Handbook of

Educational Technology

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Chapter- 1

Educational Technology

Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources." The term educational technology is often associated with, and encompasses, instructional theory and learning theory. While instructional technology covers the processes and systems of learning and instruction, educational technology includes other systems used in the process of developing human capability. Educational Technology includes, but is not limited to, software, hardware, as well as Internet applications and activities. But there is still debate on what these terms mean.

Explanation and meaning

Educational technology is most simply and comfortably defined as an array of tools that might prove helpful in advancing student learning. Educational Technology relies on a broad definition of the word "technology". Technology can refer to material objects of use to humanity, such as machines or hardware, but it can also encompass broader themes, including systems, methods of organization, and techniques. Some modern tools include but are not limited to overhead projectors, laptop computers, and calculators. Newer tools such as "smartphones" and games (both online and offline) are beginning to draw serious attention for their learning potential.

Those who employ educational technologies to explore ideas and communicate meaning are learners or teachers.

Consider the *Handbook of Human Performance Technology*. The word technology for the sister fields of Educational and Human Performance Technology means "applied science." In other words, any valid and reliable process or procedure that is derived from basic research using the "scientific method" is considered a "technology." Educational or Human Performance Technology may be based purely on algorithmic or heuristic processes, but neither necessarily implies physical technology. The word technology comes from the Greek "techne" which means craft or art. Another word, "technique," with the same origin, also may be used when considering the field Educational Technology. So Educational Technology may be extended to include the techniques of the educator.

A classic example of an Educational Psychology text is Bloom's 1956 book, *Taxonomy of Educational Objectives*. Bloom's Taxonomy is helpful when designing learning activities to keep in mind what is expected of—and what are the learning goals for—learners. However, Bloom's work does not explicitly deal with educational technology *per se* and is more concerned with pedagogical strategies.

According to some, an Educational Technologist is someone who transforms basic educational and psychological research into an evidence-based applied science (or a technology) of learning or instruction. Educational Technologists typically have 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. But few of those listed below as theorists would ever use the term "educational technologist" as a term to describe themselves, preferring terms such as "educator". The transformation of educational technology from a cottage industry to a profession is discussed by Shurville, Browne, and Whitaker.

A Short History

Educational technology in a way could be traced back to the emergence of very early tools, e.g., paintings on cave walls. But usually its history starts with educational film (1900s) or Sidney Pressey's mechanical teaching machines in the 1920s.

The first large scale usage of new technologies can be traced to US WWII training of soldiers through training films and other mediated materials. Today, presentation-based technology, based on the idea that people can learn through aural and visual reception, exists in many forms, e.g., streaming audio and video, or PowerPoint presentations with voice-over. Another interesting invention of the 1940s was hypertext, i.e., V. Bush's memex.

The 1950s led to two major, still popular designs. Skinners work led to "programmed instruction" focusing on the formulation of behavioral objectives, breaking instructional content into small units and rewarding correct responses early and often. Advocating a mastery approach to learning based on his taxonomy of intellectual behaviors, Bloom endorsed instructional techniques that varied both instruction and time according to learner requirements. Models based on these designs were usually referred to as computer-based training" (CBT), Computer-aided instruction or computer-assisted instruction (CAI) in the 1970s through the 1990s. In a more simplified form they correspond to today's "e-contents" that often form the core of "e-learning" set-ups, sometimes also referred to as web-based training (WBT) or e-instruction. The course designer divides learning contents into smaller chunks of text augmented with graphics and multimedia presentation. Frequent Multiple Choice questions with immediate feedback are added for self-assessment and guidance. Such e-contents can rely on standards defined by IMS, ADL/Scorm and IEEE.

The 1980s and 1990s produced a variety of schools that can be put under the umbrella of the label Computer-based learning (CBL). Frequently based on constructivist and cognitivist learning theories, these environments focused on teaching both abstract and domain-specific problem solving. Preferred technologies were micro-worlds (computer environments were learners could explore and build), simulations (computer environments where learner can play with parameters of dynamic systems) and hypertext.

Digitized communication and networking in education started in the mid 80s and became popular by the mid-90's, in particular through the World-Wide Web (WWW), eMail and Forums. There is a difference between two major forms of online learning. The earlier type, based on either Computer Based Training (CBT) or Computer-based learning (CBL), focused on the interaction between the student and computer drills plus tutorials on one hand or micro-worlds and simulations on the other. Both can be delivered today over the WWW. Today, the prevailing paradigm in the regular school system is Computer-mediated communication (CMC), where the primary form of interaction is between students and instructors, mediated by the computer. CBT/CBL usually means individualized (self-study) learning, while CMC involves teacher/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. It also provides tools for student and curriculum management.

In addition to classroom enhancement, learning technologies also play a major role in full-time distance teaching. While most quality offers still rely on paper, videos and occasional CBT/CBL materials, there is increased use of e-tutoring through forums, instant messaging, video-conferencing etc. Courses addressed to smaller groups frequently use blended or hybrid designs that mix presence courses (usually in the beginning and at the end of a module) with distance activities and use various pedagogical styles (e.g., drill & practise, exercises, projects, etc.).

The 2000s emergence of multiple mobile and ubiquitous technologies gave a new impulse to situated learning theories favoring learning-in-context scenarios. Some literature uses the concept of integrated learning to describe blended learning scenarios that integrate both school and authentic (e.g., workplace) settings.

Theories and practices

Three main theoretical schools or philosophical frameworks have been present in the educational technology literature. These are Behaviorism, Cognitivism and Constructivism. Each of these schools of thought are still present in today's literature but have evolved as the Psychology literature has evolved.

Behaviorism

This theoretical framework was developed in the early 20th century with the animal learning experiments of Ivan Pavlov, Edward Thorndike, Edward C. Tolman, Clark L. Hull, B.F. Skinner and many others. Many psychologists used these theories to describe and experiment with human learning. While still very useful this philosophy of learning has lost favor with many educators.

Skinner's Contributions

B.F. Skinner wrote extensively on improvements of teaching based on his functional analysis of Verbal Behavior and wrote "The Technology of Teaching", an attempt to dispel the myths underlying contemporary education as well as promote his system he called programmed instruction. Ogden Lindsley also developed the Celeration learning system similarly based on behavior analysis but quite different from Keller's and Skinner's models.

Cognitivism

Cognitive science has changed how educators view learning. Since the very early beginning of the Cognitive Revolution of the 1960s and 1970s, learning theory has undergone a great deal of change. Much of the empirical framework of Behaviorism was retained even though a new paradigm had begun. Cognitive theories look beyond behavior to explain brain-based learning. Cognitivists consider how human memory works to promote learning.

After memory theories like the Atkinson-Shiffrin memory model and Baddeley's Working memory model were established as a theoretical framework in Cognitive Psychology, new cognitive frameworks of learning began to emerge during the 1970s, 1980s, and 1990s. It is important to note that 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 and Information Processing Theory.

Constructivism

Constructivism is a learning theory or educational philosophy that many educators began to consider in the 1990s. One of the primary tenets of this philosophy is that learners construct their own meaning from new information, as they interact with reality or others with different perspectives.

Constructivist learning environments require students to utilize 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 technology when teaching with a constructivist perspective should choose technologies that reinforce prior learning perhaps in a problem-solving environment.

Connectivism

Connectivism is "a learning theory for the digital age," and has been developed by George Siemens and Stephen Downes based on their analysis of the limitations of behaviourism, cognitivism and constructivism to explain the effect technology has had on how we live, how we communicate, and how we learn. Donald G. Perrin, Executive Editor of the International Journal of Instructional Technology and Distance Learning says the theory "combines relevant elements of many learning theories, social structures, and technology to create a powerful theoretical construct for learning in the digital age."

Instructional technique and technologies

Problem Based Learning and Inquiry-based learning are active learning educational technologies used to facilitate learning. Technology which includes physical and process applied science can be incorporated into project, problem, inquiry-based learning as they all have a similar educational philosophy. All three are student centered, ideally involving real-world scenarios in which students are actively engaged in critical thinking activities. The process that students are encouraged to employ (as long as it is based on empirical research) is considered to be a technology. Classic examples of technologies used by teachers and Educational Technologists include Bloom's Taxonomy and Instructional Design.

Theorists

This is an area where new thinkers are coming to the forefront everyday. Many of the ideas spread from theorists, researchers, and experts through their blogs. Extensive lists of educational bloggers by area of interest are available at Steve Hargadon's "SupportBloggers" site or at the "movingforward". Many of these blogs are recognized by their peers each year through the edublogger awards. Web 2.0 technologies have led to a huge increase in the amount of information available on this topic and the number of educators formally and informally discussing it. Most listed below have been around for more than a decade, however, and few new thinkers mentioned above are listed here.

- Alan November
- Seymour Papert
- Will Richardson
- John Sweller
- Alex Jones
- George Siemens
- David Wiley
- David Wilson

Benefits

Educational technology is intended to improve education over what it would be without technology. Some of the claimed benefits are listed below:

- **Easy-to-access course materials**. Instructors can post the course material or important information on a course website, which means students can study at a time and location they prefer and can obtain the study material very quickly
- **Student motivation**. Computer-based instruction can give instant feedback to students and explain correct answers. Moreover, a computer is patient and non-judgmental, which can give the student motivation to continue learning. 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. The American educator, Cassandra B. Whyte, researched and reported about the importance of locus of control and successful academic performance and by the late 1980s, she wrote of how important computer usage and information technology would become in the higher education experience of the future.
- **Wide participation**. Learning material can be used for long distance learning and are accessible to a wider audience
- **Improved student writing**. It is convenient for students to edit their written work on word processors, which can, in turn, impr**ove 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**
- **Subjects made easier to learn**. Many different types of educational software are designed and developed to help children or teenagers to learn specific subjects. Exa**mples include pre-school software, computer simulators, and graphics software**
- A structure that is more amenable to measurement and improvement of outcomes. With proper structuring it can become easier to monitor and maintain student work while also quickly gauging modifications to the instruction necessary to enhance student learning.
- **Differentiated Instruction. Educational technology provides the means to focus on active student participation and to present differentiated questioning strategies. It broadens individualized instruction and promotes the development of personalized learning plans. Students are encouraged to use multimedia components and to incorporate the knowledge they gained in creative ways.**

Criticism

Although technology in the classroom does have many benefits, there are clear drawbacks as well. Lack of proper training, limited access to sufficient quantities of a technology, and the extra time required for many implementations of technology are just a few of the reasons that technology is often not used extensively in the classroom.

Similar to learning a new task or trade, special training is vital to ensuring the effective integration of classroom technology. 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.

Another difficulty is introduced when access to a sufficient quantity of a resource is limited. This is often seen when the quantity of computers or digital cameras for classroom use is not enough to meet the needs of an entire classroom. It also occurs in less noticed forms such as limited access for technology exploration because of the high cost of technology and the fear of damages. In other cases, the inconvenience of resource placement is a hindrance, such as having to transport a classroom to a computer lab instead of having in-classroom computer access by means of technology such as laptop carts.

Technology implementation can also be time consuming. There may be an initial setup or training time cost inherent in the use of certain technologies. Even with these tasks accomplished, technology failure may occur during the activity and as a result teachers must have an alternative lesson ready. Another major issue arises because of the evolving nature of technology. New resources have to be designed and distributed whenever the technological platform has been changed. Finding quality materials to support classroom objectives after such changes is often difficult even after they exist in sufficient quantity and teachers must design these resources on their own.

Educational technology and the humanities

Research from the Alberta Initiative for School Improvement (AISI) indicates that inquiry and project-based approaches, combined with a focus on curriculum, effectively supports the infusion of educational technologies into the learning and teaching process.

Technology in the classroom

There are various types of technologies currently used in traditional classrooms. Among these are:

- **Computer in the classroom:** Having a computer in the classroom is an asset to any teacher. With a computer in the classroom, teachers are able to demonstrate a new lesson, present new material, illustrate how to use new programs, and show new websites.

- **Class website:** An easy way to display your student's work is to create a web page designed for your class. Once a web page is designed, teachers can post homework assignments, student work, famous quotes, trivia games, and so much more. In today's society, children know how to use the computer and navigate their way through a website, so why not give them one where they can be a published author. Just be careful as most districts maintain strong policies to manage official websites for a school or classroom. Also, most school districts provide teacher webpages that can easily be viewed through the school district's website.

- **Wireless classroom microphones:** Noisy classrooms are a daily occurrence, and with the help of microphones, students are able to hear their teachers more clearly. Children learn better when they hear the teacher clearly. The benefit for teachers is that they no longer lose their voices at the end of the day.

- **Mobile devices:** Mobile devices such as clickers or smartphone can be used to enhance the experience in the classroom by providing the possibility for professors to get feedback.

- **SmartBoards:** An interactive whiteboard that provides touch control of computer applications. These enhance the experience in the classroom by showing anything that can be on a computer screen. This not only aids in visual learning, but it is interactive so the students can draw, write, or manipulate images on the SmartBoard.

- **Online media:** Streamed video websites can be utilized to enhance a classroom lesson (e.g. United Streaming, Teacher Tube, etc.)

There are many other tools being utilized depending on the local school board and funds available. These may include: digital cameras, video cameras, interactive whiteboard tools, document cameras, or LCD projectors.

- **Podcasts:** Podcasting is a relatively new invention that allows anybody to publish files to the Internet where individuals can subscribe and receive new files from people by a subscription. The primary benefit of podcasting for educators is quite simple. It enables teachers to reach students through a medium that is both "cool" and a part of their daily lives. For a technology that only requires a computer, microphone and internet connection, podcasting has the capacity of advancing a student's education beyond the classroom. When students listen to the podcasts of other students as well as their own, they can quickly demonstrate their capacities to identify and define "quality." This can be a great tool for learning and developing literacy inside and outside the classroom. Podcasting can help sharpen students' vocabulary, writing, editing, public speaking, and presentation skills. Students will also learn skills that will be valuable in the working world, such as communication, time management, and problem-solving.

Societies

Learned societies concerned with educational technology include:

- Association for the Advancement of Computing in Education (AACE)
- Association for Educational Communications and Technology
- Association for Learning Technology
- International Society for Performance Improvement
- International Society for Technology in Education - (ISTE)

Chapter- 2

E-Learning

E-learning comprises all forms of electronically supported learning and teaching. The information and communication systems, whether networked or not, serve as specific media to implement the learning process. The term will still most likely be utilized to reference out-of-classroom and in-classroom educational experiences via technology, even as advances continue in regard to devices and curriculum.

E-learning is essentially the computer and network-enabled transfer of skills and knowledge. E-learning applications and processes include Web-based learning, computer-based learning, virtual classroom opportunities and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio.

Abbreviations like CBT (*Computer-Based Training*), IBT (*Internet-Based Training*) or WBT (*Web-Based Training*) have been used as synonyms to e-learning. Today one can still find these terms being used, along with variations of e-learning such as elearning, Elearning, and eLearning.

Market

The worldwide e-learning industry is estimated to be worth over $48 billion US according to conservative estimates. 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.

Higher education

By 2006, 3.5 million students were participating in on-line learning at institutions of higher education in the United States. According to the Sloan Foundation reports, there has been an increase of around 12–14 percent per year on average in enrollments for fully online learning over the five years 2004–2009 in the US post-secondary system, compared with an average of approximately 2 per cent increase per year in enrollments overall. Allen and Seamen (2009) claim that almost a quarter of all students in post-secondary education were taking fully online courses in 2008, and a report by Ambient

Insight Research suggests that in 2009, 44 per cent of post-secondary students in the USA were taking some or all of their courses online, and projected that this figure would rise to 81 percent by 2014. Thus it can be seen that e-learning is moving rapidly from the margins to being a predominant form of post-secondary education, at least in the USA.

Many higher education, for-profit institutions, now offer on-line classes. By contrast, only about half of private, non-profit schools offer them. The Sloan report, based on a poll of academic leaders, indicated that students generally appear to be at least as satisfied with their on-line classes as they are with traditional ones. Private institutions may become more involved with on-line presentations as the cost of instituting such a system decreases. Properly trained staff must also be hired to work with students on-line. 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.

K-12 Learning

E-learning is also utilized by public K-12 schools in the United States. Some E-Learning environments take place in a traditional classroom others allow students to attend classes from home or other locations.

History

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.

Early e-learning systems, based on Computer-Based Learning/Training often attempted to replicate 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.

As early as 1993, William D. Graziadei described an online computer-delivered lecture, tutorial and assessment project using electronic mail. In 1997 he published an article which described developing an overall strategy for technology-based course development and management for an educational system. He said that products had to be easy to use and maintain, portable, replicable, scalable, and immediately affordable, and they had to have a high probability of success with long-term cost-effectiveness.

William D. Graziadei, Sharon Gallagher,Ronald N. Brown,Joseph Sasiadek Building Asynchronous and Synchronous Teaching-Learning Environments: Exploring a Course/Classroom Management System Solution </ref> In 1997 Graziadei, W.D., et al., published an article entitled "Building Asynchronous and Synchronous Teaching-Learning Environments: Exploring a Course/Classroom Management System Solution".

They described a process at the State University of New York (SUNY) of evaluating products and developing an overall strategy for technology-based course development and management in teaching-learning. The product(s) had to be easy to use and maintain, portable, replicable, scalable, and immediately affordable, and they had to have a high probability of success with long-term cost-effectiveness. Today many technologies can be, and are, used in e-learning, from blogs to collaborative software, ePortfolios, and virtual classrooms. Most eLearning situations use combinations of these techniques.

E-Learning 2.0

The term E-Learning 2.0 is a neologism for CSCL systems that came about during the emergence of Web 2.0 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, podcasts and virtual worlds such as *Second Life*.

E-Learning 2.0, by 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 interaction about problems and actions. Advocates of social learning claim that one of the best ways to learn something is to teach it to others.

However, it should be noted that many early online courses, such as those developed by Murray Turoff and Starr Roxanne Hiltz in the 1970s and 80s at the New Jersey Institute of Technology, courses at the University of Guelph in Canada, the British Open University, and the online distance courses at the University of British Columbia (where Web CT, now incorporated into Blackboard Inc. was first developed), have always made heavy use of online discussion between students. Also, from the start, practitioners such as Harasim (1995) have put heavy emphasis on the use of learning networks for knowledge construction, long before the term e-learning, let alone e-learning 2.0, was even considered.

There is also an increased use of virtual classrooms (online presentations delivered live) as an online learning platform and classroom for a diverse set of education providers such as Minnesota State Colleges and Universities and Sachem School District.

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. Mobile Assisted Language Learning (MALL) is a term used to describe using handheld computers or cell phones to assist in language learning. Some feel, however, that schools have not caught up with the social networking trends. Few traditional educators promote social networking unless they are communicating with their own colleagues.

Approaches to e-learning services

E-learning services have evolved since computers were first used in education. There is a trend to move towards blended learning services, where computer-based activities are integrated with practical or classroom-based situations.

Bates and Poole (2003) and the OECD (2005) suggest that different types or forms of e-learning can be considered as a continuum, from no e-learning, i.e. no use of computers and/or the Internet for teaching and learning, through classroom aids, such as making classroom lecture Powerpoint slides available to students through a course web site or learning management system, to laptop programs, where students are required to bring laptops to class and use them as part of a face-to-face class, to hybrid learning, where classroom time is reduced but not eliminated, with more time devoted to online learning, through to fully online learning, which is a form of distance education. This classification is somewhat similar to that of the Sloan Commission reports on the status of e-learning, which refer to web enhanced, web supplemented and web dependent to reflect increasing intensity of technology use. In the Bates and Poole continuum, 'blended learning' can cover classroom aids, laptops and hybrid learning, while 'distributed learning' can incorporate either hybrid or fully online learning.

It can be seen then that e-learning can describe a wide range of applications, and it is often by no means clear even in peer reviewed research publications which form of e-learning is being discussed. However, Bates and Poole argue that when instructors say they are using e-learning, this most often refers to the use of technology as classroom aids, although over time, there has been a gradual increase in fully online learning.

Computer-based learning

Computer-based learning, sometimes abbreviated to CBL, refers to the use of computers as a key component of the educational environment. While this can refer to the use of computers in a classroom, the term more broadly refers to a structured environment in which computers are used for teaching purposes.

Cassandra B. Whyte researched about the ever increasing role that computers would play in higher education. This evolution, to include computer-supported collaborative learning, in addition to data management, has been realized. The type of computers have changed over the years from cumbersome, slow devices taking up much space in the classroom, home, and office to laptops and handheld devices that are more portable in form and size and this minimalization of technology devices will continue.

Computer-based training

Computer-Based Trainings (CBTs) are self-paced learning activities accessible via a computer or handheld device. CBTs typically present content in a linear fashion, much like reading an online book or manual. For this reason they are often used to teach static processes, such as using software or completing mathematical equations. The term

Computer-Based Training is often used interchangeably with Web-based training (WBT) with the primary difference being the delivery method. Where CBTs are typically delivered via CD-ROM, WBTs are delivered via the Internet using a web browser. Assessing learning in a CBT usually comes in the form of multiple choice questions, or other assessments that can be easily scored by a computer such as drag-and-drop, radial 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. Instead of limiting students to attending courses or reading printing manuals, students are able to acquire knowledge and skills through methods that are much more conducive to individual learning preferences. For example, CBTs offer visual learning benefits through animation or video, not typically offered by any other means.

CBTs can be a good alternative to printed learning materials since rich media, including videos or animations, can easily be embedded to enhance the learning. Another advantage to CBTs are that they can be easily distributed to a wide audience at a relatively low cost once the initial development is completed.

However, CBTs pose some learning challenges as well. 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 as well as 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.

Computer-supported collaborative learning (CSCL)

Computer-supported collaborative learning (CSCL) is one of the most promising innovations **to improve teaching and learning with the help of modern information and communication technology.** Most recent developments in CSCL have been called E-Learning 2.0, but the concept of collaborative or group learning whereby instructional methods are designed to encourage or require students to work together on learning tasks has existed much longer. It is widely agreed to distinguish collaborative learning from the traditional 'direct transfer' model in which the instructor is assumed to be the distributor of knowledge and skills, which is often given the neologism E-Learning 1.0, even though this direct transfer method most accurately reflects Computer-Based Learning systems (CBL).

In *Datacloud: Toward a New Theory of Online Work*, Johndan Johnson-Eilola describes a specific computer-supported collaboration space: The Smart Board. According to

Johnson-Eilola, a “Smart Board system provides a 72-inch, rear projection, touchscreen, intelligent whiteboard surface for work” (79). In *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).

Johnson-Eilola further explains that with the Smart Board “…information work becom[es] a odied 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.

When using smart boards information is able to be introduced to students in a new, fun, and engaging way. Teachers and/or students are able to draw on the board using different colors. This can help focus ones attention on particular areas of the screen. The marks made on the smart board are able to be erased. This makes it easy to show the information in its original form. When using smart boards teaching and learning become a more active experience for both the student and the teacher.

Locus of Control remains an important consideration in successful engagement of E-learners whether using the Smart Board or another E-learning modality. 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.

Technology-enhanced learning (TEL)

Technology enhanced learning (TEL) has the goal to provide socio-technical innovations (also improving efficiency and cost effectiveness) for e-learning practices, regarding individuals and organizations, independent of time, place and pace. The field of TEL therefore applies to the support of any learning activity through technology.

Technology issues

Along with the terms *learning technology*, *instructional technology*, and Educational Technology, the term is generally used to refer to the use of technology in learning in a much broader sense than the computer-based training or *Computer Aided Instruction* of the 1980s. It is also broader than the terms *Online Learning* or *Online Education* which generally refer to purely web-based learning. In cases where mobile technologies are used, the term M-learning has become more common. E-learning, however, also has implications beyond just the technology and refers to the actual learning that takes place using these systems.

E-learning is naturally suited to distance learning and flexible learning, but can also be used in conjunction with face-to-face teaching, in which case the term Blended learning is commonly used. E-Learning pioneer Bernard Luskin argues that the "E" must be understood to have broad meaning if e-Learning is to be effective. Luskin says that the "e" should be interpreted to mean exciting, energetic, enthusiastic, emotional, extended, excellent, and educational in addition to "electronic" that is a traditional national interpretation. This broader interpretation allows for 21st century applications and brings learning and media psychology into the equation.

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 standard 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 purchase, student governments and student newspapers.

E-Learning can also refer to educational web sites such as those offering learning scenarios, worksheets and interactive exercises for children. The term is also used extensively in the business sector where it generally refers to cost-effective online training.

The recent trend in the E-Learning sector is screencasting. There are many screencasting tools available but the latest buzz is all about the web based screencasting tools which allow the users to create screencasts directly from their browser and make the video available online so that the viewers can stream the video directly. The advantage of such tools is that it gives the presenter the ability to show his ideas and flow of thoughts rather than simply explain them, which may be more confusing when delivered via simple text instructions. With the combination of video and audio, the expert can mimic the one on one experience of the classroom and deliver clear, complete instructions. From the learner's point of view this provides the ability to pause and rewind and gives the learner the advantage of moving at their own pace, something a classroom cannot always offer.

Communication technologies used in E-learning

Communication technologies are generally categorized as asynchronous or synchronous. *Asynchronous* activities use technologies such as blogs and discussion boards. The idea here is that participants may engage in the exchange of ideas or information without the dependency of other participants involvement at the same time. Electronic mail (Email) is also asynchronous in that mail can be sent or received without having both the participants' involvement at the same time. Asynchronous learning also gives students the ability to work at their own pace. This is particularly beneficial for students who have health problems. They have the opportunity to complete their work in a low stress environment.

Synchronous activities involve the exchange of ideas and information with one or more participants during the same period of time. A face to face discussion is an example of synchronous communications. *Synchronous* activities occur with all participants joining in at once, as with an online chat session or a virtual classroom or meeting.

Virtual classrooms and meetings can often use a mix of communication technologies. Participants in a virtual classroom use icons called emoticons to communicate feelings and responses to questions or statements. Other communication technologies available in a virtual classroom include text notes, microphone rights, and breakout sessions. Breakout sessions allow the participants to work collaboratively in a small group setting to accomplish a task.

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 awhile, 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 also have access to an incredible variety of enrichment courses in online learning, and can participate in internships, sports, or work and still graduate with their class.

In many models, the writing community and the communication channels relate with the E-learning and the M-learning communities. Both the communities provide a general overview of the basic learning models and the activities required for the participants to join the learning sessions across the virtual classroom or even across standard classrooms enabled by technology. Many activities, essential for the learners in these environments, require frequent chat sessions in the form of virtual classrooms and/or blog meetings.

Learning management system (LMS) and Learning content management system (LCMS)

A learning management system (LMS) is software used for delivering, tracking and managing training/education. LMSs range from systems for managing training/educational records to software for distributing courses over the Internet and offering features for online collaboration.

A learning content management system (LCMS) is software for authoring, editing and indexing e-learning 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 LMS allows for teachers and administrators to track attendance, time on task, and student progress. LMS also allows for not only teachers and administrators to track these variables but parents and students as well. Parents can log on to the LMS to track grades. Students log on to the LMS to submit homework and to access the course syllabus and lessons.

Computer-aided assessment

Computer-aided Assessment (also but less commonly referred to as E-assessment), ranging from automated multiple-choice tests to more sophisticated systems is becoming increasingly common. 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/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 which is aimed at the Eleven plus exam set in the UK.

The term *learning design* has sometimes come to refer to the type of activity enabled by software such as the open-source system LAMS which 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 has been replacing the traditional settings due to its cost effectiveness.

Electronic performance support systems (EPSS)

Electronic performance support systems (EPSS) is a "computer-based system that improves worker productivity by providing on-the-job access to integrated information, advice, and learning experiences". 1991, Barry Raybould

Content issues

Content is a core component of E-learning and includes issues such as pedagogy and learning object re-use.

Pedagogical elements

Pedagogical elements are an attempt to define structures or units of educational material. For example, this could be a lesson, an assignment, a multiple choice question, a quiz, a discussion group or a case study. These units should be format independent, so although it may be in any of the following methods, pedagogical structures would **not** include a textbook, a web page, a video conference or Podcast.

When beginning to create E-Learning content, the pedagogical approaches need to be evaluated. Simple pedagogical approaches make it easy to create content, but lack flexibility, richness and downstream functionality. On the other hand, complex pedagogical approaches can be difficult to set up and slow to develop, though they have the potential to provide more engaging learning experiences for students. Somewhere between these extremes is an ideal pedagogy that allows a particular educator to effectively create educational materials while simultaneously providing the most engaging educational experiences for students.

Pedagogical approaches or perspectives

It is possible to use various pedagogical approaches for eLearning which include:

- **instructional design** – the traditional pedagogy of instruction which is curriculum focused, and is developed by a centralized educating group or a single teacher.

- **social-constructivist** – this pedagogy is particularly well afforded by the use of discussion forums, blogs 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

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

- **Cognitive perspective** focuses on the cognitive processes involved in learning as well as how the brain works.

- **Emotional perspective** focuses on the emotional aspects of learning, like motivation, engagement, fun, etc.

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

- **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.

- **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.

Reusability, standards and learning objects

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.

A common standard format for e-learning content is SCORM whilst other specifications allow for the transporting of "learning objects" (Schools Framework) or categorizing metadata (LOM).

These standards themselves are early in the maturity process with the oldest being 8 years old. They are also relatively vertical specific: SIF is primarily pK-12, LOM is primarily Corp, Military and Higher Ed, and SCORM is primarily Military and Corp with some Higher Ed. PESC- the Post-Secondary Education Standards Council- is also making headway in developing standards and learning objects for the Higher Ed space, while SIF is beginning to seriously turn towards Instructional and Curriculum learning objects.

In the US pK12 space there are a host of content standards that are critical as well- the NCES data standards are a prime example. Each state government's content standards and achievement benchmarks are critical metadata for linking e-learning objects in that space.

An excellent example of e-learning that relates to knowledge management and reusability is Navy E-Learning, which is available to Active Duty, Retired, or Disable Military members. This on-line tool provides certificate courses to enrich the user in various subjects related to military training and civilian skill sets. The e-learning system not only provides learning objectives, but also evaluates the progress of the student and credit can be earned toward higher learning institutions. This reuse is an excellent example of knowledge retention and the cyclical process of knowledge transfer and use of data and records.

Chapter- 3

Learning Management System

A **learning management system** (commonly abbreviated as **LMS**) is a software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events, e-learning programs, and training content. As described in (Ellis 2009) a robust LMS should be able to do the following:

- 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.

LMSs range from systems for managing training and educational records, to software for distributing courses over the Internet with features for online collaboration. Corporate training use LMSs to automate record-keeping and employee registration. 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 dimensions to Learning Management Systems.

Some LMSs are Web-based to facilitate access to learning content and administration. LMSs are used by regulated industries (e.g. financial services and biopharma) for compliance training. It is also used by educational institutions to enhance and support classroom teaching and offering courses to a larger population of learners across the globe.

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.

Characteristics

LMSs cater to educational, administrative, and deployment requirements. While an LMS for corporate learning, for example, may share many characteristics with a VLE, or virtual learning environment, used by educational institutions, they each meet unique needs. The virtual learning environment used by universities and colleges allow instructors to manage their courses and exchange information with students for a course that in most cases will last several weeks and will meet several times during those weeks. In the corporate setting a course may be much shorter in length, completed in a single instructor-led event or online session.

The characteristics shared by both types of LMSs include:

- Manage users, roles, courses, instructors, facilities, and generate reports
- Course calendar
- Learning Path
- Student messaging and notifications
- Assessment and testing handling before and after testing
- Display scores and transcripts
- Grading of coursework and roster processing, including waitlisting
- Web-based or blended course delivery

Characteristics more specific to corporate learning, which sometimes includes franchisees or other business partners, include:

- Autoenrollment (enrolling Students in courses when required according to predefined criteria, such as job title or work location)
- Manager enrollment and approval
- Boolean definitions for prerequisites or equivalencies
- Integration with performance tracking and management systems
- Planning tools to identify skill gaps at departmental and individual level
- Curriculum, required and elective training requirements at an individual and organizational level
- Grouping students according to demographic units (geographic region, product line, business size, etc.)
- Assign corporate and partner employees to more than one job title at more than one demographic unit

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 back-end. Although most of the systems are commercially developed and have commercial software licenses there are several systems that have an open-source license.

Learning content management system (LCMS)

A learning content management system (LCMS) is a related technology to the learning management system in that it is focused on the development, management and publishing of the content that will typically be delivered via an LMS. An LCMS is a multi-user environment where developers may create, store, **reuse**, manage, and deliver digital learning content from a central object repository. The LMS cannot create and manipulate courses; it cannot reuse the content of one course to build another. The LCMS, however, can create, manage and deliver not only training modules but also manage and edit all the individual pieces that make up a catalog of training. LCMS applications allow users to create, import, manage, search for and reuse small units or "chunks" of digital learning content and assets, commonly referred to as learning objects. These assets may include media files developed in other authoring tools, assessment items, simulations, text, graphics or any other object that makes up the content within the course being created. An LCMS manages the process of creating, editing, storing and delivering e-learning content, ILT materials and other training support deliverables such as job aids.

Learning Management Systems compared to Learning Content Management Systems

Some systems have tools to deliver and manage instructor-led synchronous and asynchronous online training based on learning object methodology. These systems are called Learning Content Management Systems or LCMSs. LCMSs provide tools for authoring and reusing or re-purposing content (mutated learning objects) MLO as well as virtual spaces for student interaction (such as discussion forums, live chat rooms and live web-conferences). Despite this distinction, the term LMS is often used to refer to both an LMS and an LCMS, although the LCMS is a further development of the LMS. Due to this conformity issue, the acronym CLCIMS (*Computer Learning Content Information Management System*) is now widely used to create a uniform phonetic way of referencing any learning system software based on advanced learning technology methodology.

In essence, an LMS is software for planning, delivering, and managing learning events within an organization, including online, virtual classroom, and instructor-led courses. For example, an LMS can simplify global certification efforts, enable entities to align learning initiatives with strategic goals, and provide a means of enterprise-level skills management. The focus of an LMS is to manage students, keeping track of their progress and performance across all types of training activities. It performs administrative tasks, such as reporting to instructors, HR and other ERP systems but isn't used to create course content.

By contrast, an LCMS is software for managing learning content across an organization's various training development areas. It provides developers, authors, instructional designers, and subject matter experts the means to create and re-use e-learning content and reduce duplicated development efforts. In the remote AICC hosting approach, an LCMS may host the content in a central repository and allow multiple LMSs to access it.

Primary business problems an LCMS solves are

- centralized management of an organization's learning content for efficient searching and retrieval,
- productivity gains around rapid and condensed development timelines,
- productivity gains around assembly, maintenance and publishing / branding / delivery of learning content.

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.

To look at this another way, an LMS is learner–centric. It focuses on e-learning process management and content delivery. In essence, an LMS is software for planning, delivering and managing learning events within an organization, including online, virtual classroom, and instructor-led courses. For example, an LMS can simplify global certification efforts, enable entities to align learning initiatives with strategic goals and provide a means for enterprise-level skills management. The focus of an LMS is to manage students, keeping track of their progress and performance across all types of training activities. It performs administrative tasks, such as reporting to instructors, HR and other ERP systems but it isn't used to create course content.

An LCMS is content–centric. Here, the focus is on the authoring and management of e-learning reusable content.

By contrast, LCMS solutions are ideally suited to create content-centric learning strategies, supporting multiple methods for gathering and organizing content, leveraging content for multiple purposes, and operation for mission critical purposes. 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.

Rather than developing entire courses and adapting them to multiple audiences, an LCMS is designed for managing learning content across an organization's various training development areas. It provides developers, authors, instructional designers, and subject matter experts the means to create and re-use e-learning content and reduce duplicated development efforts. 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 allows for the rapid assembly of customized content.

In addition, Brandon Hall believes that: “when LCMS technology is appropriately applied and matched to an orchestrated e-learning strategy, with a complete instructional design plan for designing and using learning objects, great efficiencies can and will be achieved, such as: • The ability to make instantaneous, company-wide changes to critical learning content • Rapid and productive content development efforts • Seamless collaboration among subject matter experts and course designers • The ability to create multiple, derivative versions of content applicable to different audiences from senior management to line-level workers • Access to find and reuse learning content, ‘just-in-time’ and ‘just enough’ • Ultimate reusability of content by making it available through a wide array of output types such as structured e-learning courses, CD-ROM courses, learning material available from a Palm device or PocketPC, print-based learning for use in classroom settings, and so on.”

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.

As reported in (Bersin et al. 2009), LMSs represent an $860 million market, made up of more than 60 different providers. The six largest LMS product companies constitute approximately 50% of the market. 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 U.S. training organizations reported that they have an LMS installed, a figure that has not changed significantly over the past two years. The small business market offers the greatest opportunity for growth, as only 36 percent of these companies are using an LMS. Many of these businesses would like a low-cost, easy-to-use, easy-to-maintain system – but, as yet, they are not willing to make the commitment. An LMS is still a nontrivial investment in money and resources.

According to a 2009 report by American Society for Training and Development (ASTD) 91 percent of ASTD respondents are using LMS's in their organizations, with more than half purchasing rather than building their systems, and one-fifth of respondents opting to go with a hosted platform. And whether built or bought, the majority of respondents are satisfied with their current LMS, with 22.2 percent very satisfied, 31.1 percent satisfied, and 25.6 percent somewhat satisfied. Still, some 13.3 said they were unsatisfied, and 8.8 said they were very unsatisfied.

Most buyers of LMSs utilize an authoring tool to create their e-learning 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 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 while 329 products were compliant.

Trends

Another upcoming trend in this technology is ‘Channel Learning’ where organizations are sharing online contents and learning from their partner firms. According to a survey by trainingindustry.com, for many buyers channel learning is not their number one priority, but often there is a gap when the HR department oversees training and development initiatives, where the focus is consolidated inside traditional corporate boundaries. Software technology companies are at the front end of this curve, placing higher priority on channel trainings.

Today the biggest trend in the e-learning market is for these systems to be integrated with ‘Talent Management’ software systems. A talent management software serves towards the process of recruiting, managing, assessing, developing and maintaining an organization’s most important resources. Bersin research shows that in 2009 more than 70 percent of large companies have an LMS already and almost one third of these companies are considering replacing or upgrading these systems with integrated talent management systems.

Chapter- 4

Computerized Adaptive Testing

Computerized adaptive testing (**CAT**) is a form of computer-based test that adapts to the examinee's ability level. For this reason, it has also been called *tailored testing*.

How CAT works

CAT successively selects questions so as to maximize the precision of the exam based on what is known about the examinee from previous questions. From the examinee's perspective, the difficulty of the exam seems to tailor itself to his or her level of ability. For example, if an examinee performs well on an item of intermediate difficulty, he will then be presented with a more difficult question. Or, if he performed poorly, he would be presented with a simpler question. Compared to static multiple choice tests that nearly everyone has experienced, with a fixed set of items administered to all examinees, computer-adaptive tests require fewer test items to arrive at equally accurate scores. (Of course, there is nothing about the CAT methodology that requires the items to be multiple-choice; but just as most exams are multiple-choice, most CAT exams also use this format.)

The basic computer-adaptive testing method is an iterative algorithm with the following steps:

1. The pool of available items is searched for the optimal item, based on the current estimate of the examinee's ability
2. The chosen item is presented to the examinee, who then answers it correctly or incorrectly
3. The ability estimate is updated, based upon all prior answers
4. Steps 1–3 are repeated until a termination criterion is met

Nothing is known about the examinee prior to the administration of the first item, so the algorithm is generally started by selecting an item of medium, or medium-easy, difficulty as the first item.

As a result of adaptive administration, different examinees receive quite different tests. The psychometric technology that allows equitable scores to be computed across different sets of items is item response theory (IRT). IRT is also the preferred methodology for selecting optimal items which are typically selected on the basis of *information* rather than difficulty, per se.

The GRE General Test and the Graduate Management Admission Test are currently primarily administered as a computer-adaptive test. A list of active CAT programs is found at CAT Central, along with a list of current CAT research programs and a near-inclusive bibliography of all published CAT research.

A related methodology called multistage testing (MST) or CAST is used in the Uniform Certified Public Accountant Examination. MST avoids or reduces some of the disadvantages of CAT as described below.

Advantages

Adaptive tests can provide uniformly precise scores for most test-takers. In contrast, standard fixed tests almost always provide the best precision for test-takers of medium ability and increasingly poorer precision for test-takers with more extreme test scores.

An adaptive test can typically be shortened by 50% and still maintain a higher level of precision than a fixed version. This translates into a time savings for the test-taker. Test-takers do not waste their time attempting items that are too hard or trivially easy. Additionally, the testing organization benefits from the time savings; the cost of examinee seat time is substantially reduced. However, because the development of a CAT involves much more expense than a standard fixed-form test, a large population is necessary for a CAT testing program to be financially fruitful.

Like any computer-based test, adaptive tests may show results immediately after testing.

Adaptive testing, depending on the item selection algorithm, may reduce exposure of some items because examinees typically receive different sets of items rather than the whole population being administered a single set. However, it may increase the exposure of others (namely the medium or medium/easy items presented to most examinees at the beginning of the test).

Disadvantages

The first issue encountered in CAT is the calibration of the item pool. In order to model the characteristics of the items (e.g., to pick the optimal item), all the items of the test must be pre-administered to a sizable sample and then analyzed. To achieve this, new items must be mixed into the operational items of an exam (the responses are recorded but do not contribute to the test-takers' scores), called "pilot testing," "pre-testing," or "seeding." This presents logistical, ethical, and security issues. For example, it is impossible to field an operational adaptive test with brand-new, unseen items; all items must be pretested with a large enough sample to obtain stable item statistics. This sample may be required to be as large as 1,000 examinees. Each program must decide what percentage of the test can reasonably be composed of unscored pilot test items.

Although adaptive tests have *exposure control* algorithms to prevent overuse of a few items, the exposure conditioned upon ability is often not controlled and can easily become close to 1. That is, it is common for some items to become very common on tests for people of the same ability. This is a serious security concern because groups sharing items may well have a similar functional ability level. In fact, a completely randomized exam is the most secure (but also least efficient).

Review of past items is generally disallowed. Adaptive tests tend to administer easier items after a person answers incorrectly. Supposedly, an astute test-taker could use such clues to detect incorrect answers and correct them. Or, test-takers could be coached to deliberately pick wrong answers, leading to an increasingly easier test. After tricking the adaptive test into building a maximally easy exam, they could then review the items and answer them correctly—possibly achieving a very high score. Test-takers frequently complain about the inability to review.

CAT components

There are five technical components in building a CAT (the following is adapted from Weiss & Kingsbury, 1984). This list does not include practical issues, such as item pretesting or live field release.

1. Calibrated item pool
2. Starting point or entry level
3. Item selection algorithm
4. Scoring procedure
5. Termination criterion

Calibrated Item Pool

A pool of items must be available for the CAT to choose from. The pool must be calibrated with a psychometric model, which is used as a basis for the remaining four components. Typically, item response theory is employed as the psychometric model. One reason item response theory is popular is because it places persons and items on the same metric (denoted by the Greek letter theta), which is helpful for issues in item selection.

Starting Point

In CAT, items are selected based on the examinee's performance up to a given point in the test. However, the CAT is obviously not able to make any specific estimate of examinee ability when no items have been administered. So some other initial estimate of examinee ability is necessary. If some previous information regarding the examinee is known, it can be used, but often the CAT just assumes that the examinee is of average ability - hence the first item often being of medium difficulty.

Item Selection Algorithm

As mentioned previously, item response theory places examinees and items on the same metric. Therefore, if the CAT has an estimate of examinee ability, it is able to select an item that is most appropriate for that estimate. Technically, this is done by selecting the item with the greatest *information* at that point. Information is a function of the discrimination parameter of the item, as well as the conditional variance and pseudoguessing parameter (if used).

Scoring Procedure

After an item is administered, the CAT updates its estimate of the examinee's ability level. If the examinee answered the item correctly, the CAT will likely estimate their ability to be somewhat higher, and vice versa. This is done by using the item response function from item response theory to obtain a likelihood function of the examinee's ability. Two methods for this are called *maximum likelihood estimation* and *Bayesian estimation*. The latter assumes an *a priori* distribution of examinee ability, and has two commonly used estimators: *expectation a posteriori* and *maximum a posteriori*. Maximum likelihood is equivalent to a Bayes maximum a posterior estimate if a uniform (f(x)=1) prior is assumed. Maximum likelihood is asymptotically unbiased, but cannot provide a theta estimate for a nonmixed (all correct or incorrect) response vector, in which case a Bayesian method may have to be used temporarily.

Termination Criterion

The CAT algorithm is designed to repeatedly administer items and update the estimate of examinee ability. This will continue until the item pool is exhausted unless a termination criterion is incorporated into the CAT. Often, the test is terminated when the examinee's standard error of measurement falls below a certain user-specified value, hence the statement above that an advantage is that examinee scores will be uniformly precise or "equiprecise." Other termination criteria exist for different purposes of the test, such as if the test is designed only to determine if the examinee should "Pass" or "Fail" the test, rather than obtaining a precise estimate of their ability.

Other issues

Pass-Fail CAT

In many situations, the purpose of the test is to classify examinees into two or more mutually exclusive and exhaustive categories. This includes the common "mastery test" where the two classifications are "pass" and "fail," but also includes situations where there are three or more classifications, such as "Insufficient," "Basic," and "Advanced" levels of knowledge or competency. The kind of "item-level adaptive" CAT described here is most appropriate for tests that are not "pass/fail" or for pass/fail tests where providing good feedback is extremely important.) Some modifications are necessary for a pass/fail CAT, also known as a computerized classification test (CCT). For examinees with true scores very close to the passing score, computerized classification tests will result in long tests while those with true scores far above or below the passing score will have shortest exams.

For example, a new termination criterion and scoring algorithm must be applied that classifies the examinee into a category rather than providing a point estimate of ability. There are two primary methodologies available for this. The more prominent of the two is the sequential probability ratio test (SPRT). This formulates the examinee classification problem as a hypothesis test that the examinee's ability is equal to either some specified point above the cutscore or another specified point below the cutscore. Note that this is a point hypothesis formulation rather than a composite hypothesis formulation that is more conceptually appropriate. A composite hypothesis formulation would be that the examinee's ability is in the region above the cutscore or the region below the cutscore.

A confidence interval approach is also used, where after each item is administered, the algorithm determines the probability that the examinee's true-score is above or below the passing score. For example, the algorithm may continue until the 95% confidence interval for the true score no longer contains the passing score. At that point, no further items are needed because the pass-fail decision is already 95% accurate, assuming that the psychometric models underlying the adaptive testing fit the examinee and test. This approach was originally called "adaptive mastery testing" but it can be applied to non-adaptive item selection and classification situations of two or more cutscores (the typical mastery test has a single cutscore).

As a practical matter, the algorithm is generally programmed to have a minimum and a maximum test length (or a minimum and maximum administration time). Otherwise, it would be possible for an examinee with ability very close to the cutscore to be administered every item in the bank without the algorithm making a decision.

The item selection algorithm utilized depends on the termination criterion. Maximizing information at the cutscore is more appropriate for the SPRT because it maximizes the difference in the probabilities used in the likelihood ratio. Maximizing information at the ability estimate is more appropriate for the confidence interval approach because it minimizes the conditional standard error of measurement, which decreases the width of the confidence interval needed to make a classification.

Practical Constraints of Adaptivity

ETS researcher Martha Stocking has quipped that most adaptive tests are actually *barely adaptive tests* (BATs) because, in practice, many constraints are imposed upon item choice. For example, CAT exams must usually meet content specifications; a verbal exam may need to be composed of equal numbers of analogies, fill-in-the-blank and synonym item types. CATs typically have some form of item exposure constraints, to prevent the most informative items from being over-exposed. Also, on some tests, an attempt is made to balance surface characteristics of the items such as gender of the people in the items or the ethnicities implied by their names. Thus CAT exams are frequently constrained in which items it may choose and for some exams the constraints may be substantial and require complex search strategies (e.g., linear programming) to find suitable items.

A simple method for controlling item exposure is the "randomesque" or strata method. Rather than selecting the most informative item at each point in the test, the algorithm randomly selects the next item from the next five or ten most informative items. This can be used throughout the test, or only at the beginning. Another method is the Sympson-Hetter method, in which a random number is drawn from U(0,1), and compared to a k_i parameter determined for each item by the test user. If the random number is greater than k_i, the next most informative item is considered.

Wim van der Linden and colleagues have advanced an alternative approach called *shadow testing* which involves creating entire *shadow tests* as part of selecting items. Selecting items from shadow tests helps adaptive tests meet selection criteria by focusing on globally optimal choices (as opposed to choices that are optimal *for a given item*).

Chapter- 5

Digital Library

A **digital library** is a library in which collections are stored in digital formats (as opposed to print, microform, or other media) and accessible by computers. The digital content may be stored locally, or accessed remotely via computer networks. A digital library is a type of information retrieval system.

The *DELOS Digital Library Reference Model* defines a digital library as:

An organization, which might be virtual, that comprehensively collects, manages and preserves for the long term rich digital content, and offers to its user communities specialized functionality on that content, of measurable quality and according to codified policies.

The first use of the term *digital library* in print may have been in a 1988 report to the Corporation for National Research Initiatives The term *digital libraries* was first popularized by the NSF/DARPA/NASA Digital Libraries Initiative in 1994. These draw heavily on As We May Think by Vannevar Bush in 1945, which set out a vision not in terms of technology, but user experience. The term *virtual library* was initially used interchangeably with *digital library,* but is now primarily used for libraries that are virtual in other senses (such as libraries which aggregate distributed content).

A distinction is often made between content that was created in a digital format, known as born-digital, and information that has been converted from a physical medium, e.g., paper, by digitizing. The term hybrid library is sometimes used for libraries that have both physical collections and digital collections. For example, American Memory is a digital library within the Library of Congress. Some important digital libraries also serve as long term archives, for example, the Eprint arXiv, and the Internet Archive.

Academic repositories

Many academic libraries are actively involved in building institutional repositories of the institution's books, papers, theses, and other works which can be digitized or were 'born digital'. Many of these repositories are made available to the general public with few restrictions, in accordance with the goals of open access, in contrast to the publication of research in commercial journals, where the publishers often limit access rights.

Institutional, truly free, and corporate repositories are sometimes referred to as digital libraries.

Digital archives

Physical archives differ from physical libraries in several ways. Traditionally, archives were defined as:

1. Containing primary sources of information (typically letters and papers directly produced by an individual or organization) rather than the secondary sources found in a library (books, periodicals, etc);
2. Having their contents organized in groups rather than individual items.
3. Having unique contents.

The technology used to create digital libraries has been even more revolutionary for archives since it breaks down the second and third of these general rules. In other words, "digital archives" or "online archives" will still generally contain primary sources, but they are likely to be described individually rather than (or in addition to) in groups or collections, and because they are digital their contents are easily reproducible and may indeed have been reproduced from elsewhere. The Oxford Text Archive is generally considered to be the oldest digital archive of academic physical primary source materials.

The future

Large scale digitization projects are underway at Google, the Million Book Project, and Internet Archive. With continued improvements in book handling and presentation technologies such as optical character recognition and ebooks, and development of alternative depositories and business models, digital libraries are rapidly growing in popularity as demonstrated by Google, Yahoo!, and MSN's efforts. Just as libraries have ventured into audio and video collections, so have digital libraries such as the Internet Archive.

According to Larry Lannom, Director of Information Management Technology at the nonprofit Corporation for National Research Initiatives, "all the problems associated with digital libraries are wrapped up in archiving." He goes on to state, "If in 100 years people can still read your article, we'll have solved the problem." Daniel Akst, author of The Webster Chronicle, proposes that "the future of libraries—and of information—is digital." Peter Lyman and Hal Varian, information scientists at the University of California, Berkeley, estimate that "the world's total yearly production of print, film, optical, and magnetic content would require roughly 1.5 billion gigabytes of storage." Therefore, they believe that "soon it will be technologically possible for an average person to access virtually all recorded information."

Searching

Most digital libraries provide a search interface which allows resources to be found. These resources are typically deep web (or invisible web) resources since they frequently cannot be located by search engine crawlers. Some digital libraries create special pages or sitemaps to allow search engines to find all their resources. Digital libraries frequently use the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) to expose their metadata to other digital libraries, and search engines like Google Scholar, Yahoo! and Scirus can also use OAI-PMH to find these deep web resources.

There are two general strategies for searching a **federation** of digital libraries:

1. distributed searching, and
2. searching previously harvested metadata.

Distributed searching typically involves a client sending multiple search requests in parallel to a number of servers in the federation. The results are gathered, duplicates are eliminated or clustered, and the remaining items are sorted and presented back to the client. Protocols like Z39.50 are frequently used in distributed searching. A benefit to this approach is that the resource-intensive tasks of indexing and storage are left to the respective servers in the federation. A drawback to this approach is that the search mechanism is limited by the different indexing and ranking capabilities of each database, making it difficult to assemble a combined result consisting of the most relevant found items.

Searching over previously harvested metadata involves searching a locally stored index of information that has previously been collected from the libraries in the federation. When a search is performed, the search mechanism does not need to make connections with the digital libraries it is searching - it already has a local representation of the information. This approach requires the creation of an indexing and harvesting mechanism which operates regularly, connecting to all the digital libraries and querying the whole collection in order to discover new and updated resources. OAI-PMH is frequently used by digital libraries for allowing metadata to be harvested. A benefit to this approach is that the search mechanism has full control over indexing and ranking algorithms, possibly allowing more consistent results. A drawback is that harvesting and indexing systems are more resource-intensive and therefore expensive.

Frameworks

The formal reference models include the DELOS Digital Library Reference Model (Agosti, et al., 2006) and the Streams, Structures, Spaces, Scenarios, Societies (5S) formal framework The Reference Model for an Open Archival Information System (OAIS) provides a framework to address digital preservation.

Construction and organization

Software

There are a number of software packages for use in general digital libraries, for notable ones see Digital library software. Institutional repository software, which focuses primarily on ingest, preservation and access of locally produced documents, particularly locally-produced academic outputs, can be found in Institutional repository software.

Digitization

In the past few years, procedures for digitizing books at high speed and comparatively low cost have improved considerably with the result that it is now possible to plan the digitization of millions of books per year for creating digital libraries.

Advantages

The advantages of digital libraries as a means of easily and rapidly accessing books, archives and images of various types are now widely recognized by commercial interests and public bodies alike.

Traditional libraries are limited by storage space; digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain it. As such, the cost of maintaining a digital library is much lower than that of a traditional library.

A traditional library must spend large sums of money paying for staff, book maintenance, rent, and additional books. Digital libraries may reduce or, in some instances, do away with these fees. Both types of library require cataloguing input to allow users to locate and retrieve material. Digital libraries may be more willing to adopt innovations in technology providing users with improvements in electronic and audio book technology as well as presenting new forms of communication such as blogs; conventional libraries may consider that providing online access to their OPAC catalogue is sufficient. An important advantage to digital conversion is increased accessibility to users. They also increase availability to individuals who may not be traditional patrons of a library, due to geographic location or organizational affiliation.

- **No physical boundary**. The user of a digital library need not to go to the library physically; people from all over the world can gain access to the same information, as long as an Internet connection is available.
- **Round the clock availability** A major advantage of digital libraries is that people can gain access 24/7 to the information.
- **Multiple access**. The same resources can be used simultaneously by a number of institutions and patrons. This may not be the case for copyrighted material: a library may have a license for "lending out" only one copy at a time; this is

achieved with a system of digital rights management where a resource can become inaccessible after expiration of the lending period or after the lender chooses to make it inaccessible (equivalent to returning the resource).

- **Information retrieval**. The user is able to use any search term (word, phrase, title, name, subject) to search the entire collection. Digital libraries can provide very user-friendly interfaces, giving clickable access to its resources.
- **Preservation and conservation**. Digitization is not a long-term preservation solution for physical collections, but does succeed in providing access copies for materials that would otherwise fall to degradation from repeated use. Digitized collections and born-digital objects pose many preservation and conservation concerns that analog materials do not.
- **Space**. Whereas traditional libraries are limited by storage space, digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain them and media storage technologies are more affordable than ever before.
- **Added value**. Certain characteristics of objects, primarily the quality of images, may be improved. Digitization can enhance legibility and remove visible flaws such as stains and discoloration.
- **Easily accessible**.

Challenges

Digital preservation

Digital preservation aims to ensure that digital media and information systems are still interpretable into the indefinite future. Each necessary component of the must be migrated, preserved or emulated. Typically lower levels of systems (floppy disks for example) are emulated, bit-streams (the actual files stored in the disks) are preserved and operating systems are emulated as a virtual machine. Only where the meaning and content of digital media and information systems are well understood is migration possible, as is the case for office documents.

Copyright and licensing

Some people have criticized that digital libraries are hampered by copyright law, because works cannot be shared over different periods of time in the manner of a traditional library. The republication of material on the Web by libraries may require permission from rights holders, and there is a conflict of interest between them and publishers who may wish to create online versions of their acquired content for commercial purposes.

There is a dilution of responsibility that occurs as a result of the spread-out nature of digital resources. Complex intellectual property matters may become involved since digital material is not always owned by a library. The content is, in many cases, public domain or self-generated content only. Some digital libraries, such as Project Gutenberg, work to digitize out-of-copyright works and make them freely available to the public. An estimate of the number of distinct books still existent in library catalogues from 2000BC to 1960, has been made.

The Fair Use Provisions (17 USC § 107) under copyright law provide specific guidelines under which circumstances libraries are allowed to copy digital resources. Four factors that constitute fair use are purpose of use, nature of the work, market impact, and amount or substantiality used.

Some digital libraries acquire a license to "lend out" their resources. This may involve the restriction of lending out only one copy at a time for each license, and applying a system of digital rights management for this purpose.

Metadata creation

In traditional libraries, the ability to find works of interest was directly related to how well they were catalogued. While cataloguing electronic works digitized from a library's existing holding may be as simple as copying moving a record for the print to the electronic item, with complex and born-digital works requiring substantially more effort. To handle the growing volume of electronic publications, new tools and technologies have to be designed to allow effective automated semantic classification and searching. While full text search can be used for some searches, there are many common catalog searches which cannot be performed using full text, including:

- finding texts which are translations of other texts
- linking texts published under pseudonyms to the real authors (Samuel Clemens and Mark Twain, for example)
- differentiating non-fiction from parody (The Onion from The New York Times, for example)

Chapter- 6

Instructional Design

Instructional Design (also called **Instructional Systems Design (ISD)**) is the practice of maximizing the effectiveness, efficiency and appeal of instruction and other learning experiences. 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 phases analysis, design, development, implementation, and evaluation. As a field, instructional design is historically and traditionally rooted in cognitive and behavioral psychology.

History

Much of the foundation of the field of instructional design was laid in World War II, when the U.S. military faced the need to rapidly train large numbers of people to perform complex technical tasks, from field-stripping a carbine to navigating across the ocean to building a bomber— "Training Within Industry (TWI)". Drawing on the research and theories of B.F. Skinner on operant conditioning, training programs focused on observable behaviors. Tasks were broken down into subtasks, and each subtask treated as a separate learning goal. Training was designed to reward correct performance and remediate incorrect performance. Mastery was assumed to be possible for every learner, given enough repetition and feedback. After the war, the success of the wartime training model was replicated in business and industrial training, and to a lesser extent in the primary and secondary classroom. The approach is still common in the U.S. military.

In 1956, a committee lead 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.

During the latter half of the 20th century, learning theories began to be influenced by the growth of digital computers.

In the 1970s, 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).

Later in the 1980s and throughout the 1990s cognitive load theory began to find empirical support for a variety of presentation techniques.

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. 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.

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.

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. Mayer and his associates soon developed a Cognitive Theory of Multimedia Learning.

In the past decade, cognitive load theory has begun to be internationally accepted 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. Finally Clark, Nguyen and Sweller 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. The designers also use auditory and visual methods to communicate information to the learner.

Learning Design

The IMS Learning Design specification supports the use of a wide range of teaching methods in online learning. Rather than attempting to capture the specifics of many strategies of instruction, it does this by providing a generic and flexible language. This language is designed to enable many different styles of instruction to be expressed. The approach has the advantage over alternatives in that only one set of learning design and runtime tools need to be implemented in order to support the desired wide range of teaching styles. The language was originally developed at the Open University of the Netherlands (OUNL), after extensive examination and comparison of a wide range of pedagogical approaches and their associated learning activities, and several iterations of the developing language to obtain a good balance between generality and pedagogic expressiveness.

A criticism of Learning Design theory is that learning is an outcome. While instructional theory Instructional Design focuses on outcomes, while properly accounting for a multi-variate context that can only be predictive, it acknowledges that (given the variabilities in human capability) a guarantee of reliable learning outcomes is improbable. We can only design instruction. We cannot design learning (an outcome). Automotive engineers can design a car that, under specific conditions, will achieve 50 miles per gallon. These engineers cannot guarantee that drivers of the cars they design will (or have the capability to) operate these vehicles according to the specific conditions prescribed. The former is the metaphor for instructional design. The latter is the metaphor for Learning Design.

Instructional design models

ADDIE process

Perhaps the most common model used for creating instructional materials is the ADDIE Process. This acronym stands for the 5 phases contained in the model:

- **Analyze** – analyze learner characteristics, task to be learned, etc.
- **Design** – develop learning objectives, choose an instructional approach
- **Develop** – create instructional or training materials
- **Implement** – deliver or distribute the instructional materials
- **Evaluate** – make sure the materials achieved the desired goals

Most of the current instructional design models are variations of the ADDIE process.

Rapid prototyping

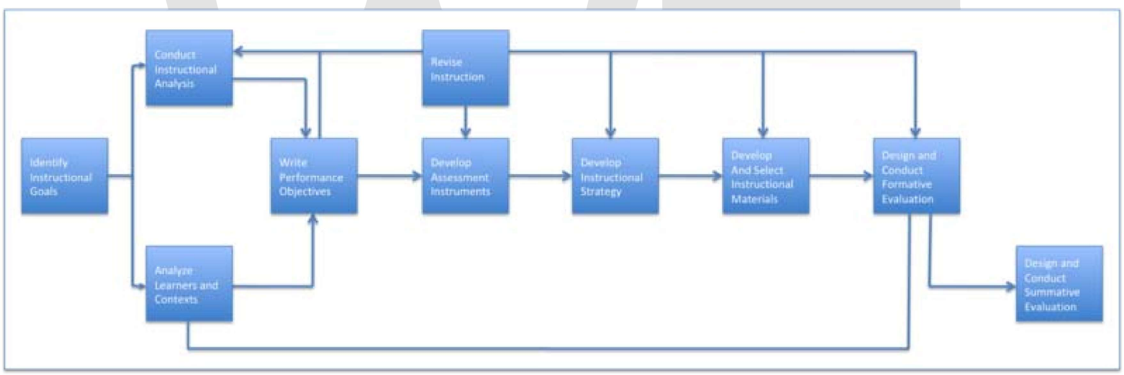
A sometimes utilized adaptation to the ADDIE model is in a practice known as rapid prototyping.

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. 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. 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 counter-productive.

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)

Dick and Carey

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



Dick and Carey made a significant contribution to the instructional design field by championing a systems view of instruction as opposed to viewing instruction as a 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". The components of the Systems Approach Model, also known as the Dick and Carey Model, are as follows:

- Identify Instructional Goal(s)
- Conduct Instructional Analysis
- Analyze Learners and Contexts
- Write Performance Objectives
- Develop Assessment Instruments
- Develop Instructional Strategy
- Develop and Select Instructional Materials

- Design and Conduct Formative Evaluation of Instruction
- Revise Instruction
- Design and Conduct Summative Evaluation

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

Instructional Development Learning System (IDLS)

Another instructional design model is the **Instructional Development Learning System (IDLS)**. 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*.

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 contributed synthesized existing theories to develop their approach to systematic design, "Instructional Development Learning System" (IDLS).

The components of the IDLS Model are:

- Design a Task Analysis
- Develop Criterion Tests and Performance Measures
- Develop Interactive Instructional Materials
- Validate the Interactive Instructional Materials

Other models

Some other useful models of instructional design include: the Smith/Ragan Model, the Morrison/Ross/Kemp Model and the OAR model, 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.

Influential researchers and theorists

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- Carr-Chellman, Alison – Instructional Design for Teachers ID4T -2010
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- Gagné, Robert M. – Nine Events of Instruction (Gagné and Merrill Video Seminar)
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- Jonassen, David – problem-solving strategies – 1990s

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- Papert, Seymour – Constructionism, LOGO – 1970s
- Piaget, Jean – Cognitive development – 1960s
- Piskurich, George – Rapid Instructional Design – 2006
- Simonson, Michael – Instructional Systems and Design via Distance Education – 1980s
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- Reigeluth, Charles – Elaboration Theory, "Green Books" I, II, and III - 1999-2010
- Skinner, B.F. – Radical Behaviorism, Programed Instruction
- Vygotsky, Lev – Learning as a social activity – 1930s
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Chapter- 7

M-Learning

The term **M-Learning**, or "mobile learning", has different meanings for different communities. Although related to e-learning and distance education, it is distinct in its focus on learning across contexts and learning with mobile devices. One definition of mobile learning is: *Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies.* In other words mobile learning decreases limitation of learning location with the mobility of general portable devices.

The term covers: learning with portable technologies including but not limited to handheld computers, MP3 players, notebooks and mobile phones. M-learning focuses on the mobility of the learner, interacting with portable technologies, and learning that reflects a focus on how society and its institutions can accommodate and support an increasingly mobile population.

M-learning is convenient in that it is accessible from virtually anywhere. M-Learning, like other forms of E-learning, is also collaborative; sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips. M-Learning also brings strong portability by replacing books and notes with small RAMs, filled with tailored learning contents. In addition, it is simple to utilize mobile learning for a more effective and entertaining experience.

History

Pre-1970s

Arguably the first instance of mobile learning goes back as far as 1901 when Linguaphone released a series of language lessons on wax cylinders. This was followed up in later years as technology improved, to cover compact cassette tapes, 8 track tape, and CDs

1970s, 1980s

Alan Kay and his colleagues in the Learning Research Group at Xerox Palo Alto Research Center [PARC] propose the Dynabook as a book-sized computer to run dynamic simulations for learning. Their *interim Dynabooks* are the first networked workstations

1990s

In May 1991, Apple Classrooms of Tomorrow (ACOT) in partnership with Orange Grove Middle School of Tucson, Arizona, use mobile computers connected by wireless networks for the 'Wireless Coyote' project. Universities in Europe and Asia develop and evaluate mobile learning for students. Palm corporation offers grants to universities and companies who create and test the use of Mobile Learning on the PalmOS platform. Knowledgility creates the first mobile learning modules for CCNA, A+ and MCSE certification using the core tools that later became **LMA.**

2000s

The European Commission funds the major multi-national MOBIlearn and M-Learning projects.

Companies were formed that specialize in three core areas of mobile learning.

1. Authoring and publishing
2. Delivery and Tracking
3. Content Development

Conferences and trade shows were created to specifically deal with mobile learning and handheld education, including: mLearn, WMUTE, and IADIS Mobile Learning international conference series, ICML in Jordan, Mobile Learning in Malaysia, Handheld Learning in London, SALT Mobile in USA.

Analysis (costs / benefits, forecast)

Value

The value of mobile learning --Tutors commented on the value of mobile learning as follows.

- It is important to bring new technology into the classroom.
- It will be more light weight device compare to books, PCs, etc.
- Mobile learning could be utilised as part of a learning approach which uses different types of activities (or a blended learning approach).
- Mobile learning supports the learning process rather than being integral to it.
- Mobile learning needs to be used appropriately, according to the groups of students involved.

- 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.
- Good IT support is needed.
- Mobile learning can be used as a 'hook' to re-engage disaffected youth.
- It is necessary to have enough devices for classroom use .

Challenges

Technical challenges include

- Connectivity and battery life
- Screen size and key size
- Ability for authors to visualize mobile phones for delivery
- Possibilities to meet required bandwidth for nonstop/fast streaming
- Number of file/assets' 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

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
- 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- and m-learning
- Design of technology to support a lifetime of learning
- 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
- Access to and use of the technology in developing countries

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 mLearning community is still fragmented, with different national perspectives, differences between academia and industry, and between the school, higher education and lifelong learning sectors.

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
- Deliver M-Learning to cellular phones using two way SMS messaging and voice-based CellCasting (podcasting to phones with interactive assessments)

According to a report by Ambient Insight in 2008, "the US market for Mobile Learning products and services is growing at a five-year compound annual growth rate (CAGR) of 21.7% and revenues reached $538 million in 2007. The data indicate that the demand is relatively immune from the recession." The findings of the report indicate that the largest demand throughout the forecast period is for custom development services, content conversion, and media services and that the healthcare sector accounts for 20% of the total US market for mobile learning.

Future

Technologies currently being researched for mobile learning include:

- Location aware learning
- Point-and-shoot learning with camera phones and 2D codes
- Near Field Communications (NFC) secure transactions
- Sensors and accelerometers in mobile devices in behavioral based learning
- Mobile content creation (including user generated content)
- Games and simulation for learning on mobile devices
- Context-aware ubiquitous learning
- Augmented reality on mobile devices

Delivery

Smartphones are one of the platforms used for mobile learning.

While many think of mobile learning as delivering eLearning on small form factor devices, or often referred to as eLearning "lite", it has the potential to do much more than deliver courses, or parts of courses. It includes the use of mobile/handheld devices to perform any of the following:

- Deliver Education/Learning
- Foster Communications/Collaboration
- Conduct Assessments/Evaluations

- Provide Access to Performance Support/Knowledge
- Capture Evidence of Learning Activity

Today, any number of portable devices can quickly and easily deliver and support these functions. Cell or smartphones, multi-game devices, personal media players (PMPs), personal digital assistants (PDAs), or wireless single-purpose devices can help deliver coaching and mentoring, conduct assessments and evaluations (e.g., quizzes; tests; surveys/polls; and certifications), provide on-the-job support and access to information, education and references, and deliver podcasts, update alerts, forms and checklists. In these ways, mobile learning can enhance and support more traditional learning modes, making it more portable and accessible. Mobile devices can also serve as powerful data collection tools and facilitate the capture of user created content.

Approaches

The use of mobile learning in the military is becoming increasingly common due to low cost and high portability.

In the classroom

- Students using handheld computers, PDAs, smartphones or handheld voting systems (such as clickers) in a classroom or lecture room (Tremblay 2010).
- Students using mobile devices (such as a Pocket PC) in the classroom to enhance group collaboration among students and instructors.

For blended learning

Mobile learning can provide support that enhances training in a corporate business or other classroom environment.

Class management

The mobile phone (through text SMS notices) can be used especially for distance education or with students whose course requires 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.

Podcasting

Podcasting consists of listening to audio recordings of lectures, and 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, but only in cases in which students take notes (Callaway & Ewen 2009).

Podcasts maybe be delivered using syndication, although it should be noted that this method of delivery is not always easily adopted (Lee, Miller & Newnham 2009).

Outdoor

- Learning in museums or galleries with handheld or wearable technologies
- Learning outdoors, for example on field trips.
- Continuous learning and portable tools for military personnel.

At work

- On the job training for someone who accesses training on a mobile device "just in time" to solve a problem or gain an update.

Life long learning and self-learning

The use of personal technology to support informal or lifelong learning, such as using handheld dictionaries and other devices for language 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, but also podcasting (Horkoff Kayes2008) have been used for helping people to acquire a language.

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)

Technologies

Mobile devices and personal technologies that can support mobile learning, include:

- E-book
- Handheld audio and multimedia guides, in museums and galleries
- Handheld game console, modern gaming consoles such as Sony PSP or Nintendo DS
- Personal audio player, e.g. for listening to audio recordings of lectures (podcasting)
- Personal Digital Assistant, in the classroom and outdoors
- Tablet PC
- UMPC, mobile phone, camera phone and SmartPhone

Technical and delivery support for mobile learning:

- 3GP For compression and delivery method of audiovisual content associated with Mobile Learning
- GPRS mobile data service, provides high speed connection and data transfer rate
- Wi-Fi gives access to instructors and resources via internet

Authoring:

- Learning Mobile Author, e.g. for authoring and publishing WAP, Java ME and Smartphone

Relevant organisations

- The International Association for Mobile Learning
    - The International Association for Mobile Learning (IAMLearn) has been formed as a membership organization to promote excellence in research, development and application of mobile and contextual learning. It organizes the annual mLearn international conference series. IAMLearn

manages a website to collate and disseminate information about new projects, emerging technologies, and teaching resources.

Relevant journals

- International Journal of Mobile and Blended Learning
- International Journal of Mobile Learning and Organisation

Mobile Learning Projects

- Federica Project
- Fon Project
- Mobile Mood Diary Project
- Motill Project
- Moule Project
- Wolf Project

Chapter- 8

Educational Animation

Educational animations are animations produced for the specific purpose of fostering learning.

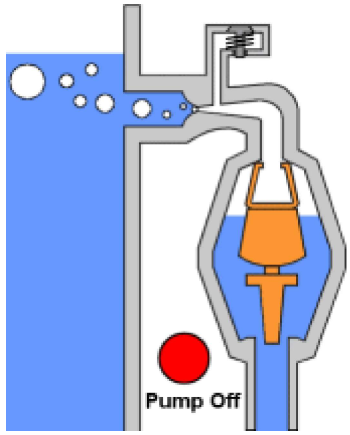
The popularity of using animations to help learners understand and remember information has greatly increased since the advent of powerful graphics-oriented computers. This technology allows animations to be produced much more easily and cheaply than in former years. Previously, traditional animation required specialised labour-intensive techniques that were both time-consuming and expensive. In contrast, software is now available that makes it possible for individual educators to author their own animations without the need for specialist expertise. Teachers are no longer limited to relying on static graphics but can readily convert them into educational animations.

Animations for Education

Educators are enthusiastically taking up the opportunities that computer animation offers for depicting dynamic content. For example, PowerPoint now has an easy-to-use animation facility that, *in the right hands*, can produce very effective educational animations. Because animations can explicitly depict changes over time (temporal changes), they seem ideally suited to the teaching of processes and procedures. When used to present dynamic content, animations can mirror both the changes in *position* (translation), and the changes in *form* (transformation) that are fundamental to learning this type of subject matter.

In contrast with static pictures, animations can show temporal change *directly* (rather than having to indicate it indirectly using auxiliary markings such as arrows and motion lines). Using animations instead of static graphics removes the need for these added markings so that displays can be not only simpler and less cluttered, but also more vivid, engaging, and more intuitively comprehended. In addition, the learner does not have to interpret the auxiliary markings and try to infer the changes that they summarise. Such interpretation and inference may demand a level of graphicacy skills that the learner does not possess. With animated depictions, information about the changes involved is available to be read straight from the display without the learner needing to perform mental animation. It's a bit of an exaggeration, but it's more like being kissed instead of reading about a kiss.

Do Animations Facilitate Learning?



Some animations challenge the learner's processing capacities

On the surface, it seems that animations should be ideal for presenting dynamic content. However, research evidence about the educational effectiveness of animations is mixed. Various investigations have compared the educational effectiveness of static and animated displays across a number of content domains. While there have been some findings that show positive effects of animations on learning, other studies have found no effects or even negative effects. In general, it can be concluded that animations are not *intrinsically* more effective than static graphics. Rather, the particular characteristics of individual animations and how they are used play a key role in the effects that they have on learning.

Do Animations Make Learning Faster?

Well-designed animations may help students learn faster and easier. They are also excellent aid to teachers when it comes to explaining difficult subjects. The difficulty of subjects may arise due to the involvement of mathematics or imagination. For instance, the flow of electric current is invisible. The operation of electric circuits is difficult for students to understand at the beginning. With the aid of computer animations, learning and teaching might become easier, faster and amusing.

Educational Effectiveness

Why is it that animations sometimes lack educational effectiveness? One possible reason is that the target learners can't process the presented information adequately. For example, it seems that when the subject matter is complex, learners may be overwhelmed by animated presentations. This is related to the role of visual perception and cognition in human information processing. Our human perceptual and cognitive systems have limited capacities for processing information. If these limits are exceeded when using an animation, learning may be compromised. For example, the pace at which the animation presents its information may exceed the speed at which the learner can process it effectively. You'll probably find it quite demanding to work out exactly what's happening in the accompanying animation (part of a pumping system) for this reason. But the solution is obvious: slow the animation down and accompany it with a written explanation. It is unlikely that superior learning is achieved by thoughtlessly substituting animation for a static graphic but by having it accompany textual explication. Another suggestion for addressing such problems is to provide user control for the learner over how the animation plays. User controllable animations allow learners to vary aspects such as the playing speed and direction, labels and audio commentary to suit themselves.

Perceptual Salience versus Thematic Relevance

Complexity of the subject matter may not be the only reason for difficulties that learners sometimes have with animations. It seems that problems can also arise from the perceptual effects of such presentations. In a poorly designed animation, the information that learners notice most readily in the animation may not be the information that is of greatest importance. Conversely, information that is relatively inconspicuous may be very important. You can see an example of this in the top right hand corner of the accompanying animation. Tucked away here is a small grey-coloured valve whose subtle movement lets air into this pumping system (which is where the bubbles come from). However, it's nowhere near as noticeable as the big, more central, orange-coloured valve that is going up and down so obviously. The point is that animations should not appear in a vacuum and most will require accompanying explanation.

Obviously, perceptibility of information does not necessarily correspond with its actual relevance to the learning task to be performed. Features of the animated display that are most conspicuous because of their contrast with the rest of the display are not always the best place for learners to direct their attention. In other words, there can be a poor correspondence between the *perceptual salience* ('noticeability') of a feature and its *thematic relevance*, and an accompanying text is needed to correct this.

This correspondence problem can occur with both static and animated graphics. On a purely perceptual level, our attention tends to be attracted by some parts of a static display more than by other parts due to their visuospatial properties. For example, an object that is centrally placed, relatively large, unusually shaped, and of a sharply contrasting colour or texture is likely to 'jump out' of the display so that we notice it very easily. Other items in the display may receive correspondingly less attention as a result. Well-designed static educational graphics take advantage of these perceptual effects. They manipulate the characteristics of the display in order to direct learner attention to the most relevant information. This helps to ensure that the learner will extract the required information from the display. There is a problem in the design of the animation shown above in this respect. Unfortunately, there are many 'educational' graphics being produced that fail to provide learners with sufficient support of this type. Designers of animation need to take such consideration into account.

Dynamic Contrast

The correspondence problems due to perceptual characteristics of a display are compounded when we go from a static to an animated graphic. Because of their dynamic character, educational animations introduce a further challenge to information extraction beyond those found with static graphics. Certain aspects of a display that changes over time have the potential to capture learner attention. If there is sufficient *dynamic contrast* between one or more items in the display and their surroundings, the effect can be very compelling in a perceptual sense. It seems that a fundamental level, our perceptual system is attuned to detect and follow such changes, irrespective of their importance in terms of the subject matter. As with static displays discussed above, items that are perceptually compelling (in this case because of their dynamic character) may not necessarily be of great thematic relevance to the given learning task. The big orange float in the accompanying animation is far more perceptible than the small grey air valve because of both its visuospatial characteristics, and its high level of dynamic contrast with the rest of the display.

The misleading effects of dynamic contrast are likely to be particularly problematic for learners who lack background knowledge in the content domain depicted in an animation. These learners can be largely in the thrall of the animation's raw perceptual effects and so tend to process the presented information in a bottom-up manner. For example, their attention within the display is likely to be directed to items that have conspicuous dynamic characteristics. As a result, there is a danger that they will attend to unimportant information merely because it is perceptually compelling. However, learners who already have considerable domain specific background knowledge are likely to be less influenced by perception alone. This is because their attention is also directed to a considerable extent by their knowledge of which aspects of the subject matter are of most relevance (irrespective of their perceptibility). As a result, their processing of information in the display has a more top-down character. In the pumping system animation example, the air valve would be noticed by those who are already familiar with pumps in general because their existing background knowledge would put them on the lookout for crucial (but visually insignificant) parts of the mechanism.

Chapter- 9

Learning Platform

A learning platform is an integrated set of interactive online services that provide teachers, learners, parents and others involved in education with information, tools and resources to support and enhance educational delivery and management.

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.

Common Learning Function Functionality

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, 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.

Description from Becta

A **learning platform** is a framework of tools that work seamlessly together to deliver a student centric learning experience by unifying educational theory & practice, technology and content. Learning platforms can be described as the next generation of Virtual Learning Environments or Learning Management Systems used by educational institutions. The major difference is that a VLE and LMS is an application, whereas the Learning Platform share characteristics with an Operating System (or Facebook Platform) where different educational web based applications can be run on the platform.

Background

Theories of learning

Teachers, even if they are not aware of the ways in which practice is informed by theory, have a shopping basket of learning theories they can pick and mix from. The work of Dewey, Piaget and Vygotsky on collaboration, interaction between peers and learning that is socially situated may be familiar to many (Wood 1994; Pound 2005). Other theories include behaviourism , learning styles, multiple intelligences, constructivism, constructionism and right brain/left brain thinking (Cuthell 2005). Behaviourism has held sway for most of the last century. It focused on observable behaviours and defines learning as the acquisition of a new behaviour. Behaviourists see learning as a relatively permanent, observable change as a result of experience (Pritchard 2005). Learning Style Theory proposes that individuals learn in different ways. It is based on the work of David Kolb, which states that there are four distinct learning styles (feeling, watching, thinking, doing) and that self-knowledge of one’s preferred learning style improves learning (Smith, Doyle et al. 2007). Multiple intelligences is an educational theory developed by psychologist Howard Gardner which suggests that different kinds of intelligence exists in human beings (Allen, Seaman et al. 2007). It’s a theory that has been fashionable in continuous professional development (CPD) training courses for teachers. Bruner’s constructivist theory states that learning is an active process and that learners construct knew ideas through their own knowledge. The learner selects information, constructs hypothesis and makes decisions. The role of the teacher in this is to translate lesson resources into a form that the learner can understand and to encourage and engage the learner in dialogue. The curriculum should be designed in a way that builds on what the pupil already knows and develops with them (Smith 2002). Bruner’s constructivist theory has been further developed into social (Thurlow, Lengel et al. 2007) and communal constructivism (Holmes, Tangney et al. 2001; Leask and Younie 2007). Influenced by the constructivist theories of Piaget, Vygotsky and Bruner, Seymour Papert developed his constructionist theory (Sefton-Green 2004). The role of the teacher is not to teach ‘at’ pupils, instead the teacher becomes a mediator of learning, working with pupils. Pupils construct understanding and draw their own conclusion through creative experimentation. Right-brain-left-brain thinking is a theory of the functions of the mind suggesting that the two different sides of the brain control two different modes of thinking. It also suggests that each of us prefers one mode over the other (OECD 2007). It's the potential (and that is a word that recurs frequently in literature relating to the use of technology for learning) for ICTs to adapt pedagogy to any of these approaches to learning that has made the adoption of computer technology so attractive at a political level.

Theories of e-learning

Good pedagogical practice has a theory of learning at its core. Technology is rarely designed for education and as a result there are really no models of e-learning, only adaptations of existing models of learning (Peachey 2004). 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 (Allen, Seaman et al. 2007). Seymour Papert's constructionist theories have been applied in Mathematics through the programming language Logo and in English with the use of the simulation Sim City.

From the mid 1990s onwards as interest in virtual communities (Abbott 2001) in higher education increases we begin to see the emergence of e-theories that build on these and other theories of learning. Wenger described communities of practice, developing what he and Lave had first written about in 1991, where learning is socially situated and mediated through a community and this theory has been adopted to explain interaction in an online community (Wenger 2007). Social constructivist theories, where the context in which learning occurs and the social contexts that learners bring to their learning, have in turn led to communal constructivist theories as a result of the growth of online learning communities. In a communal constructivist model students and teachers are not simply engaged in developing their own information but actively involved in creating knowledge that will benefit other students (Holmes, Tangney et al. 2001; Leask and Younie 2007). In trying to understand how students work collaboratively online Laurillard developed her conversational model for learning where the discussion between student and teacher, and the ways in which the teacher mediates learning (through course resources) is what leads to deep learning (Laurillard 2006). There are common threads linking together these theories of learning; community, collaboration and discussion.

Salmon (Salmon 2005) 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. 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. Through out all of this the tutor/teacher/lecturer fulfills the role of moderator or e-moderator, acting as a facilitator of student learning.

In the absence of any or many other theories and with the popularity of online environments, especially in higher education, Salmon's model has proved influential, although some criticism is now beginning to emerge. Her model does not easily transfer to other contexts (she developed it with experience of 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). The role of the moderator/e-moderator is one that is disputed. For Garrison and Anderson the moderator is not a facilitator but, as in the face-to-face classroom, is the central figure in the learning experience of the student and the key to developing deep learning in online discussions (Garrison and Anderson 2003). Best practice has yet to emerge and a single best practice model may be unlikely given the range of teaching styles, the potential ways technology can be implemented and the ways in which that technology itself is changing (Meredith and Newton 2003).

In spite of this diversity, pedagogy within British schools has focused on content, rather than process (Cuthell). Awareness of other theories of learning has not prevented a behaviorist model of teaching and learning being the dominant paradigm in teacher-pupil interactions. For most of last century pedagogy has been instructional in nature (Cuban 1986); it's how teachers were taught as pupils, it's how they were taught to teach. It may be that the focus on exam results as a way of measuring school performance, means that a change in pedagogy or a willingness to experiment is unlikely (Green and Hannon 2007). There is support in the literature for the view that new technologies are transformational (Graves 2001; Garrison and Anderson 2002) and will move education from a traditional, behaviourist, subject-focused model towards a constructivist, student-centred one (Twining, Broadie et al. 2006). This chasm between learning theory and learning practice may be a barrier to the development of VLEs and discussion forums in the school classroom.

Teacher use of computing 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. Staff using these technologies will not have grown up with them, they are not part of the net generation that has known nothing but computer and Internet access in the classroom (Laurillard 2006). In 1998 the government allocated National Lottery funds to provide ICT training for teachers. The purpose of the training programme was to ensure that teachers felt confident and competent to teach using ICT within the curriculum (HMIE 2002). The training was completed by 2003. Research into the effectiveness of the programme suggested that whilst training did improve teachers confidence in using technology, there was much dissatisfaction with its content and style of delivery (Galanouli, Murphy et al. 2004). 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). For a majority of teachers this may have been their only experience of using discussion forums for a professional purpose. Those teachers therefore who make use of forums in the classroom are likely to be in that category described by Rogers as innovators or early adopters (Rogers 2003). They are also likely to be more constructivist-oriented in their approach to learning (Conlon and Simpson 2003). Innovative pedagogical practices are exemplars and are not representative of typical practices found in schools (Law, Chow et al. 2005). In a small number of schools, as is suggested by the literature, there is an experimentation with and acceptance of constructivism but it does not permeate at grass roots level (Grünbaum, Pedersen et al. 2004). The Specialist Schools and Academies Trust (SSAT) maintains an ICT Register of innovative practice as a source of advice for teachers.

Local Education Authorities (LEAs) have been tasked with providing savings through encouraging schools to opt for an agreed central learning platform provider. In the Luton vision for the school of the future this will be used to promote collaborative synchronous and asynchronous teaching and learning through video conferencing, discussion forum, email and video streaming etc. (LEA 2006).

Government Policy and BECTA: the literature

Literature produced by the DfES, now the Department for Children, Schools & Families (DCSF) and the British Educational Communications and Technology Agency (BECTA) have been brought together here. BECTA is a government funded agency with a remit to provide leadership for improving learning through technology (BECTA 2007). With the DfES it leads the development and implementation of a national e-strategy and commissions research upon which decision making can be based. Research findings rely on quantitative evidence – for example the computer/pupil ratio (BECTA 2005), pupil access to email (BECTA 2006), etc. – and qualitative evidence – the observations of classroom practitioners (BECTA 2007) – collected from practitioner surveys. It has produced a small number of literature reviews on the use of technology for learning (BECTA 2003; 2004). It does not restrict itself to the impact of technology on pre-16 education but considers further and higher education as well (BECTA 2006). Its executive committee consists of six men and one woman, the majority of whom have a background in work with government departments. In most cases the literature it produces relates mainly to England as post devolution both the Welsh Assembly and Scottish Parliament have their own independent policies for the development of technology for learning (Assembly 2007; Donnelley 2007).

Jones (Jones 2003) credits New Labour with the idea of the knowledge economy and yet when Blair referenced education, education, education in his Ruskin College speech in 1996, many national governments were already using just such an idea to justify investment in technology in education (Daanen and Facer 2007). The knowledge economy argument states that the old 19th century structures of organising labour and manufacturing are dead or dying. The new economy of the 21st century will be an economy where knowledge is capital. If national economies want to compete globally they need a labour force skilled in the new technologies. By inference, school structures are also outdated, linked to an old industrial model (Hargreaves 2003).

The red brick classroom of our parents age is from an age of manufacturing and its organisation reflects this – this is the new age of knowledge (Cox 1997). Schools have to change (Hargreaves 2003). This is a constant theme running through the government and BECTA literature and can also be found as justification for the use of discussion forums in schools (Laferriere, Bracewell et al. 2001; McLoughlin 2003). Constructivist, student-centred learning can better meet the demands of the contemporary workplace and society, which wants self-directedness, lifelong learning, communication and collaboration skills (Twining, Broadie et al. 2006). This belief is not research or evidence based and yet it fuels political and policy statements and almost seeks to be taken for granted as fact. Selwyn does not passively accept these statements and using many of the tools of critical discourse analysis he has deconstructed many political statements relating to technology:

'Pointing to the presumed high-skill information economy ignores the fact that most workers will require little more than a 'MacDonald's level' of familiarity with technology, primarily consisting of lower order data-entry and limited problem solving skills' (Selwyn 2002; p. 15).

Laurillard is equally vociferous about attempts to link school improvement to technology.

'It is absurd to try and solve the problems of education by giving people access to information as it would be to solve the housing problem by giving people access to bricks' (JISC 2002).

In 1997 the government sponsored Stevenson Report (Stevenson 1997) informed the education world that the state of IT in schools is primitive and not improving. Stevenson highlighted the use of email and said that every teacher and pupil should have their own. Communication, so Stevenson believed, would enrich learning and motivate pupils. Research for the report had been carried out by a private business, McKinsey & Company. McKinsey only cited one example of a girls grammar school in England as evidence for the impact that email and online communication might have on teaching and learning (Company 1997). This emphasis was re-enforced in the revised National Curriculum Orders (England and Wales) for 2000 in which the use of email and the Internet as a means of sharing and exchanging information were cited (LEA 2000).Delivering a policy speech at the BETT Education Computer Show in London in 2002, Estelle Morris, then Minister for Education, described an anywhere-anytime model of teaching and learning that could only be constructed through the use of Internet based communication technologies (BBC 2002). Her 14-19 Green Paper (2002) proposed, "Flexible access and delivery (of teaching and learning) through ICT and e-Learning" (FERL 2002). At this point e-learning was still centrist in nature, driven by content and teacher control and very much part of the school improvement debate. There was little research or evidence to confirm the utopian claims that were being made at a political level.

By 2003 a major change had occurred with the publication of Towards a Unified eLearning Strategy (DfES 2003), which defined e-learning in 5 ways – concurrent learning, cinematic learning, collaborative learning, communicative learning and consensual learning (Preston and Cuthell 2005). The strategy described collaborative learning through online environments and pupils developing cognitive and social skills of communicating and collaborating, the first time this kind of language begins to be used in policy documents. The use of a VLE was central to the success of this policy. At the same time Professor David Hargreaves, Chairman of BECTA, supported by the Specialist Schools and Academies Trust (SSAT) and the DEMOS think tank (DEMOS 2007) opened up a debate within specialist trust schools with the publication of the pamphlet Education Epidemic : Transforming Secondary Schools (Hargreaves 2003). In this he placed a premium on teacher collaboration and the use of online technologies to create learning networks. Hargreaves speaks of a system where, in order to improve learning, knowledge must be shared between schools. Innovation networks are the answer. He compared this approach to the peer-to-peer networks that were developing on the Internet to allow music enthusiasts to share sound files (much of which, he failed to consider, was considered illegal). Innovation networks within education would allow teachers to share good practice in a similar way. He offers to teachers the ongoing dream of better teaching and learning through the use of technology and in that respect what he says is part of that constant theme of school improvement in the literature relating to the use of technology in education. In the same year 'ICT and Pedagogy' (Cox, Webb et al. 2003) from BECTA described briefly how technology could impact on pedagogy with online discussion and collaboration changing the relationship between teacher and taught. Clearly constructivism is in the air even if it is not mentioned by name. It's difficult to gauge the impact that such publications have although in 2003 Hargreaves work was given centre stage at the SSAT National Conference (SSAT 2007) and in SSAT literature that was sent to schools. Every specialist school received copies of Hargreaves publications. 2003 marks a growing emphasis on online collaboration in the official literature and there is a distinct link between Hargreaves work at BECTA, the DfES and SSAT.

In 2003 BECTA also published a literature review on the use of MVLEs and VLEs in education and a consideration of the implications this technology had for schools in the UK. The literature was mainly further and higher education based with simple descriptive examples of its use. It clamed that online discussion could enhance learning, improve student technological skills and promote reflective thinking. The role of the e-moderator was seen as being central to the learning process in discussion forums. Three examples are given of such use in schools, but these are only described in very simple terms with few details of any impact on learning. In a Bristol specialist school forums were being used to create a community of practice for staff, but a visit to these forums in 2007 showed little evidence of regular use. It was suggested that the London Grid for Learning (LGfL) VLE offered possibilities for collaboration and interaction throughout the city, but again there were no clear examples of how this was being achieved. Three years later the LGfL would change its VLE. Material from Learning and Teaching Scotland (LT Scotland 2000) described a range of role playing and online activities carried out in the Virtual Oilspill and Versailles Experience projects. The main learning benefit cited by one of the teachers concerned was the high quality of debate in the asynchronous forums. There was no attempt to define quality or how this was assessed and it could just as easily have been related to a teacher observation of a one time event. By contrast, a subsequent exercise saw online discussions rapidly deteriorating into social chit-chat. LT Scotland claimed that the Versailles Experience project demonstrated that online learning, when based on textual computer conferencing, could ‘work well’ with school pupils, especially with the ‘disaffected’ and those who were ‘less confident’ (BECTA 2003). Again, there was no evidence presented to back up these claims or even to define what ‘worked well’ might mean. There is little consensus about such an impact on less motivated and less confident students, despite the fact that the potential for this is a recurring theme in government and BECTA literature. LT Scotland appeared to simply repeat the unsubstantiated language of the policy statements from its Westminster counterparts. The appendices in the BECTA report listed over 20 schools using VLE technology. By 2006 less than 10% were using their original product. The BECTA literature review did not include some of the school based research that was beginning to emerge by then, for example in the Mirandanet community. It did not attempt to synthesis or analyse the research from higher education. Observations from the UK school examples were based on how staff ‘felt’. The report included one example from VLE use in Singapore. Even by 2003 there were more detailed examples of school use available at an international level for the report to make use of (Barker 1999; Bain, Huss et al. 2000; Mioduser and Nachmias 2001; Angeli, Valanides et al. 2003). The report proffered no theory of learning or model of use that might best fit pedagogical practice in British schools.

In 2004 networked learning and collaboration continued to be promoted at BETT 2004 by Charles Clark, Secretary of State for Education (Teachernet 2004). In its review of Progress towards a Unified E-Learning Strategy the DfES sought the views of school leaders, teachers, ICT co-coordinators and network managers through an online questionnaire (DfES 2004). It received 430 responses, including grouped responses from bodies such as professional associations. With around 24000 state schools in England alone there are issues over how representative the survey is. Question 15 in the survey asked:

In your experience what are the most significant achievements of e-learning? 105(49%) respondents said flexible learning was the most significant achievement of e-Learning e.g. the learner can choose a convenient time to learn, rather than having to adapt to timetables. 65(30%) highlighted collaboration amongst learners e.g. chat rooms where discussion can provide peer group support and the opportunity to debate with other students (DfES 2004).

The key research findings in a BECTA literature review of ICT and Attainment in the same year were that in relation to teaching and learning with VLEs, teachers needed to learn skills to moderate online discussions and that more research was required (Cox, Abbott et al. 2004). The review conceded that computer mediated communication (CMC) had recently been a feature of research in English classrooms, but gave no indication of where in England this research had taken place and indeed the only reference given in the main body of the document is to research from Northern Ireland.

Experiences in Northern Ireland have suggested that valuable understandings and skills can be developed through the use of asynchronous communication, although the results were not supported by any standardised test scores (Cox, Abbott et al. 2004; p. 14).

The Clark and Heaney research referred to here has been dealt with elsewhere in this paper. The 'holy grail' of test scores is mentioned. As experiences in higher education were suggesting at the time, assessment of asynchronous discussions was an unresolved issue – assessment with standardised tests was not a suitable tool. The BECTA review recognised that managing CMC was a complex task for which training was required and that the use of CMC changed classroom practice, again providing little detail of this.

2005 saw many themes being brought together in the official literature. Harnessing Technology: Transforming Learning and Children's Services, (DfES 2005) talked about the changing nature of teacher-pupil relationship, learning beyond the classroom, peer collaboration, sharing ideas through online networks, developing specially-tailored online communication activities so that students feel able to participate more in discussion, a 'children's workforce able to access online training materials and to participate in web-based discussions with their peers' (DfES 2005; p. 58). The use of the term workforce clearly demonstrates the ongoing obsession with the economy. This document represents a political vision, as opposed to one which is evidence or practice based. The clear message was that collaboration, discussion and online forums had great potential, if only they could be designed for learning. The Learning Platforms (DfES 2005; DfES 2005) literature of the same year re-enforces this. Both Primary and Secondary documents are sub-titled 'Making IT Personal', linking the use of technology into the wider government personalised learning/school improvement agenda (DfES 2007). The Primary School Document lays out reasons for adopting learning platform technology – it will raise pupil achievement and lesson teacher work burden.

'Email and chat tools make it easy for pupils to communicate within a school or even across schools, working through problems together, exchanging useful ideas and sources of information' (DfES 2005; p. 10).

The technology 'adds a new dimension to lessons, which they (pupils) find refreshing and motivating' (DfES 2005; p. 34). These statements were supported by two junior school case studies although these make little mention of asynchronous learning, apart from an example of email use by pupils (where pupil emails are checked by a member of staff before being sent via a proxy server so that pupil email addresses cannot be identified). There is little contextual analysis in the junior school case studies. Readers are told that:

'The whole process (i.e. the implementation of asynchronous learning) needs to be driven by a different model of learning, aligned more closely to modern methods of teaching in primary schools and of staff management. Such a project needs people who can concentrate purely on these issues and their implementation'(DfES 2005; p. 26)

So says a teacher quoted in the document and yet elsewhere readers are warned about the 'danger that a learning platform can dictate methods of curriculum delivery through its underlying model of learning' (DfES 2005; p. 26), with no attempt to clarify what that model might be. The use of language in the document can be emotive, for example the implication that not to adopt the technology means somehow that teachers will be viewed as not 'modern'. This is not a politically neutral document and needs to be seen in the context of a centralising government policy.

The Secondary School learning platform document repeats much of the text and many of the claims from the junior school one, but also introduces yet again the link between skills in technology and employment. 'Daily use of these tools in school will ensure that pupils are better equipped to cope and thrive as they move into the world of work' (DfES 2005; p. 10) because learning platform technology is being used in industry (again with little evidence to support this). Similar case studies appear here, with the example of one school using discussion forums in A Level history, with teachers using the questions and answers as the basis for set coursework assignments. This is as good an example as any of Cuban's observations that classroom/teacher use of technology merely replicates traditional classroom practices (Cuban 2001). The 2005 BECTA Review (BECTA 2005) simply stated that levels of VLE and MVLE use in schools was low, that there was potential for teachers to use these as professional communities of practice, but that there was no evidence of this emerging – and this at a time when the General Teaching Council for England (GTCE) was heavily involved in promoting its online forums and the DfES Innovations Unit was hosting discussion forums on the NCSL talk2learn site.

By 2006 the BECTA Review made available data relating to the use of online learning environments in the school sector. 22% of primary schools had access to a learning platform and 24% of secondary schools; 14% of primary schools had a VLE and 38% of secondary schools (BECTA 2006). There is no definition in the report of the differences between the two or indeed of the ways in which schools perceive differences. The report claims that:

There is case study evidence of a growing sophistication in the use of VLEs in the schools sector, particularly at Key Stages 3 and 4. Examples include a live mentoring service, access to web-based resources matched to learning style, and VLEs that extend to other schools and, in one, case community outlets. However, these examples currently represent pockets of leading-edge practice (BECTA 2006; p. 32).

The reference cited for sophisticated use is an unpublished BECTA report and based on this it is difficult to substantiate these claims. The live mentoring service may have been that piloted by the SSAT and this is dealt with later in this paper.

In the same year BECTA commissioned the Open University report Educational Change and ICT (Twining, Broadie et al. 2006), which was an exploration of the implementation of strands 2 and 3 of the DfES e-learning strategy. Strand 2 related to integrated online support for pupils and strand 3 dealt with a collaborative approach to personalised learning, both of which utilised learning platform/discussion forum technology. 125 schools were surveyed using a web questionnaire (as well as 70 telephone interviews), 86% of whom were implementing a learning platform/VLE or MLE. These schools had to show evidence that they were moving towards the government's e-strategy and were not typical of schools in general. If we accept that these are early adopters, of the 86% using this technology, the paper claimed that level of use varied considerably and was at best 'patchy'. Evidence is quoted from one un-named local authority with 66 schools using a learning platform managed by a commercial supplier. There are 21,000 pupils registered on the system – no distinction is made between schools or key stage groups.

'The LA estimates that roughly 50% regularly engage in discussion, much of which is of a social nature and takes place outside school time. At the time of the interview, the most active of the discussion areas was 'religion and spirituality' (Twining, Broadie et al. 2006; p. 39).

Discussions were moderated by the company and not by teachers or tutors, but there is no evidence of the ways in which they moderated discussions or assessed learning. There was no attempt to evaluate why religion and spirituality might lend themselves to online discussion in a way that other areas of the curriculum did not. This is an important area for research. Pask's (Cybernetics 2007) learning strategies – serialist learners tackle a subject step by step (for example, Mathematics or Arithmetic); holistic learners explore subjects in a haphazard way until an overall framework emerges (for example, English Literature) – may provide some insight into which subject areas best lend themselves to an approach that involves discussion forums.

The Report provides one further example of forum use:

'In one school the science department is using the communication forums to challenge students' thinking via an open community-focused dialogue in chemistry, to which the chemistry teacher also contributes' (Twining, Broadie et al. 2006; p. 39).

Again, there is little detail here, no examination of the role of the teacher and no indication of measurable outcomes, although the Report did provide one valuable insight into teaching practices and the praxis between theory, policy and practice.

'Evidence of pedagogic shifts was rare. There appeared to be a reality-rhetoric gap in this study's data: what people say needs to change is not reflected in the ways in which they advocate or are implementing technologies. While the rhetoric is about transformation, the ways in which use of ICT is envisaged is more likely to reinforce traditional pedagogical models – albeit with greater differentiation for learners through the use of ICT to automate teaching and assessment'.

This is hardly surprising. Research from across the border in Scotland had already suggested this (HMIE 2002; Condie, Munro et al. 2005). The use of technology to provide differentiated teaching and learning resources was one which had been a central theme in government literature since the 1990s. It's hard to predict anything, let alone the future (Cuban 1986) but 2007 continued with a rash of government and BECTA literature that crystal ball gazes into the next twenty years by repeating many of the existing themes and claims of the past ten years. The 2020 Vision Report (DfES 2007) described a knowledge-based economy and preparing pupils for this; it's the collaborative, team skills that industry needs to compete in global markets and it's ICTs that will enhance collaboration and creative learning. An Investigation of Personalised Learning Approaches used by Schools (DfES) (Sebba, Brown et al. 2007) said that teachers had to give up control, become more involved in discussion with pupils and use technology to facilitate collaboration with peers (in the same school and in other schools). How technology supports 14-19 Reform (BECTA(o) 2007) implied that the use of a Learning Platform by schools in the London Borough of Lewisham had significantly improved the 5 A-C grades in its schools. The BECTA Annual Review 2007 (BECTA(l) 2007) sees a return to rhetoric and utopian thinking. The opening page of the Report carries a quote from a Deputy Headteacher who has 'noticed' the benefits of technology in raising achievement, especially that of boys:

'Over the past two years the boys have achieved as well as, if not better than, the girls in this school. It's got to be down significantly to the use of ICT in classrooms right across the curriculum' (BECTA 2007; p. 1).

The use of computers in schools is linked once more to economic well being and global markets. It is claimed that only 20% of schools, 'our best schools and colleges', are using technology effectively so that it 'transforms the experience of learners' and that 'every learner can benefit' (BECTA 2007; p. 5). Simplistic use is made of a case study from a school in Northern Ireland where pupils created a multi-media tourist guide in collaboration with another school. 'As part of this, pupils used online discussion tools within LearningNI, an online learning environment, to store and share documents, images, audio and video files that they had previously created.'(BECTA 2007; p. 24)

This is a misleading statement confusing the discussion tools with the collaboration tools available on the learning platform. There is one further statement about the use of learning platform technology in a named secondary school.

'The learning platform provided an opportunity for teachers to have regular, ongoing and one-to-one dialogues with students and to respond to them as individuals taking into account their personal learning needs and styles.' (BECTA 2007; p. 7)

The Report ends with a quote from a Headteacher who explained to his staff that:

'We had no choice other than to embrace the new technology. If we didn't, they wouldn't have a job in five years' time. It wouldn't be me putting them out of work, it would be the students. They would refuse to be taught in any other way'.(BECTA 2007; p. 25)

The new technology was the learning platform with its range of collaborative tools. There's nothing like the threat of unemployment to focus the mind! This literature moves from rhetoric to hectoring, with little use of research based evidence to back up the claims that are being made. Statements about the knowledge economy, equipping pupils with technological skills they can use in employment, individualised learning, collaborative learning, inclusive learning and a change in the nature of teaching have all been themes in the literature since 1997. The linking of technology to exam success or boys achievement says more about current concerns in education than specific results from the use of technology. Learning Platforms are now obviously the main technology that will transform schools, but there are few attempts to link collaboration to the communication tools on these platforms and when a link is made it gives a misleading impression of the capabilities of the technology. Fielding states that:

'Within education there seems to be a predilection for the superficial and the smartly opportunistic, typified by an increasingly intemperate and insistent repetition of 'what works'(Fielding 2002; p.17).

The 2007 literature attempts to give an impression of 'what works' with little independent evidence or research to back up its claims. When faced with this it falls back on simple claims that that ICT 'must' be responsible for improved boys achievement – it could not be down to other factors such as classroom teaching. Yet again it attempts to assess performance in end of unit tests when clearly this method of assessment is not best suited to measuring learning in a collaborative, constructivist online world of discussion forums and learning platforms. And just in case its audience remains unconvinced the prospect of unemployment is raised. The most recent BECTA paper to be accessed was 'Learning Networks in Practice' in the BECTA Emerging Technologies for Learning series (BECTA 2007). The purpose of this series is to make practitioners aware of new technologies and to open up a debate – although quite where this debate will or should take place is unclear. The section in the paper dealing with learning networks is written by Stephen Downes, senior researcher at the National Research Council of Canada (NRCC 2007). Downes is a specialist in e-learning with expertise in Internet culture, new media and blogging. His background is in the philosophy of knowledge. Since 2005 he has published a number of articles on social networking and learning platforms. Due to their geography Canada and the United States have at least two decades of experience in the application of computer technology in distance learning. This may help to explain why research into the use of this technology with pupils in pre-16 education is in many respects more advanced than it appears in the UK, as models of distance learning have been introduced to the traditional classroom. With the growth of the virtual schools movement (Clark 2001; Hassel and Terrell 2004; Berge and Clark 2005) in the United States; an estimated 40,000 to 50,000 K-12 students enrolling in an online course in 2001-2002 (Clark 2001); and the insistence in some American states that students must complete at least one online course of study in order to achieve their graduation certificate, research into the use of online forums is increasing (Bain, Huss et al. 2000; Fisher, Evans et al. 2004; Maddux and Johnson 2005). This is the background against which Downes researches and writes and it is very different from the British audience for his BECTA paper. Downes examines the technology that has made possible the rapid adoption of social network sites such as Bebo and MySpace. 60% of 13-17 year olds in Britain have profiles on these sites (Magid and Collier 2007). Downes argues that social networking and the asynchronous forums associated with it have a central role in transforming education and that the use of this technology is not about delivering content. He says that course content should be subservient to discussion and that 'the community is the primary unit of learning'. He argues that learning through asynchronous forums becomes social rather than cognitive. He believes that pupils will create their own online content with separate network services, rather than being channeled through a VLE or learning platform. Pupils will create a Personal Learning Environment (PLE) for themselves:

These environments cut across disciplines. Students will not study algebra beginning with the first principles and progressing through the functions. They will learn the principles of algebra and other fundamental subjects as needed, progressing more deeply into the subject as the need for new knowledge is provoked by the demands of the simulation.'(BECTA 2007; p. 24)

Downes borrows heavily from the work of Garrison and Anderson at Athebascau University (Garrison and Anderson 2003) which itself is based on the use of technology by students in post compulsory education. He is influenced by theories associated with community (Wenger), conversation (Pask) and collaboration (Bruner). He makes no reference to the role of the teacher. Even in a personal learning space, Garrison and Anderson view the role of the teacher as key to deep learning on the part of the student. Downes does not describe what the learning objectives might be in a social learning space and how these might be assessed. For teachers in a system still dominated by summative end of course tests he offers no advice on how learning by discussion can be assessed. He makes no reference to that body of research that raises concerns about inequalities in social networking for learning but seems to assume that the online world is a democratic, almost utopian one, where asynchronous discussion means equality of learning for all (Magid and Collier 2007).

Despite the fact that communication technologies have developed and changed since 1997 – and that collaborative learning through online discussion has been a major theme in the literature since 2005 – government and BECTA publications make little reference to any theories of learning or models of e-learning and how these might inform classroom use of discussion forums. There is a growing, if still small, body of international literature relating to classroom use of this technology and much to be learned from experiences in further and higher education, but this makes little appearance in the official literature. Despite talk of the potential for change and transformation in the system, this literature still links forum use to the official message on communication technology in the classroom – it will help Britain to compete in the global knowledge economy; it will ensure pupils are equipped for employment in the new high tech industries; it will ensure education is inclusive, improving the engagement and achievement of those who have traditionally under performed within the school system. And that achievement will be judged by the traditional measures of classroom performance.

In 2010 BECTA published 'School use of learning platforms and associated technologies' report (BECTA 2010) carried out by the London Knowledge Lab, Institute of Education. The purpose of the study was to provide key data, analysis and exemplars to contribute to a robust evidence base on the adoption and effective use of learning platform and other integrated technologies in primary and secondary school education. A key aim of the project was to identify transferable examples of effective use of learning platforms and associated technologies. The project was designed to deliver three main types of research outcome centred around the production of evidence for effective use of learning platform technologies – that is:

- a set of case studies of schools that have effectively implemented and used learning platforms and associated technologies to help achieve educational or organisational benefit
- an evidence base and examples of effective implementation and use
- a set of benefits describing how schools have used these technologies to help them achieve their aims or to tackle specific issues.

The report was significant as it identified specific benefits for teaching, learning and management in schools based on practice. These included:

- **Improved organisation of information and communication across the school** – here learning platforms were found to be leading to improved coordination of information and communication within school communities (i.e. between school leaders, managers, teachers and governors); improved communication and organisation of learning between teachers and learners; and expanded opportunities for school-focused communication between learners.
- **Parental involvement and supporting learning at home** – here learning platforms were leading to parents being better informed about their child's learning and about the school, and learners receiving more support to continue learning at home.
- **Increased opportunities for independent and personalised learning** – here learning platforms were leading to an increased diversity of learning resources; widened access to learning resources; an increased relevance of learning resources; and increased motivation and support of independent learners.
- **Enhancing the accessibility, quality, relevance and range of learning resources** – here learning platforms were found to be helping teachers to access resources to support the curriculum; providing a range of engaging, fun and motivating resources for learners; and providing support for learner involvement in creating resources to enhance links between the school and the family/community.
- **Improved processes of monitoring and assessment for learning and teaching** – here learning platforms were found to be leading to increased opportunities for learner self-assessment and peer review; broadened forms of assessment and feedback; help for teachers to set effective targets; and effective use of information to identify learners who need additional support.

- **Increased opportunities for collaborative learning and interaction** – here learning platforms were leading to increased collaboration between teachers and schools to pool resources and expertise, and enhanced collaboration between learners.
- **Enhancing digital literacies** – here learning platforms were found to be helping learners to develop functional technology skills, collaboration skills and critical thinking about digital technology.
- **Making best use of teachers' time** – here learning platforms were leading to increased efficiency in communication and collaboration, enhanced opportunities for flexible working, and effective management and organisation of resources.
- **Facilitating effective and strategic leadership and management of teaching** – here learning platforms were leading to enhanced communication of information and goals between teaching staff, school managers and leaders; better coordination of tracking and analysis of school data; and enhanced monitoring and management of teaching.
- **Supporting additional educational needs and inclusion** – here learning platforms were found to be enhancing schools' capacity to cater for learners who had greater difficulty in learning than the majority of their peers.
- **Improved management of student behaviour and attendance** – here learning platforms were found to be supporting schools' efforts to encourage learner attendance and promote positive behaviour for learning. This was being achieved through the enhanced recording and tracking of learner data on attendance and behaviour, and enhancing communication and sharing of learner data between teachers, school managers, parents and learners.
- **Building the school identity and community** – here learning platforms were found to be providing opportunities for enhanced student voice and school democracy, and leading to increased support for the development of school community and enhanced engagement with the wider community.

Becta also produced a maturity model to assist schools in adopting and developing their use of learning platforms. The Learning Platforms: Steps to Adoption guidance helps schools use the learning platform as part of everyday practice. It allows teachers and schools to identify successes, plot progress and plan to transform their school by using the learning platform and other technology. The framework defines five levels of development: aware; develop; adopt and integrate.

The Becta **Learning Platforms:Steps to Adoption** model is based on an orginal model/idea created by LP+ and Wolverhampton local authority, based on the principles of Hooper and Reiber (Hooper, S., & Rieber, L. P. 1995). It was developed by BECTA with the support of a group of local authority consultants and advisers who constitute the Learning Platform Network (LPN)group. The LPN is platform agnostic and materials and support offered is appropriate for all schools, irrespective of the commercial or home-grown services they use. The BECTA resources and case studies will continue to be available through the LPN beyond the closure of BECTA in March 2011 and shared under the Open Government license.

Chapter- 10

Online Education and Learning

ECornell

eCornell is an online learning company established and wholly-owned by Cornell University, an Ivy League university located in Ithaca, New York, U.S. eCornell offers both certificate programs and professional development courses, to provide individuals and corporations a comprehensive online, professional and executive development curriculum.

eCornell was created in 2000 as a for-profit subsidiary of Cornell University to develop and deliver online courses.

eCornell's professional development programs are developed, designed and authored by one or more faculty from Cornell University's Johnson Graduate School of Management, School of Hotel Administration, School of Industrial and Labor Relations, and the College of Engineering. Through an interactive online course environment, practical and essential business and management skills are taught. Courses offer embedded interviews with Cornell faculty, online access to library reference guides, and additional professional and executive education opportunities at Cornell.

Courses

eCornell courses, led by live instructors, are delivered in virtual classrooms. Each program lasts for a period of two weeks, during which students work at their own pace. Course work is interactive, focusing on solutions and strategies to help meet current real-world situations students may face in the work place. Instruction is scenario-based, immersing students into situations and case studies, combining simulations, readings, online discussions, self-assessments and short written assignments.

In eCornell courses, individuals interact with both instructors and peer groups to collectively develop and apply learned knowledge. Courses also provide "Ask the Expert" interviews with Cornell University faculty as well as online access to library resources.

Certificate Programs

eCornell courses are designed for professionals and executives working within management or human resource industries. Certificate programs are aimed at providing students with an edge in the areas of Leadership and Strategic Management, Financial Management, Management Essentials, Human Resources Management, Project Leadership and Hospitality and Foodservice Management.

Leadership and Strategic Management

A series of four leadership development training programs from Cornell University's Johnson Graduate School of Management and the School of Hotel Administration. Participants who successfully complete the courses within the program receive a certificate from Cornell University.

Courses in the Leadership and Strategic Management series are designed to enable mid- and senior-level managers and executives to think and plan strategically, optimize decision making, generate new ideas and identify opportunities for change. Students apply career experience to determine how to become an effective corporate leader and to build business management skills.

Project Leadership and Systems Design

The Project Leadership program is a six-course certificate series from Cornell University's College of Engineering is designed for the Project Management Professional (PMP), project managers, and business managers. Courses are designed to distinguish project leadership from project management and develop the leadership skills for success. Through group projects, case studies, and tool sets, the Project Leadership series aims to improve leadership skills to build and manage teams, monitor and control project performance, and develop persuasion capabilities.

The Project Leadership certificate series is based on the research and teaching of Cornell University Professor Frank J. Wayno, Ph.D. Participants who successfully complete the courses within the program receive a certificate from Cornell University.

The Systems Approach to Product and Service Design from Cornell University's College of Engineering is designed for professional engineers and managers who wish to integrate a proven design methodology into their processes. The methodology, developed by Cornell University's Peter L. Jackson, Director of the Systems Engineering Program at the College of Engineering, incorporates elements of design for six sigma and systems engineering principles. The program is unique in its behavior approach to design which emphasizes customer requirements. Participants who successfully complete the courses within the program receive a certificate from Cornell University.

Financial Management

Certificate series and professional development courses in financial management from Cornell's School of Hotel Administration gives students the opportunity to develop an understanding of the time value of money. Financial management courses are built around a problem-based approach to learning, coupled with realistic case studies and scenarios.

The financial management series is designed to teach financial terminology and concepts to non-financial managers to increase financial performance, competitiveness and bring measurable results to organizations. Students make and asses critical decisions about investments and other cash flow situations.

Management Essentials

Certificate series and professional management training from Cornell's School of Industrial and Labor Relations and the School of Hotel Administration. Courses are intended to give students a competitive edge by developing key supervisory, management and financial skills.

The management essentials series is designed to improve the communications skills necessary for managers to fulfill workplace responsibilities including hiring, preventing and addressing conflict, managing time, and leading employees. Courses address interviewing techniques, conflict resolution, and methods of increasing productivity and morale while reducing stress.

Human Resources

eCornell offers human resources management training for management and professional skills development from Cornell's School of Industrial and Labor Relations. Courses are designed to build skills critical to the field of human resources.

A human resources certificate from eCornell is intended to increase effective communication and performance by managing employees.

Hospitality and Foodservice Management

A certificate series that covers important aspects of hospitality and foodservice management from the Cornell University School of Hotel Administration. Courses are designed to teach students key techniques associated with marketing, financial analysis, and accounting in the hospitality industry.

Through analysis, students learn to identify strategic opportunities through research and analysis and later create and implement a strategic plan to create a sustainable competitive advantage.

Other Programs

Nutrition Fundamentals

A two week certificate course covering the fundamentals of nutrition with a focus on a whole-food plant-based diet. Utilizing results from The China Study, which details the connection between diet and disease, Nutrition Fundamentals is authored by Dr. T. Colin Campbell, Ph. D., a professor of Nutritional Biochemistry at Cornell University.

Topics covered in the course include the state of health and healthcare in the U.S., fundamentals of nutrition, as well as the results of Dr. Campbell's China Study.

Nutrition Fundamentals is created in partnership with the T. Colin Campbell Foundation.

Corporate Programs

In the fall of 2002 eCornell signed their first corporate contracts. Over twenty companies agreed to participate in a pilot program of courses and receive survey data on student satisfaction and performance.

Corporate programs are targeted to mid- and senior-level leadership; emerging managers; human resource staff; and other high potentials identified by an organization.

Instructors

Instructors are available to students through email, chat rooms, and discussion boards. Additionally, instructors at eCornell maintain office hours for student support.

eCornell Logo

On March 3, 2009 eCornell formally announced its new brand identity, logo, and website.

eCornell's new logo replaces its original logo which was adopted shortly after the company's founding. The new logo communicates eCornell's close ties to Cornell University and reflects the tighter integration of eCornell into the strategic goals of many of Cornell's colleges. The new mark uses the same typography from Cornell's logotype and integrates a portion of the Cornell insignia. The new logo adopts the same red as Cornell to strengthen the visual alignment with the university.

In addition, the logo's iconic shape is unique to eCornell, retains a strong splash of color to enhance its visibility, and is very versatile allowing for a variety of color combinations for use in different applications and media.

Board of directors

Phil Young, chairman, partner in U.S. Venture Partners and member on the Cornell University Board of Trustees
Paul Gould , managing director and executive vice president of Allen & Company, member of the Cornell University Board of Trustees and chair of the Investment Committee
Ralph Terkowitz, partner at ABS Capital Partners
Jeff Berg, president of JFB Consulting Partners, member of the Cornell University Board of Trustees
Andrew Tisch, Co-chairman of Loews Corporation, member of the Cornell University Board of Trustees
David Zalaznick, Senior Managing Director of the Jordan Company, member of the Cornell University Board of Trustees
Chris Proulx, president and CEO of eCornell

Educaedu

Educaedu

Type	Private
Industry	Internet
Founded	2001
Headquarters	Bilbao, Spain
Key people	Fernando Bacaicoa and Mikel Castaños (Co-founders)
Products	educaedu.com,tumaster.com, buscaoposiciones.com,canalcursos.com

Educaedu is an online education directory where students can search for higher education programs around the world. Founded in 2001, Educaedu originally started in Spain with three Web sites (Busca Oposiciones, Tu Master and Canal Cursos). In January 2008, they decided to expand the directory and launch Educaedu on a global scale. It now operates in 20 countries and 9 different languages, and contains more than 100,000 different programs.

Educaedu has 75 people with 14 different nationalities. Educaedu has offices in Buenos Aires (Argentina), Bilbao (Spain), São Paulo (Brazil), Bogotá (Colombia), and Madrid (Spain) and has representatives in Santiago (Chile) and Mexico City (Mexico)

As of December 2010, Educaedu operates in the following countries:

Argentina , Australia, Austria, Brazil, Canada, Chile, Colombia, Ecuador, France, Germany, Italy, Mexico, Peru, Poland, Portugal, Russia, Spain, Turkey, UK, United States.

Languages: English, Spanish, French, German, Italian, Polish, Portuguese, Russian and Turkish.

Englishtown (Website)

EF Englishtown

Type	Private
Industry	Internet E-learning
Founded	1996
Headquarters	Switzerland
Key people	Bill Fisher, CEO
Employees	29,000
Parent	EF Education First

Englishtown (also known as **EF Englishtown**) is an online English school offering E-learning for adults. A division of EF Education First, Englishtown has worked with 1,200 companies and has 15 million users.

History

Englishtown was founded in 1996 by CEO, Bill Fisher, and is headquartered in Lucerne, Switzerland with a research and development center in Shanghai.

Partnerships

Englishtown was chosen as the Official Language Training Supplier to the Beijing 2008 Olympics and the 16th Asian Games 2010 . Englishtown has been named the language training supplier for the 2014 FIFA World Cup.

Awards and Recognition

Englishtown has won the following awards in 2010:

- Interactive Media Award (IMA)
- Comenius-EduMedia-Award
- Human Resource Executive ®'s Top Training Product of the Year Award

Related Companies and Organizations

Englishtown is a part of EF Education First. Founded in 1965, EF is now the world's largest private educational company, with a group of 15 subsidiaries and non-profit organizations centered around language learning, educational travel, cultural exchange, and academic programs.

Visionlearning

Visionlearning is a free, web-based resource for students and educators in the science, technology, engineering and mathematics (STEM) disciplines. Geared toward those studying at high school and undergraduate levels, Visionlearning takes advantage of recent advances in new media to provide students and educators with learning and teaching materials. Research by project personnel has shown that this peer-reviewed and bilingual content improves student understanding of science and facilitates multidisciplinary teaching. The project also strives to build community around improving STEM education.

Supported by the National Science Foundation and the U.S. Department of Education, Visionlearning provides educational content that not only explores specific STEM concepts, but examines how we know these things. Project leaders believe that an important facet of succeeding in these disciplines is understanding their respective histories, as well as engaging with the process of discovery.

History

In 1998, Dr. Anthony Carpi, an environmental chemist and then-assistant professor at John Jay College of the City University of New York, designed and launched a prototype Internet learning resource for science students, called The Natural Science Pages. This was in part a response to the growing evidence that poor textbook content and deficient teaching materials contribute to inadequate science education. The purpose of the prototype was to see if presenting important course information in a new form would improve what students understood, what information they remembered, and how well they performed in their class overall.

What this research showed, through standardized exam scores and student retention data, was that using the prototype significantly improved science comprehension and performance in the targeted natural science course. Further evaluations also showed that the prototype helped improve communication skills and student engagement with the course.

In response to the success of The Natural Science Pages prototype and with support of the NSF, Carpi developed the Visionlearning project, which brought on a group of scientists and educators to create content and became a website open to students and educators worldwide. In the last decade, Visionlearning has evolved into a more comprehensive website that provides free educational materials to support the science, technology, engineering, and mathematics (STEM) disciplines, with translations into Spanish. These materials include independent learning modules that focus on distinct topics within STEM disciplines, teaching resources, a MyClassroom tool (similar to Moodle or WebCT) that allows educators to customize and maintain a virtual learning environment for their students, and new media elements to benefit multiple learning styles. A key feature of all of Visionlearning's material is an emphasis on the process of science and discovery.

The Process of Science: A Philosophy for Teaching and Learning

Throughout the development of the learning modules and multimedia tools, Visionlearning has emphasized an importance on teaching science as a process, rather than "a simple set of facts and terms to be memorized." This comes from an organizational ideology that understanding how scientific knowledge evolves better prepares students to engage with the process of discovery and helps to dispel common misconceptions about science. The underlying notion is that students will develop independent, objective thinking skills regardless of whether they pursue a career in STEM disciplines, and understand that science is far more than simply conducting experiments in a lab and working with complex mathematical formulas.

Content

As of 2009, Visionlearning has developed 70 independent learning modules in nine subject areas, including biology, chemistry, earth science, and the process of science. This material has been focused into concise, relevant topic areas and grouped by discipline. Each module can be used independently, or in conjunction with others, and intentionally concentrates on core concepts to help direct learning. Supplementary materials such as quizzes, links to reviewed sources, and biographies are also provided for additional exploration. These modules are directed toward undergraduate and high school learning and have been written by experts in the relevant disciplines. Every module is peer reviewed for quality and accuracy, and includes historical context and contemporary relevance.

MyClassroom

As part of its dedication to supporting educators, Visionlearning has developed a teaching portal called MyClassroom. Similar to other virtual teaching tools (such as Blackboard, Moodle, and WebCT), MyClassroom allows educators to create a course customized to their needs. They are able to add learning modules from Visionlearning's library into their classroom, annotate any of these modules, and create their own modules for access by students enrolled in the course. Having this material accessible to students via the

Internet allows for 24 hour access to the learning materials, without cost, and aids Spanish bi-lingual students with translations.

New Media

As Visionlearning has expanded over the years, the project has embraced and integrated new media with the use of flash animations, simulations, high resolution graphics, and more recently iPod apps. To further embrace developments in technology and become more ADA compliant, the site administrators are developing additional media resources for users, such as podcasts and scripts for animations. Like many corporations today, they are also exploring the use of blogs and social networking sites, such as Facebook, to build awareness and a user base.

Position Statements

Visionlearning does not subscribe to any political party or affiliation. The project is dedicated to providing impartial information in the STEM disciplines and encouraging learning in the process of science. One important goal of the project is to provide an understanding of scientific concepts while emphasizing how the scientific community has arrived at these conclusions. The intention is that, through teaching about the process of scientific discovery, students will look at science not as factual elements, but as a way of knowing about the world.

The project does not subscribe to the belief that the Internet and new media are replacing more traditional forms or communication, but that through proper integration of all the technology available students will have a greater chance of success in STEM learning.

Sclipo

Sclipo	
	
Commercial?	Yes
Type of site	Learning Management System, Social network service
Registration	Required
Available language(s)	English, German, Spanish
Created by	Gregor Gimmy Victor Bautista
Launched	20 Oct 2006
Current status	Active

Sclipo is a Learning Management System, providing fully hosted web learning applications that help teach face-to-face and online. Sclipo's applications are accessible through a web browser, and do not require users to provide hosting or to perform system installation, configuration and maintenance.

Features

To use Sclipo's applications, users open their Web Academy on the Sclipo platform through a subscription, which is free for academic and K-12 school teachers. The Web Academy provides synchronous and asynchronous web applications to teach, socialize and administer students, teachers, content and activities for face-to-face and online education.

- Teaching applications are Course Manager, Library and Live Teaching. Features of the Course Manager include a learning path, tests, discussion forum, content sharing, progress control and live web classes. The Library allows teachers to store and share content in multiple formats: documents, videos, audio and images. Teachers can upload own content to their Library and add that from popular generic content-sharing websites such as Slideshare, Scribd, Vimeo and YouTube. The Live Teaching application allows to hold live classes, webinars and meetings via a web conferencing system over the Internet. Features of Live Teaching include multiple video and audio sharing, desktop sharing, presentations with integrated whiteboard, and public and private chat.

- Social applications include a private personal profile, a contact network, online groups, an event organizer, discussion forums, walls, feeds, the ability to follow Web Academies, a messaging system and Facebook Connect. Sclipo also provides a social network of Web Academies with central search and browse capabilities, called Campus, enabling teachers and students from different Web Academies to connect and share.

- Administration applications include tools to customize the look & feel, name and URL of the Web Academy, to set privacy levels of activities and content, to promote activities and content, to invite and administer students and teachers, and to collect payments for the purchase of services and content from teachers.

History

Founded by Gregor Gimmy, Sclipo was launched on October 20, 2006 (then called Visuarios), as a website to share user-generated educational videos. The initial product allowed professional and amateur teachers to share knowlegde online through video, making Sclipo one of the first websites of user-generated educational videos. Sclipo then recognized that independent teachers, small schools and companies in continuous education growingly used generic web applications for teaching such as Skype for live web classes and Slideshare to share documents. In addition, Sclipo saw that current learning management systems, such as Moodle or Blackboard, were too complex and expensive for a small, 1-15 teacher-sized, educational entity. Sclipo then decided to expand its offering and create a suite of web applications specifically for learning purposes and adapted to the needs of small educational entities in continuous education.

These were launched continuously, the first one being the Live Teaching application in September 2007.

Awards

- Nominated for TheEuropas, Best Learning Startup 2010 by Techcrunch
- Winner, White Bull Award 2010
- Finalist, Plugg Start-Ups Rally 2010
- Winner, Red Herring Global 100, 2008
- First Prize, European Startup 2.0 Awards, 2007

Khan Academy

The **Khan Academy** is a not-for-profit educational organization created by Salman Khan. With the stated mission "of providing a high quality education to anyone, anywhere", the Academy supplies a free online collection of over 2,130 videos on mathematics, history, finance, physics, chemistry, astronomy, and economics.

History

Salman Khan is a Bangladeshi American born and raised in New Orleans, Louisiana. His father is from Barisal, Bangladesh and his mother was born in Kolkata, India . Khan holds three degrees from the Massachusetts Institute of Technology: a BS in mathematics, a BS in electrical engineering and computer science, and an MS in electrical engineering and computer science. He also holds an MBA from Harvard Business School. In late 2004, Khan began tutoring his cousin Nadia in mathematics using Yahoo!'s Doodle notepad. When other relatives and friends sought his tutorial, he decided it would be more practical to distribute the tutorials on YouTube. Their popularity there and the testimonials of appreciative students prompted Khan to quit his job in finance in 2009 and focus on the Academy full-time.. Bill Gates once said that "I'd say we've moved about 160 IQ points from the hedge fund category to the teaching-many-people-in-a-leveraged-way category. It was a good day his wife let him quit his job."

As of December 2009, Khan's YouTube-hosted tutorials receive a total of more than 35,000 views per day. Each video runs for approximately ten minutes. Drawings are made with SmoothDraw, which are recorded and produced using video capture from Camtasia Studio. Khan eschewed a format that would involve a person standing by a whiteboard, desiring instead to present the content in a way akin to sitting next to someone and working out a problem on a sheet of paper: "If you're watching a guy do a problem [while] thinking out loud, I think people find that more valuable and not as daunting." Offline versions of the videos have been distributed by not-for-profit groups to rural areas in Asia, Latin America, and Africa. While the Khan Academy's current content is mainly concerned with pre-college mathematics and physics, Khan states that his long-term goal is to provide "tens of thousands of videos in pretty much every subject" and to create "the world's first free, world-class virtual school".

The Khan Academy also provides a web-based exercise system that generates problems for students based on skill level and performance. Khan believes his academy points to an opportunity to overhaul the traditional classroom by using software to create tests, grade assignments, highlight the challenges of certain students, and encourage those doing well to help struggling classmates.

His low-tech, conversational tutorials -- Khan's face never appears, and viewers see only his unadorned step-by-step doodles and diagrams on an electronic blackboard -- are more than merely another example of viral media distributed at negligible cost to the world. Khan Academy holds the promise of a virtual school: an educational transformation that de-emphasizes classrooms, campus and administrative infrastructure, and even brand-name instructors.

Several people have made $10,000 contributions; Ann and John Doerr gave $100,000; total revenue is about $150,000 in donations, and $2,000 a month from ads on the Web site. As of September 2010, Google announced they would be providing the Khan Academy with $2 million to support the creation of more courses and to enable the Khan Academy to translate their core library into the world's most widely spoken languages, as part of their Project 10^100. Salman is aiming at making nothing less than "tens of thousands" of tutorials offering the "first free, world-class virtual school where anyone can learn anything."

Vision

Major components:

- Video library (over 2130 videos and counting in various topic areas - logging over 36 million visits
- Automated exercises with continuous assessment (87 modules in math)
- Peer-to-peer tutoring based on objective data collected by the system (future projected)
- Khan Academy videos are licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License.

Not-for-profit partner organizations are making the content available outside of YouTube. The Lewis Center for Educational Research, which is affiliated with NASA, is bringing the content into community colleges and charter schools around the country. World Possible is creating offline snapshots of the content to distribute in rural, developing regions with limited or no access to the Internet.

Khan has stated a vision of turning the academy into a charter school:

This could be the DNA for a physical school where students spend 20 percent of their day watching videos and doing self-paced exercises and the rest of the day building robots or painting pictures or composing music or whatever.

Recognition

- Salman Khan has been featured in *San Francisco Chronicle*, on the Public Broadcasting Service (PBS), National Public Radio, CNN.
- In 2009, the Khan Academy received the Microsoft Tech Award for education.
- In 2010 at the Aspen Ideas Festival, Bill Gates endorsed the learning resource, calling it "unbelievable" and saying "I've been using [Khan Academy] with my kids."
- In 2010, Google's Project 10^{100} provided $2 million to support the creation of more courses, to allow for translation of the Khan Academy's content, and to allow for the hiring of additional staff.

Chapter- 11

Educational Software

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

History

Early History, 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. In 1967 Computer Curriculum Corporation (CCC, now Pearson Education Technologies) 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.

History 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.

History 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 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.

Major types of educational software

Children's learning and home learning

An immense number of titles, probably running into the thousands, were developed and released from the mid-1990s onwards, aimed primarily at the home education of younger children. Later iterations of these titles often began to link educational content to school curricula (such as England's National Curriculum). The design of educational software programmes for home use has been influenced strongly by computer gaming concepts – in other words, they are designed to be fun as well as educational. However as far as possible a distinction should be drawn between proper learning titles (such as these) and software where the gaming outweighs the educational value (described later).

The following are examples of children's learning software which have a structured pedagogical approach, usually orientated towards literacy and numeracy skills.

- ClickN KIDS, Research based phonics and spelling software titles
- Disney Interactive learning titles based on characters such as Winnie-the-Pooh, Aladdin, The Jungle Book and Mickey Mouse
- GCompris, contains numerous activities, from computer discovery to science
- Knowledge Adventure's JumpStart and Blaster Learning System series
- The Learning Company's Reader Rabbit, The ClueFinders and Zoombinis series.

Ergonomic hardware is fundamental for baby learning, where Tablet PCs and touchscreens are preferly used instead of keyboards and computer mice. Also, a closed environment is created, to inhabilitate the use of the keyboard (excepting some combination of keys that can only be typed by and adult), taskbar and opening of other programs and screens.

Some dedicated baby and child computers can additionally parents' explicitly allowed Java programs and USB devices (that can also be used to connect to the adult's computer).

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 e-learning are now being blended with term courseware. Most leading educational companies solicit or include courseware with their training packages. In 1992 a company called SCORE! Educational Centers formed to deliver to individual consumers courseware based on personalization technology that was previously only available to select schools and the Education Program for Gifted Youth.

Classroom aids

A further category of educational software is software 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 categories orientated towards home users. Software titles are often very specialised and produced by a wide variety of manufacturers, including many established educational book publishers.

- *The schoolzone.co.uk Guide to Digital Resources, 5th ed. (2005)* - An up-to-date full-colour guide with reviews of around 500 selected and recommended products, categorised by subject area, albeit specific to the UK school system.

Edutainment

In a broader sense, the term *edutainment* describes an intentional merger of computer games and educational software into a single product (and could therefore also comprise more serious titles described above under children's learning software). In the narrower sense used here, the term describes educational software which is primarily about entertainment, but tends to educate as well and sells itself partly under the educational umbrella. Software of this kind is not structured towards school curricula, does not normally involve educational advisors, and does not focus on core skills such as literacy and numeracy.

Reference software

Encyclopædia Britannica Ultimate Reference Suite, an example of 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.

Educational software on 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.

Computer games with learning value

These are games which were originally developed for adults or older children and which have potential learning implications. For the most part, these games provide simulations of different kinds of human activities, allowing players to explore a variety of social, historical and economic processes.

For example:

- City-building games such as the SimCity series (1989–2003) and Caesar (video game) (1993–2006) invite players to explore the social, practical and economic processes involved in city management;
- Empire-building games such as the Civilization (video game) series (1991–2005) and the Europa Universalis series (2000–2007) help players to learn about history and its political, economic and military aspects;
- Railroad management games such as Railroad Tycoon (1990–2003) and Rails Across America (2001) illuminate the history, engineering and economics of railroad management.
- Geography games such as PlaceSpotting (2008–2009) help players to find locations on earth according to some hints.

Do games such as these qualify as edutainment? To do so, they would need to have been created with a clear educational intent. In their publicity material, the developers of these games such as these generally focus more on the 'fun' aspects of the games rather than their educational potential. This might be taken as evidence of an absence of educational intent. On the other hand, large amounts of information of an overtly educational nature may be found within the manuals of many of these games (for example, Europa Universalis, Railroad Tycoon and Rails Across America), suggesting that education was indeed very much in the minds of the developers. Accordingly, these games may be classified as edutainment.

In any event, the games have been enthusiastically received in some educational circles and even passed into academic literature.

Software in 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.

Software for specific educational purposes

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

- 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.
- Language learning software (KVerbos or English in a Flash, for example)
- Notetaking
- Typing tutors (Anupama Typing Tutor, KTouch, Mario Teaches Typing or Mavis Beacon, for example)
- Driving test software
- Software for enabling simulated dissection of human and animal bodies (used in medical and veterinary college courses)
- Interactive geometry software
- Medical and healthcare educational software
- Spelling tutor software

Products and suppliers

- Adventus Interactive
- Blackboard Inc.
- Brøderbund
- CourseInfo LLC
- Davidson & Associates
- Dorling Kindersley
- Edmark
- Futurekids
- Inspiration Software
- Knowledge Adventure

- Anupama Typing Tutor
- Mavis Beacon
- Renaissance Learning
- SchoolForge
- SEBIT
- Software MacKiev
- SpicyNodes
- The Learning Company
- 3D Indiana

Chapter- 12

Specimens of Some Educational Softwares

Intelligent tutoring system

An **intelligent tutoring system** (ITS) is any computer system that provides direct customized instruction or feedback to students, i.e. without the intervention of human beings, whilst performing a task. Thus, ITS implements the theory of learning by doing. An ITS may employ a range of different technologies. However, usually such systems are more narrowly conceived of as artificial intelligence systems, more specifically expert systems made to simulate aspects of a human tutor. Intelligent Tutor Systems have been around since the late 1970s, but increased in popularity in the 1990s.

The structure of an ITS system

Intelligent tutoring systems consist of four different subsystems or modules: the interface module, the expert module, the student module, and the tutor module. The *interface module* provides the means for the student to interact with the ITS, usually through a graphical user interface and sometimes through a rich simulation of the task domain the student is learning (e.g., controlling a power plant or performing a medical operation). The *expert module* references an expert or domain model containing a description of the knowledge or behaviors that represent expertise in the subject-matter domain the ITS is teaching—often an expert system or cognitive model. An example would be the kind of diagnostic and subsequent corrective actions an expert technician takes when confronted with a malfunctioning thermostat. The *student module* uses a student model containing descriptions of student knowledge or behaviors, including his misconceptions and knowledge gaps. An apprentice technician might, for instance, believe a thermostat also signals too high temperatures to a furnace (misconception) or might not know about thermostats that also gauge the outdoor temperature (knowledge gap). A mismatch between a student's behavior or knowledge and the expert's presumed behavior or knowledge is signaled to the *tutor module*, which subsequently takes corrective action, such as providing feedback or remedial instruction. To be able to do this, it needs information about what a human tutor in such situations would do: the tutor model.

An intelligent tutoring system is only as effective as the various models it relies on to adequately model expert, student and tutor knowledge and behavior. Thus, building an ITS needs careful preparation in terms of describing the knowledge and possible behaviors of experts, students and tutors. This description needs to be done in a formal language in order that the ITS may process the information and draw inferences in order to generate feedback or instruction. Therefore a mere description is not enough; the knowledge contained in the models should be organized and linked to an inference engine. It is through the latter's interaction with the descriptive data that tutorial feedback is generated.

Use in practice

All this is a substantial amount of work, even if authoring tools have become available to ease the task. 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, Cognitive Tutors, 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. 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) is a subfiled of Intellignet Tutoring systems that is mainly concerned with teaching a natural language, producing error diagnosing and feedback of errors made by either first or second language learners. ILTS is complicated and require specialized natural language processing tools such large dictionaries, and morological and grammatical analyzers with acceptable coverage.

ITS conference

The Intelligent Tutoring Systems conference was typically held every other year in Montréal (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 recently back in Montreal in 2008 (for its 20th anniversary) by Roger Nkambou and Susanne Lajoie. ITS'2010 was held in Pittsburgh (US) by Jack Mostow, Judy Kay, and Vincent Aleven. 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 every odd numbered year. The American Association of Artificial Intelligence (AAAI) sometimes has symposia and papers related to intelligent tutoring systems. A number of books have been written on ITS including three published by Lawrence Erlbaum Associates.

Chamilo

Chamilo	
Developer(s)	Chamilo community members and professional partners
Stable release	1.8.7.1 & 2.0 / December, 2010
Operating system	Cross-platform
Type	Course Management System
License	GPL

Chamilo is an open-source (under GNU/GPL licensing) e-learning and content management system, aimed at improving access to education and knowledge globally. It is backed up by the Chamilo Association, which has goals including the promotion of the software, the maintenance of a clear communication channel and the building of a network of services providers and software contributors.

The Chamilo project aims at ensuring the availability and quality of education at a reduced cost, through the distribution of its software free of charge, the improvement of its interface for 3rd world countries devices portability and the provision of a free access public e-learning campus.

History

The Chamilo project was officially launched on the 18th of January 2010 by a considerable part of the contributing community of the (also GNU/GPL) Dokeos software, after growing discontent on the communication policy inside the Dokeos community and a series of choices that were making parts of the community insecure about the future of developments. As such, it is considered a **fork** of Dokeos (at least in its 1.8 series). The reaction to the fork was immediate, with more than 500 active users registering on the Chamilo forums in the first fortnight and more contributions collected in one month than in the previous whole year.

The origins of Chamilo's code date back to 2000, with the start of the Claroline project, which was forked in 2004 to launch the Dokeos project. In 2010, it was forked again with the publication of Chamilo 1.8.6.2.

Community

Due to its educational purpose, most of the community is related to the educational or the human resources sectors. The community itself tries to work together to offer an easy to use e-learning system.

Active community

The current (as of June 2010) active community of Chamilo is considered around 300 people. Community members are considered active when they start contributing to the project (through documentation, forum contributions, development, design).

In 2009, members of the (by then Dokeos) community started working actively on the One Laptop Per Child project together with a primary school in the Salto city in Uruguay. One of the founding members of the Chamilo Association then registered as a contributing project for the OLPC in which his company would make efforts to ensure the portability of the platform to the XO laptop. The effort has been, since then, continued as part of the Chamilo project.

Passive community

The community is considered *passive* when they use the software but do not contribute directly to it. As of October 2010, the passive community is estimated to more than 160,000 users

Chamilo Association

The Chamilo Association is a legally registered non-profit association under Belgian laws (a VZW) since June 2010. It was created to serve the general goal of improving the Chamilo project's organization and to avoid a conflict of interest between the organization controlling the software project decision process and the best interests of the community using the software. Its founding members, also its first board of directors, is composed of 7 members, of which 3 are from the private e-learning sector and 4 are from the public educational sector.

Main features of version 1

- courses, users and training cycles advanced management (including SOAP web services to manage remotely)
- SCORM 1.2 compatibility and authoring tool
- multi-institutions mode (with central management portal)
- time-controlled exams
- international characters (UTF-8)
- timezones
- automated generation of certificates
- tracking of users progress
- embedded social learning network

Technical details

Chamilo is developed mainly in PHP and relies on a LAMP or WAMP system on the server side. On the client side, it only requires a modern web browser (versions younger than 3 years old) and optionally requires the Flash plugin to make use of advanced features.

Interoperability

The Chamilo 1.8 series benefits from third party implementations that allows easy connexion to Joomla (through JFusion plugin), Drupal (through Drupal-Chamilo module), OpenID (secure authentication framework) and Oracle (through specific PowerBuilder implementations).

Extensions

Chamilo offers a videoconferencing system as well as a presentations to learning paths converter, which require advanced system administration skills to install.

Releases

2010-12 - v2.0 stable

The first version 2.0 of Chamilo. Considered to be stable software with experimental web 2.0 and 3.0 aspects expected to analyze the impact of brand new technology on education. Apart from introducing the concept of true content, object and document management, Chamilo 2.0 also focuses on integration with existing repository systems (Fedora, YouTube, Google Docs, etc.) and supports some of the most popular authentication systems (ao. LDAP, CAS, Shibboleth). It's modular and dynamic architecture provides a basis for a multitide of extensions which can be added upon installation or at a later date by means of a repository of additional functionality packages.

2010-06 - v2.0 beta

Chamilo 2.0 beta is not considered production-safe (as its name implies) but implements a series of improvements to get to a more stable and usable release.

2010-07 - v.1.8.7.1

Version 1.8.7.1, codename Palmas was launched at the end of July 2010. It included security fixes, many fixes to bugs found in 1.8.7 and a series of minor global improvements and new features.

2010-06 - v2.0 alpha

Chamilo 2.0 was originally (first plans date back to 2006 in the Dokeos Users Day in Valence, France) meant to be released as Dokeos 2.0, as a completely new backend for the LMS. The complete team of developers working on this version decided, in 2009, to move to the Chamilo project, thus leaving the Dokeos project repository with incomplete sources. Although Dokeos promised since then to release version 2.0 on the 10th of October 2010 (with a corresponding counter counting down from more than 200 days before that), it is not the total remake it was supposed to be, and it is actually expected to be equivalent in features to 1.8.6.1, mostly adding valuable visual and usability improvements.

2010-05 - v1.8.7

Version 1.8.7, codename Istanbul was launched in May 2010 with major internationalization (language and time) improvements to the previous version, moving a first major step away from Dokeos. It also added new pedagogical tools to its previous version. This version was the first to be released officially as GNU/GPL version 3.

2010-01 - v1.8.6.2

Version 1.8.6.2 of Chamilo was originally meant to be released as Dokeos 1.8.6.2 in January 2010. Because of the community schism, it was left incomplete and continued (starting November 2009) as the Chamilo project.

Statistics

The free-to-use Chamilo campus registered 12000 users in June 2010 (5 months after its launch) and 38000 users in December 2010 (11 months after its launch). The Peruvian Universidad San Ignacio de Loyola reported 800 users connected in the same 60 seconds time frame in April 2010. Globally, Chamilo registered 238000 users in December 2010.

Worldwide adoption of Chamilo

- Currently focusing on the academic sector, with many universities throughout Europe and Latin América currently using it, Chamilo is looking into the private sector market, with latest improvements oriented into the reliability of tracking learners time and efficiency.
- Chamilo is currently backed up by a series of small to medium companies which are required to register as members of the association and contribute to the open source software to be recognized as official providers.
- Year 2010 is focusing on spreading the software usage in Asia, with translation teams active in the translation to Simplified Chinese, between others.
- Chamilo is also used in public administrations : Spanish and Peruvian ministries, as well as unemployment services and NGO's.

Trademarks

Chamilo is a registered Trademark protected by the Chamilo Association, declared under Belgian law.

Cognitive tutor

A **cognitive tutor** is an intelligent tutoring system which develops a cognitive model of a student as he or she interacts with the program, providing problems and individualized instruction based on this model.

Cognitive Tutor is also the name of a product produced by Carnegie Learning. In each lesson, it tends to tell of a real world scenario. Then, it asks the student to solve a section math problems related to the scenario. The next section makes the student think of how they solved the problem and teaches them the concepts used to solve. Another scenario and questions with similar concepts are given. An example might be lesson of scientific notation for Algebra I. Students are told about how Sci. Notation is used to describe distance between planets and asked to simplify distances between planets. Then they are told how to simply move the decimal rather than simplify through multiplication, and are asked to apply this skill. The next section will be dedicated to Sci. Notation for unusually small numbers, like diameter of a cell. At the end they are asked to apply both concepts on a variety of different problems and explain in complete sentences what happens to numbers when multiplied by powers of 10 with negative or positive exponents.

Student information system

A **student info system** (SIS) is a software application for education establishments to manage student data. Student information systems provide capabilities for entering student test and other assessment scores through an electronic grade book, building student schedules, tracking student attendance, and managing many other student-related data needs in a school, college or university. Also known as **student information management system** (SIMS, SIM), **student records system** (SRS), **student management system** (SMS), **campus management system** (CMS) or **school management system** (SMS).

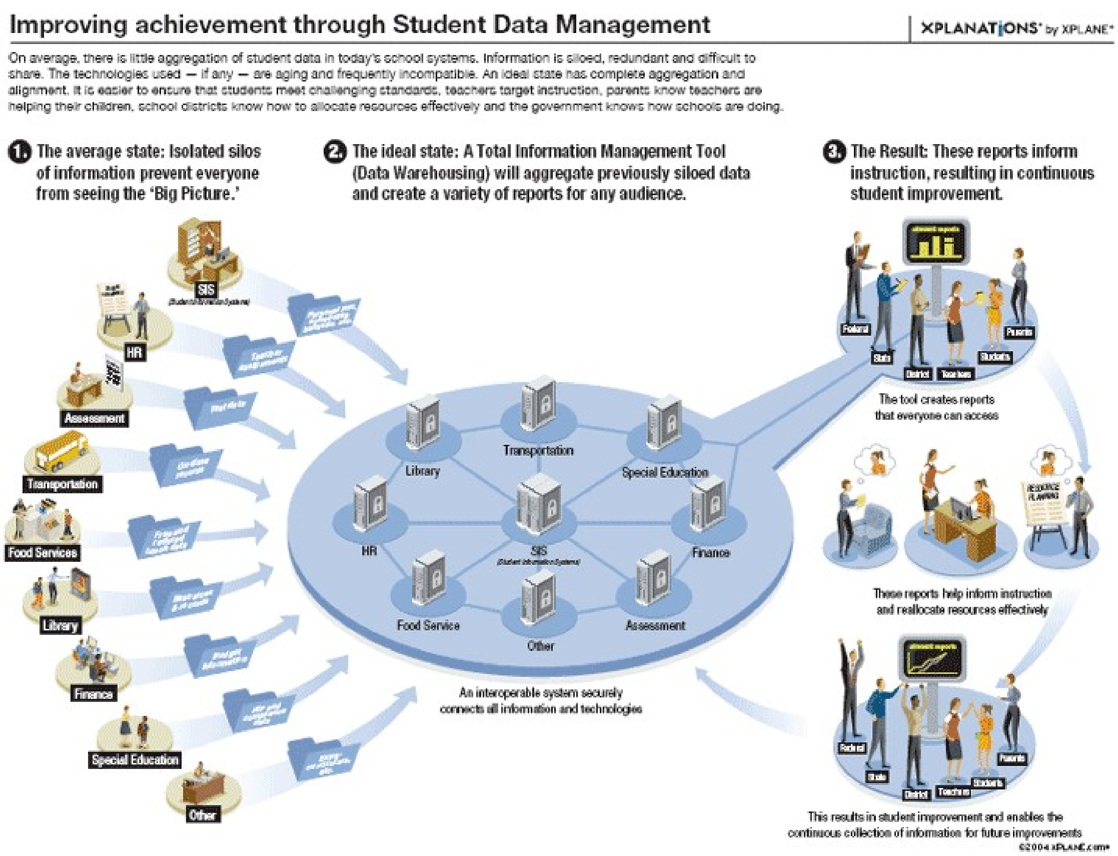


Diagram showing the importance and result of well thought out Student Data Management.

The SIS is equivalent to an Enterprise Resource Planning or ERP system for a corporate customer. As such, many of the issues with ERP System Selection Methodology, implementation, and operation of an ERP system apply to schools and their SIS systems.

Functions

These systems vary in size, scope and capability, from packages that are implemented in relatively small organizations to cover student records alone, to enterprise-wide solutions that aim to cover most aspects of running large multi-campus organizations with significant local responsibility. Many systems can be scaled to different levels of functionality by purchasing add-on "modules" and can typically be configured by their home institutions to meet local needs.

Until recently, the common functions of a student records system are to support the maintenance of personal and study information relating to:

- Handling inquiries from prospective students
- Handling the admissions process
- Enrolling new students and storing teaching option choices
- Automatically creating class & teacher schedules
- Handling records of examinations, assessments, marks and grades and academic progression
- Maintaining records of absences and attendance
- Recording communications with students
- Maintaining discipline records
- Providing statistical reports
- Maintenance boarding house details
- Communicating student details to parents through a parent portal
- Special Education / Individual Education Plan (IEP) services
- Human resources services
- Accounting and budgeting services
- Student health records

In larger enterprise solutions that have student data at their core, further functions include Student financial aid management and more may be customized by the developer. Where national or government systems exist for student finance or statistical return purposes, student records system often provide functionality that caters for this, by way of modules or core elements that handle the production of required files, or deal with the formatted transfer of information. examples are the FAFSA (Free Application for Federal Student Aid) process in the United States, the United Kingdom's Student Loans Company processes (SSAR, SSAC and ATFEE file processing), the UCAS (Universities and Colleges Admissions Service) in the United Kingdom, or the HESA and HESES student statistical returns in the United Kingdom.

In the past, universities and large school districts in particular have created their own bespoke student record systems. One such example is the ROSI system at University of

Toronto. With growing complexity in the business of educational establishments, most organizations now choose to buy customizable software, and increasing numbers are buying software as a service (SAAS). Most student information systems in use today are server-based, with the application residing on a central computer server, and being accessed by client applications at various places within and even outside the school. But student information systems have been moving to the web since the late 1990s and that trend is accelerating as institutions replace older systems.

Integrated Systems / Hosted Service

In recent years, several forces have been driving an evolution of student information systems and, as a result, leading many institutions to replace theirs. Those forces are:

- Demand for 24x7 web-based access to information by students, instructors, and (in primary and secondary education, or K-12) parents
- Increasing demands in the amount and frequency of data reporting for accountability and other purposes (so-called "vertical reporting" up to state, provincial, and national agencies)
- Importance of integrating student information systems with other tools, especially relating to instruction, courses and learning (LMS systems and on-line course ware).
    - SIF (Schools Interoperability Framework) Compliance.

Modern use also implies that smaller K-12 schools can benefit from the reducing cost of technology; this has made it possible for even these organizations to implement such school software that not only encompass the management of student information but also provide the means for parents or guardians to connect with the teaching staff through parent portals

Upgrade Pitfalls

Unlike an upgrade to a web browser or a word processor, changes and upgrades to these systems tend to have significant impact on the day-to-day operations of every school employee. These systems typically touch every aspect of school operations even when only the base modules are used. For these reasons, care should be taken to consider the impact on:

- Workflow: Since these programs are tightly tied to a school's business workflow and processes, a change to a SIS system can force changes to workflow. This can have a significant impact on daily operations if not considered carefully prior to implementation.
- Data Conversion: Data conversion of historic data (transcripts, attendance, health records, etc.) for both current and past students can also be a significant issue to transitioning to a new SIS. Since most schools are required to keep historical data

on past students, considerations should be given to what information will be converted and what will be archived.

- Customized Reports: Since there is little standardization in what and how student information is stored, most schools have their own processes and procedures (e.g. formatting and layout of data reports) for student grade printouts or attendance records. As most SISs are not perfectly compatible with the previous SIS, upgrading can be a long, and tedious process.
- Training: Some new SIS programs have a tendency to include some unnecessary features, primary for the use of power users, so training employees to use the new SIS program will most likely be a costly and time-consuming process.

Like with an ERP system, schools should consider processes similar to the ERP System Selection Methodology when selecting a SIS system.