- Instructional technology
- Comparison of operating systems for children

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4.6 External links

Graphite: Educational Software Reviews
Software & Information Industry Association: Education Division

Chapter 5

E-learning (theory)

E-learning theory describes the cognitive science principles of effective multimedia educational technology use in e-learning.[1][2][3] Cognitive research and theory suggest that selection of appropriate concurrent multimedia modalities may enhance learning, as may application of several other principles.

5.1 Principles

Main article: Modality effect

Richard E. Mayer's "modality principle" states that if materials contain both verbal and graphical information, the verbal information should be given in auditory format only, and not as written text as well.[3][4]

Theoretically, the modality principle is based on a model of working memory by Alan Baddeley and Graham Hitch who proposed that working memory has two largely independent sub-components that tend to work in parallel - one visual and one verbal/acoustic.[5] This gave rise to dual-coding theory, first proposed by Allan Paivio and later applied to multimedia by Richard Mayer. According to Mayer,[3] separate channels of working memory process auditory and visual information. Consequently, a learner can use more cognitive processing capacities to study materials that combine auditory verbal information with visual graphical information than to process materials that combine printed (visual) text with visual graphical information. In other words, the multi modal materials reduce the cognitive load imposed on working memory.

In a series of studies Mayer and his colleagues tested Paivio's dual-coding theory, with multimedia. They repeatedly found that students learning given multimedia with animation and narration consistently did better on transfer questions than those who learn from animation and text-based materials. That is, they were significantly better when it came to applying what they had learned after receiving multimedia rather than mono-media (visual only) instruction. These results were then later confirmed by other groups of researchers.

The initial studies of multimedia learning were limited to logical scientific processes that centered on cause-and-effect systems like automobile braking systems, how a bicycle pump works, or cloud formation. However, subsequent investigations found that the modality effect extended to other areas of learning.

Split attention effect Mayer found that "Students learn better from animation and narration than from animation, narration, and on-screen text."[3]

Thus, it is better to eliminate redundant material. Learners do not learn as well when they both hear and see the same verbal message during a presentation. This is a special case of the split attention effect of Sweller and Chandler.

Learning is enhanced when related components such as words and pictures are presented in "spatial contiguity", referring to the components being physically close to each other on the page or screen, rather than being separated.[3] Similarly, "temporal contiguity" refers to simultaneous presentation of corresponding words and pictures, rather than successive delivery.[3] Learning is more effective when extraneous material is excluded rather than included, which Meyer termed, "coherence".[3] The effects of improved design have more benefit for low-knowledge than high knowledge learners, and for high-spatial than for low-spatial learners.[3]

Such principles may not apply outside of laboratory conditions. For example, Muller found that adding approximately 50% additional extraneous but interesting material did not result in any significant difference in learner performance.[6] There is ongoing debate concerning the mechanisms underlying these beneficial principles,[7] and on what boundary conditions may apply.[8]

5.2 Learning theories

Main article: Learning theory (education)

Good pedagogical practice has a theory of learning at its core. However, no single best-practice e-learning standard has emerged, and may be unlikely given the range of learning and teaching styles, the potential ways technology can be implemented and the ways in

which educational technology itself is changing.[9] Various pedagogical approaches or learning theories may be considered in designing and interacting with e-learning programs.

Social-constructivist – this pedagogy is particularly well afforded by the use of discussion forums, blogs, wiki and on-line collaborative activities. It is a collaborative approach that opens educational content creation to a wider group including the students themselves. The One Laptop Per Child Foundation attempted to use a constructivist approach in its project.[10]

Laurillard's Conversational Model[11] is also particularly relevant to eLearning, and Gilly Salmon's Five-Stage Model is a pedagogical approach to the use of discussion boards.[12]

Cognitive perspective focuses on the cognitive processes involved in learning as well as how the brain works.[13]

Emotional perspective focuses on the emotional aspects of learning, like motivation, engagement, fun, etc.[14]

Behavioural perspective focuses on the skills and behavioural outcomes of the learning process. Role-playing and application to on-the-job settings.[15]

Contextual perspective focuses on the environmental and social aspects which can stimulate learning. Interaction with other people, collaborative discovery and the importance of peer support as well as pressure.[16]

Mode Neutral Convergence or promotion of 'transmodal' learning where online and classroom learners can coexist within one learning environment thus encouraging interconnectivity and the harnessing of collective intelligence.[17]

For many theorists it's the interaction between student and teacher and student and student in the online environment that enhances learning (Mayes and de Freitas 2004). Pask's theory that learning occurs through conversations about a subject which in turn helps to make knowledge explicit has an obvious application to learning within a VLE.[18]

Salmon developed a five stage model of e-learning and e-moderating that for some time has had a major influence where online courses and online discussion forums have been used.[19] In her five stage model individual access and the ability of students to use the technology are the first step to involvement and achievement. The second step involves students creating an identity online and finding others with whom to interact; online socialisation is a critical element of the e-learning process in this model. In step 3 students are giving and sharing information relevant to the course to each other. Collaborative interaction amongst students is central to step 4. The fifth step in Salmon's model involves students looking for benefits from the system and using resources from outside of it to deepen their learning. Throughout all of this the tutor/teacher/lecturer fulfills the role of moderator or

e-moderator, acting as a facilitator of student learning.

Some criticism is now beginning to emerge. Her model does not easily transfer to other contexts (she developed it with experience from an Open University distance learning course). It ignores the variety of learning approaches that are possible within computer mediated communication (CMC) and the range of learning theories that are available (Moule 2007).

5.2.1 Self-regulation

Self-regulated learning refers to several concepts that play major roles in learning, and which have significant relevance in e-learning. Zimmerman (1998) explains that in order to develop self-regulation, learning courses should offer opportunities for students to practice strategies and skills by themselves. Self-regulation is also strongly related to a student's social sources such as parents and teachers. Moreover, Steinberg (1996) found that high-achieving students usually have high-expectation parents who monitor their children closely.[20]

With the academic environment, self-regulated learners usually set their academic goals and monitor and react themselves in process in order to achieve their goals.Schunk argues, "students must regulate not only their actions but also their underlying achievement-related cognitions, beliefs, intentions and affects"(p. 359). Moreover, academic self-regulation also helps students develop confidence in their ability to perform well in e-learning courses.[20]

5.3 Teacher use of technology

Computing technology was not created by teachers. There has been little consultation between those who promote its use in schools and those who teach with it. Decisions to purchase technology for education are very often political decisions. Most staff using these technologies did not grow up with them.[21] Training teachers to use computer technology did improve their confidence in its use, but there was considerable dissatisfaction with training content and style of delivery.[22] The communication element in particular was highlighted as the least satisfactory part of the training, by which many teachers meant the use of a VLE and discussion forums to deliver online training (Leask 2002). Technical support for online learning, lack of access to hardware, poor monitoring of teacher progress and a lack of support by online tutors were just some of the issues raised by the asynchronous online delivery of training (Davies 2004). They are also likely to be more constructivist-oriented in their approach to learning.[23]

Newer generation web 2.0 services provide customizable, inexpensive platforms for authoring and disseminating

multimedia-rich e-learning courses, and do not need specialised information technology (IT) support.[24]

Pedagogical theory may have application in encouraging and assessing on-line participation.[25] Assessment methods for on-line participation have reviewed.[25]

5.4 See also

- Cognitive load
- Modality effect
- Split attention effect
- Worked-example effect
- Dual-coding theory

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Chapter 6

Instructional design

Instructional Design (also called **Instructional Systems Design (ISD)**) is the practice of creating "instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing."[1] The process consists broadly of determining the current state and needs of the learner, defining the end goal of instruction, and creating some "intervention" to assist in the transition. Ideally the process is informed by pedagogically (process of teaching) and andragogically (adult learning) tested theories of learning and may take place in student-only, teacher-led or community-based settings. The outcome of this instruction may be directly observable and scientifically measured or completely hidden and assumed. There are many instructional design models but many are based on the ADDIE model with the five phases: analysis, design, development, implementation, and evaluation. As a field, instructional design is historically and traditionally rooted in cognitive and behavioral psychology, though recently Constructivism (learning theory) has influenced thinking in the field.[2][3][4]

6.1 History

6.1.1 Origins

During World War II, a considerable amount of training materials for the military were developed based on the principles of instruction, learning, and human behavior. Tests for assessing a learner's abilities were used to screen candidates for the training programs. After the success of military training, psychologists began to view training as a system, and developed various analysis, design, and evaluation procedures.[5]

6.1.2 1946 – Edgar Dale's Cone of Experience

- In 1946, Dale outlined a hierarchy of instructional methods and their effectiveness.[6]

6.1.3 Mid-1950s through mid-1960s - The Programmed Instruction Movement

- In B. F. Skinner's 1954 article "*The Science of Learning and the Art of Teaching*", he stated that effective instructional materials, called programmed instructional materials, should include small steps, frequent questions, immediate feedback, and allow self-pacing.[5]

- The Popularization of Behavioral Objectives - Robert Mager popularized the use of learning objectives with his 1962 article "*Preparing Objectives for Programmed Instruction*". In the article, he describes how to write objectives including desired behavior, learning condition, and assessment.[5]

- In 1956, a committee led by Benjamin Bloom published an influential taxonomy of what he termed the three domains of learning: Cognitive (what one knows or thinks), Psychomotor (what one does, physically) and Affective (what one feels, or what attitudes one has). These taxonomies still influence the design of instruction.[6][7]

Bloom's Taxonomy

6.1.4   Early 1960s - The Criterion-Referenced Testing Movement

- Robert Glaser first used the term "criterion-referenced measures" in 1962. In contrast to norm-referenced tests in which an individual's performance is compared to group performance, a criterion-referenced test is designed to test an individual's behavior in relation to an objective standard. It can be used to assess the learners' entry level behavior, and to what extent learners have developed mastery through an instructional program.[5]

6.1.5   1965 - Domains of Learning, Events of Instruction, and Hierarchical Analysis

- In 1965, Robert Gagne (see below for more information) described three domains of learning outcomes (Cognitive, Affective, Psychomotor), five learning outcomes (Verbal Information, Intellectual Skills, Cognitive Strategy, Attitude, Motor Skills), and nine events of instruction in "*The conditions of Learning*", which remain foundations of instructional design practices.[5]

- Gagne's work in learning hierarchies and hierarchical analysis led to an important notion in instruction – to ensure that learners acquire prerequisite skills before attempting superordinate's ones.[5]

6.1.6   1967 - Formative Evaluation

- In 1967, after analyzing the failure of training material, Michael Scriven suggested the need for formative assessment – e.g., to try out instructional materials with learners (and revise accordingly) before declaring them finalized.[5]

6.1.7   The 1970s - Growing of Interest in the Systems Approach

- During the 1970s, the number of instructional design models greatly increased and prospered in different sectors in military, academia, and industry.[5] Many instructional design theorists began to adopt an information-processing-based approach to the design of instruction. David Merrill for instance developed Component Display Theory (CDT), which concentrates on the means of presenting instructional materials (presentation techniques).[8]

6.1.8   The 1980s - Introduction of Personal Computers into the Design Process

- During this decade, while interest in instructional design continued to be strong in business and the military, there was little evolution of ID in schools or higher education.[5][9]

- This was the era, however, when educators and researchers began to consider how the personal computer could be used in an educational environment and efforts began to design instruction that utilized this new tool.[5][6][10] PLATO (Programmed Logic for Automatic Teaching Operation) is one example of how computers began to be integrated into instruction.[11] Many of the first uses of computers in the classroom were for "drill and skill" exercises.[12] Computer-based educational games and simulations also became popular.

- This was also the time when there was a growing interest in how cognitive psychology could be applied to instructional design.[6] In the late 1980s and throughout the 1990s, cognitive load theory began to find empirical support for a variety of presentation techniques.[13]

6.1.9   The 1990s - A Growing Interest in Constructivist Theory and the Importance of Performance

- As constructivist theory began to gain traction, its influence on instructional design became more prominent as a counterpoint to the more traditional cognitive learning theory.[9][14] Constructivists believe that learning experiences should be "authentic" and produce real-world learning environments that allow the learner to construct their own knowledge.[9] This emphasis on the learner was a significant departure away from traditional forms of instructional design.[5][6][14]

- Another trend that surfaced during this period was the recognition of performance improvement as being an important outcome of learning that needed to be considered during the design process.[5][10]

- The World Wide Web is developed and begins to surface as a potential online learning tool with hypertext and hypermedia being recognized as good tools for e-learning.[11]

- As technology advanced and constructivist theory gained popularity, technology's use in the classroom began to evolve from mostly drill and skill exercises to more interactive activities that required more complex thinking on the part of the learner.[12]

- Rapid prototyping was first seen during the 1990s. In this process, an instructional design project is prototyped quickly and then vetted through a series of try and revise cycles. This is a big departure from traditional methods of instructional design that took far longer to complete.[9]

6.1.10 The 2000s - Rise of the Internet and Online Learning

- The Internet, with its social media tools and multitudes of information resources, became a very popular tool for online learning, and instructional designers recognized the need to integrate e-learning into the creation of learning objects and curricula.[5][15]

- There is a great increase in the number of online courses offered by higher education institutions.[15][16]

- Technology advanced to the point that sophisticated simulations were now readily available to learners, thus providing more authentic and realistic learning experiences.[12]

6.1.11 2010 and forward

- The influence of e-tools continues to grow and has seemingly encouraged the growth of informal learning throughout a person's lifetime. The challenge for instructional designers is how to create learning opportunities that now may occur anywhere and anytime.

6.2 Instructional Media History

6.3 Cognitive load theory and the design of instruction

Cognitive load theory developed out of several empirical studies of learners, as they interacted with instructional materials.[17] Sweller and his associates began to measure the effects of working memory load, and found that the format of instructional materials has a direct effect on the performance of the learners using those materials.[18][19][20]

While the media debates of the 1990s focused on the influences of media on learning, cognitive load effects were being documented in several journals. Rather than attempting to substantiate the use of media, these cognitive load learning effects provided an empirical basis for the use of instructional strategies. Mayer asked the instructional design community to reassess the media debate, to refocus their attention on what was most important: learning.[21]

By the mid- to late-1990s, Sweller and his associates had discovered several learning effects related to cognitive load and the design of instruction (e.g. the split attention effect, redundancy effect, and the worked-example effect). Later, other researchers like Richard Mayer began to attribute learning effects to cognitive load.[21] Mayer and his associates soon developed a Cognitive Theory of Multimedia Learning.[22][23][24]

In the past decade, cognitive load theory has begun to be internationally accepted[25] and begun to revolutionize how practitioners of instructional design view instruction. Recently, human performance experts have even taken notice of cognitive load theory, and have begun to promote this theory base as the science of instruction, with instructional designers as the practitioners of this field.[26] Finally Clark, Nguyen and Sweller[27] published a textbook describing how Instructional Designers can promote efficient learning using evidence-based guidelines of cognitive load theory.

Instructional Designers use various instructional strategies to reduce cognitive load. For example, they think that the onscreen text should not be more than 150 words or the text should be presented in small meaningful chunks.. Design of activities to engage learners follow concepts such as chronogogy (time-lead) learning design for online education to help facilitate learning activities around learner's schedules and access behaviour on online environments. The designers also use auditory and visual methods to communicate information to the learner.

6.4 Gagné's Theory of Instruction

Gagné's instructional theory is widely used in the design of instruction by instructional designers in many settings, and its continuing influence in the field of educational technology can be seen in the more than 130 times that Gagné has been cited in prominent journals in the field during the period from 1985 through 1990.[28] Synthesizing ideas from behaviorism and cognitivism, he provides a clear template, which is easy to follow for designing instructional events. Instructional designers who follow Gagné's theory will likely have tightly focused, efficient instruction.[29]

6.4.1 Overview of Gagné's instructional theory

A taxonomy of Learning Outcomes

Robert Gagné classified the types of learning outcomes. To identify the types of learning, Gagné asked how learning might be demonstrated.[30] These can be related to the domains of learning, as follows:

- Cognitive Domain

1. Verbal information - is stated

2. Intellectual skills - label or classify the concepts

3. Intellectual skills - to apply the rules and principles

4. Intellectual skills - problem solving allows generating solutions or procedures

5. Cognitive strategies - are used for learning

- Affective Domain

1. Attitudes - are demonstrated by preferring options

- Psychomotor Domain

1. Motor skills - enable physical performance

Types of Learning Outcomes

Gagné, & Driscoll elaborated on the types of learning outcomes with a set of corresponding standard verbs:[31]

- Verbal Information: state, recite, tell, declare

- Intellectual Skills

1. Discrimination: discriminate, distinguish, differentiate

2. Concrete Concept: identify, name, specify, label

3. Defined Concept: classify, categorize, type, sort (by definition)

4. Rule: demonstrate, show, solve (using one rule)

5. Higher Order Rule: generate, develop, solve (using two or more rules)

- Cognitive Strategy: adopt, create, originate

- Attitude: choose, prefer, elect, favor

- Motor Skill: execute, perform, carry out

The Nine Events of Instruction (as Conditions of Learning)

According to Gagné, learning occurs in a series of learning events. Each learning event must be accomplished before the next in order for learning to take place. Similarly, instructional events should mirror the learning events:

1. Gaining attention: To ensure reception of coming instruction, the teacher gives the learners a stimulus. Before the learners can start to process any new information, the instructor must gain the attention of the learners. This might entail using abrupt changes in the instruction.

2. Informing learners of objectives: The teacher tells the learner what they will be able to do because of the instruction. The teacher communicates the desired outcome to the group.

3. Stimulating recall of prior learning: The teacher asks for recall of existing relevant knowledge.

4. Presenting the stimulus: The teacher gives emphasis to distinctive features.

5. Providing learning guidance: The teacher helps the students in understanding (semantic encoding) by providing organization and relevance.

6. Eliciting performance: The teacher asks the learners to respond, demonstrating learning.

7. Providing feedback: The teacher gives informative feedback on the learners' performance.

8. Assessing performance: The teacher requires more learner performance, and gives feedback, to reinforce learning.

9. Enhancing retention and transfer: The teacher provides varied practice to generalize the capability.

Some educators believe that Gagné's taxonomy of learning outcomes and events of instruction oversimplify the learning process by over-prescribing.[32] However, using them as part of a complete instructional package can assist many educators in becoming more organized and staying focused on the instructional goals.[33]

Gagné's Influence on Instructional Design Theorists

Robert Gagné's work has been the foundation of instructional design since the beginning of the 1960s when he conducted research and developed training materials for the military. Among the first to coin the term "instructional design", Gagné developed some of the earliest instructional design models and ideas. These models have laid the groundwork for more present-day instructional design models from theorists like Dick, Carey, and Carey (The Dick and Carey Systems Approach Model),[34] Jerold Kemp's Instructional Design Model,[35] and David Merrill (Merrill's First Principle of Instruction).[35] Each of these models are based on a core set of learning phases that include (1) activation of prior experience, (2) demonstration of skills, (3) application of skills, and (4) integration or these skills into real world activities. The figure below illustrates these five ideas.[35]

Gagné's main focus for instructional design was how instruction and learning could be systematically connected to the design of instruction. He emphasized the design principles and procedures that need to take place for effective teaching and learning. His initial ideas, along with the ideas of other early instructional designers, can be summed up in *Psychological Principles in Systematic Development* which was written by Roberts B. Miller and edited by Gagné.[36] Gagné believed in internal learning and motivation which paved the way for theorists like Merrill, Li, and Jones who designed the Instructional Transaction Theory,[37] Reigeluth and Stein's Elaboration Theory,[38] and most notably, Keller's ARCS Model of Motivation and Design (see below).

Gagné's Influence on Education Today

Prior to Robert Gagné, learning was often thought of as a single, uniform process.[39] There was little or no distinction made between "learning to load a rifle and learning to solve a complex mathematical problem".[39] Gagné offered an alternative view which developed the idea that different learners required different learning strategies.[39] Understanding and designing instruction based on a learning style defined by the individual brought about new theories and approaches to teaching.[39] Gagné 's understanding and theories of human learning added significantly to understanding the stages in cognitive processing and instructions.[39] For example, Gagné argued that instructional designers must understand the characteristics and functions of short-term and long-term memory to facilitate meaningful learning.[39] This idea encouraged instructional designers to include cognitive needs as a top-down instructional approach.[39]

Gagné (1966) defines curriculum as a sequence of content units arranged in such a way that the learning of each unit may be accomplished as a single act, provided the capabilities described by specified prior units (in the sequence) have already been mastered by the learner.[40]

His definition of curriculum has been the basis of many important initiatives in schools and other educational environments.[40] In the late 1950s and early 1960s, Gagné had expressed and established an interest in applying theory to practice with particular interest in applications for teaching, training and learning. Increasing the effectiveness and efficiency of practice was of particular concern.[40] His ongoing attention to practice while developing theory continues to have an impact on education and training.[40]

Gagné's work has had a significant influence on American education, and military and industrial training.[41] Gagné was one of the early developers of the concept of instructional systems design which suggests the components of a lesson can be analyzed and should be designed to operate together as an integrated plan for instruction.[41] In "Educational Technology and the Learning Process" (Ed-

ucational Researcher, 1974), Gagné defined instruction as "the set of planned external events which influence the process of learning and thus promote learning.".[41]

6.5 Learning design

The concept of learning design arrived in the literature of technology for education in the late 1990s and early 2000s[42] with the idea that "designers and instructors need to choose for themselves the best mixture of behaviourist and constructivist learning experiences for their online courses".[43] But the concept of learning design is probably as old as the concept of teaching. Learning design might be defined as "the description of the teaching-learning process that takes place in a unit of learning (eg, a course, a lesson or any other designed learning event)".[44]

As summarized by Britain,[45] learning design may be associated with:

- The concept of learning design

- The implementation of the concept made by learning design specifications like PALO, IMS Learning Design,[46] LDL, SLD 2.0, etc.

- The technical realisations around the implementation of the concept like TELOS, RELOAD LD-Author, etc.

6.6 Instructional design models

6.6.1 ADDIE process

Perhaps the most common model used for creating instructional materials is the ADDIE Model. This acronym stands for the 5 phases contained in the model (Analyze, Design, Develop, Implement, and Evaluate).

Brief History of ADDIE's Development – The ADDIE model was initially developed by Florida State University to explain "the processes involved in the formulation of an instructional systems development (ISD) program for military interservice training that will adequately train individuals to do a particular job and which can also be applied to any interservice curriculum development activity."[47] The model originally contained several steps under its five original phases (Analyze, Design, Develop, Implement, and [Evaluation and] Control),[47] whose completion was expected before movement to the next phase could occur. Over the years, the steps were revised and eventually the model itself became more dynamic and interactive than its original hierarchical rendition, until its most popular version appeared in the mid-80s, as we understand it today.

The five phases are listed and explained below:[5]

ADDIE Model

ations of the ADDIE process.[48]
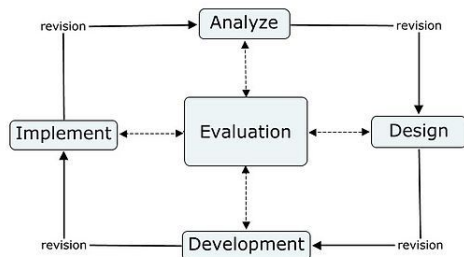
Analyze – The first phase of content development is Analysis. Analysis refers to the gathering of information about one's audience, the tasks to be completed, how the learners will view the content, and the project's overall goals. The instructional designer then classifies the information to make the content more applicable and successful.

Design – The second phase is the Design phase. In this phase, instructional designers begin to create their project. Information gathered from the analysis phase, in conjunction with the theories and models of instructional design, is meant to explain how the learning will be acquired. For example, the design phase begins with writing a learning objective. Tasks are then identified and broken down to be more manageable for the designer. The final step determines the kind of activities required for the audience in order to meet the goals identified in the Analyze phase.

Develop – The third phase, Development, involves the creation of the activities that will be implemented. It is in this stage that the blueprints of the design phase are assembled.

Implement – After the content is developed, it is then Implemented. This stage allows the instructional designer to test all materials to determine if they are functional and appropriate for the intended audience.

Evaluate – The final phase, Evaluate, ensures the materials achieved the desired goals. The evaluation phase consists of two parts: formative and summative assessment. The ADDIE model is an iterative process of instructional design, which means that at each stage the designer can assess the project's elements and revise them if necessary. This process incorporates formative assessment, while the summative assessments contain tests or evaluations created for the content being implemented. This final phase is vital for the instructional design team because it provides data used to alter and enhance the design.

Connecting all phases of the model are external and reciprocal revision opportunities. As in the internal Evaluation phase, revisions should and can be made throughout the entire process.

Most of the current instructional design models are vari-

6.6.2   Rapid prototyping

An adaptation of the ADDIE model, which is used sometimes, is a practice known as rapid prototyping.

Proponents suggest that through an iterative process the verification of the design documents saves time and money by catching problems while they are still easy to fix. This approach is not novel to the design of instruction, but appears in many design-related domains including software design, architecture, transportation planning, product development, message design, user experience design, etc.[48][49][50] In fact, some proponents of design prototyping assert that a sophisticated understanding of a problem is incomplete without creating and evaluating some type of prototype, regardless of the analysis rigor that may have been applied up front.[51] In other words, up-front analysis is rarely sufficient to allow one to confidently select an instructional model. For this reason many traditional methods of instructional design are beginning to be seen as incomplete, naive, and even counterproductive.[52]

However, some consider rapid prototyping to be a somewhat simplistic type of model. As this argument goes, at the heart of Instructional Design is the analysis phase. After you thoroughly conduct the analysis—you can then choose a model based on your findings. That is the area where most people get snagged—they simply do not do a thorough-enough analysis. (Part of Article By Chris Bressi on LinkedIn)

6.6.3   Dick and Carey

Another well-known instructional design model is **The Dick and Carey Systems Approach Model**.[53] The model was originally published in 1978 by Walter Dick and Lou Carey in their book entitled *The Systematic Design of Instruction*.

- Develop Instructional Strategy: Pre-instructional activities, content presentation, Learner participation, assessment

- Develop and Select Instructional Materials

- Design and Conduct Formative Evaluation of Instruction: Designers try to identify areas of the instructional materials that need improvement.

- Revise Instruction: To identify poor test items and to identify poor instruction

- Design and Conduct Summative Evaluation

With this model, components are executed iteratively and in parallel, rather than linearly.[53]

6.6.4 Instructional Development Learning System (IDLS)

Another instructional design model is the **Instructional Development Learning System (IDLS)**.[54] The model was originally published in 1970 by Peter J. Esseff, PhD and Mary Sullivan Esseff, PhD in their book entitled *IDLS—Pro Trainer 1: How to Design, Develop, and Validate Instructional Materials*.[55]

Peter (1968) & Mary (1972) Esseff both received their doctorates in Educational Technology from the Catholic University of America under the mentorship of Dr. Gabriel Ofiesh, a founding father of the Military Model mentioned above. Esseff and Esseff synthesized existing theories to develop their approach to systematic design, "Instructional Development Learning System" (IDLS).

Also see: Managing Learning in High Performance Organizations, by Ruth Stiehl and Barbara Bessey, from The Learning Organization, Corvallis, Oregon. ISBN 0-9637457-0-0.

The components of the IDLS Model are the following:

- Design a task analysis

- Develop criterion tests and performance measures

- Develop interactive instructional materials

- Validate the interactive instructional materials

6.6.5 Other instructional design models

Other useful instructional design models include: the Smith/Ragan Model,[56] the Morrison/Ross/Kemp Model[57] and the OAR Model of instructional design in higher education,[58] as well as, Wiggins' theory of backward design.

Learning theories also play an important role in the design of instructional materials. Theories such as behaviorism, constructivism, social learning and cognitivism help shape and define the outcome of instructional materials.

Dick and Carey made a significant contribution to the instructional design field by championing a systems view of instruction, in contrast to defining instruction as the sum of isolated parts. The model addresses instruction as an entire system, focusing on the interrelationship between context, content, learning and instruction. According to Dick and Carey, "Components such as the instructor, learners, materials, instructional activities, delivery system, and learning and performance environments interact with each other and work together to bring about the desired student learning outcomes".[53] The components of the Systems Approach Model, also known as the Dick and Carey Model, are as follows:

- Identify Instructional Goal(s): A goal statement describes a skill, knowledge or attitude (SKA) that a learner will be expected to acquire

- Conduct Instructional Analysis: Identify what a learner must recall and identify what learner must be able to do to perform particular task

- Analyze Learners and Contexts: Identify general characteristics of the target audience, including prior skills, prior experience, and basic demographics; identify characteristics directly related to the skill to be taught; and perform analysis of the performance and learning settings.

- Write Performance Objectives: Objectives consists of a description of the behavior, the condition and criteria. The component of an objective that describes the criteria will be used to judge the learner's performance.

- Develop Assessment Instruments: Purpose of entry behavior testing, purpose of pretesting, purpose of post-testing, purpose of practive items/practive problems

6.7 Motivational Design

Motivation is defined as an internal drive that activates behavior and gives it direction. The term motivation theory is concerned with the process that describe why and how human behavior is activated and directed.

Motivation Concepts *Intrinsic and Extrinsic Motivation*

- Instrinsic: defined as the doing of an activity for its inherent satisfactions rather than for some separable consequence. When intrinsically motivated a person is moved to act for the fun or challenge entailed rather than because of external rewards.[59] Intrinsic motivation reflects the desire to do something because it is enjoyable. If we are intrinsically motivated, we would not be worried about external rewards such as praise.

  Examples: Writing short stories because you enjoy writing them, reading a book because you are curious about the topic, and playing chess because you enjoy effortful thinking

- Extrinsic: reflects the desire to do something because of external rewards such as awards, money and praise. People who are extrinsically motivated may not enjoy certain activities. They may only wish to engage in certain activities because they wish to receive some external reward.[60]

  Examples: The writer who only writes poems to be submitted to poetry contests, a person who dislikes sales but accepts a sales position because he/she desires to earn an above average salary, and a person selecting a major in college based on salary and prestige, rather than personal interest.

John Keller[61] has devoted his career to researching and understanding motivation in instructional systems. These decades of work constitute a major contribution to the instructional design field. First, by applying motivation theories systematically to design theory. Second, in developing a unique problem-solving process he calls the ARCS Motivation.

6.7.1 The ARCS Model of Motivational Design

The ARCS Model of Motivational Design was created by John Keller while he was researching ways to supplement the learning process with motivation. The model is based on Tolman's and Lewin's expectancy-value theory, which presumes that people are motivated to learn if there is value in the knowledge presented (i.e. it fulfills personal needs) and if there is an optimistic expectation

for success.[62] The model consists of four main areas: Attention, Relevance, Confidence, and Satisfaction.

Attention and relevance according to John Keller's ARCS motivational theory are essential to learning. The first 2 of 4 key components for motivating learners, attention and relevance can be considered the backbone of the ARCS theory, the latter components relying upon the former.

Attention: The attention mentioned in this theory refers to the interest displayed by learners in taking in the concepts/ideas being taught. This component is split into three categories: perceptual arousal, using surprise or uncertain situations; inquiry arousal, offering challenging questions and/or problems to answer/solve; and variability, using a variety of resources and methods of teaching. Within each of these categories, John Keller has provided further sub-divisions of types of stimuli to grab attention. Grabbing attention is the most important part of the model because it initiates the motivation for the learners. Once learners are interested in a topic, they are willing to invest their time, pay attention, and find out more.

Relevance: Relevance, according to Keller, must be established by using language and examples that the learners are familiar with. The three major strategies John Keller presents are goal oriented, motive matching, and familiarity. Like the Attention category, John Keller divided the three major strategies into subcategories, which provide examples of how to make a lesson plan relevant to the learner. Learners will throw concepts to the wayside if their attention cannot be grabbed and sustained and if relevance is not conveyed.

Confidence: The confidence aspect of the ARCS model focuses on establishing positive expectations for achieving success among learners. The confidence level of learners is often correlated with motivation and the amount of effort put forth in reaching a performance objective. For this reason, it's important that learning design provides students with a method for estimating their probability of success. This can be achieved in the form of a syllabus and grading policy, rubrics, or a time estimate to complete tasks. Additionally, confidence is built when positive reinforcement for personal achievements is given through timely, relevant feedback.

Satisfaction: Finally, learners must obtain some type of satisfaction or reward from a learning experience. This satisfaction can be from a sense of achievement, praise from a higher-up, or mere entertainment. Feedback and reinforcement are important elements and when learners appreciate the results, they will be motivated to learn. Satisfaction is based upon motivation, which can be intrinsic or extrinsic. To keep learners satisfied, instruction should be designed to allow them to use their newly learned skills as soon as possible in as authentic a setting as possible.

Attention	Relevance	Confidence	Satisfaction
Perceptual Arousal Provide novelty and surprise	**Goal Orientation** Present objectives and useful purpose of instruction and specific methods for successful achievement	**Learning Requirements** Inform students about learning and performance requirements and assessment criteria	**Intrinsic Reinforcement** Encourage and support intrinsic enjoyment of the learning experience
Inquiry Arousal Stimulate curiosity by posing questions or problems to solve	**Motive Matching** Match objectives to student needs and motives	**Successful Opportunities** Provide challenging and meaningful opportunities for successful learning	**Extrinsic Rewards** Provide positive reinforcement and motivational feedback
Variability Incorporate a range of methods and media to meet students' varying needs	**Familiarity** Present content in ways that are understandable and that related to the learners' experiences and values	**Personal Responsibility** Link learning success to students' personal effort and ability	**Equity** Maintain consistent standards and consequences for success

Summary of ARCS Model

6.7.2 Motivating Opportunities Model

Although Keller's ARCS model currently dominates instructional design with respect to learner motivation, in 2006 Hardré and Miller[63] proposed a need for a new design model that includes current research in human motivation, a comprehensive treatment of motivation, integrates various fields of psychology and provides designers the flexibility to be applied to a myriad of situations.

Hardré[64] proposes an alternate model for designers called the Motivating Opportunities Model or MOM. Hardré's model incorporates cognitive, needs, and affective theories as well as social elements of learning to address learner motivation. MOM has seven key components spelling the acronym 'SUCCESS'- Situational, Utilization, Competence, Content, Emotional, Social, and Systemic.[64]

6.8 Influential researchers and theorists

Alphabetic by last name

- Bloom, Benjamin – Taxonomies of the cognitive, affective, and psychomotor domains – 1950s

- Bonk, Curtis – Blended learning – 2000s

- Bransford, John D. – How People Learn: Bridging Research and Practice – 1990s

- Bruner, Jerome – Constructivism - 1950s-1990s

- Clark, Richard – Clark-Kozma "Media vs Methods debate", "Guidance" debate.

- Clark, Ruth – *Efficiency in Learning: Evidence-Based Guidelines to Manage Cognitive Load* / Guided Instruction / Cognitive Load Theory

- Gagné, Robert M. – Nine Events of Instruction (Gagné and Merrill Video Seminar)

- Hannum, Wallace H.

- Heinich, Robert – Instructional Media and the new technologies of instruction *3rd ed.* – Educational Technology – 1989

- Jonassen, David – problem-solving strategies – 1990s

- Langdon, Danny G – The Instructional Designs Library: 40 Instructional Designs, Educational Technology Publications

- Mager, Robert F. – ABCD model for instructional objectives – 1962 - Criterion Referenced Instruction and Learning Objectives

- Marzano, Robert J. - "Dimensions of Learning", Formative Assessment - 2000s

- Mayer, Richard E. - Multimedia Learning - 2000s

- Merrill, M. David – Component Display Theory / Knowledge Objects / First Principles of Instruction

- Papert, Seymour – Constructionism, LOGO – 1970s-1980s

- Piaget, Jean – Cognitive development – 1960s

- Reigeluth, Charles – Elaboration Theory, "Green Books" I, II, and III – 1990s–2010s

- Schank, Roger – Constructivist simulations – 1990s

- Simonson, Michael – Instructional Systems and Design via Distance Education – 1980s

- Skinner, B.F. – Radical Behaviorism, Programed Instruction - 1950s-1970s

- Sweller, John – Cognitive load, Worked-example effect, Split-attention effect

- Vygotsky, Lev – Learning as a social activity – 1930s

6.9 See also

- ADDIE Model

- educational assessment

- confidence-based learning

- educational animation

- educational psychology

- educational technology

- e-learning

- e-learning framework
- electronic portfolio
- evaluation
- First Principles of Instruction
- human–computer interaction
- instructional technology
- instructional theory
- interaction design
- learning object
- learning science
- m-learning
- multimedia learning
- online education
- instructional design coordinator
- storyboarding
- training
- interdisciplinary teaching
- rapid prototyping
- lesson study
- Understanding by Design

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6.11   External links

- Instructional Design – An overview of Instructional Design

- ISD Handbook

- Edutech wiki: Instructional design model

- Debby Kalk, Real World Instructional Design Interview

Chapter 7

Synchronous learning

Synchronous learning refers to a learning environment in which everyone takes part at the same time. Lecture is an example of synchronous learning in a face-to-face environment, where learners and teachers are all in the same place at the same time. Before technology allowed for synchronous learning environments, most online education took place through Asynchronous learning methods. Since synchronous tools that can be used for education have become available, many people are turning to them as a way to help decrease the challenges associated with transactional distance that occurs in online education.

Some examples of synchronous learning environments are having students who are watching a live streaming of a class take part in a chat and having students and instructors participate in a class via a web conference tool such as BlackboardCollaborate, Adobe Connect, WebEx, Skype, etc. These synchronous experiences can be designed to develop and strengthen instructor-student and student-student relationships, which can be a challenge in distance learning programs.[1]

While many online educational programs started out as and with the advent of web conferencing tools, people can learn at the same time in different places as well. For example, use of instant messaging or live chat, webinars and video conferencing allow for students and teachers to collaborate and learn in real time.

7.1 See also

- E-learning

- Blended learning

- Asynchronous learning

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Chapter 8

Asynchronous learning

Asynchronous learning is a student-centered teaching method that uses online learning resources to facilitate information sharing outside the constraints of time and place among a network of people.[1] Asynchronous learning is based on constructivist theory, a student-centered approach that emphasizes the importance of peer-to-peer interactions.[2] This approach combines self-study with asynchronous interactions to promote learning, and it can be used to facilitate learning in traditional on-campus education, distance education, and continuing education. This combined network of learners and the electronic network in which they communicate are referred to as an asynchronous learning network.[1]

The online learning resources used to support asynchronous learning include email, electronic mailing lists, threaded conferencing systems, online discussion boards, wikis, and blogs. Course management systems such as CampusCruiser LMS,[3] Desire2Learn, Blackboard, WebCT, Moodle, and Sakai, have been developed to support online interaction, allowing users to organize discussions, post and reply to messages, and upload and access multimedia.[4] These asynchronous forms of communication are sometimes supplemented with synchronous components, including text and voice chat, telephone conversations, videoconferencing, and even meetings in virtual spaces such as *Second Life*, where discussions can be facilitated among groups of students.[4]

8.1 History

The roots of asynchronous learning are in the end of the 19th century, when formalized correspondence education (or distance learning) first took advantage of the postal system to bring physically remote learners into the educational fold. The 1920s and 1930s saw the introduction of recorded audio, desynchronizing broadcasting and revolutionizing the mass dissemination of information. The first significant distribution of standardized educational content took place during World War II; the branches of the US military produced hundreds of training films, with screenings numbering in the millions.[5]

Online asynchronous learning began with schools' and universities' substantial investment in computer technology in the early 1980s. With seminal applications such as Seymour Papert's Logo programming language, students were able to learn at their own pace, free from the synchronous constraints of a classroom lecture.[6] As computers entered more households and schools began connecting to the nascent Internet, asynchronous learning networks began to take shape. These networks augmented existing classroom learning and led to a new correspondence model for solitary learners.

Using the web, students could access resources online and communicate asynchronously using email and discussion boards. The 1990s saw the arrival of the first telecampuses, with universities offering courses and entire degree plans through a combination of synchronous and asynchronous online instruction.[7][8] Today, advanced multimedia and interactivity have enhanced the utility of asynchronous learning networks and blurred the divide between content-creator and content-consumer. New tools like class blogs and wikis are creating ever-richer opportunities for further asynchronous interaction and learning.

8.2 Development of an asynchronous community

Though the social relationships integral to group learning can be developed through asynchronous communication, this development tends to take longer than in traditional, face-to-face settings.[9] The establishment of an asynchronous community takes time and effort and tends to follow a projected course of five stages, as described by Waltonen-Moore et al.:

1. Introductions – This might include a full biography or a short "getting-to-know-you" questions. Through this step, community members begin to see one another as human beings and begin to make a preliminary, emotive connection with the other members of the community. This step is often characterized by emotive or extravagant language and represents group members' attempts to make themselves known as living individuals behind the emotionless technology medium.[10]

2. Identify with the group – Members begin to communicate with one another by reference to their commonalities as group members and seek to either establish or make known norms for successful membership. If this sense of group identity is not established, the likelihood of poor participation or attrition increases.[10]

3. Interact – Members will start interacting with one another in reference to the community's established focus and begin to share information with one another.[10] If the community is an online learning course, then students will begin to discuss course content.

4. Group cohesion and individual reflection – members of the group will begin to validate one another's ideas and opinions while, at the same time, being reflective of their own.[10]

5. Expansive questioning – Now feeling completely comfortable within the environment, focused upon the content, and respectful of other group members' thoughts and experiences, members will begin to not only post facts and deeply held beliefs, but will actually start to "think out loud", allowing other group members to take part in their personal meaning-making and self-directed inquiry.[10]

Asynchronous communities that progress efficiently through these stages tend to share at least three common attributes:

First, the community has an active facilitator who monitors, guides, and nurtures the discourse.[10] Unguided communities tend to have difficulty progressing beyond the second stage of development, because group members can become distracted from the community's intended purpose.

Second, rather than seeking to take on the role of an instructor or disseminator of knowledge, the facilitator recognizes that knowledge is an individual construct that is developed through interaction with other group members.[10] Thus, facilitators within successful communities tend not to be pedantic, but supportive.

And third, successful asynchronous communities permit a certain amount of leniency for play within their discourse.[10] That is, communities that insist upon being overly stringent on etiquette and make no room for the social development that comes from play seem to drive away participants. Rather than enriching discourse on the targeted topic, such attitudes have a negative impact on group identity development and individual comfort levels which will, in turn, decrease overall involvement.

8.3 Roles of instructors and learners

Online learning requires a shift from a teacher-centered environment to a student-centered environment where the instructor must take on multiple new roles. The constructivist theory that supports asynchronous learning demands that instructors become more than dispensers of knowledge; it requires that they become instructional designers, facilitators, and assessors of both grades and their teaching methods.[11]

As instructional designers, emphasis is placed on establishing the curriculum, methods and the media through which the content will be effectively delivered. Once the design is in place and executed, the instructor must then facilitate the communication and direct the learning. Establishing a communal spirit is vital, requiring much time commitment from the instructor, who must spend time reading, assessing, reinforcing, and encouraging the interaction and learning that is happening.[12]

The student-centered nature of asynchronous online learning requires students to be actively involved with and take more responsibility for their own learning. In addition to their normal duties as learners, students are required to:

- Become proficient with the technology required for the course;

- Use new methods of communication with both peers and instructors;

- Strengthen their interdependency through collaboration with their peers.[13]

8.4 Strengths of asynchronous learning

Asynchronous learning's greatest benefit to students is the freedom it gives them to access the course and its instructional materials at any time they choose, and from any location, with an Internet connection.[1] This allows for accessibility for diverse student populations, ranging from traditional, on-campus students, to working professionals, to international students in foreign countries.

Asynchronous learning environments provide a "high degree of interactivity" between participants who are separated both geographically and temporally and afford students many of the social benefits of face-to-face interaction.[1] Since students can express their thoughts without interruption, they have more time to reflect on and respond to class materials and their classmates than in a traditional classroom.[12]

Research shows that the time required to initially design an asynchronous course is comparable to that of a

traditional synchronous course.[4] However, most asynchronous courses have the potential to reach far more students than a traditional course and course-wide updates or modifications can be disseminated far more quickly and efficiently than traditional lecture models.

Schifter notes that a perceived additional workload is a significant barrier to faculty participation in distance education and asynchronous learning, but that perception can be mitigated through training and experience with teaching in these environments.[13]

Another advantage of asynchronous learning (and, as technology develops, many synchronous learning environments) is that there is a record of nearly everything that occurs in that environment. All materials, correspondence, and interactions can be electronically archived. Participants can go back and review course materials, lectures, and presentations, as well as correspondence between participants. This information is generally available at any time to course participants.

8.5   Shortcomings

Asynchronous learning environments pose several challenges for instructors, institutions, and students. Course development and initial setup can be costly. Institutions must provide a computer network infrastructure, including servers, audio/visual equipment, software, and the technical support needed to develop and maintain asynchronous learning environments. Technical support includes initial training and setup, user management, data storage and recovery, as well as hardware repairs and updates.[14] Research indicates faculty members who are hesitant to teach in asynchronous learning environments are so because of a lack of technical support provided by their institutions.[13] However, for faculty to teach successfully in an asynchronous learning environment, they must be technically adept and comfortable enough with the technological tools to optimize their use.

To participate in asynchronous learning environments, students must also have access to computers and the Internet. Although personal computers and web access are becoming more and more pervasive every day, this requirement can be a barrier to entry for many students and instructors. Students must also have the computer/technology skills required to participate in the asynchronous learning program. Also this is good for a successful online degree or courses.

8.6   See also

- E-learning

- Educational technology

- Blended learning

- Synchronous learning

- Networked learning

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8.8 External links

- The Sloan-C International Conference on Asynchronous Learning

- ALTMODES-Alternative Modes of Delivery: Asynchronous Learning

Chapter 9

Computer-supported collaborative learning

Computer-supported collaborative learning (CSCL) is a pedagogical approach wherein learning takes place via social interaction using a computer or through the Internet. This kind of learning is characterized by the sharing and construction of knowledge among participants using technology as their primary means of communication or as a common resource.[1] CSCL can be implemented in online and classroom learning environments and can take place synchronously or asynchronously.

The study of computer-supported collaborative learning draws on a number of academic disciplines, including instructional technology, educational psychology, sociology, cognitive psychology, and social psychology.[2] It is related to collaborative learning and computer supported cooperative work (CSCW).

9.1 History

Interactive computing technology was primarily conceived by academics, but the use of technology in education has historically been defined by contemporary research trends. The earliest instances of software in instruction drilled students using the behaviorist method that was popular throughout the mid-twentieth century. In the 1970s as cognitivism gained traction with educators, designers began to envision learning technology that employed artificial intelligence models that could adapt to individual learners.[3] Computer-supported collaborative learning emerged as a strategy rich with research implications for the growing philosophies of constructivism and social cognitivism.[4]

Though studies in collaborative learning and technology took place throughout the 1980s and 90s, the earliest public workshop directly addressing CSCL was "Joint Problem Solving and Microcomputers" which took place in San Diego in 1983. Six years later in 1989, the term "computer-supported collaborative learning" was used in a NATO-sponsored workshop in Maratea, Italy.[1][5] A biannual CSCL conference series began in 1995. At the 2002 and 2003 CSCL conferences, the International So-

ciety of the Learning Sciences (ISLS) was established to run the CSCL and ICLS conference series and the *International Journal of Computer-Supported Collaborative Learning* (*ijCSCL*) and JLS journals.[6]

The *ijCSCL* was established by the CSCL research community and ISLS. It began quarterly publication by Springer in 2006. It is peer reviewed and published both online and in print. Since 2009, it has been rated by ISI as being in the top 10% of educational research journals based on its impact factor.[7]

The rapid development of social media technologies and the increasing need of individuals to understand and use those technologies has brought researchers from many disciplines to the field of CSCL.[4] CSCL is used today in traditional and online schools and knowledge-building communities such as Wikipedia.

9.2 Theories

The field of CSCL draws heavily from a number of learning theories that emphasize that knowledge is the result of learners interacting with each other, sharing knowledge, and building knowledge as a group. Since the field focuses on collaborative activity and collaborative learning, it inherently takes much from constructivist and social cognitivist learning theories.[4]

9.2.1 Precursor theories

The roots of collaborative epistemology as related to CSCL can be found in Vygotsky's social learning theory. Of particular importance to CSCL is the theory's notion of internalization, or the idea that knowledge is developed by one's interaction with one's surrounding culture and society. The second key element is what Vygotsky called the Zone of proximal development. This refers to a range of tasks that can be too difficult for a learner to master by themselves but is made possible with the assistance of a more skilled individual or teacher.[8]

These ideas feed into a notion central to CSCL: knowledge building is achieved through interaction with others.

Cooperative learning, though different in some ways from collaborative learning, also contributes to the success of teams in CSCL environments. The five elements for effective cooperative groups identified by the work of Johnson and Johnson are positive interdependence, individual accountability, promotive interaction, social skills, and group processing.[9] Because of the inherent relationship between cooperation and collaboration, understanding what encourages successful cooperation is essential to CSCL research.

In the late 1980s and early 1990s, Marlene Scardamalia and Carl Bereiter wrote seminal articles leading to the development of key CSCL concepts: knowledge-building communities and knowledge-building discourse, intentional learning, and expert processes. Their work led to an early collaboration-enabling technology known as the Computer Supported Intentional Learning Environment (CSILE).[10] Characteristically for CSCL, their theories were integrated with the design, deployment, and study of the CSCL technology. CSILE later became Knowledge Forum, which is the most widely used CSCL technology world-wide to date.

Other learning theories that provide a foundation for CSCL include distributed cognition, problem-based learning, cognitive apprenticeship, and situated learning. Each of these learning theories focuses on the social aspect of learning and knowledge building, and recognizes that learning and knowledge building involve interpersonal activities including conversation, argument, and negotiation.[4]

9.2.2 Collaboration theory

Only in the last 15 to 20 years have researchers begun to explore the extent to which computer technology could enhance the collaborative learning process. While researchers, in general, have relied on learning theories developed without consideration of computer-support, some have suggested that the field needs to have a theory tailored and refined for the unique challenges that confront those trying to understand the complex interplay of technology and collaborative learning.[11]

Collaboration theory, suggested as a system of analysis for CSCL by Gerry Stahl in 2004, postulates that knowledge is constructed in social interactions such as discourse. The theory suggests that learning is not a matter of accepting fixed facts, but is the dynamic, on-going, and evolving result of complex interactions primarily taking place within communities of people. It also emphasizes that collaborative learning is a process of constructing meaning and that meaning creation most often takes place and can be observed at the group unit of analysis.[12] The goal of collaboration theory is to develop an understanding of how meaning is collaboratively constructed, preserved, and re-learned through the media of language and artifacts in group interaction. There are four crucial themes in collaboration theory: collaborative knowledge building (which is seen as a more concrete term than "learning"); group and personal perspectives intertwining to create group understanding; mediation by artifacts (or the use of resources which learners can share or imprint meaning on); and interaction analysis using captured examples that can be analyzed as proof that the knowledge building occurred.[11]

Collaboration theory proposes that technology in support of CSCL should provide new types of media that foster the building of collaborative knowing; facilitate the comparison of knowledge built by different types and sizes of groups; and help collaborative groups with the act of negotiating the knowledge they are building. Further, these technologies and designs should strive to remove the teacher as the bottleneck in the communication process. In other words, the teacher should not have to act as the conduit for communication between students or as the avenue by which information is dispensed. Finally, collaboration theory-influenced technologies will strive to increase the quantity and quality of learning moments via computer-simulated situations.[11]

9.3 Strategies

Currently, CSCL is used in instructional plans in classrooms both traditional and online from primary school to post-graduate institutions. Like any other instructional activity, it has its own prescribed practices and strategies which educators are encouraged to employ in order to use it effectively. Because its use is so widespread, there are innumerable scenarios in the use of CSCL, but there are several common strategies that provide a foundation for group cognition.

One of the most common approaches to CSCL is collaborative writing. Though the final product can be anything from a research paper, a Wikipedia entry, or a short story, the process of planning and writing together encourages students to express their ideas and develop a group understanding of the subject matter. Tools like blogs, interactive whiteboards, and custom spaces that combine free writing with communication tools can be used to share work, form ideas, and write synchronously.[13][14]

Technology-mediated discourse refers to debates, discussions, and other social learning techniques involving the examination of a theme using technology. For example, wikis are a way to encourage discussion among learners, but other common tools include mind maps, survey systems, and simple message boards. Like collaborative writing, technology-mediated discourse allows participants that may be separated by time and distance to engage in conversations and build knowledge

together.[14][15]

Group exploration refers to the shared discovery of a place, activity, environment or topic among two or more people. Students do their exploring in an online environment, use technology to better understand a physical area, or reflect on their experiences together through the Internet. Virtual worlds like Second Life and Whyville as well as synchronous communication tools like Skype are ideal for this kind of learning.[16][17]

Problem-based learning is a popular instructional activity that lends itself well to CSCL because of the social implications of problem solving. Complex problems call for rich group interplay that encourages collaboration and creates movement toward a clear goal.[18][19]

Project-based learning is similar to problem-based learning in that it creates impetus to establish team roles and set goals. The need for collaboration is also essential for any project and encourages team members to build experience and knowledge together. Any file sharing or communication tools can be used to facilitate CSCL in problem- or project-based environments.[20]

9.4   Teacher roles

Though the focus in CSCL is on individuals collaborating with their peers, teachers still have a vital role in facilitating learning. Most obviously, the instructor must introduce the CSCL activity in a thoughtful way that contributes to an overarching design plan for the course. The design should clearly define the learning outcomes and assessments for the activity. In order to assure that learners are aware of these objectives and that they are eventually met, proper administration of both resources and expectations is necessary to avoid learner overload. Once the activity has begun, the teacher is charged with kick-starting and monitoring discussion to facilitate learning. He or she must also be able to mitigate technical issues for the class. Lastly, the instructor must engage in assessment, in whatever form the design calls for, in order to ensure objectives have been met for all students.[21]

Without the proper structure, any CSCL strategy can lose its effectiveness. It is the responsibility of the teacher to make students aware of what their goals are, how they should be interacting, potential technological concerns, and the time-frame for the exercise. This framework should enhance the experience for learners by supporting collaboration and creating opportunities for the construction of knowledge.[22][23] Another important consideration of educators who implement online learning environments is affordance. Students who are already comfortable with online communication often choose to interact casually. Mediators should pay special attention to make students aware of their expectations for formality online.[24] While students sometime have frames of reference for online communication, they often do not have all of the skills necessary to solve problems by themselves. Ideally, teachers provide what is called "scaffolding", a platform of knowledge that they can build on. A unique benefit of CSCL is that, given proper teacher facilitation, students can use technology to build learning foundations with their peers. This allows instructors to gauge the difficulty of the tasks presented and make informed decisions about the extent of the scaffolding needed.[18]

9.5   Criticism and concerns

Though CSCL holds promise for enhancing education, it is not without barriers or challenges to successful implementation. Obviously, students or participants need sufficient access to computer technology. Though access to computers has improved in the last 15 to 20 years, teacher attitudes about technology and sufficient access to Internet-connected computers continue to be barriers to more widespread usage of CSCL pedagogy.

Furthermore, instructors find that the time needed to monitor student discourse and review, comment on, and grade student products can be more demanding than what is necessary for traditional face-to-face classrooms. The teacher or professor also has an instructional decision to make regarding the complexity of the problem presented. To warrant collaborative work, the problem must be of sufficient complexity, otherwise team work is unnecessary. Also, there is risk in assuming that students instinctively know how to work collaboratively. Though the task may be collaborative by nature, students may still need training on how to work in a truly cooperative process.

Others have noted a concern with the concept of scripting as it pertains to CSCL. There is an issue with possibly over-scripting the CSCL experience and in so doing, creating "fake collaboration." Such over-scripted collaboration may fail to trigger the social, cognitive, and emotional mechanisms that are necessary to true collaborative learning.[5]

There is also the concern that the mere availability of the technology tools can create problems. Instructors may be tempted to apply technology to a learning activity that can very adequately be handled without the intervention or support of computers. In the process of students and teachers learning how to use the "user-friendly" technology, they never get to the act of collaboration. As a result, computers become an obstacle to collaboration rather than a supporter of it.[25]

9.6   See also

- Collaborative learning

- Educational technology

- Computer supported cooperative work

- Collaborative information seeking

- Educational Psychology

- Group cognition

- Online Community of Practice

- Mobile Computer Supported Collaborative Learning

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Chapter 10

Electronic portfolio

An **electronic portfolio** (also known as an **eportfolio**, **e-portfolio**, **digital portfolio**, or **online portfolio**)[1] is a collection of electronic evidence assembled and managed by a user, usually on the Web. Such electronic evidence may include inputted text, electronic files, images, multimedia, blog entries, and hyperlinks. E-portfolios are both demonstrations of the user's abilities and platforms for self-expression, and, if they are online, they can be maintained dynamically over time.

An e-portfolio can be seen as a type of learning record that provides actual evidence of achievement. Learning records are closely related to the Learning Plan, an emerging tool that is being used to manage learning by individuals, teams, communities of interest, and organizations. To the extent that a Personal Learning Environment captures and displays a learning record, it also might be understood to be an electronic portfolio.

E-portfolios, like traditional portfolios, can facilitate students' reflection on their own learning, leading to more awareness of learning strategies and needs.[2] Results of a comparative research, by M. van Wesel and Prop, between paper-based portfolios and electronic portfolios in the same setting, suggest use of an electronic portfolio leads to better learning outcomes.[3]

10.1 Types

There are three main types of e-portfolios, although they may be referred to using different terms:

- developmental (e.g., working)
- assessment
- showcase

A developmental e-portfolio can show the advancement of skill over a period of time rubrics. The main purpose is to provide an avenue for communication between student and instructor. An assessment portfolio will demonstrate skill and competence in a particular domain or area. A showcase portfolio highlights stellar work in a specific area, it is typically shown to potential employers to gain employment. When it is used for job application it is sometimes called career portfolio. Most e-portfolios are a mix of the three main types to create a hybrid portfolio.

10.2 Usage

Today, electronic portfolios are gaining popularity in:

- Schools (*see also* Technology Integration)
- Higher education
- Continuing professional development
- Job applications/professional advertisements
- Therapy groups
- Assessment
- Accreditation
- Recognition of prior learning (RPL)

10.2.1 E-portfolios in Education

In education the electronic portfolio is a collection of a students' work that can advance learning by providing a way for them to organize, archive, and display work. The electronic format allows an instructor to evaluate student portfolios via the Internet, CD-ROM, DVD, or zip disk. Electronic portfolios have become a popular alternative to paper-based portfolios because they provide the opportunity to review, communicate and give feedback in an asynchronous manner. In addition, students are able to reflect on their work, which makes the experience of creating the e-portfolio meaningful. A student e-portfolio may be shared with a prospective employer or used to record the achievement of program or course specific learning outcomes.[4]

The uses of e-portfolios are most common in the courses with departments of education. Most preservice teachers are asked to compile an e-portfolio to demonstrate competencies needed to gain teaching certification or licensure. Student e-portfolios are increasingly being used

in other disciplines such as communications, math, business, nursing, engineering and architecture. In education e-portfolios have six major functions:

- Document, skills and learning;

- Record and track development within a program;

- Plan educational programs;

- Evaluate and monitor performance;

- Evaluate a course;

- Find a job

In general e-portfolios promote critical thinking and support the development of technology literacy skills. Faculty now use e-portfolios to record course or discipline designs that may be shared with colleagues to promote teaching and learning. A teaching e-portfolio is used to showcase career accomplishments.[4]

Best practices have been developed to guide e-portfolio use in college classrooms. Faculty is encouraged to use e-portfolios to foster collaborative learning environment where more competent students can provide feedback to peers. When students are given the opportunity to guide others it facilitates peer –to-peer learning and deeper understanding of the lesson. Next generation education e-portfolios like Digication can assist students to archive information that is specific to each lesson in a course. Using e-portfolios in this way promotes data and knowledge curation and assists students in conducting research in an organized and discriminating way.[5]

E-portfolios also help to foster an independent and autonomous way of thinking, according to Strivens.[6] This is in large part because people must focus on their collective work, think about how it will be portrayed, and what the work says about them as an individual. The individual is then in charge of their learning and the choice of where to demonstrate their proficiency. People are also forced to reflect on what they have learned and how they plan to build and improve in the future. This helps people to become better critical thinkers and helps them to develop their writing and multimedia skills. Today, many students are using multimedia such as Facebook, Twitter, and texting—all informal settings. The electronic portfolio, on the other hand, is a more formal setting where students must apply both their knowledge of how the web works and the message they want to convey. In this sense, students' use and comfort with the web at times can he a hindrance if they are not taught to use electronic portfolios in the correct fashion, suggests Lane.[7] Many universities and schools are currently working to make sure that students are gaining practice and experience with electronic portfolios so that they are able to use them to the best of their ability. For example, in places like Michigan students can earn the MCOATT (Michigan Certificate of Outstanding Achievement in Teaching Technology) for

submitting an electronic portfolio which demonstrates evidence of technology being used in the classroom.[8] This consortium is an organization aimed to make Michigan one of the leaders in integrating technology into the training of young professionals.

10.2.2   Other Uses

Some e-portfolio applications permit varying degrees of audience access, so the same portfolio might be used for multiple purposes. According to Anderson, e-portfolios can then go viral and be passed on to be easily viewed by many on the web.[9]

10.3   Services

10.4   See also

- Career portfolio

- Artist's portfolio

- Inter/National Coalition for Electronic Portfolio Research (INCEPR)

10.5   References

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10.6   External links

- Comparison of Tools

Chapter 11

Distance education

This article is about education over a distance. For learning that is spaced over time, see Distributed learning.

Distance education or **distance learning** is a mode of delivering education and instruction, often on an individual basis, to students who are not physically present in a traditional setting such as a classroom. Distance learning provides "access to learning when the source of information and the learners are separated by time and distance, or both."[1] Distance education courses that require a physical on-site presence for any reason (excluding taking examinations) have been referred to as hybrid[2] or blended[3] courses of study. Massive open online courses (MOOCs), aimed at large-scale interactive participation and open access via the web or other network technologies, are a recent development in distance education.

11.1 History

The earliest distance education courses may date back to the early 18th century in Europe. One of the earliest examples was from a 1728 advertisement in the *Boston Gazette* for "Caleb Phillips, Teacher of the new method of Short Hand," who sought students who wanted to learn through weekly mailed lessons.[4]

11.1.1 First distance education courses

The first distance education course in the modern sense was provided by Sir Isaac Pitman in the 1840s, who taught a system of shorthand by mailing texts transcribed into shorthand on postcards and receiving transcriptions from his students in return for correction. The element of student feedback was a crucial innovation of Pitman's system.[5] This scheme was made possible by the introduction of uniform postage rates across England in 1840.[6]

This early beginning proved extremely successful, and the Phonographic Correspondence Society was founded three years later to establish these courses on a more formal basis. The Society paved the way for the later formation of Sir Isaac Pitman Colleges across the country.[7]

Sir Isaac Pitman, pioneer of distance education in the 1840s.

11.1.2 University correspondence courses

The University of London was the first university to offer distance learning degrees, establishing its External Programme in 1858. The background to this innovation lay in the fact that the institution (later known as University College London) was non-denominational and, given the intense religious rivalries at the time, there was an outcry against the "godless" university. The issue soon boiled down to which institutions had degree-granting powers and which institutions did not.[8]

The compromise solution that emerged in 1836 was that the sole authority to conduct the examinations leading to degrees would be given to a new officially recognised entity called the "University of London", which would act as examining body for the University of London colleges, originally University College London and King's College London, and award their students University of

The London University *in 1827, drawn by Thomas Hosmer Shepherd*

London degrees. As Sheldon Rothblatt states, "thus arose in nearly archetypal form the famous English distinction between teaching and examining, here embodied in separate institutions."[8] With the state giving examining powers to a separate entity, the groundwork was laid for the creation of a programme within the new university that would both administer examinations and award qualifications to students taking instruction at another institution or pursuing a course of self-directed study.

William Rainey Harper, encouraged the development of external university courses at the new University of Chicago in the 1890s

Referred to as "People's University" by Charles Dickens because it provided access to higher education to students

from less affluent backgrounds, the External Programme was chartered by Queen Victoria in 1858, making the University of London the first university to offer distance learning degrees to students.[9][10] Enrolment increased steadily during the late 19th century, and its example was widely copied elsewhere.[11] This program is now known as the University of London International Programme and includes Postgraduate, Undergraduate and Diploma degrees created by colleges such as the London School of Economics, Royal Holloway and Goldsmiths.[10]

In the United States, William Rainey Harper, first president of the University of Chicago, developed the concept of extended education, whereby the research university had satellite colleges of education in the wider community. In 1892 he also encouraged the concept of correspondence school courses to further promote education, an idea that was put into practice by Columbia University.[12][13] Enrollment in the largest private for-profit school based in Scranton, Pennsylvania, the International Correspondence Schools grew explosively in the 1890s. Originally founded in 1888 to provide training for immigrant coal miners aiming to become state mine inspectors or foremen, it enrolled 2500 new students in 1894 and matriculated 72,000 new students in 1895. By 1906 total enrollments reached 900,000. The growth was due to sending out complete textbooks instead of single lessons, and the use of 1200 aggressive in-person salesmen.[14][15] There was a stark contrast in pedagogy:

> The regular technical school or college aims to educate a man broadly; our aim, on the contrary, is to educate him only along some particular line. The college demands that a student shall have certain educational qualifications to enter it, and that all students study for approximately the same length of time, and when they have finished their courses they are supposed to be qualified to enter any one of a number of branches in some particular profession. We, on the contrary, are aiming to make our courses fit the particular needs of the student who takes them.[16]

Education was a high priority in the Progressive Era, as American high schools and colleges expanded greatly. For men who were older or were too busy with family responsibilities, night schools were opened, such as the YMCA school in Boston that became Northeastern University. Outside the big cities, private correspondence schools offered a flexible, narrowly focused solution. In 1916 efficiency was enhanced by the formation of the National Association of Corporation Schools.[17]

Universities around the world used correspondence courses in the first half of the 20th century, especially to reach rural students. Australia with its vast distances was especially active; the University of Queensland established its Department of Correspondence Studies in

1911.[18] In South Africa, the University of South Africa, formerly an examining and certification body, started to present distance education tuition in 1946. The International Conference for Correspondence Education held its first meeting in 1938.[19] The goal was to provide individualized education for students, at low cost, by using a pedagogy of testing, recording, classification, and differentiation.[20][21]

11.1.3 Radio and television

The very rapid spread of radio in the United States in the 1930s led to proposals to use it for distance education. By 1938, at least 200 city school systems, 25 state boards of education, and many colleges and universities broadcast educational programs for the public schools.[22] One line of thought was to use radio as a master teacher.

> " Experts in given fields broadcast lessons for pupils within the many schoolrooms of the public school system, asking questions, suggesting readings, making assignments, and conducting tests. This mechanizes education and leaves the local teacher only the tasks of preparing for the broadcast and keeping order in the classroom."[23]

A typical setup came in Kentucky in 1948 when John Wilkinson Taylor, president of the University of Louisville, teamed up with the National Broadcasting Corporation to use radio as a medium for distance education, The chairman of the Federal Communications Commission endorsed the project and predicted that the "college-by-radio" would put "American education 25 years ahead." The University was owned by the city, and local residents would pay the low tuition rates, receive their study materials in the mail, and listen by radio to live classroom discussions that were held on campus.[24] Charles Wedemeyer of the University of Wisconsin–Madison also promoted new methods. From 1964 to 1968, the Carnegie Foundation funded Wedemeyer's *Articulated Instructional Media Project* (AIM) which brought in a variety of communications technologies aimed at providing learning to an off-campus population.

11.1.4 Open University

The Open University in the United Kingdom was founded by the then serving Labour Party government under Prime Minister Harold Wilson, based on the vision of Michael Young. Planning commenced in 1965 under Minister of State for Education Jennie Lee, who established a model for the OU as one of widening access to the highest standards of scholarship in higher education, and set up a planning committee consisting of university vice-chancellors, educationalists and television broadcasters,

Walton Hall, renovated in 1970 to act as the headquarters of the newly established Open University. (Artist: Hilary French)

chaired by Sir Peter Venables. The British Broadcasting Corporation (BBC) Assistant Director of Engineering at the time James Redmond, had obtained most of his qualifications at night school, and his natural enthusiasm for the project did much to overcome the technical difficulties of using television to broadcast teaching programmes.

The University revolutionised the scope of the correspondence program and helped to create a respectable learning alternative to the traditional form of education. It has been at the forefront of developing new technologies to improve the distance learning service and is still the largest such institution in the world. Its success helped to hasten the establishment of similar institutions elsewhere, including in the US and Japan.[25] Walter Perry was appointed the OU's first vice-chancellor in January 1969, and its Foundation Secretary was Anastasios Christodoulou. The election of the new Conservative Party government under Prime Minister Edward Heath in 1970 led to budget cuts under Chancellor of the Exchequer Iain Macleod (who had earlier called the idea of an Open University "blithering nonsense").[26] However, the OU accepted its first 25,000 students in 1971, adopting a radical open admissions policy. At the time, the total student population of conventional universities in the United Kingdom was around 130,000.

Athabasca University, Canada's Open University, was created in 1970 and followed a similar, though independently developed, pattern.[27] The Open University inspired the creation of Spain's National University of Distance Education (1972)[28] and Germany's FernUniversität in Hagen (1974).[29] There are now many similar institutions around the world, often with the name "Open University" (in English or in the local language). All "open universities" use distance education technologies as delivery methodologies and some have grown to become 'mega-universities',[30] a term coined to denote institutions with more than 100,000 students. In 1976, Bernard Luskin launched Coastline Community College as a college beyond walls, combining computer assisted instruction with telecourses produced by KOCE TV, the

Coast Community College District public television station. Coastline has been a landmark strategic success in helping to establish online distance learning using modern technology for learning.

11.1.5   Internet

Main article: Virtual education

The widespread use of computers and the internet have made distance learning easier and faster, and today virtual schools and virtual universities deliver full curricula online.[31] In 1996 Jones International University was launched by Glenn Jones, CEO and Bernard Luskin, Chancellor as the first fully online university accredited by a regional accrediting association in the US.[32]

Between 2000 and 2008, undergraduate enrollment in at least some distance programs became more and more common. The share of students "in at least one distance education class expanded from 8 percent to 20 percent, and the percentage enrolled in a distance education degree program increased from 2 percent to 4 percent."[33]

Many private, public, non-profit and for-profit institutions worldwide now offer distance education courses from the most basic instruction through the highest levels of degree and doctoral programs. Levels of accreditation vary: Widely respected universities such as Stanford University and Harvard now deliver online courses—but other online schools receive little outside oversight, and some are actually fraudulent, i.e., diploma mills. In the US, the Distance Education and Training Council (DETC) specializes in the accreditation of distance education institutions.[34]

In the United States in 2011, it was found that a third of all the students enrolled in postsecondary education had taken an accredited online course in a postsecondary institution.[35] Even though growth rates are slowing, enrollment for online courses has been seen to increase with the advance in technology. The majority of public and private colleges now offer full academic programs online.[35] These include, but are not limited to, training programs in the mental health,[36] occupational therapy,[37][38] family therapy,[39] art therapy,[40] physical therapy,[38] and rehabilitation counseling[41] fields.

Distance education has a long history, but its popularity and use has grown exponentially as more advanced technology has become available. By 2008, online learning programs were available in the United States in 44 states at the K-12 level.[42]

SazmandAsfaranjan, Y., Shirzad, F., Baradari, F., Salimi, M., & Salehi, M. in a 2013 research paper argued that implementation of internet forum, online discussion group and online learning community contribute to an efficacious distance education. Researchers showed that **socialization** plays the most vital role in effective dis-

tance education.[43]

11.2   Technologies

Although the expansion of the Internet blurs the boundaries, distance education technologies are divided into two modes of delivery: synchronous learning and asynchronous learning.

In synchronous learning, all participants are "present" at the same time. In this regard, it resembles traditional classroom teaching methods despite the participants being located remotely. It requires a timetable to be organized. Web conferencing, videoconferencing, educational television, instructional television are examples of synchronous technology, as are direct-broadcast satellite (DBS), internet radio, live streaming, telephone, and web-based VoIP.[44] Online meeting software such as Adobe Connect has helped to facilitate meetings in distance learning courses. Another form of synchronous learning that has been entering the classroom over the last couple of years is the use of robot proxies.[45]

In asynchronous learning, participants access course materials flexibly on their own schedules. Students are not required to be together at the same time. Mail correspondence, which is the oldest form of distance education, is an asynchronous delivery technology, as are message board forums, e-mail, video and audio recordings, print materials, voicemail, and fax.[44]

The two methods can be combined. Many courses offered by both open universities and an increasing number of campus based institutions use periodic sessions of residential or day teaching to supplement the sessions delivered at a distance.[46] This type of mixed distance and campus based education has recently come to called "blended learning" or less often "hybrid learning". The Open University uses a blend of technologies and a blend of learning modalities (face-to-face, distance, and hybrid) all under the rubric of "distance learning."

Distance learning can also use interactive radio instruction (IRI), interactive audio instruction (IAI), online virtual worlds, digital games, webinars, and webcasts, all of which are referred to as eLearning.[46] Media psychology and media studies have evolved as the research area in the study of media effects. Each has grown into important academic areas with graduate degree programs now providing professional research, teaching and field staff to help build understanding of the behavioral implications of media. The first MA, PhD and EdD programs in Media Psychology and Media Studies were launched in 2002 by Bernard Luskin at Fielding Graduate University.

11.3 Paced and self paced models

Distance education can be delivered in a paced format, much as traditional campus based models in which learners commence and complete a course at the same time. Paced delivery is currently the most common mode of distance education delivery. Alternatively, some institutions offer self-paced programs that allow for continuous enrolment and the length of time to complete the course is set by the learner's time, skill and commitment levels. Paced courses may be offered in either synchronus mode, but self-paced courses are almost always offered asynchronously. Each delivery model offers both advantages and disadvantages for students, teachers and institutions.

Paced models are a familiar mode as they are used almost exclusively in campus based schools. Institutes that offer both distance and campus programs usually use paced models as teacher workload, student semester planning, tuition deadlines, exam schedules and other administrative details can be synchronized with campus delivery. Student familiarity and the pressure of deadlines encourages students to readily adapt to and usually succeed in paced models. However, student freedom is sacrificed as a common pace is often too fast for some students and too slow for others. In addition life events, professional or family responsibilities can interfere with a students capability to complete tasks to an external schedule. Finally, paced models allows students to readily form communities of inquiry[47] and to engage in collaborative work.

Self-paced courses maximize student freedom, as not only can students commence studies on any date, but they can complete a course in as little time as a few weeks or up to a year or longer. Students often enrol in self-paced study when they are under pressure to complete programs, have not been able to complete a scheduled course, need additional courses or have pressure which precludes regular study for any length of time. The self-paced nature of the programming, though is an unfamiliar model for many students and can lead to excessive procrastination resulting in course incompletion. Assessment of learning can also be challenging as exams can be written on any day, making it possible for students to share examination questions with resulting loss of academic integrity. Finally, it is extremely challenging to organize collaborative work activities, though some schools[48] are developing cooperative models based upon networked and connectivist pedagogies,[49] for use in self-paced programs.

11.4 Benefits

Distance learning can expand access to education and training for both general populace and businesses since its flexible scheduling structure lessens the effects of the many time-constraints imposed by personal respon-sibilities and commitments.[50] Devolving some activities off-site alleviates institutional capacity constraints arising from the traditional demand on institutional buildings and infrastructure.[50] Furthermore, there is the potential for increased access to more experts in the field and to other students from diverse geographical, social, cultural, economic, and experiential backgrounds.[39] As the population at large becomes more involved in lifelong learning beyond the normal schooling age, institutions can benefit financially, and adult learning business courses may be particularly lucrative.[50] Distance education programs can act as a catalyst for institutional innovation[50] and are at least as effective as face-to-face learning programs,[37][51] especially if the instructor is knowledgeable and skilled.[40]

Distance education can also provide a broader method of communication within the realm of education. With the many tools and programs that technological advancements have to offer, communication appears to increase in distance education amongst students and their professors, as well as students and their classmates. The distance educational increase in communication, particularly communication amongst students and their classmates, is an improvement that has been made to provide distance education students with as many of the opportunities as possible as they would receive in in-person education. The improvement being made in distance education is growing in tandem with the constant technological advancements. Present-day online communication allows students to associate with accredited schools and programs throughout the world that are out of reach for in-person learning. By having the opportunity to be involved in global institutions via distance education, a diverse array of thought is presented to students through communication with their classmates. This is beneficial because students have the opportunity to "combine new opinions with their own, and develop a solid foundation for learning.".[52] It has been shown through research that "as learners become aware of the variations in interpretation and construction of meaning among a range of people [they] construct an individual meaning," which can help students become knowledgeable of a wide array of viewpoints in education.[52] To increase the likelihood that students will build effective ties with one another during the course, instructors should use similar assignments for students across different locations to overcome the influence of co-location on relationship building.[53]

The high cost of education affects students in higher education, to which distance education may be an alternative in order to provide some relief. Distance education has been a more cost-effective form of learning, and can sometimes save students a significant amount of money as opposed to traditional education. Distance education may be able to help to save students a considerable amount financially by removing the cost of transportation.[54] In addition, distance education may be able to save students from the economic burden of high-

priced course textbooks. Many textbooks are now available as electronic textbooks, known as e-textbooks, which can offer digital textbooks for a reduced price in comparison to traditional textbooks. Also, the increasing improvements in technology have resulted in many school libraries having a partnership with digital publishers that offer course materials for free, which can help students significantly with educational costs.[54]

Within the class, students are able to learn in ways that traditional classrooms would not be able to provide. It is able to promote good learning experiences and therefore, allow students to obtain higher satisfaction with their online learning.[55] For example, students can review their lessons more than once according to their need. Students can then manipulate the coursework to fit their learning by focusing more on their weaker topics while breezing through concepts that they already have or can easily grasp.[55] When course design and the learning environment are at their optimal conditions, distance education can lead students to higher satisfaction with their learning experiences.[56] Studies have shown that high satisfaction correlates to increased learning. Students who are enrolled in distance education with high satisfaction in their online coursework are then motivated intrinsically to learn, which often means that their performance in class will improve.[56][57] For those in a healthcare or mental health distance learning program, online-based interactions have the potential to foster deeper reflections and discussions of client issues[38] as well as a quicker response to client issues, since supervision happens on a regular basis and is not limited to a weekly supervision meeting.[41] This also may contribute to the students feeling a greater sense of support, since they have ongoing and regular access to their instructors and other students.[38][41]

Distance learning may enable students who are unable to attend a traditional school setting, due to disability or illness such as decreased mobility and immune system suppression, to get a good education.[58] Children who are sick or are unable to attend classes are now able to attend them in "person" through the use of robot proxies. This helps the students have experiences of the classroom and social interaction that they are unable to receive at home or the hospital, while still keeping them in a safe learning environment. Over the last few years more students are entering safely back into the classroom thanks to the help of robots. Attached is an article from the New York Times: A Swiveling Proxy Will Even Wear a Tutu that explains the positive impact of virtual learning in the classroom.[59] Distance education may provide equal access regardless of socioeconomic status or income, area of residence, gender, race, age, or cost per student.[60] Applying universal design strategies to distance learning courses as they are being developed (rather than instituting accommodations for specific students on an as-needed basis) can increase the accessibility of such courses to students with a range of abilities, disabilities, learning

styles, and native languages.[61] Distance education graduates, who would have never have been associated with the school under a traditional system, may donate money to the school.[62]

Distance Learning may also offer a final opportunity for adolescences that are no longer permitted in the General Education population due to behavior disorders. Instead of these students having no other academic opportunities, they may continue their education from their homes and earn their diplomas, offering them another chance to be an integral part of society.

11.5   Criticism

Barriers to effective distance education include obstacles such as domestic distractions and unreliable technology,[63] as well as students' program costs, adequate contact with teachers and support services, and a need for more experience.[64]

Some students attempt to participate in distance education without proper training of the tools needed to be successful in the program. Students must be provided with training on each tool that is used throughout the program. The lack of advanced technology skills can lead to an unsuccessful experience. Schools have a responsibility to adopt a proactive policy for managing technology barriers.[65]

The results of a study of Washington state community college students showed that distance learning students tended to drop out more often than their traditional counterparts due to difficulties in language, time management, and study skills.[66]

Distance learning benefits may outweigh the disadvantages for students in such a technology driven society however before indulging into use of educational technology a few more disadvantages should be considered. Some say a negative to distance education is the lack of direct face-to-face social interaction, however as more people become used to personal and social interaction online (for example dating, chat rooms, shopping, blogging etc.) it is becoming easier for learners to both project themselves and socialize with others. Not all courses required to complete a degree may be offered online. Health care profession programs in particular, require some sort of patient interaction through field work before a student may graduate.[67] Studies have also shown that students pursuing a medical professional graduate degree who are participating in distance education courses, favor face to face communication over professor-mediated chat rooms and/or independent studies. However, this is little to correlation between student performance when comparing the previous different distance learning strategies.[37]

There is a theoretical problem about the application of traditional teaching methods to online courses because

online courses may have no upper size limit. Daniel Barwick noted that there is no evidence that large class size is always worse or that small class size is always better, although a negative link has been established between certain types of instruction in large classes and learning outcomes; he argued that higher education has not made a sufficient effort to experiment with a variety of instructional methods to determine whether large class size is always negatively correlated with a reduction in learning outcomes.[68] Early proponents of Massive Open Online Courses (MOOC)s saw them as just the type of experiment that Barwick had pointed out was lacking in higher education, although Barwick himself has never advocated for MOOCs.

There may also be institutional challenges. Distance learning is new enough that it may be a challenge to gain support for these programs in a traditional brick-and-mortar academic learning environment.[38] Furthermore, it may be more difficult for the instructor to organize and plan a distance learning program,[41] especially since many are new programs and their organizational needs are different from a traditional learning program.

Another benefit of distance education is one for developing countries. Judith Adler Hellman states, "In the face of the pressure on these countries to join the global information economy, distance education appears to provide the opportunity to train more people better and at lower cost."[69]

Even though there are advantages in advancing industrial countries, there are still negative sides to distance education. Hellman states, "These include its cost and capital intensiveness, time constraints and other pressures on instructors, the isolation of students from instructors and their peers, instructors' enormous difficulty in adequately evaluating students they never meet face-to-face, and drop-out rates far higher than in classroom-based courses."[69]

11.6 Educational technology

The modern use of electronic educational technology (also called e-learning) facilitates distance learning and independent learning by the extensive use of Information and Communications Technology (ICT), replacing traditional content delivery by postal correspondence. Instruction can be synchronous and asynchronous online communication in an interactive learning environment or virtual communities, in lieu of a physical classroom. "The focus is shifted to the education transaction in the form of virtual community of learners sustainable across time."[70]

One of the most significant issues encountered in the mainstream correspondence model of Distance Education is transactional distance. Transactional distance results from the lack of appropriate communication between learner and teacher. This gap has been observed to become wider if there is no communication between the learner and teacher and has direct implications over the learning process and future endeavors in Distance Education. Distance Education providers began to introduce various strategies, techniques, and procedures to increase the amount of interaction between learner and teacher. These measures e.g. more frequent face-to-face tutorials, increased use of Information and Communication Technologies including teleconferencing and the Internet, were designed to close the gap in transactional distance.[71]

11.7 See also

- Continuing education
- Degree completion program
- Educational technology
- Open admissions
- Open-door academic policy
- Open supported learning
- Open universities
- Public, educational, and government access (PEG)
- List of DETC online universities
- International Correspondence Schools
- Sunrise Semester
- Virtual education
- Virtual learning environment
- School choice
- Media psychology
- Cooling out
- University of the People

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11.10   External links

- Distance learning at DMOZ

- *The International Review of Research in Open and
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  arly journal

- *The Journal of Distance Education / Revue de
  l'Éducation à Distance*, scholarly journal

- "Radio in education" full text books and articles on-
  line; from 1930s and 1940s

- "Issues in Distance Education book series from
  Athabasca University Press". A series of over 10
  books related to distance education research. Avail-
  able in print for sale or online as open access.

- The Center on Accessible Distance Learning (Ac-
  cessDL), DO-IT Center, University of Washington

Chapter 12

OpenCourseWare

OpenCourseWare (**OCW**) are course lessons created at universities and published for free via the Internet. OCW projects first appeared in the late 1990s, and after gaining traction in Europe and then the United States have become a worldwide means of delivering educational content.

12.1 History

The OpenCourseWare movement started in 1999 when the University of Tübingen in Germany published videos of lectures online for its *timms* initiative (Tübinger Internet Multimedia Server).[1] The OCW movement only took off, however, with the launch of MIT OpenCourseWare at the Massachusetts Institute of Technology (MIT) and the Open Learning Initiative at Carnegie Mellon University[2] in October 2002. The movement was soon reinforced by the launch of similar projects at Yale, the University of Michigan, and the University of California Berkeley.

MIT's reasoning behind OCW was to "enhance human learning worldwide by the availability of a web of knowledge".[3] MIT also stated that it would allow students (including, but not limited to its own) to become better prepared for classes so that they may be more engaged during a class. Since then, a number of universities have created OCW, some of which have been funded by the William and Flora Hewlett Foundation.[3]

12.2 Principles

According to the website of the OCW Consortium, an OCW project:

- is a free and open digital publication of high quality educational materials, organized as courses.

- is available for use and adaptation under an open license, such as certain Creative Commons licenses.

- does not typically provide certification or access to faculty.[4]

12.3 edX

Main article: edX

Ten years after the US debut of OCW, in 2012 MIT and Harvard University announced the formation of edX, a massive open online course (MOOC) platform to offer online university-level courses in a wide range of disciplines to a worldwide audience at no charge. This new initiative was based on MIT's "MITx" project, announced in 2011, and extends the concepts of OCW by offering more structured formal courses to online students, including in some cases the possibility of earning academic credit or certificates based on supervised examinations. A major new feature of the edX platform is the ability for students to interact with each other and with teachers in online forums. In some cases, students will help evaluate each other's work, and may even participate in some of the teaching online.

In addition, edX is being used as an experimental research platform to support and evaluate a variety of other new concepts in online learning.

12.4 Problems

A problem is that the creation and maintenance of comprehensive OCW requires substantial initial and ongoing investments of human labor. Effective translation into other languages and cultural contexts requires even more investment by knowledgeable personnel. This is one of the reasons why English is still the dominant language, and fewer open courseware options are available in other languages.[5] The OCW platform SlideWiki[6] addresses these issues through a crowdsourcing approach.

12.5 Americas

12.5.1 Brazil

- Fundação Getulio Vargas (FGV Online)

- Universidade Estadual de Campinas[7]

12.5.2 Mexico

- Universidad de Monterrey, 2007[8]

- Universidad Anáhuac México Norte, 2010[9]

12.5.3 United States

This listing is roughly in the order of adoption of OCW principles.

- Massachusetts Institute of Technology (MIT), 2002[10]

- Carnegie Mellon University, 2002 [10]

- University of California, Berkeley

- Stanford University[10]

- Princeton University[10]

- University of Pennsylvania[10]

- University of Michigan[10]

- Harvard University[10]

- Yale University[11]

- Caltech

The following are not directly affiliated with a specific university:

- Academic Earth - privately owned

- Khan Academy - non-profit

- Students Circle Network - peer to peer

- Coursera - venture capital financed[10]

- Udacity - venture capital financed[12]

- edX - non-profit

12.6 Asia

12.6.1 China

OpenCourseWare originally initiated by MIT and the Hewlett Foundation, began movement in China in September, 2003, when MIT and the Internet Engineering Task Force (IETF) joined together with the Beijing Jiaotong University to organize an OpenCourseWare conference in Beijing. As a result of this conference, 12

universities petitioned the government to institute a program of OpenCourseWare in China. This group included both some of the most prestigious universities in China, as well as the Central Radio and Television University, which is China's central open university, covering more than 2 million students.

As a result of this petition, the Chinese government approved to institute the CORE(China Open Resources for Education)[13] to promote the OpenCourseWare in Chinese Universities, with Fun-Den Wang (the head of IETF) as chairman. The CORE is an NGO supported by Hewlett Foundation, Internet Engineering Task Force (IETF) and other fundations. According to CORE's website, it has nearly 100 Chinese universities as members, including the most prestigious universities in China, such as Tsinghua University, Peking University and Shanghai Jiaotong University.[14] This organization organized volunteers to translate foreign OpenCourseWare, mainly MIT OpenCourseWare into Chinese and to promote the application of OpenCourseWare in Chinese universities. At February, 2008, 347 courses had been translated into Chinese and 245 of them were used by 200 professors in courses involving a total of 8,000 students. It also tried to translate some Chinese courses into English, but the number is not too much and some are only title translated.[15] There have also been produced 148 comparative studies comparing MIT curriculum with Chinese curriculum using the MIT OpenCourseWare material.[16] CORE's offices are hosted within the China Central Radio and Television University, and they receive partial funding from the IETF and the Hewlett foundation.[17] They also host annual conferences on open education, and the 2008 conference was co-located with the international OpenCourseWare Consortium conference, which brought a large amount of foreign participants.[18]

But before the OpenCourseWare conference in Beijing and the establishment of CORE, at April 8, 2003, the Ministry of Education had published a policy to launch the China Quality Course (精品课程) program.[19] This program accepts applications for university lecturers that wish to put their courses online, and gives grants of between $10,000 – 15,000 CAD per course that is put online, and made available free of charge to the general public (ibid.). The most prestigious award is for the "national level CQOCW", then there is "provincial level" and "school level". From 2003 to 2010, there have produced 3862 courses at the national level by 746 universities.[20] According to the official website for the China Quality Course, the total number of the courses available online is more than 20,000.[21] These typically include syllabus, course notes, overheads, assignments, and in many cases audio or video of the entire lectures.[17] The scale of this project has also spurred a large research activity, and over 3,000 journal articles have been written in Chinese about the topic of OpenCourseWare.[22]

12.6.2 Pakistan

The Virtual University (Urdu:ی ٹورس ی ٹونی یورس; Vu), is a public university located in urban area of Lahore, Punjab, Pakistan. Its additional campus is also located in residential area of Karachi, Sindh, Pakistan.

Established in 2002 by the Government of Pakistan to promote distance education in modern information and communication sciences as its primary objectives, the university is noted for its online lectures and broadcasting rigorous programs regardless of their students' physical locations. The university offers undergraduate and postgraduate courses in business administration, economics, computer science, and information technology. Due to its heavy reliance on serving lectures through the internet, Pakistani students residing overseas in several other countries of the region are also enrolled in the University's programs.

12.6.3 India

The National Programme on Technology Enhanced Learning (NPTEL) is a Government of India sponsored collaborative educational programme. By developing curriculum-based video and web courses the programme aims to enhance the quality of engineering education in India. It is being jointly carried out by 7 IITs and IISc Bangalore, and is funded by the Ministry of Human Resources Development of the Government of India.

Flexilearn is a very useful open course portal. It was initiated by Indira Gandhi National Open University, and apart from providing free course materials, flexilearn also provides opportunities to enroll oneself for a course and appear for exam conducted by university and thereby get certification.

To provide open access to the resources for school education, Department of School Education and Literacy, Ministry of Human Resource Development, Government of India and the Central Institute of Educational Technology, National Council of Educational Research and Training launch National Repository of Open Educational Resources" (NROER) Anyone can participate in, contribute, curate and organise resources and activities, growing it to reach every teacher and every student in all languages. TARGET AUDIENCE

Teachers: The repository is primarily for teachers so that they can have access to variety of resources available in different subject areas. The idea is to introduce teachers to a bouquet of resources and provide them with an opportunity to pick and choose the resources which suits their requirement in classroom transaction. In addition to accessing resources and using them in their classroom, teacher can also create and contribute resources.

Teacher Educators: The repository aims to house various policy documents for example copy of National Curriculum Frameworks, National Focus Group papers on all the subjects and other policy documents which will be helpful for teacher educators.

Students/ Parents: Students can access variety of resources. They should be able to access the resources grade wise, subject wise and language wise.

Photographers: Photographs and images which can be mapped to school curriculum are invited. Photographers or any individual who has an access to such photographs/images can contribute to the repository making it relevant for school students and teachers by appropriately tagging them and by providing relevant keywords.

Producers: Documentary filmmakers/ audio producers/ video producers who have produced films/ video/ audio programmes can contribute to the repository. Also by having a look at spectrum of content which the repository plans to offer they can create content and contribute.

Other government and non-government organizations: As far as e-content is concerned, it is available in abundance. Many organisations have been creating such content for many years. The NROER aims to bring all such organisations on board so that the content created by all these organisations can be mapped to school curriculum and can be made available to teachers and students.

12.6.4 Japan

OpenCourseWare originally initiated by MIT and the Hewlett Foundation, was introduced and adopted in Japan.

In 2002, researchers from the National Institute of Multimedia Education (NIME) and Tokyo Institute of Technology (Tokyo Tech) studied the MIT OpenCourseWare, leading them to develop an OCW pilot plan with 50 courses at Tokyo Institute of Technology in September.[23] Later, in July 2004, MIT gave a lecture about MIT OpenCourseWare at Tokyo Tech that prompted the first meeting of the Japan OCW Alliance. The meeting was held with four Japanese universities that had mainly been recruited through the efforts of MIT professor Miyagawa, and his personal contacts. In one case, the connection was the former president of the University of Tokyo being an acquintance of Charles Vest, the former president of MIT.[24]

In 2006, the OCW International Conference was held at Kyoto University wherein the Japanese OCW Association was reorganized into the Japan OCW Consortium.[23] At that time, Japan OCW Consortium had over 600 courses; currently they have 18 university members, including the United Nations University (JOCW, n.d.). On Japanese university campuses there are few experts in content production, which makes it difficult to get support locally, and many of the universities have had to outsource their production of OCW. In example, the University of Tokyo has had to mainly employ students to create

OCW.[23]

The motivation for joining the OCW movement seems to be to create positive change among Japanese universities, including modernizing presentation style among lecturers, as well as sharing learning material.[24] Japanese researchers have been particularly interested in the technical aspects of OCW, for example in creating semantic search engines. There is currently a growing interest for Open Educational Resources (OER) among Japanese universities, and more universities are expected to join the consortium.[25]

"In order to become an integral institution that contributes to OER, the JOCW Consortium needs to forge solidarity among the member universities and build a rational for OER on its own, different from that of MIT, which would support the international deployment of Japanese universities and also Japanese style e-Learning."[25]

12.7 Europe

12.7.1 Germany

- University of Tübingen, 1999[1]
- SlideWiki.org (developed at University of Leipzig)

12.7.2 France

- France Universite Numerique: The Mooc portal for French Universities, founded in 2013 with state support.

12.7.3 Netherlands

- Delft University of Technology, 2007[26]

12.7.4 Romania

- Politehnica University of Bucharest, 2012[27]

12.7.5 Turkey

- Middle East Technical University

12.8 Middle East

In the United Arab Emirates, a discussion, led by Dr. Linzi j. Kemp, American University of Sharjah,[28] has begun about sharing teaching and learning materials ('open course ware') through a community of educators and practitioners in the GCC. There is growing

availability of high quality and free open access materials shared between universities e.g. MIT (USA). We are also exposed to an example of resource sharing through 'The Open University (UK), OpenLearn' platform. Kemp (2013) proposes that teaching and learning will be enhanced when across institutions of higher education, we work together to bring our shared knowledge into classrooms. Furthermore, when we open up this platform to include practitioners e.g. Employers, then the relationship with industry will further ensure teaching and learning is available and beneficial for a wider community.

12.9 See also

- Berkeley Webcast
- China Open Resources for Education
- Education in Japan
- Khan Academy
- MIT OpenCourseWare
- National Programme on Technology Enhanced Learning
- Notre Dame OpenCourseWare
- Open educational resources
- Open.Michigan
- Open Yale Courses
- Saylor Foundation
- Tufts OpenCourseWare
- Virtual University of Pakistan

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12.11 External links

- OCW Consortium

- Educational News of India

- China - Official website of CORE

- China - Official website of China Quality Open-CourseWare (Chinese)

- Japan - Japan OpenCourseWare Consortium

- India - National Programme on Technology Enhanced Learning (NPTEL)

Chapter 13

Virtual learning environment

A **virtual learning environment** (**VLE**) is a Web-based platform for the digital aspects of courses of study, usually within educational institutions. VLEs typically: allow participants to be organised into cohorts, groups and roles; present resources, activities and interactions within a course structure; provide for the different stages of assessment; report on participation; and have some level of integration with other institutional systems.[1][2] For those who edit them VLEs may have a de facto role as authoring and design environments.[3] VLEs have been adopted by almost all higher education institutions in the anglosphere.[4]

13.1 Major components

The following are the basic or the main components required for a virtual learning environment or online education curriculum to take place[5]

A VLE may include some or all of the following elements:

- The course syllabus

- Administrative information about the course: prerequisites, credits, registration, payments, physical sessions, and contact information for the instructor.

- A notice board for current information about the ongoing course

- The basic content of some or all of the course; the complete course for distance learning applications, or some part of it, when used as a portion of a conventional course. This normally includes material such as copies of lecture in the form of text, audio, or video presentations, and the supporting visual presentations

- Additional resources, either integrated or as links to outside resources. This typically consists of supplementary reading, or innovative equivalents for it.

- Self-assessment quizzes or analogous devices, normally scored automatically

- Formal assessment functions, such as examinations, essay submission, or presentation of projects. this now frequently includes components to support peer assessment

- Support for communications, including e-mail, threaded discussions, chat rooms, Twitter and other media, sometimes with the instructor or an assistant acting as moderator. Additional elements include wikis, blogs, RSS and 3D virtual learning spaces.

- Management of access rights for instructors, their assistants, course support staff, and students

- Documentation and statistics as required for institutional administration and quality control

- Authoring tools for creating the necessary documents by the instructor, and, usually, submissions by the students

- Provision for the necessary hyperlinks to create a unified presentation to the students.

A VLE is normally not designed for a specific course or subject, but is capable of supporting multiple courses over the full range of the academic program, giving a consistent interface within the institution and—to some degree—with other institutions using the system. The virtual learning environment supports an exchange of information between a user and the learning institute he or she is currently enrolled in through digital mediums like e-mail, chat rooms, web 2.0 sites or a forum thereby helping convey information to any part of the world with just a single click.[6]

13.2 Similar terms

Computerized learning systems have been referred to as electronic educational technology, e-learning, learning platform or learning management system. The major difference is that a VLE and LMS is an application, whereas the Learning Platform share characteristics with an Operating System (or CoursePark Platform) where

different educational web based applications can be run on the platform.

The terms virtual learning environment (VLE) and learning platform are generically used to describe a range of integrated web based applications that provide teachers, learners, parents and others involved in education with information, tools and resources to support and enhance educational delivery and management. These terms are broadly synonymous with 'managed learning environments' (MLEs) and 'managed virtual learning environments' (MVLEs).

The applications that form part of these online services can include web pages, email, message boards and discussion forums, text and video conferencing, shared diaries, online social areas, as well as assessment, management and tracking tools.[7][8]

The term learning platform refers to a range of tools and services often described using terms such as educational extranet, VLE, LMS, ILMS and LCMS providing learning and content management. The term learning platform also includes the personal learning environment (PLE) or personal online learning space (POLS), including tools and systems that allow the development and management of eportfolios.

The specific functionality associated with any implementation of a learning platform will vary depending upon the needs of the users and can be achieved by bringing together a range of features from different software solutions either commercially available, open source, self built or available as free to use web services. These tools are delivered together via a cohesive user environment with a single entry point, through integration achieved by technical standards.

- a Learning Management System (LMS). Related concepts include" Content Management System (CMS), which properly refers to the organization of the educational or other content, not the overall environment; Learning Content Management System (LCMS), which is more often used for corporate training systems than for systems in education institutions; Managed Learning Environment (MLE), which normally refers to the overall infrastructure in an institution of which the VLE is a component, Learning Support System (LSS); Online Learning Centre (OLC); or Learning Platform (LP), education via computer-mediated communication (CMC); or online education. The term "Virtual Learning Environment" is more commonly used in Europe and Asia, while the synonymous term "Learning Management System" is the more common usage in North America.

The term LMS can also mean "Library Management System" (which is now more commonly referred to as Integrated Library System, or ILS).

13.3 Purpose

VLE Learning platforms commonly allow:

- Content management – creation, storage, access to and use of learning resources

- Curriculum mapping and planning – lesson planning, assessment and personalisation of the learning experience

- Learner engagement and administration – managed access to learner information and resources and tracking of progress and achievement

- Communication and collaboration - emails, notices, chat, wikis, blogs

In principle a learning platform is a safe and secure environment that is reliable, available online and accessible to a wide user base. A user should be able to move between learning platforms throughout their life with no loss of access to their personal data. The concept of a learning platform accommodates a continuously evolving description of functionality **changing to meet the needs of the user**. Becta publishes Functional Requirements and Technical Specifications that give a more precise description of how a learning platform may be constructed.

13.4 Justification

Institutions of higher and further education use VLEs in order to:

- Economize on the time of teaching staff, and the cost of instruction.

- Facilitate the presentation of online learning by instructors without web authoring experience.

- Provide instruction to students in a flexible manner to students with varying time and location constraints.

- Provide instruction in a manner familiar to the current web-oriented generation of students.

- Facilitate the networking of instruction between different campuses or even colleges.

- Provide for the reuse of common material among different courses.

- Provide automatic integration of the results of student learning into campus information systems.

13.5   Standards

Most VLEs support the Shareable Content Object Reference Model (SCORM) as a standard, but there are no commonly used standards that define how the learner's performance within a course can be transferred from one VLE to another.

There are also standards for sharing content such as those defined by the IMS Global Consortium. Local bodies such as in the schools sector in the UK the DCSF via Becta have additionally defined a learning platform "conformance framework" to encourage interoperability.

Virtual Learning Environments are not limited only to students and learners in university level studies. There are many virtual learning environments for students in grades K-12. These systems are also particularly suited for the needs of independent educational programs, charter schools and home-based education.

13.6   Assessment

Educators need benchmark tools to assess a virtual learning environment as a viable means of education.

Walker developed a survey instrument known as the Distance Education Learning Environment Survey (DELES), which is accessible to students anywhere.[9] DELES examines instructor support, student interaction and collaboration, personal relevance, authentic learning, active learning, and student autonomy.

Harnish and Reeves provide a systematic criteria approach based on training, implementation, system usage, communication, and support.[10]

13.7   Systems available

There are many open source and proprietary VLEs available for use. On-demand elearning services are also a popular choice because they can be deployed in minutes and do not require instructors and institutions to run their own servers.

Many VLEs are placed on a web server. In a typical VLE there are one or more programs or languages that provides the user (Teacher-Student) interface, and which interacts with a database. For example, a VLE might use PHP as its web language/program, with MySQL as a database.

13.8   See also

- Online communication between school and home
- Virtual world#Education
- University of the People

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[5] http://whatis.techtarget.com/definition/virtual-learning-environment-VLE-or-managed-learning-environment-MLE

[6] http://www.diva-portal.org/smash/get/diva2:603927/FULLTEXT01.pdf

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13.10   External links

- Traditional Education vs Online Education
- Virtual Universities Giving You A Career Boost
- The Hassles In Online Education

13.11   Further reading

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Chapter 14

Learning management system

A **learning management system** (**LMS**) is a software application for the administration, documentation, tracking, reporting and delivery of electronic educational technology (also called e-learning) education courses or training programs.[1]

LMSs range from systems for managing training and educational records to software for distributing online or blended/hybrid college courses over the Internet with features for online collaboration. Colleges and universities use LMSs to deliver online courses and augment on-campus courses. Corporate training departments use LMSs to deliver online training, as well as to automate record-keeping and employee registration.

14.1 Characteristics

14.1.1 History

The history of the application of computers to education is filled with generic terms such as computer-based instruction (CBI), computer-assisted instruction (CAI), and computer-assisted learning (CAL), generally describing drill-and-practice programs, more sophisticated tutorials, and more individualized instruction, respectively.[2] LMS has its history in another term, integrated learning system (ILS) which offers additional functionality beyond instructional content such as management and tracking, more personalized instruction, and integration across the system . The term ILS was originally coined by Jostens Learning, and LMS was originally used to describe the management system part of the PLATO K-12 learning system, content-free and separate from the courseware. The term LMS is currently used to describe a number of different educational computer applications.[3]

14.1.2 Purpose

The key to understanding the difference between LMS and other computer education terms is to understand the systemic nature of LMS. LMS is the framework that handles all aspects of the learning process. An LMS is the infrastructure that delivers and manages instructional content, identifies and assesses individual and organizational learning or training goals, tracks the progress towards meeting those goals, and collects and presents data for supervising the learning process of the organization as a whole.[4] A Learning Management System delivers content but also handles registering for courses, course administration, skills gap analysis, tracking, and reporting.[5]

Most LMSs are web-based to facilitate access to learning content and administration. They are also used by educational institutions to enhance and support classroom teaching and offering courses to a larger population of learners. LMSs are used by regulated industries (e.g. financial services and biopharma) for compliance training. Student self-service (e.g., self-registration on instructor-led training), training workflow (e.g., user notification, manager approval, wait-list management), the provision of on-line learning (e.g., computer-based training, read & understand), on-line assessment, management of continuous professional education (CPE), collaborative learning (e.g., application sharing, discussion threads), and training resource management (e.g., instructors, facilities, equipment), are all-important dimensions of learning management systems.

Some LMS providers include "performance management systems", which encompass employee appraisals, competency management, skills-gap analysis, succession planning, and multi-rater assessments (i.e., 360 degree reviews). Modern techniques now employ competency-based learning to discover learning gaps and guide training material selection.

For the commercial market, some Learning and Performance Management Systems include recruitment and reward functionality.

A robust LMS should be able to do the following:[1]

- centralize and automate administration

- use self-service and self-guided services

- assemble and deliver learning content rapidly

- consolidate training initiatives on a scalable web-based platform

- support portability and standards

- personalize content and enable knowledge reuse

14.1.3 LMS and CMS compared

The inappropriate use of LMS in the literature is perhaps most commonly associated with computer applications which we would identify as Course Management Systems (CMS). These systems are used primarily for online or blended learning, supporting the placement of course materials online, associating students with courses, tracking student performance, storing student submissions, and mediating communication between the students as well as their instructor. Some of this same functionality can be seen within LMSs as well, so it is understandable why confusion might exist about the differences between the two types of systems. However, the systemic nature of an LMS does not limit its functionality to that of a CMS.[6]

14.1.4 LMS and LCMS compared

The focus of an LMS is to deliver online courses or training to learners, while managing students and keeping track of their progress and performance across all types of training activities. An LMS is not used to create course content.

By contrast, a learning content management system (LCMS) is a related software technology that provides a multi-user environment where developers, authors, instructional designers, and subject matter experts may create, store, reuse, manage, and deliver digital educational technology (also known as e-learning) content from a central object repository. LCMS focuses on the development, management and publishing of the content that will typically be delivered via an LMS. Users can both create and re-use content and reduce duplicated development efforts.

Rather than developing entire courses and adapting them to multiple audiences, an LCMS provides the ability for single course instances to be modified and republished for various audiences maintaining versions and history. The objects stored in the centralized repository can be made available to course developers and content experts throughout an organization for potential reuse and repurpose. This eliminates duplicate development efforts and allows for the rapid assembly of customized content. Some systems have tools to deliver and manage instructor-led synchronous and asynchronous online training based on learning object methodology.

LCMSs provide tools for authoring and reusing or repurposing content (mutated learning objects, or MLOs) as well as virtual spaces for student interaction (such as discussion forums, live chat rooms and live web-conferences). LCMS technology can either be used in tandem with an LMS, or as a standalone application for learning initiatives that require rapid development and distribution of learning content.

While LMS and LCMS products have different strengths and weaknesses, they generally address the following areas of functionality:[7]

LMS Functionality

- Course Content Delivery

- Student Registration and Administration

- Training Event Management (i.e., scheduling, tracking)

- Curriculum and Certification Management

- Skills and Competencies Management

- Skill Gap Analysis

- Individual Development Plan (IDP)

- Reporting

- Training Record Management

- Courseware Authoring

- Resource Management

- Virtual Organizations

LCMS Functionality

- Template-driven, Collaborative Content Development

- Facilitated Content Management (i.e., indexing and reuse)

- Publishing

- Workflow Integration

- Automated Interface with an LM

14.1.5 LMS as the ubiquitous term

Despite this distinction, the term LMS is often used to refer to both an LMS and an LCMS, although the LCMS is actually a complementary solution to an LMS. Either as separate platforms or as a merged product, LCMSs work together with LMSs to develop and deliver course content to students. Due to lack of industry standardization as well as being a young industry, products that combine LCMS and LMS attributes may be referred to as course management systems (CMS), learning management systems (LMS) and LMS/LCMS.[8] Blackboard Inc. currently refers to their Blackboard Learn platform as an LMS (Blackboard Inc., 2013). At this time, LMS represents the ubiquitous term for a product containing attributes of both a LMS and a LCMS, whether for CMS or LMS use.

14.2   Technical aspects

Most LMSs are web-based, built using a variety of development platforms, like Java/J2EE, Microsoft .NET or PHP. They usually employ the use of a database like MySQL, Microsoft SQL Server or Oracle as the backend data store. Although most of the systems are commercially developed and have commercial software licenses there are several systems that have an open-source license. Corporate LMSs support multilingual content as services can span across the world. SCORM (Sharable Content Object Reference Model) support is a de facto standard for LMS systems.[9]

14.3   Learning management industry

In the relatively new LMS market, commercial vendors for corporate and education applications range from new entrants to those that entered the market in the nineties. In addition to commercial packages, many open source solutions are available.

In the higher education market as of fall 2013, Blackboard is the leading provider with 41% market share, with Moodle (23%), Desire2Learn (11%) and Instructure being the next three largest providers.[10] In the corporate market, the six largest LMS providers constitute approximately 50% of the market, with SuccessFactors Learning, Saba Software, Voniz Inc and Sumtotal Systems being the four largest providers.

In addition to the remaining smaller LMS product vendors, training outsourcing firms, enterprise resource planning vendors, and consulting firms all compete for part of the learning management market. Approximately 40 percent of US training organizations reported that they have an LMS installed, a figure that has not changed significantly over the past two years. Another service related to LMS comes from the standardized test preparation vendors, where companies such as Princeton Review or BenchPrep offer online test prep courses.

Most buyers of LMSs utilize an authoring tool to create their educational content, which is then hosted on an LMS. In many cases LMSs include a primitive authoring tool for basic content manipulation. For advanced content creation buyers must choose an authoring software package that integrates with their LMS in order for their content to be hosted. There are authoring tools on the market which meet AICC and SCORM standards and therefore content created in tools such as these can be hosted on an AICC or SCORM certified LMS. By May 2010, ADL had validated 301 SCORM-certified products[11] while 329 products were compliant.[12]

Evaluation of LMSs is a complex task and significant research supports different forms of evaluation, including iterative processes where students' experiences and approaches to learning are evaluated.[13] Considerations in selecting an LMS/LCMS have been reviewed.[7]

14.4   See also

- Authoring system
- Competency-based management
- Competency management system
- Digital content creation
- Intelligent tutoring system
- Learning objects
- Educational technology (e-learning)
- List of learning management systems
- LAMS - Learning Activity Management System
- SCORM - Sharable Content Object Reference Model
- Student information system
- Virtual learning environment

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14.8 External links

- Free Software Directory: Education (Free Software Foundation)

- World Wide Scientific Educational Library

- Top Learning Management System Software

Chapter 15

History of virtual learning environments

Main article: Virtual learning environment

A **virtual learning environment** (VLE) is a system that creates an environment designed to facilitate teachers' management of educational courses for their students, especially a system using computer hardware and software, which involves distance learning. In North America, a virtual learning environment is often referred to as a "learning management system" (LMS).

15.1 Terminology

The terminology for systems which integrate and manage computer-based learning has changed over the years. Terms which are useful in understanding and searching for earlier materials include:

- "Computer Assisted Instruction" (CAI)

- "Computer Based Training" (CBT)

- "Computer Managed Instruction" (CMI)

- "Course Management System" (CMS)

- "Integrated Learning Systems" (ILS)

- "Interactive Multimedia Instruction" (IMI)

- "Learning Management System" (LMS)

- "Massive open online course" (MOOC)

- "On Demand Training" (ODT)

- "Technology Based Learning" (TBL)

- "Technology Enhanced Learning" (TEL)

- "Web Based Training" (WBT)

- "Media Psychology"

Pressey Testing Machine (exterior)
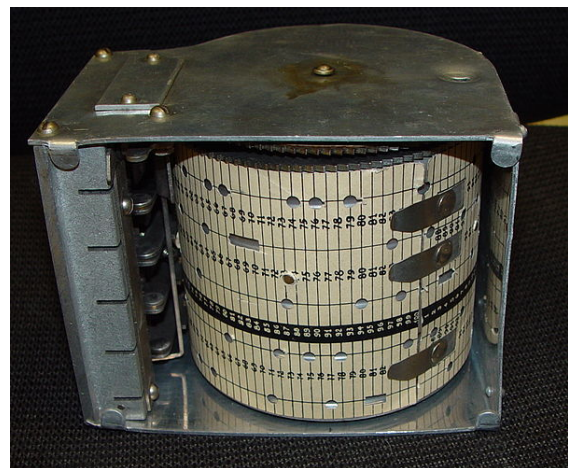
Pressey Testing Machine (interior)

15.2 Pre-1940s

- 1728: March 20, Boston Gazette contains an advertisement from Caleb Phillipps, "Teacher of the New Method of Short Hand," advising that any "Persons in the Country desirous to Learn this Art,

may by having the several Lessons sent weekly to them, be as perfectly instructed as those that live in Boston."[1]

- 1840: Isaac Pitman begins teaching shorthand, using Great Britain's Penny Post.[1]

- 1874: Institutionally sponsored distance education began in the United States in 1874 at the Illinois Wesleyan University.[1]

- 1890: International Correspondence Schools (ICS) is launched by newspaperman Thomas J. Foster in Scranton, Pennsylvania and becomes the world's largest study-at-home school.

- 1883: The Correspondence University of Ithaca, New York (a correspondence school) was founded in 1883.[1]

- 1892: The term "distance education" was first used in a University of Wisconsin–Madison catalog for the 1892 school year.[2]

- 1906–7: The University of Wisconsin–Extension[3] was founded, the first true distance learning institution.[4]

- 1909: *The Machine Stops* a short story by E. M. Forster, which describes an audio/visual communication network being used to deliver a lecture on Australian music to a remote audience.[5]

- 1920s: Sidney Pressey, an educational psychology professor at Ohio State University, develops the first "teaching machine."[6] This device offered drill and practice exercises, and multiple choice questions.

- 1929: M.E. LaZerte, Director of the School of Education, University of Alberta, developed a set of instructional devices for teaching and learning. For example, he "developed several devices and methods to minimize instructor/testor involvement, so as to increase the likelihood of gathering data in a consistent manner." One mechanical device that he developed was the "problem cylinder" which could present a problem to a student and check whether the steps to a solution given by the student were correct.[7]

15.3 1940s

1945

- Vannevar Bush describes a hypertext-like device called the "memex" in his article *As we may think*[8] in The Atlantic.

1948

- Norbert Wiener writes about human-machine communications in his landmark book "Cybernetics or Control and Communication in the Animal and the Machine" (MIT Press, 1948).

15.4 1950s

15.4.1 1953

- The University of Houston offers the first televised college credit classes via KUHT, the first public television station in the United States. The live telecasts ran from 13 to 15 hours each week, making up about 38% of the program schedule. Most courses aired at night so that students who worked during the day could watch them. By the mid-1960s, with about one-third of the station's programming devoted to education, more than 100,000 semester hours had been taught on KUHT.[9]

15.4.2 1953–1956

- B. F. Skinner develops "programmed instruction" [B.F. Skinner Foundation – Better Behavioral Science for a More Humane World] and an updated "teaching machine".[10][11]

15.4.3 1956

- Gordon Pask and Robin McKinnon-Wood develop SAKI, the first adaptive teaching system to go into commercial production. SAKI taught keyboard skills and it optimized the rate by which a trainee keyboard operator learned by making the difficulty level of the tasks contingent on the learner's performance. As the learner's performance improved the rate of teaching increased and instructional support was delayed.[12]

15.4.4 1956–1958

- Harvey White, a physics professor at U.C. Berkeley, produced 163 high school physics lessons at Pittsburgh's PBS station WQED that were broadcast into public schools in the area. Each 30 minute lesson was also filmed and subsequently distributed to dozens of educational/public television stations. In the academic year 1957–1958, White's television physics course was used in many thousands of public school classrooms across the nation in which over 100,000 students were enrolled. This course already made evident two important characteristics of distance education that carry over to contemporary online instruction: enormous economies of scale and

higher labor productivity of the classroom based teacher/tutor/facilitator.[13]

15.4.5 1957

- Frank Rosenblatt invented the "perceptron" in 1957 at the Cornell Aeronautical Laboratory in an attempt to understand human memory, learning, and cognitive processes.[14] This was the beginning of machine learning.

15.4.6 1958

- Charles Bourne and Douglas Engelbart publish an article in DATAMATION magazine that outlines the requirements of and a proposal for a National Technical Information Service for the USA.[15]

15.4.7 1959

- Rath, Anderson, and Brainerd reported a project using an IBM 650 to teach binary arithmetic to students.[16]

- The University of Chicago first produces Sunrise Semester, a series of courses delivered via broadcast television.[17]

15.5 1960s

15.5.1 1960

- PLATO (Programmed Logic for Automated Teaching Operations) system developed at the University of Illinois at Urbana-Champaign. One of the primary developers was Donald Bitzer. The rights to PLATO are now owned by PLATO Learning, which delivers managed course content over the Internet. The PLATO system featured multiple roles, including *students*, who could study assigned lessons and communicate with teachers through on-line notes, *instructors*, who could examine student progress data, as well as communicate and take lessons themselves, and *authors*, who could do all of the above, plus create new lessons. There was also a fourth type of user, called a *multiple*, which was used for demonstrations of the PLATO system.[18]

- Project Xanadu, the first known attempt at implementing a hypertext system, founded by Ted Nelson.

- Teaching Machines Inc, a group of psychologists produced a series of programmed learning texts. The texts were based on the work of B.F. Skinner, breaking complicated tasks to a one-step-at-a-time activity (terminal learning objectives). Grolier and

TMI marketed Min-Max (a teaching machine) with machine programs and programmed text books.[19]

15.5.2 1962

- Douglas Engelbart publishes his seminal work, "Augmenting Human Intellect: a conceptual framework".[20] In this paper, he proposes using computers to augment training. With his colleagues at the Stanford Research Institute, Engelbart started to develop a computer system to augment human abilities, including learning. The system was simply called the oNLine System (NLS), and it debuted in 1968.

- The initial concept of a global information network should be given to J.C.R. Licklider in his series of memos entitled "On-Line Man Computer Communication", written in August 1962. However, the actual development of the internet must be given to Lawrence G. Roberts of MIT.[21]

15.5.3 1963

- Ivan Sutherland develops Sketchpad, the first graphical user interface for a computer, and publishes a description of it in his PhD. dissertation at MIT.[22]

- The first computer for instruction is installed at Orange Coast College, California. The OCC program leads the way. Bernard Luskin serves as director of the first teacher education program funded by the Federal Government under the Educational Professions Development Act to train develop the national curriculum for data processing and train the first 100 teachers.

- A chapter in the Daily Express Science Annual, entitled Teaching Machines and Programmed Learning, describes interactive teaching machines and shows photos of a number of systems including *The Grundy Tutor*,[23] *The Auto Tutor* and the *Empirical Tutor*.[24] These electronic devices present frames of information followed by questions, and branch to other frames depending on the button pressed by the learner. The article states that the Auto Tutor was designed by Norman Crowder, an American psychologist. It describes a British machine, the Empirical Tutor thus: "In addition to the printed programme it can use film sequences, slide projectors, tape recorders or even real apparatus, which the student may use to help him to decide how to answer the question in the frame". The article also refers to a language teaching system developed by Professor Rand Morton of Michigan University. A science fiction story in the same Annual, by Brian Aldiss, predicts mobile learning, wearable computing,

brain–computer interfaces, the development of personal computing in the nineteen-seventies, and concern over global warming.[25][26]

- Douglas Engelbart invents the computer mouse, and a prototype is constructed by Bill English.[27] Engelbart was awarded a patent in 1970 for an improved version of the mouse.[28]

15.5.4   1964

- The first *authoring system* for developing lessons and courses on a computer system is produced. The "PLATO compiler" allowed the development of various forms of "teaching logic" for fields varying from mathematics to the behavioral sciences.[29]

- The Computer Assisted Instruction Laboratory is established at Pennsylvania State University, College of Education.[30]

- The Altoona Area School District in Pennsylvania began to use computers to instruct students.[30]

15.5.5   1965

- A five-year study of the impact of the PLATO system is published.[29] Here are some highlights: "The results of exploratory queuing studies show that the system could teach as many as a thousand students simultaneously, while still allowing each student to proceed through the material independently." The PLATO system had two different ways to teach – "tutorial logic" where the system presented facts and examples, and then asked questions on the materials presented, and "inquiry logic" where the student could request and organize appropriate information from the computer. The presentation of materials ("slide selector") was called an *electronic book*. The store of information in the system was called an *electronic blackboard*. PLATO had a sophisticated *help system*, whereby different types of wrong answers resulted in the student being sent different help sequences. A rudimentary *spell checker* was included in the system. A *comment page* allowed the student to comment on the lessons at any time. An *instructor page* allowed the instructor to communicate with the student. A "perfect workbook" recorded student responses to questions, as well as kept a *record of each button the student pushed* and the time at which he or she pushed it. These records were stored on magnetic tape for later *statistical analysis*.

- IBM, via its subsidiary Science Research Associates, Inc., introduces COURSEWRITER[31] for the IBM 1500,[32] an online interactive CAI system in the 1960s. The system included course management features and roles for the users such as instructor,

manager, and student, and allowed intercommunication among them. Stanford University participated in the research and development that predated the IBM 1500s release.

- Ted Nelson uses the terms "hypertext" and "hypermedia" in his paper Complex information processing: a file structure for the complex, the changing and the indeterminate.[33]

- Research in the field of computer-assisted instruction began in France at the universities in Paris, Grenoble and Toulouse.[34]

- The Department of Industrial and Vocational Education at the University of Alberta purchased a "Fabritek transistorized training computer" to teach students in electronics courses.[7]

15.5.6   1967

- The Division of Educational Research Services was formed at the University of Alberta, and this unit immediately acquired an electronic optical examination scoring machine, and an IBM magnetic tape typewriter. It shared an IBM 360/67 computer with the rest of the university, and used it mostly for statistical analysis.[7]

- The CAN (Completely Arbitrary Name) authoring language is developed by staff at the Ontario Institute for Studies in Education (OISE). "The initial design goal was to provide a lesson authoring language which could be used by classroom instructors with limited knowledge of computing."[35]

- The first CAI application is written in APL for the Faculty of Education at the University of Alberta. It consisted of an arithmetic drill program that "automatically adjusted its level of difficulty as a function of the student's rate of success".[7]

15.5.7   1968

- Telesecundaria a system based on satellite TV for secondary students in rural areas, was set up by the Mexican Government. Initially, over 6,500 students were served in 304 classrooms, each one equipped with a satellite dish and a black-and-white TV set. The system is still in use, but now reaches over a million students in 16,000 rural facilities in Mexico and several Central American countries.

- An IBM 1500 system was installed at the University of Alberta, where on-line courses included cardiology training for the University's medical school. This system was finally taken out of service on April 10, 1980, after twelve years of operation. University's medical school. This system was finally taken

out of service on April 10, 1980, after twelve years of operation. Over 20,000 people had used the system in that interval, and programming was available for 17 university courses. The instructional operating system of the IBM 1500 had a registration system, bookmarking, authoring, and progress reports all built-in.[7]

- Alan Kay, a graduate student at the University of UTAH, proposes the FLEX language. The FLEX Machine, a computer running the FLEX language is the first attempt to develop an object-oriented programming-based personal computer.[36]

- Douglas Engelbart and 17 of his colleagues demonstrate the new oNLine System (NLS) at the Fall Joint Computer Conference held at the Convention Center in San Francisco.[37]

- The MITRE Corporations begins development of their Time-shared, Interactive, Computer-Controlled, Information Television (TICCIT) system. It is described as a computer based system of instruction that is "low-cost, high quality education that is completely *individualized*."[38]

15.5.8   1969

- The US Department of Defense commissions ARPANET (and thus the Internet as we know it).[39]

- Stanford University broadcasts 12 Stanford engineering courses on two channels via the Stanford Instructional Television Network (SITN).[40]

- The first Associate Committee on Instructional Technology is formed at the National Research Council of Canada.[41]

- Karl L. Zinn published a report entitled "Comparative study of languages for programming interactive use of computers in instruction" – EDUCOM Research Memorandum RM-1469.[42]

- R. Allan Avner and Paul Tenczar publish a manual for TUTOR, the authoring language of the PLATO system.[43]

- The Language Information Network and Clearinghouse System (LINCS) Project of the Center for Linguistics at the National Science Foundation in Washington, DC was developed as a computerized information management system to facilitate the transfer of scientific information within the language science community.[44]

- Beginning of a seven-year project called Project Solo or Soloworks in Pittsburgh, USA. The group put out 33 newsletters over the course of the project. This is an early example of student controlled, individualized use of computers in education. The idea

of going "solo" was that the student was in charge of his or her own learning. However, the limitations of the approach were also recognized, and the group ended up proposing a "Community of Learning" model in 1976.[45]

- The Merit Computer Network interconnects the mainframe computers at three large universities – University of Michigan, Michigan State University, and Wayne State University. The Merit Network facilitated instructional uses of computing facilities among the three institutions.[46][47]

15.6   1970s

15.6.1   1970

- The Havering Computer Managed Learning System was developed in London, England. By 1980 it had been used by over 10,000 students and 100 teachers in applications that included science technology, remedial mathematics, career guidance, and industrial training.[48]

- Flanagan reports on Project Plan, where computers were used for learning management, though a student-centric model that integrated information on students past achievement, interests, etc. to develop an individualized plan of study which served to guide the learner through a series of Teacher Learning Units. This was implemented though a medium-sized computer and terminals in the schools.[49]

- Bernard Luskin received his PhD. in 1970. The title of his doctoral dissertation was *An Identification and Examination of Obstacles to the Development of Computer Assisted Instruction*, U.C.L.A. Luskin was an important pioneer and advocate for computers in higher education in California in the 1970s and 1980s.[50]

- California funded a two-year project to determine the potential needs of distance education in the future. Under the direction of Dr. Bernard Luskin, this consortium of all community and state colleges in California developed a broad plan of action, one that predicted many of the technological innovations we use today.[51]

- Computers first used in elementary schools in Saskatoon, Saskatchewan, Canada.[52]

- National Science Foundation (NSF) funded three initial projects for the study of "Natural Language Processing." These projects included the University of California, Irvine Physics Computer Development Project, headed by Alfred Bork and Research Assistant, Richard L. Ballard. The Mitre Ticcit Project conducted at the University of Texas, later

moved to Brigham Young University in Provo, Utah, and its sister project called the PLATO Project, was conducted at the University of Illinois, Champaign. Over 140 natural language dialog programs were created between 1970 and 1978. UCI's Physics Computer Development Project conducted approximately 55 educational programs and spearheaded development throughout the UC system. Initial projects were conducted on Teletype model 33, paper tape punch machine that operated at a 110 baud rate.[53]

15.6.2 1971

- The MITRE Corporation begins a year-long demonstration of the TICCIT system among Reston, Virginia cable television subscribers. Interactive television services included informational and educational demonstrations using a touch-tone telephone. The National Science Foundation refunds the PLATO project and funds MITRE's proposal to modify its TICCIT technology as a computer-assisted instruction (CAI) system to support English and algebra at community colleges. MITRE subcontracts instructional design and courseware authoring tasks to the University of Texas at Austin and Brigham Young University.

- Project EXTEND was set up in Michigan as a "small college consulting service for instructional computing."[54] It offered programming support and faculty development to those university instructors who wanted to get involved with computer-based instruction.[55]

- University of Delaware forms Project DELTA (Delaware Total Approach to Education). The project provides Computer Aided Instruction to high school students throughout Delaware utilizing instructional material served from a central DEC PDP-11/70.[56]

- Ivan Illich describes computer-based "learning webs" in his book *Deschooling Society*.[57] Among the features of his proposed system are

  - Reference Services to Educational Objects — which facilitate access to things or processes used for formal learning.

  - Skill Exchanges — which permit persons to list their skills, the conditions under which they are willing to serve as models for others who want to learn these skills, and the addresses at which they can be reached.

  - Peer-Matching — a communications network which permits persons to describe the learning activity in which they wish to engage, in the hope of finding a partner for the inquiry.

  - Reference Services to Educators-at-Large — who can be listed in a directory giving the addresses and self-descriptions of professionals, paraprofessionals, and free-lancers, along with conditions of access to their services.

15.6.3 1972

- Patrick Suppes, professor at Stanford University, developed computer-based courses in Logic and Set Theory that were offered to Stanford undergraduates from 1972 to 1992.[58]

- The Learning Research Group is formed at Xerox PARC in Palo Alto, California. It is led by Alan Kay, who advanced the idea of a graphical user interface (GUI) by inventing icons for folders, menus, and overlapping windows. Kay and his group envisioned a computer for teaching and learning that they called the "KiddiKomputer", to be programmed using the Smalltalk language they had developed. While Kay could see many educational uses for this computer, he had four initial projects in mind: 1) Teaching thinking skills, 2) Teaching modeling through the simulation of systems, 3) Teaching interface skills, and 4) Tracking what children would do with the computer outside school hours, when left to their own devices. Second level projects for teaching children with a computer included 1) Computer evaluation, 2) Iconic programming, especially for children under 8. Kay and his colleagues started teaching programming to children and adults in 1973.

- First Canadian Symposium on Instructional Technology held in Calgary, Alberta.[41]

- The Project Outreach Report is issued by the California Higher Education Commission. This report leads the way to legislation where public funds may be used for non-classroom based instruction and provides funds to produce the model telecourse, Contemporary California Issues, that is the course that serves as the model for modern distance learning programs. Project Outreach director was Bernard Luskin, Vice Chancellor, Coast Community Colleges.

15.6.4 1973

- The *National Development Program in Computer Assisted Learning* was set up in the UK in January, 1973.[59]

- A report written for the University of Michigan described the educational uses of computers at the university. These included "drill, skills practice,

programmed and dialog tutorials, testing and diagnosis, simulation, gaming, information processing, computation, problem solving, model construction, graphic display, the management of instructional resources, and the presentation and display of materials."[60]

- An integrated student information system at Trinity University in Texas maintained data on about 1,500 variables. These included all student academic and personal data, all faculty data that dealt with courses and teaching, all course data in regards to student, faculty and class meeting times and days, enrollments, buildings, and the college calendar and catalog. There was also "an interaction course management system".[61]

- As a post-doc at Carnegie-Mellon University, Jay Warner needed to teach undergraduate metallurgy students how to use new software that would calculate phase diagrams (graphical representations of metal states/phases as a function of composition and temperature) based on thermodynamic properties. He wrote a CAI (Computer-Assisted Instruction) module that, however crudely, used some of the principles discussed in this article. A frame, or paragraph of information, was presented, and the machine branched to different follow-up frames and questions depending on the response to the embedded questions. The whole thing was written in FORTRAN IV. It proved useful; students could then use the software without close attendance by the instructor. This work was in no way as dramatic as the other accomplishments of the day, however it does show that by this time CAL was not restricted to studies of learning methods.

15.6.5   1974

- Murray Turoff founded the Computerized Conferencing and Communications Center at New Jersey Institute of Technology (NJIT) and over the next 15 years conducts an immense amount of research on Computer-mediated communication (CMC) with Starr Roxanne Hiltz. Much of this is on its applicability to the "Virtual Classroom", including field trials in the 1980s. The specifications for EIES 2 are particularly seminal – note in particular the material on roles, resources and hypertext.[62]

- Launched in June 1974, *Creative Computing* was the first computer magazine for general readers and hobbyists. The Jan–Feb 1976 issue had an article on "Learning with Computer Games".

- An "international school" was held in a remote Italian resort to explore the state of the art of computer-assisted instruction (CAI). Direct connections with computers in Italy and the United States made it possible to demonstrate a variety of existing CAI systems. Papers describing the use of CAI in five sets of educational institutions were presented.[63]

15.6.6   1975

- The NSF-funded TICCIT Project begins testing English and algebra courseware at Northern Virginia Community College in Alexandria, Virginia, and at Phoenix College, part of the Maricopa County Community College District system in Phoenix, Arizona. The modified TICCIT system supports 128 student terminals made of modified television sets providing text and graphics in seven colors, digital audio, and a video switching device to embed video into the computer generated instruction. A specialized keyboard allows students to control their own progress through the courseware, which includes both tutorials, drills, and testing.[64] What is interesting about TICCIT is that it was based on a *learner controlled* command language that allowed the user to manipulate his or her own sequencing and development of learning strategies.[65]

- COMIT was a sophisticated system of computer-assisted instruction developed jointly by IBM and the University of Waterloo in Canada. It emphasized unique audiovisual capabilities of the television set and light pens. The project ran until 1978.[66]

- The Michigan Terminal System (MTS), a computer time-sharing operating system developed at the University of Michigan, included a program called CONFER developed by Robert Parnes that gave it the capabilities of computer conferencing.[67]

15.6.7   1976

- Edutech Project of Encinitas California (now Digital ChoreoGraphics of Newport Beach, CA) develops DOTTIE, a TV Set-Top device linking the home TV to online services such as CompuServ and The Source via a common household telephone.

- Development of the language Pop11 (derived from the Edinburgh AI language Pop2) and its teaching tools starts at the University of Sussex. This later evolved into Poplog.[68]

- Development of the KOM computer conferencing system begins at Stockholm University. See Jacob Palme's history of KOM

- First experimental developments at the Open University of what became the Cyclops system – then called a telewriting or audio-graphic system but nowadays would be called a whiteboard system –

under two separate teams in the Faculties of Mathematics (Read and Bacsich) and Technology (Pinches and Liddell) – the first team focusing on storage on cassette tape of digital data to drive VDUs, the second focusing on transmission of handwriting over telephone lines. There were similar developments under way in the US and France.[69]

- Coastline Community College, having no physical campus, became the first Virtual College in the United States. Distance learning pioneer Bernard Luskin is founding president.[70]

- Second Canadian Symposium on Instructional Technology held in Quebec City, Quebec.[41]

- Open University in the UK sets up the CICERO project with three courses taught online.[71]

- A report by Karl L. Zinn at the University of Michigan describes computer-based conferencing, computer-based seminars, computer-assisted curriculum development, computer-based committees, and computer-based proposal preparation.[72]

- Coastline Community College is launched as a college beyond walls. This is the first community college to be launched with no campus, centering on telecourses and community facilities. Founding president Bernard Luskin coins the slogan, "The community is the campus, the citizens are the students.

15.6.8   1977

- With the Canadian federal Department of Communications, TVOntario (TVO) pioneered the use of satellites for educational teleconferencing and direct-to-home transmission through the Hermes project. The experiment allowed students in California and Toronto to interact via electronic classrooms.[73]

- The Communications Research Center of the Canadian federal government's Department of Communications developed Telidon, a second generation videotext system that was used in field trials in several educational settings.[74]

- Digital Equipment Corporation (DEC) provides Computer-Aided Instruction (CAI) tutorials for its BASIC programming language on DEC PDP computers.

- At the UK Open University, the software and hardware teams developing telewriting systems merged to form the Cyclops project and gained funding, initially internally, later from UK government sources. There is little trace of Cyclops now on the Open University web site.[75]

15.6.9   1978

- Pathlore (as part of Legent Corp.) started developing CBT solutions. In 1995 it became divested from Legent. Its PHOENIX software delivered "virtual classrooms" to many corporate networks.[76] Pathlore was acquired by SumTotal Systems in 2005.[77]

- The National Science Foundation releases its evaluation of the MITRE TICCIT project demonstration, giving a mixed review of the success of using the computer-television system as the primary source of instruction for English and algebra.

- The Defense Research Institute in Sweden released the KOM computer conferencing system which (at its peak) had a thousand users[78]

15.6.10   1979

- Prestel, claimed by BT as "the world's first public viewdata service", was opened in London in September, running on a cluster of minicomputers. It had been conceived in the early 1970s by Samuel Fedida of the Post Office Research Laboratories at Dollis Hill, London. Similar developments were under way in France (Teletel) and Canada (Telidon). Only those active at the time will remember the sense of euphoria and opening of possibilities in what would now be called the e-business and e-learning worlds. (Sadly, the concept was premature, although in France it had most success.) A number of mainframe, minicomputer and even microcomputer based systems and services were later developed in educational circles of which perhaps the best known were OPTEL, Communitel, ECCTIS and NERIS.[79]

- In Canada, groups including TVOntario, Athabasca University, the University of Victoria, and the University of Waterloo participated in Telidon experiments during the late 70s and early 80s. Telidon, an alphageometric videotex information system used set-top boxes with TV sets, or subsequently software decoders running on PCs (Apple II, MAC, and PC decoders were available) to display text and graphics. The intent was to demonstrate and develop educational applications for videotex and teletext systems. This work continued until 1983, when the Telidon coding structure became a North American standard – ANSI T500 – NAPLPS (North American Presentation Layer Protocol Syntax).

- The Athabasca University educational Telidon project used a Unix path structure which allowed the storage of information pages in the file system tree. This is now the universal storage method for pages on the internet. As described, the system had the

ability to create separate user groups with different access privileges, and to implement "action scripts" to access system functions, including email and dynamic content generation. The AU system was described in Abell, R.A. "Implementation of a Telidon System Using UNIX File Structures" in Godfrey, D. and Chang, E. (eds) The Telidon Book, Reston Publishing Company, Reston, VA, 1981)

- An article by Karl L. Zinn in *Educational Technology* describes the uses of microcomputers at the University of Michigan. Uses included "word processing, extending laboratory experience, simulation, games, tutorial uses, and building skills in computing."[80]

15.7 1980s

15.7.1 1980

- Successmaker is a K–12 learning management system with an emphasis on reading, spelling and numeracy. According to the Pearson Digital Learning website, the South Colonie Central School District in Albany, New York "has been using SuccessMaker since 1980, and in 1997 the district upgraded the software to SuccessMaker version 5.5."

- The Open University begins a pilot trial of a viewdata (videotex) system OPTEL, on a DEC-20 mainframe. This had been conceived by Peter Zorkoczy even before the launch of the national Prestel system in 1979 and was locally specified and coded (in COBOL) by Peter Frogbrook (RIP) and Gyan Mathur. One of the main motivations was its applicability to online learning. It was available via dial-up from home, and later in the 1980s via telnet(!) on the X.25 and internet networks. There were individual user codes and passwords, giving different access rights; the one generic access code was regularly attacked by hackers even in these far-off days, as URLs still on the web attest. The system is overviewed in "Viewdata-Style Delivery Mechanisms for CAL", CAL Research Group Technical Report No. 11.

- Seymour Papert at MIT publishes "Mindstorms: children, computers, and powerful ideas". (New York: Basic Books). This book inspired a number of books and dissertations on "microworlds" and their impact on learning.[81]

- The idea of *managing teaching resources using a computer* is described in a paper by J.M. Leclerc and S. Normand from the University of Montreal. Their system was programmed in BASIC, and used a computer to track documents, human resources,

structured activities, and places for training and observation. Evaluation activities were also available in the system.[82]

- The University of Montreal offered CAFÉ, a computer system that taught written French. Graduated groups of questions were generated according to individual indicators. Students went through the system at their own pace.[83]

- TLM (The Learning Manager) was released in 1980 and included distinct roles for students, instructors, educational assistants, and administrators. The system could be accessed remotely by dial-up as a student or an instructor using a terminal emulator. The system had a sophisticated test bank capability and generated tests and practice activities based on a learning objective data structure. Instructors and students could communicate through the terminal. Instructors could lock out students or post messages. Originally called LMS (Learning Management System), TLM was used extensively at SAIT (Southern Alberta Institute of Technology) and Bow Valley College, both located in Calgary, Alberta, Canada.[84]

15.7.2 1981

- School of Management and Strategic Studies at the Western Behavioral Sciences Institute in La Jolla, California starts an online program.[85]

- University of Sussex, UK, implements Poplog, an interactive learning environment for AI and computing students. It includes hyperlinked teaching materials, an extensible text editor, multiple programming languages and interactive demonstrations of AI programs.[86]

Cyclops telewriting system, tutor's station

- Field trials begin of the Cyclops whiteboard system in the East Midlands Region of the Open University and run for two years. The evaluation was funded by

a grant from British Telecom and allowed the evaluation Director Tony Bates to employ Mike Sharples and David McConnell as research fellows. Audio-visual material for Cyclops was produced on the *Cyclops Studio* , a multimedia editing system coded in UCSD Pascal by a software team led by Paul Bacsich and including Mark Woodman. Cyclops was later awarded a BCS prize for innovation and systems installed in Indonesia. There are only passing references now to Cyclops on the open Web (see under names cited) – the best source of specifications and chronology is the article "Cyclops:shared-screen teleconferencing" in *The Role of Technology in Distance Education*, edited Tony Bates, Croom Helm, 1984.[87]

- Over this period the Open University was also developing its own viewdata (videotex) system, called OPTEL, for use in education. This had in fact started about the same time as Cyclops in yet another team at the OU. The project ran until about 1985 when it faded away, as did videotex generally across the world (except the Minitel in France). In addition to OPTEL, several other systems were implemented including VOS (Videotex Operating System) which allowed the display and manipulation of text files via videotex. VOS was further developed into a telesoftware, transactional (gateway) and email system and then used in a commercial development for IMS, the media research company (using a very early precursor of Web/CGI development). These were coded in Pascal and COBOL on the DEC-20 mainframe. Some of the ideas of OPTEL were taken over into the ECCTIS project delivering course data via viewdata from a Unisys mainframe – indeed one of the former OPTEL staff joined ECCTIS as Director. Systems were also specified to deliver Computer-Assisted Learning – see in particular the article "Viewdata systems" in *The Role of Technology in Distance Education*.[87] There are only fragmentary references now to OPTEL on the open Web.

- Allen Communication in Salt Lake City, Utah, introduced the first commercial interactive videodisc.[88]

- BITNET, founded by a consortium of US and Canadian universities, allowed universities to connect with each other for educational communications and e-mail. At its peak in 1991, it had over 500 organizations as members and over 3000 nodes. Its use declined as the World Wide Web grew.

- Alfred Bork wrote an article entitled *Information Retrieval in Education*, in which he identified the ways "computer-based techniques can be used for course management, direct learning, and research."[89]

15.7.3   1982

- The Computer Assisted Learning Center (CALC) founded as a small, offline computer-based, adult learning center. Origins of CALCampus

- Edutech Project of Encinitas California (now Digital ChoreoGraphics of Newport Beach, CA) implements PIES, an interactive online educational development and delivery system for the PILOT author language, using a client-server paradigm for online delivery of personalized courseware to students via popular video-game consoles and microcomputers. The system was used by Pepperdine University, Georgia Tech, San Diego County Department of Education, and Alaska Department of Education for distance learning.

- CET (later NCET and now Becta) publishes *Videotex in Education: A new technology briefing*, a 54-page booklet written by Vincent Thompson, Mike Brown and Chris Knowles. This is out of print and few copies are now available. (ISBN 0-86184-072-0)

- Hermann Maurer invents MUPID, an innovative videotex device later used widely in Austria. This starts a strand of development leading on to Hyper-G and a range of other developments.[90] See also the of Hyper-G.

- Carnegie Mellon University and IBM create the Information Technology Center which begins the Andrew Project at Carnegie Mellon. One of the primary goals of the project is to provide a platform for "computer-aided instruction" using a distributed workstation computing environment, authenticated access to both personal and public file spaces in a distributed file system (AFS), authoring tools for computer-based lessons, and collaboration tools including bulletin boards and electronic messaging.[91]

- Peter Smith of the UK Open University completes his PhD thesis (157 pp) on "Radiotext: an application of computer and communication systems in distance teaching". (Only one reference online.) It is believed that the work started in the late 1970s under the supervision of Peter Zorkcozy, who also conceived the OPTEL viewdata system. Radiotext denoted the transmission of data over radio signals, just as it can be sent over telephone lines. It may seem normal now, as in the Radio Data System (RDS) in these days of digital radio, but in the 1970s the concept was novel and complex for their colleagues to grasp.

15.7.4   1983

- McConnell, D. and Sharples, M. (1983). Distance teaching by Cyclops: an educational evaluation of

the Open University's telewriting system. British Journal of Educational Technology, 14(2), pp. 109–126. Paper describes the CYCLOPS system, developed at the Open University UK in the early 1980s, which provides multi-site tutoring through a shared whiteboard system providing voice conferencing combined with synchronous handwriting and real-time annotation of downloaded graphics. A more comprehensive set of six short papers describing Cyclops was published in *Media in Education and Development* vol. 16 no. 2, June 1983, pp. 58–74.

- Aregon International rewrote the Cyclops content authoring system as the Excom 100 Studio and created and produced the Excom 100 terminal, a commercial version of the Cyclops terminal incorporating lightpen, graphics tablet, and keyboard as input devices. Excom 100 was awarded the BCS IT award in the "Application" category for 1983. 03:20, 13 November 2010 (UTC)

- MIT announces a 5 year, Institute wide experiment to explore innovative uses of computers for teaching. This initiative is known as Project Athena.

- Fourth Canadian Symposium on Instructional Technology held in Winnipeg in October 1983.[92]

15.7.5   1984

- Asymetrix founded by Paul Allen (a colleague of Bill Gates). Asymetrix created ToolBook. Later it became Click2Learn and then merged with Docent to become SumTotal Systems which offers a complete Learning Management solution.[93]

- The Annenberg/CPB project (funded by the Annenberg Foundation) publishes *Electronic text and higher education: a summary of research findings and field experiences*, Report number 1 in their "Electronic Text Report Series". This reviews videotex and teletext experiences relevant to education in the US, UK and Canada. This document may help to counteract received wisdom that prior to the Web, US agencies did not undertake studies of the relevance of online systems to education.[94]

- In the Faculty Authoring Development Program and Courseware Authoring Tools Project at Stanford University (1984–1990s) several dozen teaching applications were created, including tutorials in economics, drama simulations, thermodynamics lessons, and historical and anthropological role-playing games.

- Article on "Computing at Carnegie-Mellon University" describes the benefits to students and faculty of a new project using networked personal computers set up by IBM and the university.

- Students and faculty at the University of Waterloo use IBM PCs networked together to do their work and to develop applications (a "JANET"). One PC acts as a server for files in the network.

- The OECD organized a conference in Paris, France on "Education and the New Information Technology."

- Antic (magazine) publishes a review of a cartridge for Atari home computers allowing Atari users to access courseware on the CDC PLATO system via modem.

- Computer Teaching Corporation (CTC) launched TenCORE which was the leading authoring language in the late 1980s. It was MS-DOS based. CTC also produced a network-based Computer Managed Instruction System which allowed users to take on the roles of author, student and administrator and to create and participate in a plurality of courses.[95]

- The Intercultural Learning Network created at UC, San Diego linked schools in Japan, Israel, Mexico, and California and Alaska in the U.S. in the first online Learning Circle. This effort was funded by an Apple "wheels for the MInd" grant.

- ComSubLant adopts an elearning program for use on all U.S. submarines to train crewmen at sea. It was developed by FTG1 Doner Caldwell at Submarine Group Six and ran on the Tektronix 4052A computer. The program utilized a lesson / test bank covering all submarine sonar publications on large format tape cartridge.

15.7.6   1985

- In 1985, the Graduate School of Computer and Information Sciences, at Nova Southeastern University, pioneers accredited graduate degrees through online courses,[96] awarding their first doctorate.

- In 1985, Patrick Suppes, professor at Stanford University, received a grant from the National Science Foundation to develop a first-year calculus course on computer. After several years of development and testing in summer camps, computer-based courses in Beginning Algebra, Intermediate Algebra, and Precalculus were created and tested during the 1991–92 academic year. In Fall 1992, after porting the software to the Windows operating system, the Education Program for Gifted Youth (EPGY) was formally launched at Stanford University, making these courses available to qualified students.[97]

- Project Athena at MIT, on the potential uses of advanced computer technology in the university

curriculum, has been underway for two years by this time, and about 60 educational development projects are in progress.[98]

- Daniel V. Klein develops UOLT, a Unix-based On Line aid to Training. This system features presentation of on-line courses and individualized testing and grading. Later renamed and published as "UBOAT – A Unix Based On-Line Aid to Tutorials", in the Proceedings of the European Unix User's Group, Dublin IRELAND, September 1987.[99]

- The SuperBook Project started at Bell Communications Research, Morristown, USA. The purpose of the project was to find new ways of navigating online books.[100] Jacob Nielsen commented online that "In 1990, Bell Communications Research's SuperBook project proved the benefits of integrating search results with navigation menus and other information space overviews."

- The decision is taken (at the CALITE 85 conference) to found ASCILITE, the Australian Society of Computers In Learning In Tertiary Education. (It took two more years for all details to be finalised.) See the history of ASCILITE. ASCILITE is the co-publisher of the Australasian Journal of Educational Technology (AJET).

15.7.7 1986

- Tony Bates publishes "Computer Assisted Learning or Communications: Which Way for Information Technology in Distance Education?", *Journal of Distance Education/ Revue de l'enseignement a distance*, reflecting (in 1986!) on ways forward for e-learning, based on 15 years of operational use of computer networks at the Open University and nine years of systematic R&D on CAL, viewdata/videotex, audio-graphic teleconferencing and computer conferencing. Many of the systems specification issues discussed later are rehearsed here.[101]

- Edward Barrett comes to MIT in the Program in Writing and Humanistic Studies. He becomes co-director of a group working on a distance learning project called the "Networked Educational Online System" (NEOS), a suite of programs for teaching writing and other subjects in specially designed electronic seminar rooms.[102]

- First version of LISTSERV is written by Eric Thomas, an engineering student in Paris, France. It was first used in the BITNET network for electronic mailing lists among universities.[103]

- Fifth Canadian Symposium on Instructional Technology held May 5–7 in Ottawa.[104]

- First version of CSILE installed on a small network of Cemcorp ICON computers at an elementary school in Toronto, Canada. CSILE included text and graphical notes authored by several kinds of users (students, teachers, others) with attributes such as comments and thinking types which reflect the role of the note in the author's thinking. Thinking types included "my theory", "new information", and "I need to understand". CSILE later evolved into Knowledge Forum.

- Intersystem Concepts, Inc., founded by Steven Okonski and Gary Dickelman, introduces the Summit Authoring System which includes student tracking and bookmarks plus instructor course management features. It is the first to bring streaming media to a virtual learning environment.

- Research Report 24, September 1986, published from the Computerized Conferencing and Communications Center, New Jersey Institute of Technology: 'The Virtual Classroom: Building the Foundations' Starr Roxanne Hiltz, Project Director, Research Report for the 1985-86 Academic Year, "Tools for the Enhancement and evaluation of a Virtual Classroom' includes chapters on research, software development, implementation issues, evaluation methods, student participation and outcomes, with brief descriptions of online courses offered at NJIT, Upsala College and The New School for Social Research.

- Bernard Luskin becomes founding president of Philips Interactive Media, the first large scale interactive media company making breakthroughs in digital CD.

15.7.8 1987

- In 1987, NKI Distance Education in Norway starts its first online distance education courses. The courses were provided through EKKO, NKI's self-developed Learning Management System(LMS). The experiences are described in the article *NKI Fjernundervisning: Two Decades of Online Sustainability* in Morten Flate Paulsen's book *Online Education and Learning Management Systems* which is available from the author via Campus NooA hb-jhgfkug;yucvlju,fvg;/.vgfluflj.b;'

- From this year until 1991 several UK groups of researchers associated in one way or another with the Open University, the UK Department for Industry (especially the Alvey programme, the transputer team and the Information Technology Consultancy Unit) and the emerging European Commission DELTA programme, carry out a mass of specification and prototyping work on "educational environments". Projects include the Thought

Box; the Learning Systems Reference Model; Portable Educational Tools Environment (joint OU, Harlequin and Chorus Systèmes); and Transputer-Based Communications-oriented Learning System. Among the non-OU co-workers were Chris Webb, Bill Olivier and Oleg Liber, all still active in e-learning. (No useful material left on the current public Web.)

- Authorware Inc.   is formed in Minneapolis/St. Paul. From initial prototypes developed on both mainframe and very early personal computers, a Macintosh-based authoring system called "Course of Action" is introduced; later a PC version is developed. Shortly after its introduction, the title of the authoring system is changed to match the name of the company. Authorware went on to become the first and most widely used industry-standard development tool.

- The Athena Writing Project at MIT publishes "Electronic Classroom: Specification for a user interface"[105]

- 1987, Glenn Jones of Jones Intercable in Denver, Colorado believed he saw a potential goldmine when he created a new system, called Mind Extension University in 1987. Jones created a system where telecourses could be provided across a network to various colleges and at the same time, students could interact with the instructors and each other, by using email, sent over the internet. Jones then began to beam the courses by satellite, so anyone with a satellite dish could watch the classes and if they had a computer and a phone line they could interact with the class.[106]

- A group of companies in Alberta, working with Alberta Government Telephones, create a pre-internet "whiteboard-like" audiographic teleconferencing system. Using PCs, specialized NAPLPS-based software, and audioconferencing bridges, the system shares graphics, text, and voice, for synchronous multipoint instructor/student student/student communication. The system was used by the Commonwealth of Learning in several locations around the globe, and was also used by Arctic College in Alaska for distance education. In some implementations, the students uploaded assignments to instructors for marking.

15.7.9   1988

- Probably the first large-scale use of computer conferencing in distance teaching when the Open University UK launched DT200 *Introduction to Information Technology* with 1000 students per year. The ur-evaluation by Robin Mason is a good description

– see Chapter 9 of *Mindweave* – Internet Archive Universidade Federal de Mato Grosso do Sul

- Edward Barrett and James Paradis publish a chapter entitled "The Online Environment and In-House Training" in Edward Barrett (Ed.) Text, *Con*Text, and HyperText (1988-MIT Press), that describes Project Athena as an Educational On-Line System (EOS).[107]

- Question Mark (see QuestionMark) introduces a DOS-based Assessment Management System. A Windows based version was introduced in 1993, and an internet version was introduced in 1995. See Questionmark's website.

- Utilizing colleague Stephen Wolfram's *Mathematica* computer algebra system, mathematics professors at the University of Illinois, Jerry Uhl and Horacio Porta along with Professor Bill Davis of The Ohio State University, develop Calculus&*Mathematica* and offer calculus courses at UIUC and OSU in computer labs.

- Peter Copen launches the New York State/Moscow Schools Telecommunications Project, linking 12 schools in New York State with 12 in Moscow in the former Soviet Union to demonstrate that students can learn better through direct interaction online and will become global citizens. This was the pilot project for what later became iEARN (International Education and Resource Network).

- Online Learning Circles (developed from the Intercultural Learning Network, UCSD as one of the first networks that connected classrooms from around the world in groups of 8–10 classrooms around themes) was offered on the AT&T Learning Network .

15.7.10   1989

- Tim Berners-Lee, then a young British engineer working at CERN in Switzerland, circulated a proposal for an in-house online document sharing system which he described as a "web of notes with links". After the proposal was grudgingly approved by his superiors, he called the new system the World Wide Web.[108]

- Chris Moore, Chief Technology Officer at THINQ Learning Solutions for many years, pioneered the TrainingServer learning management system for Syscom, Inc. Syscom was acquired by THINQ in 2000. THINQ was by Saba in 2005. Chris Moore has recently founded Zeroed-In Technologies.

- Lancaster University (UK) launches the MSc in Information Technology and Learning: now the world's longest continually running Masters programme taught using virtual learning methods (see

Goodyear, P (2005) The emergence of a networked learning community: lessons learned from research and practice, in Kearsley, G. (ed) Online learning, Englewood Cliffs NJ: Educational Technology Publications, 113–127.)

- The Calculus&*Mathematica* support team at the University of Illinois begin offering computerized calculus courses utilizing *Mathematica* over the internet to High School students in rural Illinois.

- John S. Quarterman published a 700+ page book, "The Matrix: Computer Networks and Conferencing Systems Worldwide" (Digital Press, 1989). This book provided detailed addressing protocols on how different computer networks could connect with each other for the purpose of exchanging information and holding discussions, and network maps of the developing Internet.

- Networked Educational Online System (NEOS) developed and deployed at MIT. The system provided coursework exchange between different roles allowing for grading, annotating, and public discussions. Nick Williams, William Cattey, "The Educational On-Line System", Proceedings of the EUUG Spring Conference, EUUG, (April 1990)

- Scardamalia, M., Bereiter, C., McLean, R. S., Swallow, J., & Woodruff, E. (1989). Computer supported intentional learning environments. Journal of Educational Computing Research, 5, 51–68. Paper discusses CSILE project and related software.

- The first release of Lotus Notes 1.0 is shipped. Release 1.0 includes functionality which is "revolutionary" for the time, including allowing system/server administrators to create a user mailbox, user records in a Name and Address database, and to notarize the user's ID file through dialog boxes. Also includes an electronic mail system with return receipt and notification features, and on-line help, "a feature not offered in many products at this time." Official history of Lotus Notes

- Publication of the book *Mindweave: Communication, Computers and Distance Education*, edited by Robin Mason and Anthony Kaye (published by Pergamon Press, Oxford, 273p). This was a hugely influential book on computer conferencing on which many of the leading experts of the time collaborated. In addition to descriptions of applications, there were several chapters describing or specifying systems, in particular the *Thought Box*. The book is available second-hand (e.g. via Amazon) but the full text (no images) is on the web.[109]

- The first public article specifying the *Thought Box* appears as Chapter 7 of *Mindweave*, written by Gary Alexander and Ches Lincoln. It is entitled

"The thought box: A computer-based communication system to support distance learning". Although the specification is couched in terms of a hardware device linked to a remote mail/resources server the article also describes the prototype work being done in HyperCard, and it could be argued that this software prototype had many of the features of a modern *Personal Learning Environment*. In fact, over the next few years, the HyperCard route was the way by which the ideas were advanced, eventually appearing in the XT001 online course in the early 1990s and in several other Open University courses.[110]

- The Athena Writing Project at MIT produces this publication: N. Hagan Heller, "Designing a User Interface for the Educational On-line System", Massachusetts Institute of Technology, Boston, MA, May 1989.

- Education 2010 is published. This 83-page booklet (published by Newman Software, ISBN 0-948048-04-2) arose out of an invitational conference at Bangor in July, 1989, with a brief to examine the possible role of IT in Education in the year 2010. With a few notable exceptions such as Stephen Heppell, few of the conference delegates are active now in e-learning – but it makes interesting reading.

- ECCTIS Limited was formed when it successfully completed in a closed tendering exercise for the ECCTIS online (viewdata) courses information service earlier run by the UK Open University. "ECCTIS" is one of the few names from the viewdata era of the 1980s to carry on till this day, even if somewhat changed. ECCTIS has a useful history page.

- Dr. John Sperling and Terri Hedegaard Bishop begin the University of Phoenix Online campus, based in San Francisco, California. It was the first private university venture to deliver complete academic degree programs (Master's and Bachelor's degrees) and services to a mass audience, via asynchronous online technologies. This early success is later documented in a paper written by Hedegaard-Bishop and Howard Garten (Professor at University of Dayton, Dayton, Ohio), "The Rise of Computer Conferencing Courses and Online Education: Challenges for Accreditation and Assessment" and published in a collection of Papers on Self-Study and Institutional Improvement by the North Central Association of Colleges and Schools, (1993) 137–145.

- F.C. Prasse and B.T. Hackett present at the 1989 Technology and Innovations in Training and Education (TITE) Conference on an operational distance education prototype fielded in 1987 using off-the-shelf RBBS software and featuring messaging, current issues, a multi-topic asynchronous threaded discussion format, as well as a searchable online reference database. Prasse, F.C. & Hackett, B.T. (1989).

Continuing education and problem solving using remote data terminals. In L. Wiekorst (Ed.), *Proceedings of the 1989 Conference on Technology and Innovations in Training and Education*, pp. 237–246. Atlanta, GA: American Defense Preparedness Association.

15.8   1990s

Main article: History of virtual learning environments in the 1990s

15.8.1   1991

- In datacloud|*Datacloud: Toward a New Theory of Online Work*, Johndan Johnson-Eilola describes a specific computer-supported collaboration space: The Smart Board, which was introduced in 1991. According to Johnson-Eilola, a "Smart Board system provides a 72-inch, rear projection, touchscreen, intelligent whiteboard surface for work" (79). In datacloud|*Datacloud*, Johnson-Eilola asserts that "[w]e are attempting to understand how users move within information spaces, how users can exist within information spaces rather than merely gaze at them, and how information spaces must be shared with others rather than being private, lived within rather than simply visited" (82). He explains how the Smart Board system offers an information space that allows his students to engage in active collaboration. He makes three distinct claims regarding the functionality of the technology: 1) The Smart Board allows users to work with large amounts of information, 2) It offers an information space that invites active collaboration, 3) The work produced is often "dynamic and contingent" (82).[111]

- Johnson-Eilola further explains that with the Smart Board "…information work becom[es] a bodied experience" (81). Users have the opportunity to engage with—inhabit—the technology by direct manipulation. Moreover, this space allows for more than one user; essentially, it invites multiple users.[111]

15.8.2   1992

- Philips Interactive Media, led by CEO Bernard Luskin, and Paramount Pictures, led by Eric Doctorow pioneer full motion video movies on CD. The first full motion video MPEG compression methods are developed and full motion video becomes available for all manner of digital programs.[112]

15.8.3   1994

- TeleEducation NB, a provincial distance learning network in the Canadian province of New Brunswick implemented a primitive DOS-based learning management system designed by Rory McGreal.[113]

15.8.4   1995

- Arnold Pizer and Michael Gage at the University of Rochester Department of Mathematics develop WeBWorK (a free Perl-based system for delivering individualized homework problems over the web) for use in mathematics instruction.[114]

- Steve Molyneux at University of Wolverhampton in the UK develops WOLF (Wolverhampton Online Learning Framework) one of the first e-Learning environments in the UK.[115]

- In 1995 Murray Goldberg at University of British Columbia began looking at the application of web-based systems to education and developed WebCT in early 1996.[116]

- In 1995 The University of Auckland Business School launched CECIL (computer supported learning or CSL) with students enrolled in February 1996. It's the University of Auckland's LMS & still operating.Cecil websiteCecil: The First Web-based LMS

- Jerrold Maddox, at Penn State University, taught a course, Commentary on Art, on the web starting in January 1995. It was the first course taught at a distance using the web.

- Neville Gordon-Carroll and Vaughn Taylor at Microsoft launched MOLI - Microsoft Online Institute - an online learning proof of concept built as a result of an intensive research project into the future of technology based learning. The desired outcome was a platform for self-directed learning at any time, from anywhere with content that was dynamically updated and immediately relevant. MOLI was initially developed by Microsoft on the MSN proprietary platform then rapidly migrated to the internet as Microsoft embraced the internet in mid 1995. Microsoft Online Institute was a simple hosted learning platform that was made available to private and public learning institutions to conduct and experiment with their own classrooms, content and instruction model. During this time Microsoft actively evangelized internet based learning to higher education institutions, learning content developers and traditional education companies. Despite initial resistance to this new learning model

several companies and institutions used MOLI as an experimental platform before launching their own offerings.

15.8.5 1996

- Glenn Jones, Chairman, and Bernard Luskin, founding chancellor of Jones International University launch Jones International University which becomes the first accredited fully web based university.[117]

15.8.6 1997

- In February 1997, Steven Narmontas, introduced a small group of faculty members of Western New England College to a software system he had worked on as a spare time project. Dubbed "The Manhattan Project", because it was largely developed in secret, the software enabled teachers to post files to a web site for their students to read. The earliest version of "Manhattan" also supported a few discussion groups and private messaging. Latter it will be the LMS "The Manhattan Virtual Classroom"[118]

- Neal Sample and Mark Arnold present "JavaScript for Simulation Education" at the NAU/web.97 conference (Flagstaff, Arizona, 12–15 June 1997). Their paper presents earlier work (pre-1997) on experiences presenting coursework over the Internet. At the same conference, other academics presented their work in the field of e-learning. A copy of the Sample/Arnold paper can be found here:[119]

- CourseInfo LLC founded by Dan Cane and Stephen Gilfus at Cornell University. http://www.news.cornell.edu/chronicle/97/10. 16.97/Web_company.html

Develops the "Interactive Learning Network" ILN 1.5, and installs it at several academic institutions including Cornell University, Yale Medical School and University of Pittsburgh. The ILN was the first e-learning system of its kind to leverage an install on top of a relational database MySqL.

- Blackboard Inc founded by Michael Chasen and Matt Pitinsky in Washington, DC.[120]

15.8.7 1998

- Ian D. Thompson at the University of Strathclyde creates version one of the SPIDER VLE system for the School of Pharmacy.

- Ian Reid at the University of South Australia creates version one of UniSAnet, its in-house virtual learning environment.[121]

- Coursepackets.com, founded by entrepreneur, and then UT student, Alan Blake, launches in the fall semester at the University of Texas at Austin. The company was the first to provide scanned, online versions of course-packets for students. Coursepackets.com changed its name to CourseNotes.com when it began offering expanded services in early 2000.

15.8.8 1999

- John Baker (entrepreneur) a student at the University of Waterloo creates version one of Desire2Learn learning system for faculty in engineering.

- Bernard Luskin pilots first course in media psychology at Fielding Graduate University leading to the first PhD program in media psychology.

15.9 2000s

15.9.1 2000

- January, 2000: CourseNotes.com, founded by entrepreneur, and then UT student, Alan Blake, launches in early 2000, with dozens of classes at the University of Texas at Austin. The service was marketed since the summer of 1999, and provides comprehensive professor web sites, including virtually all features offered by Blackboard (i.e., course documents, calendaring, grades, quizzes & surveys, announcements, etc.). The company was later renamed ClassMap and operational until early 2001.

- January 2000: Lamp and Goodwin of Deakin University publish "Using Computer Mediated Communications to Enhance the Teaching of Team Based Project Management" (conference presentation copyright 1999), an evaluation of a trial of FirstClass to teach project management at Deakin in 1998–99. It contains the memorable observation "There were some comments about features which students believed that FirstClass didn't have (eg email, chat sessions on demand) when, in fact, they were available facilities..."University Note also that there are several specifications of pre-2000 versions of FirstClass available (usually as PDF files at university sites) on the web.

- January 2000: [ILIAS], which has been developed at University of Cologne since 1997, has become open source software under the GPL (first release: ILIAS 1.6). Together with developers from other universities in Northrhine-Westfalia the ILIAS team founded the CampusSource initiative to promote the

development of open source LMS and other software for teaching at universities.

- April 2000: ePath Learning, established in 1999, launches the first online LMS, ePath Learning ASAP, making it affordable for businesses to create and manage online learning and training. Their vision is to make online learning accessible to everyone. (http://www.epathlearning.com/index.php/ epath-about-us/history.html).

- May, 2000: ArsDigita, a Boston Massachusetts based start-up who developed the Arsdigita Community System since their inception in 1997 deploys Caltech Portals at my.caltech.edu

Later that year in October 2000, deploy the ArsDigita Community Education System (ACES) at MIT Sloan School. The system is called Sloanspace.[122] The ArsDigita Community System as well as ACES in the next few years grow to OpenACS and .LRN

- May 1, 2000: Randy Graebner's master's thesis from MIT is published, Online Education Through Shared Resources.

- Mid June, Reda Athanasios, President of Convene International leaves the company to form Learning Technology Partners (which later buys Convene). Now that the Virtual classroom idea is well established, what is needed next is to build all the other supporting technologies to turn the Virtual Classroom to a Virtual Campus with SMS and e-commerce support, he claims. Learning Technology Partners seeks to build technologies to support the Virtual Classroom.

- June 30, 2000: Blackboard Inc. file a patent application relating to "Internet-based education support systems and methods". An international patent application (WO application 0101372) is filed on the same date. The applications claim priority from a provisional patent application filed June 30, 1999. A US patent is granted in 2006 (See below) and patent applications in Europe, Canada, Mexico and Australia are also pursued from the WO application.

- Blackboard Inc. acquires MadDuck Technologies LLC, developers of "Web Course in a Box".[123]

- ETUDES 2.5 is demonstrated in March at TechEd 2000 in Palm Springs, California. At or prior to this release, ETUDES included a number of features of VLEs, including course and role based access via login, electronic assignment submission, online assessment, and synchronous and asynchronous communications. The system is in use by a number of community colleges in California, including Foothill, Miracosta, and Las Positas.

- "The Political Economy of Online Education" (Onrain Kyouiku no Seijikeizaigaku) by Kimura Tadamasa was published in May, with the rubric "this book examines the role of secondary education in the new information society, from a variety of perspectives – sociology, psychology, and human resource management – using concrete examples of online education in educational environments." ISBN 4-7571-4017-7. NTT publishing. Tokyo. (Japanese).

- The MIT Sloan School of Management launches the first production version of ACES 3.4 with a pilot of 8 Fall 2000 classes.

- Northern Virginia Community College's Extended Learning Institute begins using Blackboard after having previously used a variety of other products for Internet-based course delivery, including Lotus Notes (1995), FirstClass (1996–1999), Serf (1997–1999), and Allaire Forums (1999ff.) for its engineering degree program and other courses ; NVCC also used WebBoard (1999) and Web Course in a Box (1998), prior to beginning its use of Blackboard.[124]

- In fall 2000 the open source LMS OLAT developed at University of Zurich won the MeDiDa-Prix for its paedagogical concept. It was optimized to support a blended learning concept.

- In May 2000, HEFCE, the Higher Education Funding Council for (universities in) England, commissions a comparative analysis of the main VLEs, as part of a series of studies for the imminent UK e-University. Over 40 specially created vendor submissions mostly delivered by 17 June 2000 are analysed by a team led by Paul Bacsich. A companion study analsyed what were then called Learning Administration Systems, in a team comprising Christopher Dean, Oleg Liber, Sandy Britain and Bill Olivier. Final reports were delivered in September 2000.

- Webster & Associates / Infosentials Ltd launches learningfast.com in first half of year. Complete course based assessment, with separate user and administrator logins. Users, on login, are provided with a list of courses that matches their subscription level. Subsequently sold to Monash University.

- In July, 2000, CyberLearning Labs, Inc. is founded. Its primary product, the ANGEL Learning Management System (LMS) evolved from research at Indiana University-Purdue University Indianapolis (IUPUI). The company will later change its name to ANGEL Learning, Inc.[125]

- A Manual for Students in Web-Based Courses: What do you do now that they have gone to the Web? was published online by Kent Norman at the

University of Maryland, College Park, Laboratory for Automation Psychology.

- The Claroline project was initiated in 2000 at the Catholic University of Louvain (Belgium) by Thomas De Praetere and was financially supported by the Louvain Foundation. Developed from teachers to teachers, Claroline is built over sound paedagogical principles allowing a large variety of paedagogical setup including widening of traditional classroom and online collaborative learning.

15.9.2 2001

- Technological Fluency Institute releases CAT1 (Computer Assessment and Tutorial) which assesses a persons technical abilities and offers help tutorials for participants.

- CourseWork.Version I (CW), a full-featured course management system, was developed at Stanford University's Academic Computing. CW supported multiple courses allowing multiple roles for users. CW's consisted of a set of tools for authoring and distributing course websites that inclued: a course homepage, announcements, syllabus, schedule, course materials, assignments (based on a 1998 version of CW), gradebook and assync discussion. This version was initially developed as part of the Open Knowledge Initiative, partially funded by the Andrew W. Mellon Foundation.

- Microsoft releases Microsoft Encarta Class Server (See Press Release)

- The Bodington system released as open source by the University of Leeds, UK

- Moodle is published via CVS by Martin Dougiamas to early testers The announcement is here.

- LON-CAPA is first used in courses at Michigan State University.[126]

- version 2.0 of COSE is launched after further funding from the Jisc

- Murray Goldberg (founder of WebCT) and others start a company called Silicon Chalk.[116] Silicon Chalk builds software for the classroom to be used in laptop learning environments. Examples of features include presentation and audio beaming to student laptops, student note taking, student polling, student questions, control of student applications, recording of entire lecture experience for archiving, searching and later replay, etc. Silicon Chalk gains a dedicated usership of approximately 70 institutions but never achieves profitability. It is sold to Horizon Wimba in 2005.

- The MIT Sloan School of Management adopts ACES 3.4 (internally named SloanSpace) as their course management system.

- Brandon Hall publishes an article in ASTD's "Learning Circuits", entitled LMS 2001. It lists 59 learning management systems available that year.

- Thinking Cap, the first XML LMS / LCMS launched. Separation of content from presentation allows for single source creation of training content.

- ILIAS 2.0 released in August.[127]

- PTT launches the first commercial version of its Trainee Records Management System (TRMS).

- August 2001: the Pedagogy Group of the UK e-University (UKeU) started work on development of what eventually became (in 2003) the UKeU learning environment. An "e-University Functional Model" was created in October 2001 but specification work continued well into 2002. See the UKeU Overview, especially Section 3, for a description of the early days of UKeU.

- December 2001: The open-source course management system spotter is released.

15.9.3 2002

- Microsoft release Class Server 3.0 on June 6 Press release

- ATutor first public open source release in December ATutor Release News[128]

- Moodle version 1.0 is released in August[129]

- Fle3 version 1.0 released in February – the first open source version of FLE software

- The MIT Sloan School of Management migrates ACES to OpenACS 4.0, thereby creating the first instance of .LRN (1.0).[130]

- The Centre for Applied Research in Educational Technologies at the University of Cambridge deploys CamCommunities, an open-source community system (OpenACS) based on .LRN, for use on campus.Sakai VRE for Education Research, a project funded by the JISC's.[131]

- In July, Reda Athanasios of Learning Technology Partners buys his old company Convene and instantly gains two data centers and IZIO the Learning Platform developed in Stanford and purchased later by Convene.

- Start of the OLAT rebuilt project. The goal of the project was to rebuild the LAMP-based LMS on a scalable, safe and fast Java EE-based architecture that supports campus-wide e-learning.[132]

- The first PhD program in Media Psychology is launched at Fielding Graduate University by Bernard Luskin. This major step brings attention and expertise to the growing realization that a greater understanding of human behavior is necessary for improved learning systems in the future.

- ILIAS open source team starts to redesign the system and to develop ILIAS 3.

- November 2002: OpenText announce the acquisition of Centrinity, the then owners of FirstClass – see the

- December 2002: ACODE, the Australasian Council on Open, Distance and E-Learning, continues under a new name the work of a series of earlier organisations originating with NCODE in 1993. See the history of ACODE.

- Bernard Luskin launches first PhD program in media psychology at Fielding Graduate University.

15.9.4 2003

- LON-CAPA version 1.0 released in August (in use at 12 universities, 2 community colleges and 8 high schools)

- December 2003: Serco Group acquires Teknical, the VLE company spun out of the University of Lincoln.

- Early in the year WebCT announces over 6 million students users and 40,000 instructor users teaching 150,000 courses per year at 1,350 institutions in 55 countries.[133]

- LogiCampus released its first open source edition in November 2003 on sourceforge.net. LogiCampus news release archive

15.9.5 2004

- The Sakai Project founded, promising to develop an open source Collaboration and Learning Environment for the needs of higher education.[134]

- Public release of Dokeos open-source VLE, which is a fork of Claroline.[135]

- OLAT 3.0 released. This is the first OLAT release that is entirely written in Java as a result of the OLAT rebuild project initiated in 2002.

- First stable ILIAS 3 release published in June..

- In July ILIAS is certified officially by ADL CO-Lab as SCORM 1.2 compliant. ILIAS is the first free software LMS that reaches the maximum conformance level LMS-RTE3.[136]

- University of South Africa (Unisa) and Technikon South Africa (TSA) merged on 1 January 2004. The functionality of their two in-house developed CMSs (Unisa SOL and TSA COOL) was combined into a new system called "*my*Unisa" . *my*Unisa is built within the Sakai framework. The new *my*Unisa infrastructure was launched on 9 January 2006. By August 2006 *my*Unisa was one of the largest installs of Sakai with more than 110 000 students.

- October: Murray Goldberg, the inventor of WebCT, and still an adjunct professor at the University of British Columbia, wins this year's EnCana Principal Award from the Ernest C. Manning Awards Foundation.[116] The award, with a cash prize of $100,000, is given each year to a Canadian innovator. The press release perhaps comes closest to being a brief official history of WebCT from the University point of view.[137]∗ Roger Boshier releases an irreverent history of e-learning in British Columbia, covering WebCT and many lesser-known developments. The file date is 2004 but the chronology stops just before 2000. See *A Chronology of Technological Triumph, Zealotry and Utopianism in B.C. Education*. An earlier (1999) version of this with the title addition of *Leaping Fords and Conquering Mountains* is also available.

- The American National Standards Institute, International Committee for Information Technology Standards (ANSI/INCITS) adopts the Sandhu, Ferraiolo, Kuhn RBAC (Role-Based Access Control) NIST "unified model" proposal as an industry consensus standard (INCITS 359:2004). A page is prepared (date uncertain) detailing the history of Role-Based Access Control from the Ferrailo and Kuhn paper in 1992 up to the date of the standard.

- eLML started as a spin-off from the Gitta project.[138]

15.9.6 2005

- Microsoft release Microsoft Class Server 4.0 on 27 January (See Press release).

- OLAT 4.0 was introduced with many new features like the integration of XMPP, RSS, SCORM and an extension framework that allows adding code by configuration and without the need to patch the original code set.

- January 2005: EADTU – the European Association of Distance Teaching Universities – launches the "Excellence" project, with the support of the eLearning Programme of the European Commission (DG Education and Culture), to set a standard for quality in e-learning. The project is a cooperation between 13 "significant partners" in the European scene of

higher education e-learning together with quality assessment and accreditation.[139]

- March 2005: The New Zealand Ministry of Education authorises release of a report describing (in anonymised terms) the benchmarking of e-learning, covering most university-level institutions in the country. The Report on the E-Learning Maturity Model Evaluation of the New Zealand Tertiary Sector weighs in at a hefty 12 MB.

- April 28, 2005: Blackboard are granted AU 780938B based on their international patent application filed in 2000. The granted claims are similar to the claims later granted in the US (See below).

- June 2005: Janice Smith (Jan Smith) publishes "From flowers to palms: 40 years of policy for online learning" [in the UK], *ALT-J, Research in Learning Technology*, vol. 13 no. 2 pp. 93–108 – with a particularly useful chronology on page 95. As the ALT-J editor Jane Seale notes, "the purpose of the review is to make sense of the current position in which the field finds itself, and to highlight lessons that can be learned from the implementation of previous policies".

- July 2005: Dorian James Rutter finishes a long-awaited PhD thesis *From Diversity to Convergence: British Computer Networks and the Internet, 1970-1995* (prelims+464 pages). This covers in particular the early history of viewdata and online services with a whole chapter on Prestel. (http://eprints.dcs.warwick.ac.uk/1692)

- July 2005: The European Foundation for Quality in eLearning is launched, initially funded by the EU Triangle project.[140]

- September 2005: The Higher Education Academy announced the UK Higher Education e-Learning Benchmarking Exercise and Pathfinder Programme during a joint Academy/Jisc session at ALT-C 2005. The initial announcement was followed by a call to the sector for Expressions of Interest to participate in the e-learning benchmarking exercise (e-benchmarking). A consultative Town Meeting was also held at the Academy, York in November 2005. (The pilot phase of the e-Learning Benchmarking Exercise commenced in January 2006.)

- October 13, 2005: Blackboard files patent #7,493,396, requiring that a single user be allowed to have multiple roles, and that the list of course links provided after login vary depending on the user's role for each course.

- O'Reilly Mediapurchases Useractive, inc. and starts O'Reilly Learning (which eventually become The O'Reilly School of Technology), which creates online learning courses in programming and system

administration skills. This enterprise is the first full-scale effort to expand the use of the useractive constructivist model of learning on the internet.

- NACON Consulting, LLC. pioneers its distance education system, "VirtualOnDemand", designed to train users on real software using virtual machines, with the only user component needed being a web browser. The Army initiates a pilot program and uses this system to train IT support personnel in various network security software. NACON also releases a stand-alone virtual training appliance.

- Boston University launches the first online doctoral program in music education, which within two years admits nearly 350 students.[141]

- KEWL.nextgen started up in PHP.

15.9.7   2006

- The Virtual Learning Environment SCOLAS-TANCE is now available in its English version VLE Scolastance

- 17 January 2006: Blackboard is granted US 6988138 relating to "Internet-based education support systems" claiming priority from its provisional patent application of 30 June 1999 (among others). The claims require that a series of educational courses stored on a server be accessible by different users from different computers. Users can access multiple courses and can have different access privileges for files relating to each course based on course-specific roles of student, instructor, and/or administrator.

- 14 February 2006: Indiana University awarded the service mark Oncourse from the United States Patent and Trademark Office (Reg. No. 3,058,558). FOR: EDUCATIONAL SERVICES, NAMELY, PROVIDING AN ONLINE COURSE MANAGEMENT SYSTEM FOR TEACHERS AND STUDENTS, IN CLASS 41 (U.S. CLS. 100, 101, AND 107). FIRST USE: 1-3-1998; IN COMMERCE 1-3-1998.

- 28 February 2006: Merger of WebCT into the Blackboard company. Both WebCT and Blackboard VLEs continue to exist as separate software. (See press release)

- 26 July 2006: Blackboard files a complaint for patent infringement against Desire2Learn under its US patent. Blackboard tells the Chronicle of Higher Ed. that it will not go after Moodle and Sakai.

- August: WBTSystems, which has been an independent VLE developer in Ireland since 1994, is acquired by

- October: OLAT 5.0 has been released which brings a comprehensive full text search service to the systems core. The addition of a calendar and wiki component stresses the emphasis of a collaborative environment. AJAX and web 2.0 technologies are controllable by users.

- On August 9, 2006, a complaint was filed against Blackboard by Portaschool of Atlanta, GA in the United States District Court of the Northern District of Georgia for deceptive business practices, and knowingly and willingly misrepresenting themselves in a patent application.

15.9.8   2007

- On January 7, Microsoft released the Sharepoint Learning Kit. The software is SCORM 2004 certified and is used in conjunction with Microsoft Office Sharepoint Server to provide LMS functionality.

- On January 25, it was announced that the Software Freedom Law Center was successful in its request that the United States Patent and Trademark Office re-examine the e-learning patent owned by Blackboard Inc. The request was filed in November 2006 on the behalf of Sakai, Moodle, and ATutor. The Patent Office found that prior art cited in SFLC's request raises "a substantial new question of patentability" regarding all 44 claims of Blackboard's patent. Groklaw, a website that tracks legal issues generally related to Open Source software, has the press release: Groklaw.org

- February 1, Blackboard announced via press release "The Blackboard Patent Pledge". In this pledge to the open source and do-it-yourself course management community, the company vows to forever refrain from asserting its patent rights against open-source developers, except where it is deemed necessary.[142]

- February: Technological Fluency Institute releases a Windows XP version of its online prescriptive diagnostic performance based CAT1 program.

- March 7: The OLAT team releases OLAT 5.1 which has an emphasis on consolidation of features and bugfixing. Besides this a new glossary function has been added and accessibility has been improved.

- July: Michigan Virtual University launches a learning management system from Meridian Knowledge Solutions to deliver training to 150,000 Michigan public-school teachers and administrators and foster collaboration among these learners via online collaboration spaces.[143]

- August: The MIT Sloan School of Management replaces ACES (internally named SloanSpace) with Stellar as its course management system and Microsoft SharePoint to manage administrative content.[144] At the 2007 MIT Sloan Talent Show, an MBA student protests SloanSpace with a song titled "I Can't Find It In SloanSpace" to the tune of Garth Brooks' "Friends in Low Places".

- September: xTrain LLP.[145] launches first of its kind, (ODT) On Demand Training on the Internet. Users have access to high quality video training with social network communities, leading experts and portfolio reviews and certifications.

- September: Epignosis[146] releases its web2.0 virtual learning environment (eFront) as Open-Source software.

- October 18: Controlearning s.a. and ocitel s.a. designed and developed Campus VirtualOnline, (CVO), a platform where mixed e-learning content, e-books, e-money, e-docs, e-talents is found in a single place.

15.9.9   2010

- January 18, 2010: Public release of Chamilo open-source VLE, which is a fork of Dokeos.[147]

- September 28, 2010: Public major release of OLAT 7. New features are the implementation of important standards like REST API, IMS Global Basic LTI, IMS QTI 2.1[148]

- Large LMS providers start to dive into the talent management systems market, possibly starting a global tendency to do more with the information about LMS users

  - September 2010: SumTotal acquires Softscape

  - September 2010: Taleo acquires Learn.com

15.9.10   2011

- Comcept Pvt Ltd Releases Teletaleem a Live Classroom service

15.10   See also

- E-Learning

- History of automated adaptive instruction in computer applications

- History of personal learning environments

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15.12   Further reading

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- Course Management System comparison from Edu-Tools.info

- Visual history of company consolidation in the LMS space

- Jensen, Bob, History and Future of Course Authoring Technologies, Trinity University

- trinity.edu U.S. and International training and education alternatives

- trinity.edu Bob Jensen's Other History and Learning Technology Documents and Links

- A Personal History of CMC (Computer Conferencing) from 1972 to 1998 by Jacob Palme

- The evolution of an LMS: Cecil fifteen years on

Chapter 16

Moodle

Moodle is a highly flexible, free software, open source learning platform.[3][4] With comprehensive, customizable and secure learning management features, it can be used to create a private website for dynamic online courses. Moodle (acronym for *modular object-oriented dynamic learning environment*), (stylized in lower-case as **moodle**) is a also known as a learning management system, or virtual learning environment. The platform can be used for e-learning projects in University, Corporate training, School and Other sectors.

Moodle was originally developed by Martin Dougiamas to help educators create online courses with a focus on interaction and collaborative construction of content, and is in continual evolution. The first version of Moodle was released on 20 August 2002. Nowadays Moodle is built by the Moodle project which is led and coordinated by Moodle HQ, an Australian company of 30 developers which is financially supported by a network of 60 Moodle Partner service companies worldwide.

16.1 Overview

Moodle is a learning platform that enhances the existing learning environment.[5] As an E-learning tool, Moodle has a wide range of standard and innovative features such as calendar and Gradebook. Moodle is a leading Virtual learning environment [6] and can be used in many types of environments such as education, training and development and business settings.[7][8]

16.1.1 Activities

These are groups of features within Moodle, usually completed by a student to interact with other students, or with the teacher.[9]

- Assignment submission[10]

- Forum for discussion [11]

- Chat for instant messages [12]

- Database as a bank of record entries [13]

- Glossary, list of definitions [14]

- Survey, for gathering data from students[15]

- Online quiz[16]

- Wiki module[17]

- Gamification[18]

16.1.2 Plugins

Plugins are a flexible tool set, allowing Moodle users to extend the features of the site. There are hundreds of plugins for Moodle, extending the features of Moodle's core functionality. Each plugin is maintained in the Moodle plugins directory.[19] Moodle's infrastructure supports many types of plug-ins. Many freely available third-party Moodle plugins make use of this infrastructure.[20] Moodle users can use PHP to write and contribute new modules. Moodle's development has been assisted by the work of open source programmers.[21] This has contributed towards its rapid development and rapid bug fixes. By default Moodle includes the TCPDF library that allows the generation of PDF documents from pages.

16.1.3 Themes

Graphical themes for Moodle can be installed to change the look and functionality of a Moodle site or individual course. Many Moodle themes are available directly from Moodle downloads site,[22] ranging from BigBlueButton to Attendance.

16.1.4 Translations

Moodle has been translated in over 100 languages, available for any site administrator to install.[23] Each language pack is maintained and contributed by people all over the globe.[24]

16.1.5   Mobile

Many Moodle themes are based on Responsive web design and allow Moodle to be used easily on Mobile devices. A Moodle Mobile app is available in Google Play,[25] App Store (iOS),[26] and the Windows Phone Store [27]

16.2   Elearning standards compliance

Moodle has adopted a number of elearning standards.

Sharable Content Object Reference Model (SCORM) is a collection of elearning standards and specifications that define communications between client side content and a server side learning management system, as well as how externally authored content should be packaged in order to integrate with the LMS effectively. There are two versions: SCORM 1.2 and SCORM 2004. Moodle is SCORM 1.2 compliant, and passes all the tests in the ADL Conformance test suite 1.2.7 for SCORM 1.2. SCORM 2004 is not supported in Moodle, however Rustici Software have a Moodle plugin which can turn any Moodle site into a fully compliant SCORM 2004 LMS. [28]

The AICC HACP standard for CMI was developed by the Aviation Industry Computer-Based Training Committee (AICC) and is used to call externally authored content and assessment packages. AICC content packages are supported in Moodle 2.1 and later versions.

Experience API, also known as xAPI and previously referred to as Tin Can API, was finalised in 2014 as a successor to SCORM. Moodle is an early adopter of the xAPI standard via community-built plugins for launching xAPI activities from a Moodle course [29] and exporting quiz results as xAPI statements. There is an ongoing community discussion about whether xAPI compliance should be built into Moodle core.

IMS Content Packages can also be imported into Moodle. In addition, Moodle Book activities can be exported as IMS Content Packages. [30]

Learning Tools Interoperability (LTI) is a standard way of integrating rich learning applications (often remotely hosted and provided through third-party services) with educational platforms. Moodle uses the External Tool activity to act as an 'LTI consumer' as standard, and will act as an 'LTI provider' using a plugin. [31]

16.3   Deployment

Users can download[32] and install Moodle on a Web server, such as Apache HTTP Server, and a number of database management systems, such as PostgreSQL, are supported. Pre-built combinations of Moodle with a Web server and database are available for Microsoft Windows and Macintosh. Other automated installation approaches exist, such as installing a Debian package, deploying a ready-to-use TurnKey Moodle appliance,[33] using the Bitnami installer, or using a "one-click install" service such as Installatron.[34]

Some free Moodle hosting providers allow educators to create Moodle-based online classes without installation or server knowledge. Certified Moodle Partners[35] provide other Moodle services, including hosting, training, customization and content development. This network of providers support development of the Moodle project through royalties.[36]

16.4   Interoperability

Moodle runs without modification on Unix, Linux, FreeBSD, Windows, Mac OS X, NetWare and any other systems that support PHP and a database, including most webhost providers.

Data goes in a single database. Moodle version 1.6 could use MySQL or PostgreSQL. Version 1.7, released November 2006, makes full use of database abstraction so that installers can choose one from many types of database servers such as Oracle and Microsoft SQL Server.

Electronic e-learning systems can have many dimensions of interoperability. Moodle's interoperability features include:

- authentication, using LDAP, Shibboleth, or various other standard methods (e.g. IMAP)

- enrollment, using IMS Enterprise among other standard methods, or by direct interaction with an external database

- quizzes and quiz questions, allowing import/export in a number of formats: GIFT (moodle's own format), IMS QTI, XML and XHTML *(NB although export works very well, import is currently not complete)*. Moodle provides various types of questions: calculated, description, essay, matching, embedded answers, multiple choice, short answer, numerical, random short answer matching, true/false.

- resources, using IMS Content Packaging, SCORM, AICC (CBT), LAMS

- integration with other Content Management Systems such as Drupal, Joomla or Postnuke (via third-party extensions)

- syndication, using RSS or Atom newsfeeds; external newsfeeds can be displayed in a course, and forums, blogs, and other features can be made available to others as newsfeeds.

Moodle also has import features for use with other specific systems, such as importing quizzes or entire courses from Blackboard or WebCT. However, these import tools are not perfect. As of February 2010, Moodle will not import Blackboard courses, apparently due to changes in php code-releases. Some available utilities help convert Blackboard courses to a Moodle-friendly format.[37]

In March 2012 Blackboard acquired two companies based on Moodle's software including Baltimore-based Moodlerooms Inc. and NetSpot of Adelaide, Australia.[38] The Red Hat site, Opensource.com, reports that Moodle will always be an open source project, with clear delineation between Blackboard and Moodle[39]

16.5 Background

16.5.1 Origins

Martin Dougiamas, who has graduate degrees in computer science and education, wrote the first version of Moodle. Dougiamas started a Ph.D. to examine "the use of open source software to support a social constructionist epistemology of teaching and learning within Internet-based communities of reflective inquiry." Although how exactly social constructionism makes Moodle different from other eLearning platforms is difficult to show, it has been cited as an important factor by Moodle adopters.[40][41] Other Moodle adopters, such as the Open University in the UK, have pointed out that Learning Management Systems can equally be seen as "relatively pedagogy-neutral".[42]

16.5.2 Pedagogical approach

The stated philosophy of Moodle[43] includes a constructivist and social constructionist approach to education, emphasizing that learners (and not just teachers) can contribute to the educational experience. Using these pedagogical principles, Moodle provides a flexible environment for learning communities.[44]

16.5.3 Origin of name

The acronym *Moodle* stands for *modular object-oriented dynamic learning environment.* (In the early years the "m" stood for "Martin's", named after Martin Dougiamas, the original developer). As well as being an acronym, the name was chosen because of the dictionary definition of Moodle[45] and to correspond to an available domain name.[46]

"Moodle" is a trademark in many countries around the world registered to Martin Dougiamas. Only certified Moodle Partners may legally use the trademark to ad-

vertise any Moodle-related services such as hosting, customization, training and so on.

16.6 Moodle statistics and market share

By 31 August 2011:

- Moodle had a user-base of 55,110 registered sites with 44,966,541 users in 4,763,446 courses in 214 countries and in more than 75 languages.[47]

- The site with the most users, moodle.org, has 66 courses and 1,090,234 users. Following a £5 million investment in 2005, The Open University, UK is the second-largest Moodle deployment by user-base, with 714,310 users and 6,093 courses. A comprehensive list of the top ten Moodle sites (by courses and by users) is maintained at moodle.org.[48]

By 31 August 2014:

- Moodle had a user-base of 88,070 registered sites with 76,675,352 users in 8,324,096 courses in 241 countries.[47]

You can find the updated statistics at: https://moodle.net/stats/

16.7 Development

Moodle has continued to evolve since 1999 (since 2001 with the current architecture). Major improvements in accessibility and display flexibility were developed in 1.5. The current version can be seen at the top of the table of releases, below. It has been translated into 82 different languages and is accessible in many countries worldwide.

Not having to pay license fees or to limit growth, an institution can add as many Moodle servers as needed. The Open University of the UK currently uses a Moodle installation for their 200,000 users [49] while the UK government uses a Moodle installation for their Civil Service Learning platform serving half a million employees.

It is often known for individual departments of institutions to use the unlimited feature, such as the maths department of the University of York.

The development of Moodle continues as a free software project supported by a team of programmers and an international user community, drawing upon contributions posted to the online Moodle Community website that encourages debate and invites criticism.

Users can freely distribute and modify the software under the terms of the GNU General Public License version 3 or any later version.[2]

Because Moodle is an open source software, it can be customized to fit the needs of e-learning projects for University, Corporate training, School and Other sectors.

16.8   Services Providers

There are many vendors that offers Moodle services. A complete list of Moodle Certified Service Providers (Moodle Partners) can be found at http://www.moodle.com.

16.8.1   Releases

16.9   Certification

Since 2006 there has been an official certification available for teachers using Moodle. Initially called the Moodle Teacher Certificate (MTC), this was renamed in 2008 to the Moodle Course Creator Certificate (MCCC). MCCC is available only through Moodle Partners, and through Central Certification Services. Discussion is ongoing regarding an official Moodle Administrators Certificate.

16.10   Moodle conferences

A MoodleMoot is a conference for Moodle community member, held to learn about Moodle, share experiences of the learning platform, discuss research in related educational technologies and contribute ideas to future Moodle development.[51] Held around the world, MoodleMoots are organised by a university, Moodle Partner, Moodle associations and Moodle HQ.[52]

Moodle Calendar[53] has announcements of MoodleMoots.

16.11   See also

- Educational technology

- Student Information System

- Learning management system

- List of applications with iCalendar support

- Online learning community

- List of free and open-source software packages

16.12   References

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[7] "E-learning". http://www.cpce-polyu.edu.hk/itu/new/: Information Technology Unit (itu). Retrieved 2011-03-01. Moodle is a well-known e-learning platform in tertiary institutions. Many universities and colleges use Moodle as the online learning system in their daily teaching and learning. Moodle is a free open source software it means developer can make modification based on their needs. CPCE decides to use Moodle as a e-learning platform for HKCC and SPEED from 2009/10 academic year onwards.

[8] "E-Learning Features". http://www.cpce-polyu.edu.hk/itu/new/: Information Technology Unit (itu). Retrieved 2011-03-01. Moodle serves as an online e-learning platform to facilitate the communications between teachers and students. Some typical features provided by Moodle are listed below.

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[10] "Managing a Moodle Course - Activities - Assignment module".

[11] "Managing a Moodle Course - Activities - Assignment module".

[12] "Managing a Moodle Course - Activities - Assignment module".

[13] "Managing a Moodle Course - Activities - Database module".

[14] "Managing a Moodle Course - Activities - Glossary module".

[15] "Managing a Moodle Course - Activities - Survey module".

[16] "Managing a Moodle Course - Activities - Quiz module".

[17] "Managing a Moodle Course - Activities - Quiz module".

[18] "How to Gamify Moodle in 20 Minutes". Frederic Nevers.

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[23] "Moodle Translations".

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[25] "Moodle Mobile app on Google Play".

[26] "Moodle Mobile app on iTunes App Store".

[27] "Moodle Mobile app on Windows Phone Store".

[28] "SCORM Cloud Moodle Integration". scorm.com.

[29] "Launch externally Tin Can API activities from Moodle and track on any LRS.". Andrew Downes on Moodle.org Forums.

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[48] Moodle Statistics

[49] Case study in Linux Pro magazine

[50] Marsden, Dan (2 April 2012). "Moodle 1.9 Long Term support". Moodle. Retrieved 27 May 2013.

[51] MoodleMoot at moodle.org

[52] "MoodleMoot hosted by Moodle HQ".

[53] The Conference Center at moodle.org

16.13 External links

16.13.1 Moodle

- Official website

- Moodle chapter in *The Architecture of Open Source Applications*

16.13.2 Other

- Moodle news

- Free learning/teaching moodle community - MoodleSocial

- Moodle on WikEd

- Official teacher certification - the Moodle

- Free Course for teachers about Moodle - Spanish

- Free course content available for download on MoodleShare

Chapter 17

Blackboard Learning System

The **Blackboard Learning System** is a virtual learning environment and course management system developed by Blackboard Inc. It is a Web-based server software which features course management, customizable open architecture, and scalable design that allows integration with student information systems and authentication protocols. It may be installed on local servers or hosted by Blackboard ASP Solutions. Its main purposes are to add online elements to courses traditionally delivered face-to-face and to develop completely online courses with few or no face-to-face meetings.

17.1 History

On Jan 21 1997, Stephen Gilfus and Dan Cane started a company called CourseInfo LLC and were developing a software product that would power online education and be scalable for wider institutional application.[1] At the same time, Matthew Pittinsky and Michael Chasen formed Blackboard LLC and were contracted to help lead the formation of the Educause IMS standards group for online education technology. The two groups merged to form Blackboard Inc., which then developed the Blackboard Learning System.[2]

On October 17, 2012 Michael Chasen, CEO and co-founder of Blackboard, announced that he was leaving the company he founded 15 years earlier.[3]

17.2 Functions

The Blackboard Learning System provides users with a platform for communication and sharing content.

Communication

- Announcements: Professors and teachers may post announcements for students to read. These can be found under the announcement tab, or can be made to pop-up when a student accesses Blackboard.

- Chat: This function allows those students who are online to chat in real time with other students in their class section.

- Discussions: This feature allows students and professors to create a discussion thread and reply to ones already created.

- Mail: Blackboard mail allows students and teachers to send mail to one another. This feature supports mass emailing to students in a course.

Content

- Course content: This feature allows teachers to post articles, assignments, videos etc.

- Calendar: Teachers can use this function to post due dates for assignments and tests.

- Learning modules: This feature is often used for strictly online classes. It allows professors to post different lessons for students to access.

- Assessments: This tab allows teachers to post quizzes and exams and allows students to access them via the internet

- Assignments: This features allows assignments to be posted and students to submit assignments online

- Grade Book: Teachers and professors may post grades on Blackboard for students to view.

- Media Library: Videos and other media may be posted under this function.[4]

17.3 Criticism

See also: Blackboard_Inc. § Blackboard_legal_issues

Blackboard Inc has had several legal issues, including faulty patent rights claims.[5] In addition, a number of educational institutions,[6][7][8] teachers,[9][10][11][12] and students[13][14][15][16][17] have expressed concerns about the reliability of Blackboard. McMaster University in Hamilton, Ontario, Canada has replaced their Blackboard system after multiple problems during one year of use.[18] Citing numerous glitches and high costs, many

universities are turning to the cheaper, open source alternative Moodle, including Montana State University,[19] Vassar College,[20] California State University, Long Beach,[21] and many other schools.[22] Rensselaer Polytechnic Institute's implementation of the system notably suffered sporadic outages in the Grade Book section during the finals of the Fall 2014 semester. [23]

Stephanie J. Coopman has published an in-depth analysis of the pros and cons of the Blackboard system. She finds the "hierarchical" power structure implicit to the system to be troubling.[24] The system has also been criticized for having poor Linux compatibility and support.[25]

17.4 Product development and competition

The Blackboard Learning System has undergone several iterations, and new uses have arisen as some educational institutions move from augmentation of traditional classroom learning to supporting full online and virtual campus education.

From the late 2000s, the product has also faced competition from free and/or open source competitors such as Edvelop[26] or Moodle.[27]

17.5 See also

- CourseInfo LLC - the precursor to Blackboard Inc.

17.6 References

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[10] "Protesting Blackboard 8.0"

[11] "WTF University Meets Blackboard"

[12] "Oh, Blackboard, Wherefore Do I Hate Thee?"

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[25] "Blackboard - No Linux for Online Education". Thoughts on Technology (blog). Retrieved 19 September 2010.

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17.7 External links

- Official website

Chapter 18

Learning object

A **learning object** is "a collection of content items, practice items, and assessment items that are combined based on a single learning objective".[1] The term is credited to Wayne Hodgins when he created a working group in 1994 bearing the name[2] though the concept was first described by Gerard in 1967.[3] Learning objects go by many names, including content objects, chunks, educational objects, information objects, intelligent objects, knowledge bits, knowledge objects, learning components, media objects, reusable curriculum components, nuggets, reusable information objects, reusable learning objects, testable reusable units of cognition, training components, and units of learning.

Learning objects offer a new conceptualization of the learning process: rather than the traditional "several hour chunk", they provide smaller, self-contained, re-usable units of learning.[4]

They will typically have a number of different components, which range from descriptive data to information about rights and educational level. At their core, however, will be instructional content, practice, and assessment. A key issue is the use of metadata.

Learning object design raises issues of portability, and of the object's relation to a broader learning management system.

18.1 Definitions

The Institute of Electrical and Electronics Engineers (IEEE) defines a learning object as "any entity, digital or non-digital, that may be used for learning, education or training".[5]

Chiappe defined Learning Objects as: "A digital self-contained and reusable entity, with a clear educational purpose, with at least three internal and editable components: content, learning activities and elements of context. The learning objects must have an external structure of information to facilitate their identification, storage and retrieval: the metadata."[6]

The following definitions focus on the relation between learning object and digital media. RLO-CETL, a

British inter-university Learning Objects Center, defines "reusable learning objects" as "web-based interactive chunks of e-learning designed to explain a stand-alone learning objective".[7] Daniel Rehak and Robin Mason define it as "a digitized entity which can be used, reused or referenced during technology supported learning".[8]

Adapting a definition from the Wisconsin Online Resource Center, Robert J. Beck suggests that learning objects have the following key characteristics:

- Learning objects are a new way of thinking about learning content. Traditionally, content comes in a several hour chunk. Learning objects are much smaller units of learning, typically ranging from 2 minutes to 15 minutes.

- Are self-contained – each learning object can be taken independently

- Are reusable – a single learning object may be used in multiple contexts for multiple purposes

- Can be aggregated – learning objects can be grouped into larger collections of content, including traditional course structures

- Are tagged with metadata – every learning object has descriptive information allowing it to be easily found by a search[4]

18.2 Components

The following is a list of some of the types of information that may be included in a learning object and its metadata:

- General Course Descriptive Data, including: course identifiers, language of content (English, Spanish, etc.), subject area (Maths, Reading, etc.), descriptive text, descriptive keywords

- Life Cycle, including: version, status

- Instructional Content, including: text, web pages, images, sound, video

- Glossary of Terms, including: terms, definition, acronyms

- Quizzes and Assessments, including: questions, answers

- Rights, including: cost, copyrights, restrictions on Use

- Relationships to Other Courses, including prerequisite courses

- Educational Level, including: grade level, age range, typical learning time, and difficulty. [IEEE 1484.12.1:2002]

- Typology as defined by Churchill (2007): presentation, practice, simulation, conceptual models, information, and contextual representation [9]

18.3 Metadata

One of the key issues in using learning objects is their identification by search engines or content management systems. This is usually facilitated by assigning descriptive learning object metadata. Just as a book in a library has a record in the card catalog, learning objects must also be tagged with metadata. The most important pieces of metadata typically associated with a learning object include:

1. **objective:** The educational objective the learning object is instructing

2. **prerequisites:** The list of skills (typically represented as objectives) which the learner must know before viewing the learning object

3. **topic:** Typically represented in a taxonomy, the topic the learning object is instructing

4. **interactivity:** The Interaction Model of the learning object.

5. **technology requirements:** The required system requirements to view the learning object.

18.4 Mutability

A mutated learning object is, according to Michael Shaw, a learning object that has been "re-purposed and/or re-engineered, changed or simply re-used in some way different from its original intended design". Shaw also introduces the term "contextual learning object", to describe a learning object that has been "designed to have specific meaning and purpose to an intended learner".[10]

18.5 Portability

Before any institution invests a great deal of time and energy into building high-quality e-learning content (which can cost over \$10,000 per classroom hour),[11] it needs to consider how this content can be easily loaded into a Learning Management System. It is possible for example, to package learning objects with SCORM specification and load it in Moodle Learning Management System or Desire2Learn Learning Environment.

If all of the properties of a course can be precisely defined in a common format, the content can be serialized into a standard format such as XML and loaded into other systems. When it is considered that some e-learning courses need to include video, mathematical equations using MathML, chemistry equations using CML and other complex structures, the issues become very complex, especially if the systems needs to understand and validate each structure and then place it correctly in a database.

18.6 Criticism

In 2001, David Wiley criticized learning object theory in his paper, The Reusability Paradox which is summarized by D'Arcy Norman as, *If a learning object is useful in a particular context, by definition it is not reusable in a different context. If a learning object is reusable in many contexts, it isn't particularly useful in any.* In Three Objections to Learning Objects and E-learning Standards, Norm Friesen, Canada Research Chair in E-Learning Practices at Thompson Rivers University, points out that the word *neutrality* in itself implies *a state or position that is antithetical ... to pedagogy and teaching.*

18.7 See also

- Intelligent tutoring system

- North Carolina Learning Object Repository (NCLOR)

- Serious games

18.8 References

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[5] Learning Technology Standards Committee 2002, p. 45

[6] Chiappe, Segovia & Rincon 2007, p. 8.

[7] "Learning Objects", *RLO-CETL: Reusable Learning Objects*, retrieved 2008-04-29.

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18.10   External links

- The Learning Objects at Milwaukee's Center for International Education.

Chapter 19

Learning object metadata
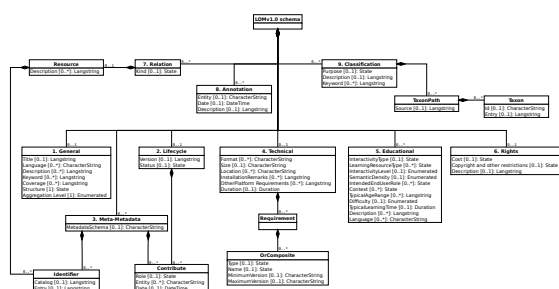
A schematic representation of the hierarchy of elements in the LOM data model

Learning Object Metadata is a data model, usually encoded in XML, used to describe a learning object and similar digital resources used to support learning. The purpose of learning object metadata is to support the reusability of learning objects, to aid discoverability, and to facilitate their interoperability, usually in the context of online learning management systems (LMS).

The IEEE 1484.12.1 – 2002 Standard for Learning Object Metadata is an internationally recognised open standard (published by the Institute of Electrical and Electronics Engineers Standards Association, New York) for the description of "learning objects". Relevant attributes of learning objects to be described include: type of object; author; owner; terms of distribution; format; and pedagogical attributes, such as teaching or interaction style.

19.1 IEEE 1484.12.1 – 2002 Standard for Learning Object Metadata

19.1.1 In brief

The IEEE working group that developed the standard defined learning objects, *for the purposes of the standard,* as being "any entity, digital or non-digital, that may be used for learning, education or training." This definition has struck many commentators as being rather broad in its scope, but the definition was intended to provide a broad

class of objects to which LOM metadata might usefully be associated rather than to give an instructional or pedagogic definition of a learning object. *IEEE 1484.12.1* is the first part of a multipart standard, and describes the LOM data model. The LOM data model specifies which aspects of a learning object should be described and what vocabularies may be used for these descriptions; it also defines how this data model can be amended by additions or constraints. Other parts of the standard are being drafted to define bindings of the LOM data model, i.e. define how LOM records should be represented in XML and RDF (*IEEE 1484.12.3* and *IEEE 1484.12.4* respectively). This article focuses on the LOM data model rather than issues relating to XML or other bindings.

IMS Global Learning Consortium is an international consortium that contributed to the drafting of the IEEE Learning Object Metadata (together with the ARIADNE Foundation) and endorsed early drafts of the data model as part of the IMS Learning Resource Meta-data specification (IMS LRM, versions 1.0 – 1.2.2). Feedback and suggestions from the implementers of IMS LRM fed into the further development of the LOM, resulting in some drift between version 1.2 of the IMS LRM specification and what was finally published at the LOM standard. Version 1.3 of the IMS LRM specification realigns the IMS LRM data model with the IEEE LOM data model and specifies that the IEEE XML binding should be used. Thus, we can use the term 'LOM' in referring to both the IEEE standard and version 1.3 of the IMS specification. The IMS LRM specification also provides an extensive *Best Practice and Implementation Guide*, and an *XSL transform* that can be used to migrate metadata instances from the older versions of the IMS LRM XML binding to the IEEE LOM XML binding.

19.2 Technical details

19.2.1 How the data model works

The LOM comprises a **hierarchy of elements**. At the first level, there are nine categories, each of which contains sub-elements; these sub-elements may be simple elements that hold data, or may themselves be aggregate

elements, which contain further sub-elements. The semantics of an element are determined by its context: they are affected by the parent or container element in the hierarchy and by other elements in the same container. For example, the various *Description* elements (1.4, 5.10, 6.3, 7.2.2, 8.3 and 9.3) each derive their context from their parent element. In addition, description element 9.3 also takes its context from the value of element 9.1 *Purpose* in the same instance of *Classification*.

The data model specifies that some elements may be repeated either individually or as a group; for example, although the elements 9.2 (*Description*) and 9.1 (*Purpose*) can only occur once within each instance of the *Classification* container element, the *Classification* element may be repeated - thus allowing many descriptions for different purposes.

The data model also specifies the **value space** and **datatype** for each of the simple data elements. The value space defines the restrictions, if any, on the data that can be entered for that element. For many elements, the value space allows any string of Unicode character to be entered, whereas other elements entries must be drawn from a declared list (i.e. a controlled vocabulary) or must be in a specified format (e.g. date and language codes). Some element datatypes simply allow a string of characters to be entered, and others comprise two parts, as described below:

- **LangString** items contain Language and String parts, allowing the same information to be recorded in multiple languages

- **Vocabulary** items are constrained in such a way that their entries have to be chosen from a controlled list of terms - composed of Source-Value pairs - with the Source containing the name of the list of terms being used and the Value containing the chosen term

- **DateTime** and **Duration** items contain one part that allows the date or duration to be given in a machine readable format, and a second that allows a description of the date or duration (for example "mid summer, 1968").

When implementing the LOM as a data or service provider, it is not necessary to support all the elements in the data model, nor need the LOM data model limit the information which may be provided. The creation of an application profile allows a community of users to specify which elements and vocabularies they will use. Elements from the LOM may be dropped and elements from other metadata schemas may be brought in; likewise, the vocabularies in the LOM may be supplemented with values appropriate to that community.

19.2.2   Requirements

The key requirements for exploiting the LOM as a data or service provider are to:

- Understand user/community needs and to express these as an application profile

- Have a strategy for creating high quality metadata

- Store this metadata in a form which can be exported as LOM records

- Agree a binding for LOM instances when they are exchanged

- Be able to exchange records with other systems either as single instances or *en masse*.

19.2.3   Related specifications

There are many metadata specifications; of particular interest is the Dublin Core Metadata Element Set (commonly known as Simple Dublin Core, standardised as *ANSI/NISO Z39.85 − 2001*), which provides a simpler, more loosely-defined set of elements with some overlap with the LOM, and which is useful for sharing metadata across a wide range of disparate services. The Dublin Core Metadata Initiative is also working on a set of terms which allow the Dublin Core Element Set to be used with greater semantic precision (Qualified Dublin Core). The Dublin Education Working Group aims to provide refinements of Dublin Core for the specific needs of the education community.

Many other education-related specifications allow for LO metadata to be embedded within XML instances, such as: describing the resources in an IMS Content Package or Resource List; describing the vocabularies and terms in an IMS VDEX (Vocabulary Definition and Exchange) file; and describing the question items in an IMS QTI (Question and Test Interoperability) file.

The IMS Vocabulary Definition and Exchange (VDEX) specification has a double relation with the LOM, since not only can the LOM provide metadata on the vocabularies in a VDEX instance, but VDEX can be used to describe the controlled vocabularies which are the value space for many LOM elements.

LOM records can be transported between systems using a variety of protocols, perhaps the most widely used being OAI-PMH.

19.2.4   Application profiles

UK LOM Core

For UK Further and Higher Education, the most relevant family of application profiles are those based around the

UK LOM Core.[1] The UK LOM Core is currently a draft schema researched by a community of practitioners to identify common UK practice in learning object content, by comparing 12 metadata schemas. UK LOM is currently legacy work, it is not in active development.

CanCore

CanCore provides detailed guidance for the interpretation and implementation of each data element in the LOM standard.[2] These guidelines (2004) constitute a 250-page document, and have been developed over three years under the leadership of Norm Friesen, and through consultation with experts across Canada and throughout the world. These guidelines are also available at no charge from the CanCore Website.

ANZ-LOM

ANZ-LOM is a metadata profile developed for the education sector in Australia and New Zealand. The profile provides interpretations of metadata structures and illustrates how to apply controlled vocabularies, especially using the "classification" element. It is supported by detailed examples of learning resource metadata, including regional vocabularies. The ANZ-LOM profile was first published by The Le@rning Federation (TLF) in January, 2008.

Vetadata

The Australian Vocational Training and Education (VET) sector uses an application profile of the IEEE LOM called Vetadata. The profile contains five mandatory elements, and makes use of a number of vocabularies specific to the Australian VET sector. This application profile was first published in 2005. The Vetadata and ANZ-LOM profiles are closely aligned.

NORLOM

NORLOM is the Norwegian LOM profile. The profile is managed by NSSL (The Norwegian Secretariat for Standardization of Learning Technologies)

ISRACore

ISRACORE is the Israeli LOM profile. The Israel Internet Association (ISOC-IL) and Inter University Computational Center (IUCC) have teamed up to manage and establish an e-learning objects database.

SWE-LOM

SWE-LOM is the Swedish LOM profile that is managed by IML at Umeå University as a part of the work with the national standardization group TK450 at Swedish Standards Institute.

TWLOM

TWLOM is the Taiwanese LOM profile that is managed by Industrial Development and Promotion of Archives and e-Learning Project

LOM-FR

LOM-FR is a metadata profile developed for the education sector in France. This application profile was first published in 2006.

NL LOM

NL LOM is the Dutch metadata profile for educational resources in the Netherlands. This application profile was the result of merging the Dutch higher education LOM profile with the one used in primary and secondary Dutch education. The final version was released in 2011.

LOM-CH

LOM-CH is a metadata profile developed for the education sector in Switzerland. It is currently available in French and German. This application profile was published in July 2014.

LOM-ES

LOM-ES is a metadata profile developed for the education sector in Spain. It is available in Spanish.

Others

Other application profiles are those developed by the Celebrate project[3] and the metadata profile that is part of the SCORM reference model.[4]

19.3 See also

- Application profile

- Content package

- Dublin Core

- IMS Global

- Learning object

- Metadata

- Metadata Standards

- OAI-PMH

- SCORM

- XML

- m:Learning Object Metadata

19.4   References

[1] http://zope.cetis.ac.uk/profiles/uklomcore/

[2] Norm Friesen et al. (2003-01-20). "CanCore Guidelines: Introduction". Athabasca University. Retrieved 2009-02-23.

[3] European Schoolnet, CELEBRATE Application Profile (2003).

[4] ADL, SCORM.

19.5   External links

- cancore.athabascau.ca is a thorough element-by-element guide to implementing the IEEE LOM.

- www.imsglobal.org: IMS Global Learning Consortium Learning resource meta-data specification.

- ltsc.ieee.org: XML Binding Specification.

- www.intrallect.com: A mapping between the IEEE LOM and IMS Learning Resource Metadata

- www.ontopia.net: Metadata? Thesauri? Taxonomies? Topic Maps! Making sense of it all, 2004.

Chapter 20

Intelligent tutoring system

An **intelligent tutoring system** (ITS) is a computer system that aims to provide immediate and customized instruction or feedback to learners,[1] usually without intervention from a human teacher. ITSs have the common goal of enabling learning in a meaningful and effective manner by using a variety of computing technologies. There are many examples of ITSs being used in both formal education and professional settings in which they have demonstrated their capabilities and limitations. There is a close relationship between intelligent tutoring, cognitive learning theories and design; and there is ongoing research to improve the effectiveness of ITS. An ITS aims to solve the problem of over-dependency of students over teachers for quality education. It aims to provide access to high quality education to each and every student, thus reforming the entire education system.

20.1 History of ITS

20.1.1 Early mechanical systems

The possibility of intelligent machines have been discussed for centuries. Blaise Pascal created the first calculating machine capable of mathematical functions in the 17th century simply called Pascal's Calculator. At this time the mathematician and philosopher Gottfried Wilhelm Leibniz envisioned machines capable of reasoning and applying rules of logic to settle disputes (Buchanan, 2006).[2] These early works contributed to the development of the computer and future applications.

The concept of intelligent machines for instructional use date back as early as 1924, when Sidney Pressey of Ohio State University created a mechanical teaching machine to instruct students without a human teacher.[3][4] His machine resembled closely a typewriter with several keys and a window that provided the learner with questions. The Pressey Machine allowed user input and provided immediate feedback by recording their score on a counter.[5]

Pressey himself was influenced by Edward L. Thorndike, a learning theorist and educational psychologist at the Columbia University Teacher College of the late 19th

Skinner teaching machine 08

and early 20th centuries. Thorndike posited laws for maximizing learning. Thorndike's laws included the law of effect, the law of exercise, and the law of recency. Following later standards, Pressey's teaching and testing machine would not considered intelligent as it was mechanically run and was based on one question and answer at a time,[5] but it set an early precedent for future projects. By the 1950s and 1960s, new perspectives on learning were emerging. Burrhus Frederic "B.F." Skinner at Harvard University did not agree with Thorndike's learning theory of connectionism or Pressey's teaching machine. Rather, Skinner was a behaviourist who believed that learners should construct their answers and not rely on recognition.[4] He too, constructed a teaching machine structured using an incremental mechanical system that would reward students for correct responses to questions.[4]

20.1.2 Early electronic systems

In the period following the second world war, mechanical binary systems gave way to binary based electronic machines. These machines were considered intelligent when compared to their mechanical counterparts as they had the capacity to make logical decisions. However, the study of defining and recognizing a machine intelligence was still in its infancy.

Alan Turing, a mathematician, logician and computer scientist, linked computing systems to thinking. One of his most notable papers outlined a hypothetical test to assess the intelligence of a machine which came to be known as the Turing test. Essentially, the test would have a person communicate with two other agents, a human and a computer asking questions to both recipients. The computer passes the test if it can respond in such a way that the human posing the questions cannot differentiate between the other human and the computer. The Turing test has been used in its essence for more than two decades as a model for current ITS development. The main ideal for ITS systems is to effectively communicate.[5] As early as the 1950s programs were emerging displaying intelligent features. Turing's work as well as later projects by researchers such as Allen Newell, Clifford Shaw, and Herb Simon showed programs capable of creating logical proofs and theorems. Their program, The Logic Theorist exhibited complex symbol manipulation and even generation of new information without direct human control and is considered by some to be the first AI program. Such breakthroughs would inspire the new field of Artificial Intelligence officially named in 1956 by John McCarthy in 1956 at the Dartmouth Conference.[2] This conference was the first of its kind that was devoted to scientists and research in the field of AI.

The latter part of the 1960s and 1970s saw many new CAI (Computer-Assisted instruction) projects that built on advances in computer science. The creation of the ALGOL programming language in 1958 enabled many schools and universities to begin developing Computer Assisted Instruction (CAI) programs. Major computer vendors and federal agencies in the US such as IBM, HP, and the National Science Foundation funded the development of these projects.[6] Early implementations in education focused on programmed instruction (PI), a structure based on a computerized input - output system. Although many supported this form of instruction, there was limited evidence supporting its effectiveness.[5] The programming language LOGO was created in 1967 by Wally Feurzeig and Seymour Papert as a language streamlined for education. PLATO, an educational terminal featuring displays, animations, and touch controls that could store and deliver large amounts of course material, was developed by Donald Bitzer in the University of Illinois in the early 1970s. Along with these, many other CAI projects were initiated in many countries including the US, the UK, and Canada.[6]

The PLATO V CAI terminal in 1981

At the same time that CAI was gaining interest, Jaime Carbonell suggested that computers could act as a teacher rather than just a tool (Carbonell, 1970). A new perspective would emerge that focused on the use of computers to intelligently coach students called Intelligent Computer Assisted Instruction or Intelligent Tutoring Systems (ITS). Where CAI used a behaviourist perspective on learning based on Skinner's theories (Dede & Swigger, 1988),[7] ITS drew from work in cognitive psychology, computer science, and especially artificial intelligence.[7] There was a shift in AI research at this time as systems moved from the logic focus of the previous decade to knowledge based systems—systems could make intelligent decisions based on prior knowledge (Buchanan, 2006).[2] Such a program was created by Seymour Papert and Ira Goldstein who created Dendral, a system that predicted possible chemical structures from existing data. Further work began to showcase analogical reasoning and language processing. These changes with a focus on knowledge had big implications for how computers could be used in instruction. The technical requirements of ITS, however, proved to be higher and more complex than CAI systems and ITS systems would find limited success at this time.[6]

Towards the latter part of the 70's interest in CAI technologies began to wane.[6][8] Computers were still expensive and not as available as expected. Developers and instructors were reacting negatively to the high cost of developing CAI programs, the inadequate provision for instructor training, and the lack of resources.[8]

20.1.3 Microcomputers and intelligent systems

The microcomputer revolution in the late 1970s and early 80s helped to revive CAI development and jumpstart development of ITS systems. Personal computers such as the Apple 2, Commodore PET, and TRS-80 reduced the resources required to own computers and by 1981, 50% of US schools were using computers (Chambers & Sprecher, 1983).[6] Several CAI projects utilized the Apple 2 as a system to deliver CAI programs in high schools and universities including the British Columbia Project and California State University Project in 1981.[6]

The early 80s would also see Intelligent Computer-Assisted Instruction (ICAI) and ITS goals diverge from their roots in CAI. As CAI became increasingly focused on deeper interactions with content created for a specific area of interest, ITS sought to create systems that focused on knowledge of the task and the ability to generalize that knowledge in non-specific ways (Larkin & Chabay, 1992).[7] The key goals set out for ITS were to be able to teach a task as well as perform it, adapting dynamically to its situation. In the transition from CAI to ICAI systems, the computer would have to distinguish not only between the correct and incorrect response but the type of incorrect response to adjust the type of instruction. Research in Artificial Intelligence and Cognitive Psychology fueled the new principles of ITS. Psychologists considered how a computer could solve problems and perform 'intelligent' activities. An ITS programme would have to be able to represent, store and retrieve knowledge and even search its own database to derive its own new knowledge to respond to learner's questions. Basically, early specifications for ITS or (ICAI) require it to "diagnose errors and tailor remediation based on the diagnosis" (Shute & Psotka, 1994, p. 9).[5] The idea of diagnosis and remediation is still in use today when programming ITS.

A key breakthrough in ITS research was the creation of LISPITS, a program that implemented ITS principles in a practical way and showed promising effects increasing student performance. LISPITS was developed and researched in 1983 as an ITS system for teaching students the LISP programming language (Corbett & Anderson, 1992).[9] LISPITS could identify mistakes and provide constructive feedback to students while they were performing the exercise. The system was found to decrease the time required to complete the exercises while improving student test scores (Corbett & Anderson, 1992).[9] Other ITS systems beginning to develop around this time include TUTOR created by Logica in 1984 as a general instructional tool[10] and PARNASSUS created in Carnegie Mellon University in 1989 for language instruction.[11]

20.1.4 Modern ITS

After the implementation of initial ITS, more researchers created a number of ITS for different students. In the late 20th century, Intelligent Tutoring Tools (ITTs) was developed by the Byzantium project, which involved six universities. The ITTs were general purpose tutoring system builders and many institutions had positive feedbacks while using them. (Kinshuk, 1996)[12] This builder, ITT, would produce an Intelligent Tutoring Applet (ITA) for different subject areas. Different teachers created the ITAs and built up a large inventory of knowledge that was accessible by others through the Internet. Once an ITS was created, teachers could copy it and modify it for future use. This system was efficient and flexible. However, Kinshuk and Patel believed that the ITS was not designed from an educational point of view and was not developed based on the actual needs of students and teachers. (Kinshuk and Patel, 1997).[13] Modern day ITS try to replicate the role of a teacher, a teaching assistant and involves problem generation, intelligent automatic feedback generation with a high recall value.

There were three ITS projects that functioned based on conversational dialogue: AutoTutor, Atlas (Freedman, 1999),[14] and Why2. The idea behind these projects was that since students learn best by constructing knowledge themselves, the programs would begin with leading questions for the students and would give out answers as a last resort. AutoTutor's students focused on answering questions about computer technology, Atlas's students focused on solving quantitative problems, and Why2's students focused on explaining physical systems qualitatively. (Graesser, VanLehn, and others, 2001)[15] Other similar tutoring systems such as Andes (Gertner, Conati, and VanLehn, 1998)[16] tend to provide hints and immediate feedbacks for students when students have trouble answering the questions. They could guess their answers and have correct answers without deep understanding of the concepts. Research was done with a small group of students using Atlas and Andes respectively. The results showed that students using Atlas made significant improvements compared with students who used Andes.[17] However, since the above systems require analysis of students' dialogues, improvement is yet to be made so that more complicated dialogues can be managed.

The current architectures which dominate the field are the AutoTutor, Cognitive Tutor, and the Generalized Intelligent Framework for Tutoring

20.2 Structure

Intelligent tutoring systems consist of four basic components based on a general consensus amongst researchers (Nwana,1990;[18] Freedman, 2000;[19] Nkambou et al., 2010[20]):

1. The Domain model

2. The Student model

3. The Tutoring model, and

4. The User interface model

The *domain model* (also known as the cognitive model or expert knowledge model) is built on ACT-R theory which tries to take into account all the possible steps required to solve a problem. More specifically, this model "contains the concepts, rules, and problem-solving strategies of the domain to be learned. It can fulfill several roles: as a source of expert knowledge, a standard for evaluating the student's performance or for detecting errors, etc." (Nkambou et al., 2010, p. 4).[20]

The *student model* can be thought of as an overlay on the domain model. It is considered as the core component of an ITS paying special attention to student's cognitive and affective states and their evolution as the learning process advances. As the student works step-by-step through their problem solving process the system engages in a process called *model tracing*. Anytime the student model deviates from the domain model the system identifies, or *flags*, that an error has occurred.

The *tutor model* accepts information from the domain and student models and makes choices about tutoring strategies and actions. At any point in the problem-solving process the learner may request guidance on what to do next, relative to their current location in the model. In addition, the system recognizes when the learner has deviated from the production rules of the model and provides timely feedback for the learner, resulting in a shorter period of time to reach proficiency with the targeted skills.[21] The tutor model may contain several hundred production rules that can be said to exist in one of two states, *learned* or *unlearned*. Every time a student successfully applies a rule to a problem, the system updates a probability estimate that the student has learned the rule. The system continues to drill students on exercises that require effective application of a rule until the probability that the rule has been learned reaches at least 95% probability.[22]

Knowledge tracing tracks the learner's progress from problem to problem and builds a profile of strengths and weaknesses relative to the production rules. The cognitive tutoring system developed by John Anderson at Carnegie Mellon University presents information from knowledge tracing as a *skillometer*, a visual graph of the learner's success in each of the monitored skills related to solving algebra problems. When a learner requests a hint, or an error is flagged, the knowledge tracing data and the skillometer are updated in real-time.

The *user interface* component "integrates three types of information that are needed in carrying out a dialogue: knowledge about patterns of interpretation (to understand a speaker) and action (to generate utterances) within dialogues; domain knowledge needed for communicating content; and knowledge needed for communicating intent" (Padayachee, 2002, p. 3).[23]

Nkambou et al. (2010) make mention of Nwana's (1990)[18] review of different architectures underlining a strong link between architecture and paradigm (or philosophy). Nwana (1990) declares, "[I]t is almost a rarity to find two ITSs based on the same architecture [which] results from the experimental nature of the work in the area" (p. 258). He further explains that differing tutoring philosophies emphasize different components of the learning process (i.e., domain, student or tutor). The architectural design of an ITS reflects this emphasis, and this leads to a variety of architectures, none of which, individually, can support all tutoring strategies (Nwana, 1990, as cited in Nkambou et al., 2010). Moreover, ITS projects may vary according to the relative level of intelligence of the components. As an example, a project highlighting intelligence in the domain model may generate solutions to complex and novel problems so that students can always have new problems to work on, but it might only have simple methods for teaching those problems, while a system that concentrates on multiple or novel ways of teaching a particular topic might find a less sophisticated representation of that content sufficient.[19]

20.3   Design   and   development methods

Apart from the discrepancy amongst ITS architectures each emphasizing different elements, the development of an ITS is much the same as any instructional design process. Corbett et al. (1997) summarized ITS design and development as consisting of four iterative stages: (1) needs assessment, (2) cognitive task analysis, (3) initial tutor implementation and (4) evaluation.[24]

The first stage known as needs assessment, is common to any instructional design process, especially software development. This involves a *learner analysis*, consultation with subject matter experts and/or the instructor(s). This first step is part of the development of the expert/knowledge and student domain. The goal is to specify learning goals and to outline a general plan for the curriculum; it is imperative not to computerize traditional concepts but develop a new curriculum structure by defining the task in general and understanding learners' possible behaviours dealing with the task and to a lesser degree the tutor's behavior. In doing so, three crucial dimensions need to be dealt with: (1) the probability a student is able to solve problems; (2) the time it takes to reach this performance level and (3) the probability the student will actively use this knowledge in the future. Another important aspect that requires analysis is cost effectiveness of the interface. Moreover, teachers and student entry characteristics such as prior knowledge must be assessed since both groups are going to be system users.[24]

The second stage, cognitive task analysis, is a detailed approach to expert systems programming with the goal of developing a valid computational model of the required problem solving knowledge. Chief methods for developing a domain model include: (1) interviewing domain experts, (2) conducting "think aloud" protocol studies with domain experts,(3) conducting "think aloud" studies with novices and (4) observation of teaching and learning behavior. Although the first method is most commonly used, experts are usually incapable of reporting cognitive components. The "think aloud" methods, in which the experts is asked to report aloud what s/he is thinking when solving typical problems, can avoid this problem.[24] Observation of actual online interactions between tutors and students provides information related to the processes used in problem-solving, which is useful for building dialogue or interactivity into tutoring systems.[25]

The third stage, initial tutor implementation, involves setting up a problem solving environment to enable and support an authentic learning process. This stage is followed by a series of evaluation activities as the final stage which is again similar to any software development project.[24]

The fourth stage, evaluation includes (1) pilot studies to confirm basic usability and educational impact; (2) formative evaluations of the system under development, including (3) parametric studies that examine the effectiveness of system features and finally, (4) summative evaluations of the final tutor's effect: learning rate and asymptotic achievement levels.[24]

Eight principles of ITS design and development

Anderson et al. (1987)[26] outlined eight principles for intelligent tutor design and Corbett et al. (1997)[24] later elaborated on those principles highlighting an all-embracing principle which they believed governed intelligent tutor design, they referred to this principle as:

Principle 0: An intelligent tutor system should enable the student to work to the successful conclusion of problem solving.

1. Represent student competence as a production set.

2. Communicate the goal structure underlying the problem solving.

3. Provide instruction in the problem solving context.

4. Promote an abstract understanding of the problem-solving knowledge.

5. Minimize working memory load.

6. Provide immediate feedback on errors.

7. Adjust the grain size of instruction with learning.

8. Facilitate successive approximations to the target skill.[24]

20.4   Use in practice

All this is a substantial amount of work, even if authoring tools have become available to ease the task.[27] This means that building an ITS is an option only in situations in which they, in spite of their relatively high development costs, still reduce the overall costs through reducing the need for human instructors or sufficiently boosting overall productivity. Such situations occur when large groups need to be tutored simultaneously or many replicated tutoring efforts are needed. Cases in point are technical training situations such as training of military recruits and high school mathematics. One specific type of intelligent tutoring system, the Cognitive Tutor, has been incorporated into mathematics curricula in a substantial number of United States high schools, producing improved student learning outcomes on final exams and standardized tests.[28] Intelligent tutoring systems have been constructed to help students learn geography, circuits, medical diagnosis, computer programming, mathematics, physics, genetics, chemistry, etc. Intelligent Language Tutoring Systems (ILTS), e.g. this[29] one, teach natural language to first or second language learners. ILTS requires specialized natural language processing tools such as large dictionaries and morphological and grammatical analyzers with acceptable coverage.

20.5   Applications

During the rapid expansion of the web boom, new computer-aided instruction paradigms, such as e-learning and distributed learning, provided an excellent platform for ITS ideas. Areas that have used ITS include natural language processing, machine learning, planning, multi-agent systems, ontologies, semantic Web, and social and emotional computing. In addition, other technologies such as multimedia, object-oriented systems, modeling, simulation, and statistics have also been connected to or combined with ITS. Historically non-technological areas such as the educational sciences and psychology have also been influenced by the success of ITS.[30]

In recent years, ITS has begun to move away from the search-based to include a range of practical applications.[31] ITS have expanded across many critical and complex cognitive domains, and the results have been far reaching. ITS systems have cemented a place within formal education and these systems have found homes in the sphere of corporate training and organizational learning. ITS offers learners several affordances such as individualized learning, just in time feedback, and flexibility in time and space.

While Intelligent tutoring systems evolved from research in cognitive psychology and artificial intelligence, there are now many applications found in education and in organizations. Intelligent tutoring systems can be found in

online environments or in a traditional classroom computer lab, and are used in K-12 classrooms as well as in universities. There are a number of programs that target mathematics but applications can be found in health sciences, language acquisition, and other areas of formalized learning.

Reports of improvement in student comprehension, engagement, attitude, motivation, and academic results have all contributed to the ongoing interest in the investment in and research of theses systems. The personalized nature of the intelligent tutoring systems affords educators the opportunity to create individualized programs. Within education there are a plethora of intelligent tutoring systems, an exhaustive list does not exist but several of the more influential programs are listed below.

20.5.1 Examples in education

Algebra Tutor PAT (PUMP Algebra Tutor or Practical Algebra Tutor) developed by the Pittsburgh Advanced Cognitive Tutor Center at Carnegie Mellon University, engages students in anchored learning problems and uses modern algebraic tools in order to engage students in problem solving and in sharing of their results. The aim of PAT is to tap into a students' prior knowledge and everyday experiences with mathematics in order to promote growth. The success of PAT is well documented (ex. Miami-Dade County Public Schools Office of Evaluation and Research) from both a statistical (student results) and emotional (student and instructor feedback) perspective.[32]

Mathematics Tutor The Mathematics Tutor (Beal, Beck & Woolf, 1998) helps students solve word problems using fractions, decimals and percentages. The tutor records the success rates while a student is working on problems while providing subsequent, lever-appropriate problems for the student to work on. The subsequent problems that are selected are based on student ability and a desirable time in is estimated in which the student is to solve the problem.[33]

eTeacher eTeacher (Schiaffino et al., 2008) is an intelligent agent that supports personalized e-learning assistance. It builds student profiles while observing student performance in online courses. eTeacher then uses the information from the student's performance to suggest a personalized courses of action designed to assist their learning process.[34]

ZOSMAT ZOSMAT was designed to address all the needs of a real classroom. It follows and guides a student in different stages of their learning process. This is a student-centered ITS does this by recording the progress in a student's learning and the student program changes based on the student's effort. ZOSMAT can be used for either individual learning or in a real classroom environment alongside the guidance of a human tutor.[35]

REALP REALP was designed to help students enhance their reading comprehension by providing reader-specific lexical practice and offering personalized practice with useful, authentic reading materials gathered from the Web. The system automatically build a user model according to student's performance. After reading, the student is given a series of exercises based on the target vocabulary found in reading.[36]

CIRCSlM-Tutor CIRCSIM_Tutor is an intelligent tutoring system that is used with first year medical students at the Illinois Institute of Technology. It uses natural dialogue based, Socratic language to help students learn about regulating blood pressure.[37]

Why2-Atlas Why2-Atlas is an ITS that analyses students explanations of physics principles. The students input their work in paragraph form and the program converts their words into a proof by making assumptions of student beliefs that are based on their explanations. In doing this, misconceptions and incomplete explanations are highlighted. The system then addresses these issues through a dialogue with the student and asks the student to correct their essay. A number of iterations may take place before the process is complete.[38]

SmartTutor The University of Hong Kong (HKU) developed a SmartTutor to support the needs of continuing education students. Personalized learning was identified as a key need within adult education at HKU and SmartTutor aims to fill that need. SmartTutor provides support for students by combining Internet technology, educational research and artificial intelligence.[39]

AutoTutor AutoTutor assists college students in learning about computer hardware, operating systems and the Internet in an introductory computer literacy course by simulating the discourse patterns and pedagogical strategies of a human tutor. AutoTutor attempts to understand learner's input from the keyboard and then formulate dialog moves with feedback, prompts, correction and hints.[40]

ActiveMath ActiveMath is a web-based, adaptive learning environment for mathematics. This system strives for improving long-distance learning, for complementing traditional classroom teaching, and for supporting individual and lifelong learning.[41]

ESC101-ITS The Indian Institute of Technology, Kanpur, India developed the ESC101-ITS, an intelligent tutoring system for introductory programming problems.

20.5.2 Examples in corporate training and industry

SHERLOCK "SHERLOCK" is used to train Air Force technicians to diagnose problems in the electrical systems of F-15 jets. The ITS creates faulty schematic diagrams of systems for the trainee to locate and diagnose. The ITS provides diagnostic readings allowing the trainee to

decide whether the fault lies in the circuit being tested or if it lies elsewhere in the system. Feedback and guidance are provided by the system and help is available if requested.[42]

Cardiac Tutor The Cardiac Tutor's aim is to support advanced cardiac support techniques to medical personnel. The tutor presents cardiac problems and, using a variety of steps, students must select various interventions. Cardiac Tutor provides clues, verbal advice, and feedback in order to personalize and optimize the learning. Each simulation, regardless of whether the students were successfully able to help their patients, results in a detailed report which students then review.[43]

CODES Cooperative Music Prototype Design is a Web-based environment for cooperative music prototyping. It was designed to support users, especially those who are not specialists in music, in creating musical pieces in a prototyping manner. The musical examples (prototypes) can be repeatedly tested, played and modified. One of the main aspects of CODES is interaction and cooperation between the music creators and their partners.[44]

20.6   Effectiveness

Assessing the effectiveness of ITS programs is problematic. ITS vary greatly in design, implementation, and educational focus. When ITS are used in a classroom, the system is not only used by students, but by teachers as well. This usage can create barriers to effective evaluation for a number of reasons; most notably due to teacher intervention in student learning. Teachers often have the capability to enter new problems into the system, adjusting the curriculum and creating interactions with the students as they learn. All of these variables make evaluation of an ITS complex.[45]

Despite the inherent complexities, numerous studies have attempted to measure the overall effectiveness of ITS, often by comparisons of ITS to human tutors.[46][47][48][49] Reviews of early ITS systems (1995) showed an effect size of $d = 1.0$ in comparison to no tutoring, where as human tutors were given an effect size of $d = 2.0$.[46] Kurt VanLehn's much more recent overview (2011) of modern ITS found that there was no statistical difference in effect size between expert one-on-one human tutors and step-based ITS.[49] Some individual ITS have been evaluated more positively than others. Studies of the Algebra Cognitive Tutor found that the ITS students outperformed students taught by a classroom teacher on standardized test problems and real-world problem solving tasks.[50] Subsequent studies found that these results were particularly pronounced in students from special education, non-native English, and low-income backgrounds.[51]

Some recognized strengths of ITS are their ability to provide immediate yes/no feedback, individual task selection, on-demand hints, and support mastery learning.[49][52]

20.7   Limitations

Intelligent tutoring systems are expensive both to develop and implement. The research phase paves the way for the development of systems that are commercially viable. However, the research phase is often expensive; it requires the cooperation and input of subject matter experts, the cooperation and support of individuals across both organizations and organizational levels. Another limitation in the development phase is the conceptualization and the development of software within both budget and time constraints. There are also factors that limit the incorporation of intelligent tutors into the real world, including the long timeframe required for development and the high cost of the creation of the system components. A high portion of that cost is a result of content component building.[20] For instance, surveys revealed that encoding an hour of online instruction time took 300 hours of development time for touring content.[53] Similarly, building the Cognitive Tutor took a ratio of development time to instruction time of at least 200:1 hours.[46] The high cost of development often eclipses replicating the efforts for real world application.[54] Intelligent tutoring systems are not, in general, commercially feasible for real-world applications.[54]

A criticism of Intelligent Tutoring Systems currently in use, is the pedagogy of immediate feedback and hint sequences that are built in to make the system "intelligent". This pedagogy is criticized for its failure to develop deep learning in students. When students are given control over the ability to receive hints, the learning response created is negative. Some students immediately turn to the hints before attempting to solve the problem or complete the task. When it is possible to do so, some students bottom out the hints - receiving as many hints as possible as fast as possible - in order to complete the task faster. If students fail to reflect on the tutoring system's feedback or hints, and instead increase guessing until positive feedback is garnered, the student is, in effect, learning to do the right thing for the wrong reasons. Tutoring systems are unable to detect shallow learning and therefore, the learning for some users is not optimal.[55]

Another criticism of intelligent tutoring systems is the failure of the system to ask questions of the students to explain their actions. If the student is not learning the domain language than it becomes more difficult to gain a deeper understanding, to work collaboratively in groups, and to transfer the domain language to writing. For example, if the student is not "talking science" than it is argued that they are not being immersed in the culture of science, making it difficult to undertake scientific writing or participate in collaborative team efforts. Intelligent tutoring systems have been criticized for being too "instructivist" and removing intrinsic motivation, social learning

contexts, and context realism from learning.[56]

Practical concerns, in terms of the inclination of the sponsors/authorities and the users to adapt intelligent tutoring systems, should be taken into account.[54] First, someone must have a willingness to implement the ITS.[54] Additionally an authority must recognize the necessity to integrate an intelligent tutoring software into current curriculum and finally, the sponsor or authority must offer the needed support through the stages of the system development until it is completed and implemented.[54]

Evaluation of an intelligent tutoring system is an important phase; however, it is often difficult, costly, and time consuming.[54] Even though there are various evaluation techniques presented in the literature, there are no guiding principles for the selection of appropriate evaluation method(s) to be used in a particular context.[57][58] Careful inspection should be undertaken to ensure that a complex system does what it claims to do. This assessment may occur during the design and early development of the system to identify problems and to guide modifications (i.e. formative evaluation).[59] In contrast, the evaluation may occur after the completion of the system to support formal claims about the construction, behaviour of, or outcomes associated with a completed system (i.e. summative evaluation).[59] The great challenge introduced by the lack of evaluation standards resulted in neglecting the evaluation stage in several existing ITS'.[57][58][59]

20.8   Current and Future directions

Some aspects that human tutors can do that intelligent tutoring systems are still limited by are in the areas of dialogue and feedback. One reason for these limitations are that human tutors are able to interpret the affective state of the student. Current research has been focusing on how to improve on these areas of ITS to make it more effective.

Dialogue

Human tutors have the ability to understand a person's tone and inflection within a dialogue and interpret this to provide continual feedback through an ongoing dialogue. Intelligent tutoring systems are now being developed to attempt to simulate natural conversations. To get the full experience of dialogue there are many different areas in which a computer must be programmed; including being able to understand tone, inflection, body language, and facial expression and then to respond to these. Dialogue in an ITS can be used to ask specific questions to help guide students and elicit information while allowing students to construct their own knowledge.[60] The development of more sophisticated dialogue within an ITS has been a focus in some current research partially to address the limitations and create a more constructivist approach

to ITS.[61]

Emotional Affect

There is a growing body of work that is considering the role of affect on learning and trying to develop intelligent tutoring systems that will be able to interpret and adapt to the different emotional states.[62][63] Humans do not just use cognitive processes in learning but the affective processes they go through also plays an important role. For example, learners learn better when they have a certain level of disequilibrium (frustration), but not enough to make the learner feel completely overwhelmed.[62] This has motivated affective computing to begin to produce and research creating intelligent tutoring systems that can interpret the affective process of an individual.[62] An ITS can be developed to read an individual's expressions and other signs of affect in an attempt to find and tutor to the optimal affective state for learning. There are many complications in doing this since affect is not expressed in just one way but in multiple ways so that for an ITS to be effective in interpreting affective states it may require a multimodal approach (tone, facial expression, etc...).[62] These ideas have created a new field within ITS, that of Affective Tutoring Systems (ATS).[63] One example of an ITS that addresses affect is Gaze Tutor which was developed to track students eye movements and determine whether they are bored or distracted and then the system attempts to reengage the student.[64]

20.9   ITS conference

The Intelligent Tutoring Systems conference was created in 1988 by Claude Frasson (Canada) and is typically held every other year, opposite the International Conference on Artificial Intelligence in Education.[65] It was hosted in Montreal (Canada) by Claude Frasson and Gilles Gauthier, in 1988, 1992, 1996 and 2000; in San Antonio (US) by Carol Redfield and Valerie Shute in 1998; in Biarritz (France) and San Sebastian (Spain) by Guy Gouardères and Stefano Cerri in 2002; in Maceio (Brazil) by Rosa Maria Vicari and Fábio Paraguaçu in 2004; in Jhongli (Taiwan) by Tak-Wai Chan in 2006. The conference was back in Montreal in 2008 (for its 20th anniversary) and hosted by Roger Nkambou and Susanne Lajoie. ITS 2010 was held in Pittsburgh (US), hosted by Jack Mostow, Judy Kay, and Vincent Aleven. ITS 2012 (http://its2012.its-conferences.com) was held in Chania (Crete), hosted by George Papadourakis, Stefano Cerri and William Clancey. ITS 2014 (http://its2014.its-conferences.com) was held in Honolulu(Hawaii), hosted by Martha Crosby, Stefan Trausan-Matu and Kristy Elizabeth Boyer. The International Artificial Intelligence in Education (AIED) Society publishes The International Journal of Artificial Intelligence in Education (IJAIED) and produces the International Conference on Artificial Intelligence in Education (http://iaied.org/conf/1/) every odd numbered

year. The American Association of Artificial Intelligence (AAAI) will sometimes have symposia and papers related to intelligent tutoring systems. A number of books have been written on ITS including three published by Lawrence Erlbaum Associates.

20.10 See also

- Educational technology
- Instructional technology
- Learning objects
- Serious games
- Educational data mining

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- Freedman, Reva (2000). "What is an Intelligent Tutoring System?". *Intelligence* **11** (3): 15–16. doi:10.1145/350752.350756.

- Intelligent Tutoring Systems: Using AI to Improve Training Performance and ROI

- A Framework for Model-Based Adaptive Training

- A Conceptual Framework for Internet based Intelligent Tutoring Systems

- Intelligent Tutoring Systems with Converersational Dialogue

- ELM-ART: An intelligent tutoring system on world wide web

- The defining characteristics of intelligent tutoring systems research: ITSs care, precisely

- Authoring Intelligent Tutoring Systems: An analysis of the state of the art

- Cognitive modeling and intelligent tutoring

- Intelligent Tutoring Goes To School in the Big City

- Adaptive Hypermedia: From Intelligent Tutoring Systems to Web-Based Education

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20.13   External links

- Intelligent Tutoring Systems in the AI topics website of the Association for the Advancement of Artificial Intelligence

- The 11th International Conference on Intelligent Tutoring Systems - Co-adaptation in Learning - Chania (2012)

- The 10th International Conference on Intelligent Tutoring Systems - Bridges to Learning - Pittsburgh (2010)

- The 9th International Conference on Intelligent Tutoring Systems - Intelligent Tutoring Systems: Past and Future - Montreal (2008)

- The 8th International Conference on Intelligent Tutoring Systems (2006)

- The 2007 Artificial Intelligence in Education conference.

- MERLOT - Multimedia Educational Resource for Learning and Online Teaching

Chapter 21

Serious game

A **serious game** or **applied game** is a game designed for a primary purpose other than pure entertainment. The "serious" adjective is generally prepended to refer to products used by industries like defense, education, scientific exploration, health care, emergency management, city planning, engineering, and politics.

21.1 Definition and scope

Serious games are simulations of real-world events or processes designed for the purpose of solving a problem. Although serious games can be entertaining, their main purpose is to train or educate users, though it may have other purposes, such as marketing or advertisement. Serious game will sometimes deliberately sacrifice fun and entertainment in order to achieve a desired progress by the player. Serious games are not a game genre but a category of games with different purposes. This category includes some educational games and advergames, political games, or evangelical games.[1] Serious games are primarily focused on an audience outside of primary or secondary education.

21.2 Overview

The term "serious game" has been used long before the introduction of computer and electronic devices into entertainment. Clark Abt discussed the idea and used the term in his 1970 book *Serious Games*,[2] published by Viking Press. In that book, his references were primarily to the use of board and card games. But he gave a useful general definition which is still considered applicable in the computer age:

> Reduced to its formal essence, a game is an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context. A more conventional definition would say that a game is a context with rules among adversaries trying to win objectives. We are concerned with serious games in the sense that these games have an

explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement.

It is not a new idea. Military officers have been using war games in order to train strategic skills for a long time. One early example of a serious game is a 19th-century Prussian military training game called *Kriegsspiel*, the German name for wargame.

Mike Zyda provided an update and a logical approach to the term in his 2005 article in *IEEE Computer* entitled, "From Visual Simulation to Virtual Reality to Games". Zyda's definition begins with "game" and proceeds from there:

- Game: "a physical or mental contest, played according to specific rules, with the goal of amusing or rewarding the participant."

- Video Game: "a mental contest, played with a computer according to certain rules for amusement, recreation, or winning a stake."

- Serious Game: "a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives."

Long before the term "serious game" came into wide use with the Serious Games Initiative in 2002, games were being made for non-entertainment purposes. The continued failure of the edutainment space to prove profitable, plus the growing technical abilities of games to provide realistic settings, led to a re-examination of the concept of serious games in the late 1990s. During this time, a number of scholars began to examine the utility of games for other purposes, contributed to the growing interest in applying games to new purposes. Additionally, the ability of games to contribute to training expanded at the same time with the development of multi-player gaming. In 2002, the Woodrow Wilson International Center for Scholars in Washington D.C. launched a "Serious Games Initiative" to encourage the development of games that address policy and management issues. More focused

sub-groups began to appear in 2004, including Games for Change which focuses on social issues and social change, and Games for Health which addresses health care applications.

Other authors, though, (as Jeffery R. Young) consider that Serious Games didn't obtain the success that was expected, and new theories, like "Smart Gaming" have appeared to replace it.

There is no single definition of serious games, though they are generally held to be games used for training, advertising, simulation, or education. Alternate definitions include the application of games concepts, technologies and ideas to non-entertainment applications. This can also include specific hardware for video games, such as exergaming.

Serious games are aimed for a large variety of audiences, including primary or secondary education, professionals and consumers. Serious games can be of any genre, use any game technology, and be developed for any platform. Some may consider them a kind of edutainment; however, the mainstay of the community are resistant to this term.

A serious game is not a simulation alone. It may be a simulation combined with elements of game-play, specifically a chance to win. All have the look and feel of a game, a chance to win, but correspond to non-game events or processes from the real world, including business operations and military operations (even though many popular entertainment games depicted business and military operations). The games are made to provide an engaging, self-reinforcing context in which to motivate, educate and train the players. Other purposes for such games include marketing and advertisement. The largest users (unsubstantiated by business intelligence) of serious games appear to be the US government and medical professionals. Other commercial sectors are actively pursuing development of these types of tools as well.

21.3   History

Gaming has been used in educational circles since at least the 1900s. Use of paper-based educational games became popular in the 1960s and 1970s, but waned under the Back to Basics teaching movement.[3] (The Back to Basics teaching movement is a change in teaching style that started in the 1970s when students were scoring poorly on standardized tests and exploring too many electives. This movement wanted to focus students on reading, writing and arithmetic and intensify the curriculum.[4]) With the proliferation of computers in the 1980s, the use of educational games in the classroom became popular with titles that included Oregon Trail, Math Blaster, and Number Munchers. Though these games were popular among teachers and students, they were also criticized due to the fact that they did not provide the

player with new kinds of learning, and instead provided a "slightly easier-to-swallow version of drill-and-practice" learning.[5]

In the 1990s, newer games such as The Incredible Machine and the Dr. Brain series were introduced to challenge kids to think in new ways, apply their current skills, and learn new ones, but these games were unpopular among teachers because it was difficult to map these newer games to their curriculum, especially in a high school setting where in-class time is at a premium. The 1990s also saw the Internet being introduced to schools, which with limited computer resources took precedence over playing games.[5]

The early 2000s saw a surge in different types of educational games, especially those designed for the younger learner. Many of these games were not computer-based but took on the model of other traditional gaming system both in the console and hand-held format. In 1999, LeapFrog Enterprises introduced the LeapPad, which combined an interactive book with a cartridge and allowed kids to play games and interact with a paper-based book. Based on the popularity of traditional hand-held gaming systems like Nintendo's Game Boy, they also introduced their hand-held gaming system called the Leapster in 2003. This system was cartridge-based and integrated arcade–style games with educational content.[6]

In 2001, Henry Jenkins, Director of Comparative Media Studies and Randy Hinrichs, Group Research Manager for Learning Science and Technology group were co-principal investigators working on a project known as Games-to-Teach. Games-to-Teach inspired the serious gaming initiatives that followed. The partnership between MIT and Microsoft developed conceptual prototypes for interactive serious gaming, with Kurt Squire, now professor at University of Wisconsin as principal PhD candidate working on the project. The MIT iCampus project lasted for six years. During this time, serious games were created with several faculty members using role playing techniques, mobile technologies, physics based racing games to teach physics, and other experiences. Topics included media in science, engineering education, education in media, complex system dynamics, and collaboration. Hephaestus was a massively multiplayer Xbox online mechanical engineering game. Environmental detectives used handheld PCs to investigate health problems in the city of Boston. Biohazard was codeveloped with Carnegie Mellon University, MIT and Microsoft Research. Players worked collaboratively with first responders to a chemical attack in a subway. This was a multiplayer RPG designed for the PC/Xbox in which sources of epidemic outbreaks were investigated to determine how to control crowds and deliver decontamination treatments and manage resources efficiently. Hinrichs began the award winning company 2b3d.net to build serious games in health, business, education and created the first Certificate in Virtual Worlds at the University of

Washington to build curriculum around how to engage avatars in serious game environments. Henry Jenkins joined USC as Professor of Communication, Journalism, Cinematic Arts and Education. Jenkins has played a significant role in demonstrating the importance of new media technologies in educational settings.

In 2002 another movement had started outside of formal educational sector that was coined as the "serious game movement," which originated from the Woodrow Wilson International Center for Scholars, where David Rejecsk and Ben Sawyer started the initiative. The primary consumer and producer of serious games is the United States Military, which needs to prepare their personnel for enter a variety of environments, cultures, and situations. They need to understand their surroundings, be able to communicate, use new technologies and quickly make decisions.[5] The first serious game is often considered to be *Army Battlezone*, an abortive project headed by Atari in 1980, designed to use the *Battlezone* tank game for military training.[7] Two other well known serious games that were commissioned by the Army are America's Army (2002) and Full Spectrum Warrior (2004).

Outside of the government, there is substantial interest in serious games for formal education, professional training, healthcare, advertising, public policy and social change. For example, games from websites such as Newsgaming.com are "very political games groups made outside the corporate game system" that are "raising issues through media but using the distinct properties of games to engage people from a fresh perspective," says Henry Jenkins, the director of MIT's comparative media studies program. Such games, he said, constitute a "radical fictional work."[1]

21.4 Development

In recent years, the US government and military have periodically looked towards game developers to create low-cost simulations that are both accurate and engaging. Game developers' experience with gameplay and game design made them prime candidates for developing these types of simulations which cost millions of dollars less than traditional simulations, which often require special hardware or complete facilities to use.

Advantages to this include:

- Video and computer game developers are accustomed to developing games quickly and are adept at creating games that simulate—to varying degrees—functional entities such as radar and combat vehicles. Using existing infrastructure, game developers can create games that simulate battles, processes and events at a fraction of the cost of traditional government contractors.

- Traditional simulators usually cost millions of dollars not only to develop, but also to deploy, and generally require the procurement of specialized hardware. The costs of media for serious games is very low. Instead of volumes of media or computers for high-end simulators, SGs require nothing more than a DVD or even a single CD-ROM, exactly like traditional computer and video games require. Deploying these to the field requires nothing more than dropping them in the mail or accessing a dedicated web site.

- While SGs are meant to train or otherwise educate users, they often hope to be engaging. Game developers are experienced at making games fun and engaging as their livelihood depends on it. In the course of simulating events and processes, developers automatically inject entertainment and playability in their applications.

21.5 Research and education

Health education is a particular area where results have been observed by the use of serious games "Video games, enhanced by behavior-change technology and motivating story lines, offer promise for promoting diet and physical activity change for diabetes and obesity prevention in youth." (Thompson).

Intrinsic motivation is another feature provided by serious games that facilitates education. To produce motivation four characteristics are provided by serious games "challenge, curiosity, control and the imagination / imaginary (fantasy)" (Mouaheb). These four characteristics create a particular advantage "in an educational context the game is likely to make the learning process interesting in itself to obtain the greatest motivation in the learner" (Mouaheb).

The dynamic nature of virtual environments also causes "active participation by the player" (Mouaheb). Active participation leads to "a fertile ground for the generation of real cognitive conflicts ensuring a personal and solid build of knowledge" (Mouaheb). Another researcher confirms this view "computer games are more engaging, motivating and interesting by virtue of their interaction, rich universes, challenges and safety" (Egenfeldt-Nielsen).

The combination of all these factors leads to significant benefits "retention increases when using computer games compared to other teaching" (Egenfeldt-Nielsen). The use of reward in a behavioral sense is also a powerful tool in serious games "the video game will ask a question and the player will answer. When students link the question and the answer enough times, reinforced by a reward, learning will occur" (Egenfeldt-Nielsen).

Limited studies have been performed to compare the effectiveness of serious games to other learning formats.

One such study comparing games to an educational video found that "The children playing the video game expressed more enjoyment and learned the same as those watching the television program" (Egenfeldt-Nielsen). Studies have shown that games can have a strong effect on day-to-day health management. In one study, children who played a game about healthy living principles had "a 77 percent drop in visits to urgent care and medical visits in the experimental group compared with the control group" (Egenfeldt-Nielsen).

21.6 Classification

The classification of serious games is something that is yet to solidify, there are however a number of terms in reasonably common use for inclusion here.

Advergames The use of games for advertising. The approach can include numerous different ways of advertising more or less well-known from other media. You can have product placement, banners in-game or just traffic triggers.

Edutainment A combination of education and entertainment.

Games-Based Learning or "Game Learning" These games have defined learning outcomes. Generally they are designed in order to balance the subject matter with the gameplay and the ability of the player to retain and apply said subject matter to the real world.[8] For example, in soft skills training like Merchants and Triskelion

Edumarket Games When a serious game combines several aspects (such as advergaming and edutainment aspects or persuasive and news aspects), the application is an Edumarket game. For example, *Food Force* combines news, persuasive and edutainment goals.

Newsgames Journalistic games that report on recent events or deliver an editorial comment. Examples include *September 12th*[9]

Simulations or Simulation Games Games used for the acquisition or exercise of different skills, to teach effective behavior in the context of simulated conditions or situations. In practice, are widely used simulation driving different vehicles (cars, trains, airplanes; e.g. *FlightGear*), simulation of management of specific industries (e.g. *Transport Tycoon*), and universal business simulation, developing strategic thinking and teaching users the basics of macro-and microeconomics, the basics of business administration (e.g. *Virtonomics*).

Persuasive Games Games used as persuasion technology

Organizational-dynamic games Teach and reflect the dynamics of organizations

Games for Health Such as games for psychological therapy, cognitive training, emotional training[10] or physical rehabilitation uses.[11] Technology and mental health issues can use Serious Games to make therapy accessible to adolescents who would otherwise would not find a psychotherapist approachable.

Exergaming Games that are used as a form of exercise.

Art Games Games used to express artistic ideas or art produced through the medium of video games

Productivity game Games which reward points for accomplished real-world tasks using to-do lists.

Training See Gamification.

Games with a purpose Try to solve various tasks that require common sense or human experience in an entertaining setting.

Additionally Julian Alvarez and Olivier Rampnoux (from the European Center for Children's Products, University of Poitiers) have attempted to classify serious games in 5 main categories: Advergaming, Edutainment, Edumarket game, Diverted game and Simulation game.[12]

21.7 Examples

- *A Force More Powerful* (Windows) The video game is designed to teach the waging of conflict using nonviolent methods. Intended for use by activists and leaders of nonviolent resistance and opposition movements.

- *Amnesty the game* (Facebook and internet) a game that supports Amnesty International efforts to worldwide abolish the death penalty.

- *Beer distribution game* (offline as well as online) a simulation game created by a group of professors of MIT in the early 1960s aimed at illustrating important supply chain management principles, such as the bullwhip effect.

- *Close Combat: Marines*: the first version of the *Close Combat* universe made specifically for military training purposes. Forces consist of USMC and OpFor troops.

- *CyberCIEGE* (Microsoft Windows): Computer network security sim game developed by the Naval Postgraduate School. Players protect assets while enabling "users" to achieve their goals.

- *Darfur is Dying* (Internet) An online game by mtvU that simulates life in a Darfur refugee camp.

- *DARWARS Ambush! Convoy Simulator* developed as part of DARPA's DARWARS project, designed to create low-cost experiential training systems

- *Democracy* A political strategy game, that simulates the process of government through simulated policies, laws voters and other variables. Used by a number of US / European schools and other institutions.

- *EteRNA*, (Internet) a game in which players attempt to design RNA sequences that fold into a given configuration. Designs are evaluated to improve computer models predicting RNA folding, included selected designs actually synthesized to evaluate RNA folding dynamics against computer predictions.

- *FloodSim* (Internet) A flood prevention simulation/strategy game designed to inform the people of the United Kingdom about the dangers of flooding as well as to help gather public opinion on the problem that flooding presents to the UK. The player takes control of the UK's flood policies for three years and attempts to protect the people and the economy of the United Kingdom from damage due to floods.

- *Foldit* (Windows, Linux, Mac) Protein folding, puzzle game where results can be used in real science.

- *Food Force* (Mac/Windows) Humanitarian video game. The UN's World Food Programme designed this virtual world of food airdrops over crisis zones and trucks struggling up difficult roads under rebel threat with emergency food supplies.

- *Freedom: The Underground Railroad* A cooperative strategy board game that has players working together as Abolitionists to help bring an end to slavery in the United States.

- *Genomics Digital Lab* (Mac/Windows) A series of interactive science games where users learn about the importance of plants and their contribution to energy and the environment.

- *Global Conflict: Palestine* (Mac/Windows): A 3D-adventure/rpg-game. You are given the role of a reporter in Jerusalem, and have to write articles for your paper.

- *HabitRPG* (Internet) A habit building program that treats your life like a Role Playing Game.

- *Harpoon* (Mac/Windows): Entertainment version was "dual use" from 1989 forward. Professional version *Harpoon 3 Professional* created in 2002 with help from Australian Defense Department, updated in 2006.

- *History of Biology game* (Mac/Windows): History of Biology is a browser based scavenger hunt style educational game designed to teach high school students and general interest groups about the history of biology covering topics such as early microscopes, classification, taxonomy, heredity, genetics, and evolution.

- *Houthoff Buruma The Game*: serious game for recruitment purposes, developed by Dutch law firm Houthoff Buruma.

- *IBM CityOne* (Internet): designed by IBM as part of the *IBM Smarter Planet initiative*. The game is designed to educate the player of the complex systems and how they connect in a modern city.

- *IntelliGym* (Mac/Windows/Linux): A series of computer based cognitive simulators that trains athletes and designed to enhance brain skills associated with sports-related performance.

- *Merchants*: A video game designed by Gamelearn to learn and train negotiation skills.

- *Microsoft Flight Simulator* (Microsoft Windows) developed as a comprehensive simulation of civil aviation. Notably one of the few flight simulation games that does not concentrate on simulation of aerial warfare.

- *NanoMission* (Microsoft Windows): A series created for the non-profit group Científica in order to teach about nanomedicine, nanotechnology and associated concepts through a series of action games.

- *Novicraft HRD game* (Microsoft Windows): NoviCraft is a serious game for supporting business customers in social excellence, in learning to construct shared understanding together with different people in changing contexts.

- *Peacemaker* (Mac/PC) A commercial game simulation of the Israeli-Palestinian conflict designed to promote "dialog and understanding among Israelis, Palestinians and interested people around the world".

- *Phylo* (Internet): A game that invites players to give in to their addictive gaming impulses while contributing to the greater good by trying to decode the code for genetic diseases.[13]

- *Re-Mission* (Microsoft Windows): 3-D Shooter to help improve the lives of young persons living with cancer.

- *Ship Simulator* (Microsoft Windows): a simulator which simulates maneuvering various ships in different environments, although without the effects of wind and current.

- *SimPort* (Mac/Windows): A simulation game in which players learn about the intricacies involved in construction large infrastructure projects, like a major sea port.

- *SimulTrain* (Mac/Windows/Online): A project management simulation of the planning and execution phases of a medium-sized project for a team of four people.

- *Steel Beasts Professional* (Microsoft Windows): Tank simulator, developed by eSim Games, and used by several armies around the world.

- *Triskelion*: A video game designed by Gamelearn to learn and train time management skills.

- *VBS1* & *VBS2* Training tool for the British Military and the USMC and other military forces around the world. Developed by BIA, and based on the game engine used in *Operation Flashpoint* and *Armed Assault*.

- *X-Plane* (Linux/Mac/Windows): a comprehensive civil aviation simulator. An FAA approved version exists which enables low cost flight training.

21.8   See also

- Educational video game

- Edutainment

- Business game

- Business simulation game

- Brain fitness

- Games for Change

- Game with a purpose

- Gamification

- Gamification of learning

- Global warming game

- Innovation game

- Intelligent tutoring system

- International Simulation and Gaming Association

- Learning objects

- Serious Games Showcase and Challenge

- State of Play (conference series)

- Technology and mental health issues

- Transreality gaming

- g-learning

- Gamelearn

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Chapter 22

Sharable Content Object Reference Model

Sharable Content Object Reference Model (**SCORM**) is a collection of standards and specifications for web-based electronic educational technology (also called e-learning). It defines communications between client side content and a host system (called "the run-time environment"), which is commonly supported by a learning management system. SCORM also defines how content may be packaged into a transferable ZIP file called "Package Interchange Format."[1]

SCORM is a specification of the Advanced Distributed Learning (ADL) Initiative from the Office of the United States Secretary of Defense.

SCORM 2004 introduced a complex idea called sequencing, which is a set of rules that specifies the order in which a learner may experience content objects. In simple terms, they constrain a learner to a fixed set of paths through the training material, permit the learner to "bookmark" their progress when taking breaks, and assure the acceptability of test scores achieved by the learner. The standard uses XML, and it is based on the results of work done by AICC, IMS Global, IEEE, and Ariadne.

22.1 SCORM versions

22.1.1 SCORM 1.1

SCORM 1.1 is the first production version. It used a Course Structure Format XML file based on the AICC specifications to describe content structure, but lacked a robust packaging manifest and support for metadata. Quickly abandoned in favor of SCORM 1.2.

22.1.2 SCORM 1.2

This was the first version that was widely used. It is still widely used and is supported by most Learning Management Systems.

22.1.3 SCORM 2004

This is the current version. It is based on new standards for API and content object-to-runtime environment communication, with many ambiguities of previous versions resolved. Includes ability to specify adaptive sequencing of activities that use the content objects. Includes ability to share and use information about the success status for multiple learning objectives or competencies across content objects and across courses for the same learner within the same learning management system. A more robust test suite helps ensure good interoperability.

SCORM 2004 editions

- 3rd Edition (October 2005) — clarification of various conformance requirements and of the interaction between content objects and the runtime environment for sequencing; some new conformance requirements to improve interoperability.

- 4th Edition Released (March 31, 2009) — more stringent interoperability requirements, more flexible data persistence.[2]

SCORM 2004 specification books

- Overview — introduces SCORM and describes how the other books relate

- Run-Time Environment — describes runtime API and data model used for communication between content objects and learning management systems

- Sequencing and Navigation — describes how sequencing between learning activities is defined and interpreted

- Compliance Requirements — detailed list of the conformance requirements that are verified by the ADL SCORM conformance test suite.

22.1.4 Experience API (Tin Can API)

The Experience API (also known as xAPI or Tin Can API) was finalized to version 1.0 in April 2013. The Experience API solves many of the problems inherent with older versions of SCORM.[3] Just like SCORM, ADL is the steward of the Experience API. AICC with their CMI-5 planned to use xAPI as their transport standard, but AICC membership decided to dissolve the organization and transferred CMI-5 to ADL.[4]

The Experience API (Tin Can API) is a web service that allows software clients to read and write experiential data in the form of "statement" objects. In their simplest form, statements are in the form of "I did this", or more generally "actor verb object". More complex statement forms can be used. There is also a built-in query API to help filter recorded statements, and a state API that allows for a sort of "scratch space" for consuming applications. Experience API statements are stored in a data store called a Learning Record Store, which can exist on its own or within a Learning Management System.[5]

22.2 SCORM timeline

- January 1999 — Executive Order 13111 signed tasking the DoD to develop common specifications and standards for e-learning across both federal and private sectors

- January 2000 — SCORM Version 1.0

- January 2001 — SCORM Version 1.1

- October 2001 — SCORM Version 1.2

- January 2004 — SCORM 2004 (1st Edition)

- July 2004 — SCORM 2004 (2nd Edition)

- June 2006 — Department of Defense Instruction (DoDI) 1322.26 Requiring DoD Use of SCORM

- October 2006 — SCORM 2004 (3rd Edition)

- March 2009 — SCORM 2004 (4th Edition)

- 2009 — The first three specification books were adopted as technical reports by ISO/IEC JTC1/SC36, standard number ISO/IEC TR 29163.

- October 2010 — ADL awards a Broad Agency Announcement to Rustici Software to conduct research and community interviews in an effort to begin the creation of the next generation of SCORM. This is called Project Tin Can.

- September 2011 — The initial draft of the next generation of SCORM (named the Tin Can API) is released.

- June 2012 — .9 version of the Tin Can API is released.

- August 2012 — .95 version of the Tin Can API is released.

- April 2013 — 1.0.0 version is released, project name was changed to "Experience API" or xAPI, but many still refer to it as the Tin Can API.

22.3 See also

- ADL Registry

- Authoring tool

- Computer aided instruction

- Educational technology

- Educational technology (electronic educational technology is also called e-learning)

- LETSI

- SLOOP Project

- Experience API

22.4 External links

- Official website

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Chapter 23

E-learning

For the use of all types of technology, including electronic technologies, in learning and education, see Educational technology. For a list of articles on learning theory, see Learning theory (disambiguation).

E-learning (or eLearning) is the use of electronic educational technology in learning and teaching.

information and communication technology (ICT) in education, EdTech, learning technology, multimedia learning, technology-enhanced learning (TEL), computer-based instruction (CBI), computer managed instruction, computer-based training (CBT), computer-assisted instruction or computer-aided instruction (CAI), internet-based training (IBT), flexible learning, web-based training (WBT), online education, virtual education, virtual learning environments (VLE) (which are also called learning platforms), m-learning, and digital education.[1] In usage, all of these terms appear in articles and reviews; the term "e-learning" is used frequently, but is variously and imprecisely defined and applied.[2][3][4]

These alternative terms are all linguistically more restrictive than "educational technology" in that they refer to the use of modern tools, such as computers, digital technology, electronic media, networked digital devices and associated software and courseware with learning scenarios, worksheets and interactive exercises that facilitate learning. However, these alternative names individually emphasize a particular digitization approach, component or delivery method. Accordingly, each conflates to the broad domain of educational technology. For example, m-learning *emphasizes* mobility, but is otherwise indistinguishable *in principle* from educational technology.

23.1 History, theory, types of media and information and communication technologies, and usage settings

Main article: Educational technology

The origin or etymology of e-learning is contested, with the e- part not necessarily meaning electronic as per e-mail or e-commerce. Coined between 1997 and 1999, e-learning became first attached to either a distance learning service[5] or it was used for the first time at the CBT systems seminar.[6] Since then the term has been used extensively to describe the use of online, personalised, interactive or virtual education.

Bernard Luskin, an educational technology pioneer, advocated that the "e" of e-learning should be interpreted to mean "exciting, energetic, enthusiastic, emotional, extended, excellent, and educational" in addition to "electronic." [3] Parks suggested that the "e" should refer to "everything, everyone, engaging, easy".[4] These broad interpretations focus on new applications and developments, as well as learning theory and media psychology.

Moore *et al* found "significant variation in the understanding and usage of terms used in this field" and pointed to "implications for the referencing, sharing and collaboration of results."[2] In usage, e-learning is an extremely significant (but incomplete) subset of educational technology. As such, various aspects of e-learning are discussed in that article.

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23.3 External links

- UNESCO Guide To Measuring Information And Communication Technologies (ICT) In Education

- European Foundation for Quality in eLearning (EFQUEL)

- eLearning wiki: table of contents

Chapter 24

M-learning

m-learning or **mobile learning** is defined as "learning across multiple contexts, through social and content interactions, using personal electronic devices."[1]:page 4 A form of e-learning distance education, m-learners can use mobile device educational technology in many locations at their time convenience.[2]

M-learning technologies include handheld computers, MP3 players, notebooks, mobile phones and tablets. M-learning focuses on the mobility of the learner, interacting with portable technologies. Using mobile tools for creating learning aids and materials becomes an important part of informal learning.[3]

M-learning is convenient in that it is accessible from virtually anywhere. Sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips. This highly active process has proven to increase exam scores from the fiftieth to the seventieth percentile, and cut the dropout rate in technical fields by 22 percent.[4] M-learning also brings strong portability by replacing books and notes with small devices, filled with tailored learning contents.

The use of mobile learning in the military is becoming increasingly common due to low cost and high portability.

24.1 Background

Mobile learning is the delivery of learning, education or learning support on mobile phones, PDAs or tablets.

New mobile technology, such as hand-held based devices, is playing a large role in redefining how we receive information. The recent advances in mobile technology are changing the primary purpose of mobile devices from making or receiving calls to retrieving the latest information on any subject. "Numerous agencies including the Department of Defense (DoD), Department of Homeland Security (DHS), Intelligence community, and law enforcement are utilizing mobile technology for information management." [5]

24.2 Approaches

24.2.1 Classroom

Classroom applications combine the use of handheld computers, PDAs, smartphones or handheld voting systems (such as clickers) with traditional resources. (Tremblay 2010).

Class management

Mobile devices(such as a Pocket PC) in the classroom can be used to enhance group collaboration among students through communication applications, interactive displays, and video features.[6]

- Existing mobile technology can replace cumbersome resources such as textbooks, visual aids, and presentation technology.[7]

- Interactive and multi-mode technology allows students to engage and manipulate information.

- Mobile Device features with WIFI capabilities allow for on-demand access to information.[7]

- Access to classroom activities and information on mobile devices provides a continuum for learning inside and outside the classroom.[8]

In a literature review conducted by FutureLab, researchers found that increased communication, collaboration, and understanding of concepts was a result of mobile technology applications.[8]

Class management

Mobile devices can be used in brick-and-mortar or online settings to enhance learning experiences.[9]

- The mobile phone (through text SMS notices) can be used especially for distance education or with students whose courses require them to be highly mobile and in particular to communicate information regarding availability of assignment results, venue changes and cancellations, etc. It can also be of value to business people, e.g. sales representatives who do not wish to waste time away from their busy schedules to attend formal training events.

- Mobile devices facilitate online interaction between instructor and student, and student to student.

- Blended learning takes the classroom out of a traditional brick-and-mortar setting. Students become part of virtual communities used for collaboration. Blended learning transitions away from a traditional teaching environment to a customized and interactive web platform for the user [8]

Podcasting

Podcasting consists of listening to audio recordings of lectures. It can be used to review live lectures (Clark & Westcott 2007) and to provide opportunities for students to rehearse oral presentations. Podcasts may also provide supplemental information to enhance traditional lectures (McGarr 2009) (Steven & Teasley 2009).

Psychological research suggests that university students who download podcast lectures achieve substantially

higher exam results than those who attend the lecture in person (only in cases in which students take notes) (Callaway & Ewen 2009).

Podcasts may be delivered using syndication, although this method of delivery is not always easily adopted (Lee, Miller & Newnham 2009).

24.2.2 At work

M-learning in a workplace can be very different from a school's context. Although employees do occasionally attend face to face training events, the majority of work-based learning happens on the job, often at the moment of need. Because of this, m-learning is being used in a wider range of modes:

- On the job training for someone who accesses training on a mobile device.

- Just in time training to solve a problem or gain an update.

- Performance support. Immediate access to tools to streamline a work-task

- Reference guides and ebooks

- Checklists

Due to the very diverse training needs across a large organisation, self-serve learning is more common than is found at the school, or college level. Mobile is seen as an effective way to reach a large number of employees easier and more effectively.[10]

24.2.3 Lifelong learning and self-learning

Mobile technologies and approaches, i.e. Mobile Assisted Language Learning (MALL), are also used to assist in language learning. For instance handheld computers, cell phones, and podcasting (Horkoff Kayes2008) have been used to help people acquire and develop language skills.

24.2.4 Other

- Improving levels of literacy, numeracy, and participation in education amongst young adults.

- Using the communication features of a mobile phone as part of a larger learning activity, e.g.: sending media or texts into a central portfolio, or exporting audio files from a learning platform to your phone.

- Developing workforce skills and readiness among youth and young adults.[11]

24.3   Analysis

24.3.1   Value

The value of mobile learning[12]—Tutors who have used m-learning programs and techniques have made the following value statements in favor of m-learning.

- It is important to bring new technology into the classroom.

- Devices used are more lightweight than books and PCs.

- Mobile learning can be used to diversify the types of learning activities students partake in (or a blended learning approach).

- Mobile learning supports the learning process rather than being integral to it.

- Mobile learning can be a useful add-on tool for students with special needs. However, for SMS and MMS this might be dependent on the students' specific disabilities or difficulties involved.

- Mobile learning can be used as a 'hook' to re-engage disaffected youth.

Benefits [2][13][14]

- Relatively inexpensive opportunities, as the cost of mobile devices are significantly less than PCs and laptops

- Multimedia content delivery and creation options

- Continuous and situated learning support

- Decrease in training costs

- Potentially a more rewarding learning experience

24.3.2   Challenges

Technical challenges include

- Connectivity and battery life

- Screen size and key size[15]

- Meeting required bandwidth for nonstop/fast streaming

- Number of file/asset formats supported by a specific device

- Content security or copyright issue from authoring group

- Multiple standards, multiple screen sizes, multiple operating systems

- Reworking existing E-Learning materials for mobile platforms

- Limited memory[16]

- Risk of sudden obsolescence [17]

Social and educational challenges include

- Accessibility and cost barriers for end users: Digital divide.

- How to assess learning outside the classroom

- How to support learning across many contexts[18]

- Content's security or pirating issues

- Frequent changes in device models/technologies/functionality etc.

- Developing an appropriate theory of learning for the mobile age

- Conceptual differences between e-learning and m-learning

- Design of technology to support a lifetime of learning[19][20]

- Tracking of results and proper use of this information

- No restriction on learning timetable

- Personal and private information and content

- No demographic boundary

- Disruption of students' personal and academic lives[21]

- Access to and use of the technology in developing countries[22]

- Risk of distraction [2]

24.3.3   Growth

Over the past ten years mobile learning has grown from a minor research interest to a set of significant projects in schools, workplaces, museums, cities and rural areas around the world. The m-learning community is still fragmented, with different national perspectives, differences between academia and industry, and between the school, higher education and lifelong learning sectors.[23]

Current areas of growth include:

- Testing, surveys, job aids and just-in-time (J.I.T.) learning

- Location-based and contextual learning

- Social-networked mobile learning

- Mobile educational gaming

- Delivering m-Learning to cellular phones using two way SMS messaging and voice-based CellCasting (podcasting to phones with interactive assessments) [23]

- Cloud computer file storage [13]

24.4 See also

- E-learning

- Instructional simulation

- mHealth

- Offline mobile learning

- Smartphone

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Chapter 25

Offline mobile learning

Offline mobile learning refers to the ability to access learning materials on a mobile device without requiring an Internet connection.

Generally, web-based applications functionalities are dependent on ability to access to the Web. While there are many practical reasons why the application require an access to the data on server, every feature of an application may not necessarily need to have such real-time access and therefore it may be possible to enhance the user experience and wider applicability of application by providing offline access to certain features.

Before choosing which features to support locally (offline) and when to connect to the server, simply list all the features of your application as in Table 1 below and identify the need.

Table 1: List of features of web application and identifying need of connectivity.

Tasks that require a single service request are well suited to offline scenarios. Such tasks follow a "compose and forward" model, where the user specifies all of the required data for the service request, which is then forwarded to the actual service when the client reconnects. Examples of this type of task are: composing an e-mail, composing a meeting request, and entering order information. All of these tasks are discrete items that the user can complete offline and that result in a single service request.[1]

25.1 Mobile Learning: Developing Countries

The developed world's emphasis on highly sophisticated technological devices is a futuristic dream for most developing countries.[2] Nevertheless, these countries realise that M-Learning is more than just using a mobile device for E-Learning, and that it requires an entirely different approach. In order to utilize M-Learning efficiently in these developing countries, there is a need to understand this approach, as technology becomes available.

These mobile technologies have successfully enabled learning opportunities and support to those learners in developing countries who are situated far distances away from educational facilities, and do not have the infrastructure to support access.

Most developing countries do not have an extensive infrastructure to support M-Learning, and this makes it more complicated to implement it in these countries. However, these developing worlds still maintain similar needs for M-Learning as developed countries do. Ken Masters (2004) proposes that the lack of infrastructure should be no reason for developing countries to delay implementing M-Learning. It is essential, that if the need exists, institutions within these developing countries should establish and commence mobile learning efforts as soon as possible.

Users in developing countries have the same need for M-Learning to be mobile, accessible and affordable, as those in developed countries do. The very significance of M-Learning is its ability to make learning mobile, away from the classroom or workplace. These Wireless and mobile technologies enable learning opportunities to learners who do not have direct access to learning in these places. Many learners in developing countries have trouble accessing the internet, or experience difficulty in affording technology that enables learning in an E-Learning environment. Mobile devices are a cheaper alternative compared to traditional E-Learning equipment such as PC's and Laptops.

However, to fully utilize this potential it is imperative to explore the factors that determine mobile telecommunications development in the developing world[3] Delivering mobile services on open hardware and open software not just practically make sense but can also lower the cost and thus increase the possibility of offering sustainable services in the future. *While the benefits of open-source software are proven, it is important to conduct a broader study to investigate the potential role of relatively new copyleft approach for custom hardware, as supporting mobile learners in their own socio-cultural contexts of developing countries is a significant challenge.* [4]

25.2   Technologies

A range of devices exist from mobile phones to single-purpose devices such as E-book readers. Current web technologies provide limited support for offline access to content and therefore web applications are generally designed for online interactions with server and require Internet connection to work. But mobile device is often disconnected by nature and wireless network connection is not available all the time. Device needs to store data locally in a fully searchable database and application should allow continuous interaction regardless of availability of Internet. Application should also be device and platform independent.

25.3   Challenges

Some modern mobile devices have the capability to store thousands of documents and therefore have the potential to be used as powerful offline learning tools. The traditional graphical file browser does not scale well on physically constrained devices. In addition, documents obtained from random sources on the Internet may contain ambiguous names and therefore may be difficult to relocate on the device.

Typically, the optimal solution is to use the local store as much as possible, since it's usually faster than a remote connection. However, the more work an application does locally, the more code you need to write to implement the feature locally and to synchronize the corresponding data. There is a cost/benefit tradeoff to consider, and some features may not be worthwhile to support locally.[5]

25.4   Specific Devices

- WikiReader

- The Ben NanoNote from Qi Hardware is copyleft hardware. Copyleft hardware is hardware where all information needed for its production is free. You are left with physical goods on one side, and free information on the other side. The Qi Hardware project builds the most advanced copyleft hardware in the world.[6]

25.5   See also

- Fusion Mobile Nigeria Limited

- mLearning

25.6   References

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25.7   External links

- Math4Mobile - Free offline mobile applications

- Fusion Mobile | Nigeria's Mobile m-Learning Platform

Chapter 26

E-assessment

In its broadest sense, **e-assessment** is the use of information technology for any assessment-related activity. This definition embraces a wide range of student activity ranging from the use of a word processor to on-screen testing. Due to its obvious similarity to e-learning, the term e-assessment is becoming widely used as a generic term to describe the use of computers within the assessment process. Specific types of e-assessment include computerized adaptive testing and computerized classification testing.

E-assessment can be used not only to assess cognitive and practical abilities but anxiety disorders, such as social anxiety disorder, i.e. SPAI-B. Cognitive abilities are assessed using *e-testing* software, while practical abilities are assessed using *e-portfolios* or *simulation* software.

26.1 Components

An e-testing system designed to focus on lower level associations comprises two components: (1) an assessment engine; and (2) an item bank. An *assessment engine* comprises the hardware and software required to create and deliver a test. Most e-testing engines run on standard hardware so the key characteristic is the software's functionality. There is a wide range of software packages. The software does not include the questions themselves; these are provided by an *item bank*. Once created, the engine uses the item bank to generate a test. Traditional paper-and-pencil testing is similar, but the test is pulled from the bank at only one time, when it is sent to publishing.

The creation of the item bank is more costly and time consuming than the installation and configuration of the assessment engine. This is due to the fact that assessment engines can be bought "off the shelf," whereas an item bank must be developed for each specific application.

An e-assessment system designed to focus on more sophisticated forms of knowledge requires some sort of interactive activity and a system for inviting students to reason or solve problems around that activity. One influential program of research is known as Evidence Centered Design, or ECD. ECD involves the use of Bayesian Inference Nets to create a sophisticated model of student cognition, and a set of activities or problems that students work on that allow the system to estimate the individuals understanding of the particular domain.

26.2 Advantages

E-assessment is becoming widely used. It has many advantages over traditional (paper-based) assessment. The advantages include:

1. lower long-term costs

2. instant feedback to students

3. greater flexibility with respect to location and timing

4. improved reliability (machine marking is much more reliable than human marking)

5. improved impartiality (machine marking does not 'know' the students so does not favour nor make allowances for minor errors)

6. greater storage efficiency - tens of thousands of answer scripts can be stored on a server compared to the physical space required for paper scripts

7. enhanced question styles which incorporate interactivity and multimedia.

There are also *disadvantages*. E-assessment systems are expensive to establish and not suitable for every type of assessment (such as extended response questions). The main expense is not technical; it is the cost of producing high quality assessment *items* - although that cost is identical when using paper-based assessment.

The best examples follow a Formative Assessment structure and are called "Online Formative Assessment". This involves making an initial formative assessment by sifting out the incorrect answers. The author/teacher will then explain what the pupil should have done with each question. It will then give the pupil at least one practice at each slight variation of sifted out questions. This is the formative learning stage. The next stage is to make

a Summative Assessment by a new set of questions only covering the topics previously taught. Some will take this even further and repeat the cycle such as BOFA Online 11 plus papers which is aimed at the eleven plus exam set

26.3   E-assessment standards

In order to create a mechanism for the sharing of high quality assessment items, global standards have emerged. The IMS Question and Test Interoperability specification (QTI) provides a common format for describing and distributing question items across disparate systems.

26.4   Hand-held student response systems

An area of E-assessment that has seen extensive growth in recent years is the use of hand held student response devices (often referred to as clickers or voting devices). These allow a teacher to carry out whole-group assessments, polls and surveys quickly and easily.[1] They use either radio or infra red to communicate with a central hub that is usually attached to a computer. In many school classrooms these devices may also be used in combination with an interactive whiteboard.

26.5   Note on terminology

Various terms are used to describe the use of a computer for assessment purposes. These include: 1. Computer-Assisted Assessment or Computer-Aided Assessment (CAA) 2.   Computer-Mediated Assessment (CMA) 3. Computer-Based Assessment (CBA) 4. Computer-Aided Assessment 5. Online assessment

Although these terms are commonly used interchangeably, they have distinct meanings.

Computer Assisted/Mediated Assessment refers to any application of computers within the assessment process; the role of the computer may be extrinsic or intrinsic. It is, therefore, a synonym for e-assessment which also describes a wide range of computer-related activities. Within this definition the computer often plays no part in the actual assessment of responses but merely facilitates the capture and transfer of responses between candidate and human assessor.

Computer-Based Assessment refers to assessment which is built around the use of a computer; the use of a computer is always intrinsic to this type of assessment. This can relate to assessment of IT practical skills or more commonly the on screen presentation of knowledge tests. The defining factor is that the computer is marking or assessing the responses provided from candidates. It can

be performed on an equivalent electronic device such as a cell phone or PDA. CBA systems enable educators and trainers to author, schedule, deliver, and report on surveys, quizzes, tests and exams.[2] They may be a stand-alone system or a part of a virtual learning environment, possibly accessed via the World Wide Web.

Online assessment refers to assessment activity which requires the use of the internet. In reality, few high stakes assessment sessions are actually conducted online in real-time, but the transfer of data prior to and after the assessment session is conducted via the internet. There are many examples of practice and diagnostic tests being run real time over the internet.

26.6   History

See also: PLATO (computer system)

E-assessment dates to the PLATO system (1960) from the University of Illinois. This was commercialized by Control Data Corporation (then owner of PLATO) in the 1970s, starting with an online testing system for National Association of Securities Dealers (now the Financial Industry Regulatory Authority), a private-sector regulator of the US securities markets. The system was developed by Michael Stein, E. Clarke Porter and PLATO veteran Jim Ghesquiere, in cooperation with NASD executive Frank McAuliffe. The testing business grew slowly and was ultimately spun off from CDC as Drake Training and Technologies (today Thomson Prometric) in 1990.

This was then transitioned off of mainframes to a LAN-based client-server architecture (with Novell), and the testing business exploded in the 1990s with increased networks, together with IT certifications and testing centers from various companies, including Novell and Microsoft. Further expansion was occasioned by Pearson VUE, founded by PLATO/Prometric veterans E. Clarke Porter, Steve Nordberg and Kirk Lundeen in 1994, who were one of the first to use the internet, and developed self-service test registration.

The computer-based testing industry has continued to grow, adding professional licensure and educational testing as important business segments.

26.7   See also

- Cambridge Neuropsychological Test Automated Battery
- Computer-adaptive test
- Computerized classification test
- E-learning
- CDR Computerized Assessment System

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26.9 Further Reading

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26.10 External links

- The e-Assessment Association is a professional body for e-Assessment.

- International Annual Conference on e-Assessment.

- Transforming Assessment has a rage of examples of e-assessment in web 2.0 and virtual world learning environments (Based at the University of Adelaide, Australia)

- e-assessment section at JISC, UK.

- CAA Centre still offers the most to-the-point treatment of Computer-Based testing for use in Higher Education.

- eAssessment at the Open University, UK shows how to use an opensource computer-assisted assessment (CAA) system called OpenMark designed to mark less structured questions.

26.11 Software

- BeAXi E-Assessment E-Assessment suite

- Examination Online Online E-Assessment Solution

26.12 Text and image sources, contributors, and licenses

26.12.1 Text

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- **OpenCourseWare** *Source:* http://en.wikipedia.org/wiki/OpenCourseWare?oldid=646602821 *Contributors:* Ronz, Mike Linksvayer, Masao, Zj, Naufana, Houshuang, Discospinster, Billymac00, Gary, Wiki-uk, Ringbang, OwenX, Mindmatrix, SchuminWeb, Tedder, Bgwhite, Arichnad, Eugrus, Tachs, Dawhitfield, SmackBot, Rahuagra502, MartinPoulter, Rogerhc, Rrburke, Mion, Kuru, Beetstra, Hu12, Lucid, HelloAnnyong, Denysmonroe81, MaxEnt, Cydebot, Thijs!bot, Candeo gauisus, Electron9, JAnDbot, Dsp13, Hamsterlopithecus, Steven Walling, User A1, DGG, Gwern, Bcartolo, Funandtrvl, Soeren1611, Devlinb, Alsalamahm, Greg.grossmeier, Alexbr82, Nopetro, Atgrauer, MattKeegan, Linzij, Drmies, Editor2020, XLinkBot, Addbot, HATA A. K., MrOllie, Download, EconoPhysicist, Tech licensing, Yobot, AnomieBOT, Felipe P, Mbailey33, Kathy Tam, 16x9, Nasa-verve, Virustm, Ivan Shmakov, Celuici, FrescoBot, Monget, Zx1986, Kenfyre, HRoestBot, WoolyPig, Anonymousfreak, Jonkerz, Bagafact, Hkloepper, Mean as custard, Likestolearn, OpenEducation4all, ImprovingWiki, Zollerriia, Clavenke, Rither, Bemanna, David.mansfield, SBaker43, Delusion23, Reify-tech, CasualVisitor, Kinotshi, Wfvanvalkenburg, Avinkarri, Yash raina, Tbobo05, Globedit, Liu275, LidaChina, Zoe Bertrand, Sprout2112, VtheBear, Tbirdcymru, Lucieneantunes, ReconditeRodent, Pasternaker, JulianaAlvim, Monkbot, KH-1, Imayankkr and Anonymous: 55

- **Virtual learning environment** *Source:* http://en.wikipedia.org/wiki/Virtual%20learning%20environment?oldid=645273175 *Contribu-*

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- **Learning management system** *Source:* http://en.wikipedia.org/wiki/Learning%20management%20system?oldid=646602438 *Contributors:* Antiochus, Jose Icaza, Boud, Bondgrrrl, Kku, Haakon, Ronz, Glenn, Andrevan, Faran, SEWilco, Toreau, Cobaltbluetony, Orangemike, Uzume, Edcolins, Quarl, Leolucas, Udzu, Rculatta, Qui1che, Monkeyman, Discospinster, Cnyborg, S.K., Shanafme, Srippon, Geschichte, Vijairaj, Calton, Stuartyeates, RHaworth, Tabletop, Sega381, Mandarax, Pdelong, Stardust8212, ElKevbo, AJackl, Ysangkok, Mindme, Jonathan Kovaciny, Tarmo, YurikBot, Cjvezeau, Freerick, Akamad, NawlinWiki, Cleared as filed, Irishguy, PM Poon, .marc., Zzuuzz, Closedmouth, GraemeL, Nelson50, Farm, Asterion, ChemGardener, Veinor, SmackBot, McGeddon, C.Fred, SmartGuy Old, Gilliam, Ohnoitsjamie, Betacommand, Chris the speller, Oli Filth, Sadads, KieferSkunk, Nixeagle, JonHarder, Akshyin, Papagel, MrRadio-Guy, Radagast83, Bernardwillis, TechPurism, Weregerbil, Quakerfriend, Mion, Vuttaa, Heyjohngreen, Harryboyles, Kompere, Bitamois, Dicklyon, RichardF, Nabeth, Dreftymac, Zero sharp, AbsolutDan, OS2Warp, ScottW, CmdrObot, Rcollman, Craigolson, Neo assyrian, J S Pannu, Pungu, DJKay, Johnkoetsier, Fisler, Bob Little, Gmadey, Betacommand2, Jessemonroy650, Epbr123, Supriyoc, Vinaymr, Vkdwivedi, Jonny-mt, Lsonne, Sherbrooke, Anomrabbit, Behnam Ghiaseddin, JEH, Alphachimpbot, Spacefarer, JAnDbot, Davidsavill, Leuko, Ajaque, MER-C, Joaquimoly, Seanashbrook, Twsx, Gwledig, Dorte Nielsen, Marconeli, Oicumayberight, Ywarnier, Darinphillips, Ynsingh, Cputrdoc, R'n'B, Greyhound4334, Deben Dave, Keynesian, Athaenara, Sylligardakis, ProfJ, Ctina2 99, Claudioerba, Jbersin, AntiSpamBot, Ssadler, Redrocket, Shariq81, Wbpro, Eswaronline, Ffflo, Cholula94, Gremchild, Kwcrisman, Simplylearn, Marcosaedro, Zeetha, LeaveSleaves, Wempen, Theacademy.com, Svoy, Gfusco, Ashokpundit, Jason m butler, GothWalker, Pedroliska, Kg anish, Hhenry, Shaddyz, Mylearningspace, C45207, Apecrazy, Chris George 1977, Abc123uandme, SieBot, Halloranc, Rpadoilla, Dawn Bard, Jbmurray, S.T. Rock, JerseyBoy1, Rlewer, Robbbingham, Angelaleffler, Gabrusha, Cgarland, Tblogs, Simplydigi, Andy1green, OKBot, Nschmutz, Randomocity2, Chety, Apienczy, Susanborton, Jdstein89, 101i, Varezzi, JL-Bot, Eomerr, Michaelsshaw, Bsx, Ldcjim, The Thing That Should Not Be, Sissdesk, Mehmet2006, Doabarrelroll, Niccoled, Magnos, Skipsmith521, Rumkeswani, DragonBot, Justapersona, Jworoner, Ltedstone, Vishucht, Rudolph.cm, Tnxman307, Chorpita, Rockjock810, Account9000, Dekisugi, Sjacob, Tonyd49, Petercoooper, Thingg, DumZiBoT, Jedhallam, Kiran gurumukhi, Sudhakar srr, Hotlavasoftware, Flibbermewidget, Sammorgan101, Pjurisic, Wise12day, Atheyja, Interkrok, Addbot, Lakewood66, AlexAnderson478, DustyRain, Open.herzen, Fieldday-sunday, Leszek Jańczuk, Cst17, MrOllie, Terrillja, Mariam-t, Santhonys, Zorrobot, SalvageTheSauce, Luckas-bot, Yobot, Cprabhakar, Ptbotgourou, Dcapitald, Morganfosstveit, AnomieBOT, Tccarmichael, Lmxonline, Jjungmann, Piano non troppo, Instrdesign, Materialscientist, Mediclazarus, Lifelearning, Roux-HG, Robertjcollins, LilHelpa, Surgisphere, Cleach, Informetica, Erud, Melmann, Parevest, Stratbeans, RibotBOT, Gromar, Skipalong, Hjohnsondesign, MuffledThud, Figaronline, Wbstafford, Gthollingsworth, Edtechguy46, FrescoBot, Krwt, Inc ru, Recognizance, Fagome, T@Di, Cf44, Taweetham, TabithaFournier, Ezoom, Sc2000goto, Scapesoft, ChristineNTS, Jonesey95, Competentum, Skyerise, ECBAPR, Ranoushranoush, Reader74, Ashwinkumariyer, Antiochus21, Pavel.nps, Rosehope, Kritikajoshi2, Swanny101, Lambertson1150, Vivekdodd, Elearningfan, Lotje, Zisser, 777sms, Prasantasahoo2009, Jreiss186, Dharward, Diannaa, Rhwang, Mean as custard, DexDor, Elishkiya, Venakis, Vpolavia, Donnelly1111, RadBikken, EmausBot, Eremit1977, Jgilley9, Werieth, Pxtreme75, Instructureinnovates, Bencarstens, Abksharma, Brian.whitmer, Bemanna, OnePt618, Priyankgupta86, Bianca.pizza, Δ, Udaynagella, Beautyandlight, Ashunigam, Olemsa, ChuispastonBot, Maximilianklein, Paduch, FeatherPluma, ClueBot NG, Dru of Id, LearningPool55, Widr, Andiec1123, SummerForever, AvocatoBot, Linlovesu, Avinash.royyuru, Amin2013, Stephnrmn, BattyBot, Zachball, Mdann52, RecCoo, KScherer, Gordjohn, Stickycookiethief, LibrarianAnnie, Es137Custom, Jodosma, Tomprentice, Amtojsingh12, Mmskirby, Ugog Nizdast, Bisswajit, Caliandson, Sameerpp, Rupli88, Momochdk, Virenkapadia, Monkbot, Ostroumov, Btgrimes, U2fanboi, Archie Skye, Gartners, MonicaWSpence, SJBEditor, Sharma.ashoks, Norbhere and Anonymous: 443

- **History of virtual learning environments** *Source:* http://en.wikipedia.org/wiki/History%20of%20virtual%20learning%20environments?oldid=643356918 *Contributors:* Bryan Derksen, The Anome, Edward, Delirium, Haakon, Andrevan, Stone, Earthsound, Phil Boswell, Wilfred com, Softcafe, Davidds, Edcolins, Andycjp, Alexf, Jeremykemp, Greg544, Ppa, JoeSmack, Violetriga, Bobo192, Bustter, Giraffedata, Kaganer, Davidjennings, Henry W. Schmitt, Stuartyeates, Firsfron, Tabletop, Wikiklrsc, Philbarker, Mamling, Rjwilmsi, Jivecat, Messenjer, Meisenstadt, Brendano, ElKevbo, Ttwaring, Naraht, Straycat, Intgr, K1v1n, Bgwhite, RussBot, Chaser, Gaius Cornelius, ChrisBrown, Rat144, ONEder Boy, Emersoni, Nils peterson, Avraham, WAS 4.250, Frederik.Questier, Rurik,

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• **Moodle** *Source:* http://en.wikipedia.org/wiki/Moodle?oldid=646461044 *Contributors:* Ellmist, Hirzel, Ewen, Roan, Haakon, Den fjättrade ankan, Mxn, INyar, Emperorbma, Dysprosia, Doradus, Wik, Haukurth, SEWilco, Flambergius, Mdchachi, Joy, Mackensen, Jni, Craig Stuntz, Kizor, Peak, Dittaeva, Davidds, Hadal, Smoge, Msm, Everyking, Dougiamas, D2s, Bobblewik, Gadfium, Utcursch, Beland, Oneiros, Sam Hocevar, Howardjp, Jh51681, RevRagnarok, Mike Rosoft, Rolandg, Slady, Discospinster, MiddleOfNowhere, Rich Farmbrough, Oska, Xezbeth, Ascánder, Gronky, Stereotek, Violetriga, Elwikipedista, CanisRufus, Chalst, The bellman, Barcex, NetBot, Mike Schwartz, Cwolfsheep, Raja99, Poli, Polarscribe, Free Bear, YPavan, ProductBox, Here, Jensverner, Zntrip, Stuartyeates, Arky, Deeahbz, Davidkazuhiro, Taatparya, KaurJmeb, Male1979, Watcanz, Liface, Mandarax, Grammarbot, Sjakkalle, Rjwilmsi, Tawker, Kalogeropoulos, MoederDao, Sbeattie, Tbaker, FlaBot, Latka, Gary Cziko, Alexjohnc3, DiamondDave, Wavelength, Borgx, Mattgibson, Kaydell, Mithridates, David Woodward, Bovineone, Artlader, Rmackenzie, Saidkassem, MrMac, Samir, Matroidas, DeadEyeArrow, Lucky number 49, Erpingham, Phgao, Zzuuzz, Lkdasa, Frederik.Questier, Sean Whitton, GraemeL, Rurik, Kiełek, Libro, Ehogberg, SmackBot, Colinstu, JoshDuffMan, C.Fred, Jtneill, Delldot, Eskimbot, Rlorenzo, Mcld, Ignacioerrico, Gilliam, Ohnoitsjamie, Turadg, Bluebot, MalafayaBot, Slingshotsean, Pasado, DHN-bot, Colonies Chris, Toughpigs, JGXenite, Sct72, Wild girl, Can't sleep, clown will eat me, Eliyahu S, Papagel, Blake-, Nils Simon, Mcochran, Wizardman, Sturm, Facugaich, Where, Deiz, Kukini, Thomaspaine, SashatoBot, Heyjohngreen, Trobb, IronGargoyle, Slasher-fun, Julthep, Dr.K., RichardF, Jon Westfall, Martin Vögeli, Jpag87a, Pramette, SamuliK, Woodshed, Esposimi, Jose Armando Jeronymo, Pudeo, Chris55, AbsolutDan, Dia^, JossDude, Dgw, FlyingToaster, WeisheitSuchen, Bingomzan, Cydebot, Wikien2009, J S Pannu, MrSuber13, Olz06, Dancter, Tacman1123, Lbertybell, Thijs!bot, Epbr123, Maberdour, Oldiowl, Etm157, Renap, Dfrg.msc, AgentPeppermint, Wallydallas, Edalton, Leesonma, Mentifisto, Somaroy, Brycethornton, Isilanes, Ephery, Billselak, Can-Dutch, MER-C, Jamesohagan, Nicolaasuni, Magioladitis, Mmn100, CTF83!, BotheredByBees, Froid, Jbvetter, Catgut, Johnbibby, Dorte Nielsen, Aishisheep, Adrian J. 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• **Blackboard Learning System** *Source:* http://en.wikipedia.org/wiki/Blackboard%20Learning%20System?oldid=638873428 *Contributors:* Robbot, Micru, Enric Naval, Srippon, Danski14, Woohookitty, Koavf, ONEder Boy, Moe Epsilon, Grapkoski, Goetz, SmackBot, Wegesrand, Fogster, JHP, SuziT9, Mojo Hand, Ericsil24, Magioladitis, Nyttend, DGG, Sigmundg, Speck-Made, Athaenara, Heero Kirashami, X!, Someguy1221, Ngch89, Monty845, Logan, Jbmurray, FlamingSilmaril, Sveinunglarsen, Alexbot, Ericwilliammarshall, Aprock, Stackboard, Berean Hunter, Nrigores, IXavier, Zorrobot, Yobot, Victoriaearle, AnomieBOT, LilHelpa, Charles nelson reilly, Iwearshoess, Thorenn, Marksml, Jreiss186, Usuvb3, Epopescue, Rwqerqwrerqw, Vrixxedu, Alph Bot, Instructureinnovates, ClueBot NG, Elearning.addict, Widr, MerlIwBot, Jtwall12, BG19bot, BattyBot, Khazar2, Rachelrenren, Gracemanman, Happyday1, Monde17, Bl26ehre, K21hask, Bl03cook, YiFeiBot, Blacksahaeta and Anonymous: 51

• **Learning object** *Source:* http://en.wikipedia.org/wiki/Learning%20object?oldid=644812706 *Contributors:* Derek Ross, Mav, The Anome, Hirzel, Jose Icaza, Lexor, Kabads, Ixfd64, Ronz, Angela, EdH, Saltine, Jamesday, Micru, AlistairMcMillan, Guanabot, LeeHunter, Lkmorlan, Danielcarvalho, BWatkins, Philbarker, TheRingess, Dmccreary, FlaBot, Chobot, Leighblackall, Zwobot, CQ, KennethUrban, SmackBot, Ohnoitsjamie, ARK, Korte, Mr.Z-man, Mion, MHV, Robofish, DanielLemire, Makyen, Ryulong, Ericblazek, JiriK, CmdrObot, Thijs!bot, Miss Dark, Mbell, Nf1234, Mmorrey, Seanashbrook, Steven Walling, DGG, Tom CLO, Josepant, Pierfranco, Thelearningfederation, Hmcti, Mbonetti, Eubulides, Rjgodoy, AS, Asgara, Jbmurray, Kaychitwood, Yerpo, Michaelsshaw, Justin W Smith, Cdnchameleongirl, Manco Capac, Petercoooper, DumZiBoT, EjsBot, Leszek Jańczuk, Damiens.rf, Stu 22, Download, Numbo3-bot, Redlandrain, OlEnglish, Legobot, Luckas-bot, Yobot, Citation bot, Ashishtanwer, Arifjinha, Meadowsa, Chunkthechunk, EmausBot, WikitanvirBot, Ever.anon, FeatherPluma, Dr.Helfrich, Helpful Pixie Bot, Johnp2hunt, BattyBot, Kurlands2, Reatlas, D Wiley BYU and Anonymous: 54

- **Learning object metadata** *Source:* http://en.wikipedia.org/wiki/Learning%20object%20metadata?oldid=630082448 *Contributors:* Nadavkav, Ary29, Joyous!, Discospinster, Rich Farmbrough, Stesmo, Downes, Danhash, Brianwc, Marasmusine, RHaworth, Philbarker, FlaBot, Chobot, Nesbit, Gaius Cornelius, Lusanaherandraton, Thiseye, PM Poon, CQ, H@r@ld, Meegs, SmackBot, Stevage, Dual Freq, Abmac, SunAdmin111, Hu12, J Di, Loxlie, CmdrObot, Osoneill, Cydebot, Thijs!bot, BackwardsBoy, Vitello, Nf1234, Goldenrowley, GermanX, Frepa, Anton Khorev, VolkovBot, Rjgodoy, Asimong, Brezenbene, Carriearchdale, Felix Folio Secundus, Addbot, Slismann, Ettrig, Yobot, O Wise 1, Mcanabalb, Ssalonso, LilHelpa, MauritsBot, FrescoBot, Ipseity, Local contributor, Jsweetin, DrilBot, Jan.pawlowski, Sallyrenee, Wimmuskee, MichaelaBrighella3, DalbS, ScotXW, D.nyffenegger and Anonymous: 39

- **Intelligent tutoring system** *Source:* http://en.wikipedia.org/wiki/Intelligent%20tutoring%20system?oldid=643544726 *Contributors:* Dreamyshade, Wwheeler, Pbsloep, Giraffedata, Bobrayner, Rjwilmsi, Nesbit, Ohnoitsjamie, Turadg, Bluebot, John, Nabeth, CmdrObot, Nick Number, Spacefarer, PhilKnight, Magioladitis, Boffob, Gwern, Pleasantville, Koedinger, Synthebot, Macdonald-ross, Antonio Lopez, JL-Bot, Machina.sapiens, Heureka!, Mhjackson, Sun Creator, Mfolkerson, M.boli, WikHead, Addbot, Jarble, Luckas-bot, Yobot, Ptbotgourou, AnomieBOT, Materialscientist, Citation bot, Nkambou, Eugene-elgato, FrescoBot, Citation bot 1, Aleven, SpookyFM, Zabbarob, RjwilmsiBot, John of Reading, SunTzuWarmaster, Cmaclell, Helpful Pixie Bot, SeanBCVancouver, Bflink, Yuting1031, Bckay, MacSD36, IDGCL, Awsfueduc, Jamiesonj, Farimahsalimi, Sonwol, EDUC892 G4, Sethtee, Helyue, FionaGraham5, Simspire, 4tomz0110, Kevin12xd, Rajnakr, NEOANALYSIS, Antrocent, Monkbot, Dsprc, Mudgal.aayush and Anonymous: 56

- **Serious game** *Source:* http://en.wikipedia.org/wiki/Serious%20game?oldid=646182744 *Contributors:* Mrwojo, Frecklefoot, Edward, Gabbe, Ixfd64, Ronz, Julesd, Andrewman327, Stewartadcock, Alan Liefting, Gracefool, Alan Au, Andycjp, Mike Rosoft, Roger.smith, MeltBanana, Femto, Cretog8, Cmdrjameson, 99of9, Jason One, CyberSkull, Goodoldpolonius2, Sciurinæ, Frescard, Marasmusine, RememberMe, Toussaint, Rjwilmsi, Tim!, Lordsatri, Kibeth, TheDJ, Alvin-cs, SteveBaker, Wavelength, Ismail, Yamara, Eleassar, Icthyos, Kvn8907, Manuelhp42, Wknight94, Chase me ladies, I'm the Cavalry, E Wing, Amren, Veinor, SmackBot, Pintman, Hethatishere, McGeddon, Jagged 85, Darklock, Mloundermon, Darth Panda, Phantom brave, Uncleharpoon, Addshore, Mwtoews, Scientizzle, Waftybuzz, Robofish, Nabeth, Hu12, Larry Baum, Dreftymac, Hogui, WikiMarshall, Fvasconcellos, Lamoxlamae, CmdrObot, Wafulz, Meparry, Schalliol, Mika1h, ZsinjBot, Drinibot, Lijakaca, HalJor, Cydebot, Gizmo2511, Jhumbug, Nxain, Underpants, NMChico24, Mattisse, Bobblehead, Playgen, X900BattleGrape, Acerview54, Vendettax, Zchris87v, Niladmirari, Dreaded Walrus, Ioeth, Leuko, Itzaferg, Genuiben, Parcemihi, Jfriedberg, Jdrumgoole, Blepp, JNW, JamesBWatson, Stavanger, Elianealhadeff, Kalleo, PIrish, Tltuser, Thibbs, Jodi.a.schneider, DGG, Gwern, TheMultinational, DrDavidSchwartz, Bobsterling, Nickpunt, Angelojohn, Gobion, Ddankner, Richiekim, Andaxp, SCB '92, SharkD, D3sqie, SolotaireDeaton, Travcoffey, Matthew.kahl, Kwarner04, Rjclaudio, Lauer, Dendritelady, Overcow, Graemeduncan, Fredrick day, Portalguy, Akimboo, Maxweinberg, J18wiki, Samsw12, GL1zdA, Schiec, Natg 19, Redknightlearning, PjotrAtVSTEP, AlleborgoBot, Rhart sg, JeremiahAlexander, Water79, Wuhwuzdat, JL-Bot, Canglesea, Caspian1, Martarius, Abacus11, Rjhinrichs, Alina917, Julian Alvarez, Trivialist, Mlcblj, Evilnumber27, Bren34, Rhododendrites, Plastic Fish, VictorLy, Kesterel, Apparition11, Malone70, XLinkBot, Miguel Pereira, Jwarmerdam, GameLegend, Ost316, NathanLands, Addbot, EricKuhnen, Fyrael, Dov Jacobson, Mistertoes, Looie496, MrOllie, Robert The Rebuilder, Lightbot, Jarble, Michal 113, Mps, Mr.Yahoo!, Yobot, Tohd8BohaithuGh1, TheMelMonster, N1RK4UDSK714, AnomieBOT, Ditman, WaaghMan, Samfrado, Swings and roundabouts, TheMonsterMel, Kokcharov, Rtodainfinity, Colt .55, Flavsgirl46, FrescoBot, XXXamsterdam, Wexxxx, Demian Sepp, Emscharf, Daisyblue, Aaron-GSN, Callanecc, Spacecat4, Phaedra1122, Nerekop, Superzusgw, RjwilmsiBot, Kleyson, DrJHoward, Mathias Fuchs, EmausBot, Sergomen1, Uevans, Olheinz, Ciatile, Hue GS, Your Lord and Master, Mmvd, Antonangelo, A.groot, Fdm20cgsiegel, Jontesta, Makecat, Wayne Slam, Erianna, NoJoker, Egenfeldt, Suapatela, Nghafouri, ClueBot NG, Thoisy, Larux, Maksimlekler, Delusion23, Widr, Helpful Pixie Bot, Djhaniff, Mark Arsten, Stevekling80, Refluxziekte, F.bellotti, BattyBot, Darylgolden, Youssefgamil, Cumminkm, Mogism, MoniStreit, EikeFA, Blacknight87, AgnesLP, NickZangus, Advancis, Atibbetts, JoshLemer, Sightestrp, Neenu86, AntonieWiedemann, RobertTKS, Rwtks, Brianmayer00, Htr1234, Hgy1990 and Anonymous: 265

- **Sharable Content Object Reference Model** *Source:* http://en.wikipedia.org/wiki/Sharable%20Content%20Object%20Reference%20Model?oldid=643534135 *Contributors:* MichaelTinkler, Bryan Derksen, The Anome, Hirzel, Kabads, Ronz, EdH, Rashack, R3m0t, Securiger, Ryanrs, Nadavkav, AlistairMcMillan, D2s, Jerith, Utcursch, Beland, Grstain, Monkeyman, LeeHunter, Elwikipedista, Jon the Geek, Remuel, Postrach, Woohookitty, Jannex, Nuggetboy, Schzmo, Kbdank71, Xosé, Jehochman, Utuado, FlaBot, Gurch, BillAlbing, Imnotminkus, Korg, YurikBot, Matthai, Romanc19s, Dialectric, Malcolma, Gujamin, Novasource, Zzuuzz, Knowlengr, Parham, Albert ip, Teryx, KnightRider, SmackBot, Alan Pascoe, IEdML, Eskimbot, Ohnoitsjamie, Oli Filth, MalafayaBot, Weregerbil, Mr Stephen, Dicklyon, Waggers, RichardF, Nabeth, Norm mit, Iridescent, P tasso, Annaswims, CmdrObot, Cydebot, DJKay, Infinito, Claude Ostyn, Voldemortuet, Thijs!bot, Beardedone, Begs, Supriyoc, Ghassan.geara, Jjmarks, AntiVandalBot, JAnDbot, Steveprutz, VoABot II, BennyBeta, BrianCaudill, Speck-Made, Bitmapped, Mauroj, Bektur, Vahcic, Martial75, VolkovBot, TXiKiBoT, Perohanych, SueHay, ^demonBot2, Chuck Sirloin, Markdask, Permacultura, ClueBot, Hutcher, Sabbe, Mehmet2006, Excirial, Alexbot, Cybersparc, Petercoooper, Rusticmb, DumZiBoT, Ost316, Avoided, Jmkim dot com, Atheyja, Addbot, Jadeivy, Codefly, Dianna m, Yobot, CaveatScriptor, AnomieBOT, Law, Instrdesign, Camarta, Setede, MrScruffy04, Backflipdoll, Steveaddison, Pxtreme75, Pjguay, HupHollandHup, FeatherPluma, Icomrox, Widr, Pszmyt, ChrisGualtieri, Ikatesha, Mikegerwitz, JeffreHorne, Hi.prabhat, JimmyDonnellan and Anonymous: 160

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