



One history of technology and media in distance education

Une histoire des technologies et des médias dans la formation à distance

Una historia de las tecnologías y de los medios de comunicación en la formación a distancia

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ABSTRACT

There is a long history of the use of technology in distance education. It is necessary to look beyond the technological tools to examine the systems of media that enable meaning to be communicated and understood through the use of technology. The article looks at the development of oral, written, video and computer technologies and media from the perspective of their influence on distance education. It concludes with some lessons from this historical perspective regarding media and technology in distance education today.

Keywords: technology, media, distance learning, history, communication

RÉSUMÉ

C'est une longue histoire que celle de l'usage des technologies dans la formation à distance. Au-delà des seuls outils technologiques, il faut cependant regarder les dispositifs médiatiques qui permettent à une signification d'être communiquée et comprise au moyen des technologies. Cet article s'intéresse au développement des technologies orale, écrite, audio et vidéo et à celui des médias du point de vue de leur influence sur la formation à distance, et

conclut sur quelques leçons à tirer de cette perspective historique quant à l'usage des technologies et des médias dans la formation à distance d'aujourd'hui.

Mots-clés : technologies, médias, formation à distance, histoire, communication

RESUMEN

El uso de las tecnologías en la formación a distancia tiene una larga historia. Más allá de las herramientas tecnológicas, cabe considerar los dispositivos mediáticos que permiten que se comunique y entienda un significado por medio de las tecnologías. Este artículo se interesa por el desarrollo de las tecnologías orales, escritas, audio y vídeo, y en el de los medios de comunicación, desde el punto de vista de su influencia en la formación a distancia. A modo de conclusión, a partir de esta perspectiva histórica, se presentan algunas lecciones de actualidad para la formación a distancia en cuanto al uso de las tecnologías y de los medios de comunicación.

Palabras clave: tecnologías, medios de comunicación, formación a distancia, historia, comunicación

Introduction

All history is in some sense personal, driven by the interests and background of those who write the history. My history of technology in distance education will inevitably be influenced by my British and North American, mainly anglophone, experience.

Secondly, definitions in this field are particularly important. In my open, online textbook, *Teaching in a digital age*¹, I make a distinction between technology and media.

Technology or media?

I define educational technology as things or tools used to support teaching and learning. Thus computers, software programs such as a learning management system, or a transmission or communications network, are all technologies. Technology often includes a combination of tools with particular technical links that enable them to work as a technology system, such as the telephone network or the Internet. However, technologies or even technological systems do not of themselves communicate or create meaning. They just sit there until commanded to do something or until they are activated or until a person starts to interact with the technology. At this point, we start to move into media.

¹ Bates, T. (2019). *Teaching in a Digital Age: Guidelines for designing teaching and learning (2nd edition)*. Contact North / Contact Nord (<https://teachonline.ca/teaching-in-a-digital-age/teaching-in-a-digital-age-second-edition>) in which some of the material in this article has appeared previously.

For communication to occur, a medium also requires a deliberate act to create a message or content, and someone who receives and interprets the message. Thus, there are three essential components of a communication medium: someone who creates a message or content, the technology that carries the message or content, and someone to interpret the message or content (see Shannon & Weaver, 1962/1949). We use our senses, such as sound and sight, to interpret media. In this sense, we can consider text, graphics, audio and video as media 'channels', in that they intermediate ideas and images that convey meaning. Every interaction we have with media is an interpretation of reality, and again usually involves some form of human intervention, such as writing (for text), drawing or design for graphics, talking, scripting or recording for audio and video. Note that there are two types of intervention in media: by the 'creator' who constructs information, and by the 'receiver', who must also interpret it. There is a whole field of research and theory around how meaning is conveyed by signs or images, called semiology (see, for instance, Barthes, 1970). Media of course depend on technology, but technology is only one element of media. In reality, technology and media are continually used interchangeably in everyday communications, and it is not always easy to make a clear separation or distinction. (For instance, is the Internet a medium or a technology? It will depend on the context in which the word is used.) However, the distinction is important, particularly in education. Technology is too narrow a lens; we really need to talk about media in education.

This distinction is important because it enables us to consider face-to-face teaching as just another medium of communication. Then we can examine and compare the 'affordances', the potential educational benefits, of both face-to-face teaching, and other media or delivery systems, such as online learning.

This leads into another important concept. Different media have different educational effects or affordances (see for instance, Salomon, 1979; Gibson, 1986; Puentedura, 2014). If you just transfer the same teaching to a different medium, you fail to exploit the unique characteristics of that medium. Put more positively, you can do different and often better teaching by adapting it to the medium. That way students will learn more deeply and effectively (see Bates, 2019, *Teaching in a digital age*, Chapter 8 for many examples²).

With this conceptual background I will now provide my personal history of technology and media in distance education.

Oral communication

One of the earliest means of formal teaching was oral – through human speech – although over time, technology has been increasingly used to facilitate or 'back-up' oral communication. In ancient times, stories, folklore, histories and news were transmitted and maintained through oral communication, making accurate memorization a critical skill, and the oral tradition is still the case in many aboriginal cultures. For the ancient Greeks, oratory and speech were the means by which people learned and passed on learning. Homer's Iliad and the Odyssey were recitative poems, intended for public performance. To be learned, they had to be memorized by listening, not by reading, and transmitted by recitation, not by writing. Lectures go back at least as far as the ancient Greeks. Demosthenes (384-322 BC) was an outstanding orator whose speeches influenced the politics of Athens.

Nevertheless, by the fifth century B.C, written documents existed in considerable numbers in ancient Greece. If we believe Plato, education has been on a downward spiral ever since. According to Plato, Socrates caught one of his students (Phaedrus) pretending to recite a speech from memory that in fact he

² <https://pressbooks.bccampus.ca/teachinginadigitalagev2/part/chapter-8-pedagogical-differences-between-media/>

had learned from a written version. Socrates then told Phaedrus the story of how the god Theuth offered the King of Egypt the gift of writing, which would be a 'recipe for both memory and wisdom'. The king was not impressed. According to the king:

... it [writing] will implant forgetfulness in their souls; they will cease to exercise memory because they will rely on what is written, creating memory not from within themselves, but by means of external symbols. What you have discovered is a recipe not for memory, but for reminding. And it is no true wisdom that you offer your disciples, but only its semblance, for by telling them many things without teaching them anything, you will make them seem to know much, while for the most part they will know nothing. And as men filled not with wisdom but the conceit of wisdom, they will be a burden to their fellow men. (Socrates, *Phaedrus*, 274c-275, translation by Manguel, 1996, p. 58).

Slate boards were in use in India in the 12th century AD, and blackboards/chalkboards became used in schools around the turn of the 18th century. At the end of World War Two the U.S. Army started using overhead projectors for training (Chasos, 2013), and their use became common for lecturing, until being largely replaced by electronic projectors and presentational software such as PowerPoint around 1990. This may be the place to point out that most technologies used in education were not developed specifically for education but for other purposes (mainly for the military or business).

Although the telephone dates from the late 1870s, the standard telephone system never became a major educational tool, not even in distance education, because of the high cost of analogue telephone calls for multiple users, although audio-conferencing has been used to supplement other media since the 1970s. In the early 1980s the Open University in the United Kingdom developed an audio-graphics system called Cyclops that worked over the public telephone system for delivery through its regional study centres (McConnell & Sharples, 1983). This enabled tutors in the regional offices to communicate in real time with distance students in their homes. This was the forerunner of teleconferencing technology such as Blackboard Collaborate and Zoom.

The British Broadcasting Corporation (BBC) began broadcasting educational radio programs for schools in the 1920s. The first adult education radio broadcast from the BBC in 1924 was a talk on *Insects in Relation to Man*, and in the same year, J.C. Stobart, the new Director of Education at the BBC, mused about 'a broadcasting university' in the journal *Radio Times* (Robinson, 1982).

In the late 1970s audio-cassettes were used by the Open University in the United Kingdom eventually as a replacement for the BBC's radio programs. A significant lesson here was learned about the advantages of asynchronous – any time, any place – technologies. Students not only preferred audio cassettes to the radio programs, but also learned more, because they could spend more time on task, by replaying and going over the material many times (Durbridge, 1984). Audio-graphics, the combination of an audio cassette talking students through printed materials specifically designed to integrate with the audio-recordings, were particularly successful in teaching mathematics at the Open University, and were a forerunner of the Khan Academy, which combines video graphics with voice-over.

All of these technologies illustrate the oral basis of communication for teaching.

Written communication

The role of text or writing in education also has a long history. According to the Bible, Moses used chiseled stone to convey the ten commandments in a form of writing, probably around the 7th century BC.

Even though Socrates is reported to have railed against the use of writing, written forms of communication make analytic, lengthy chains of reasoning and argument much more accessible, reproducible without distortion, and thus more open to analysis and critique than the transient and synchronous (same time and place) nature of speech.

The invention of the printing press in Europe in the 15th century was a truly disruptive technology, making written knowledge much more freely available, very much in the same way as the Internet has done today. Because of the explosion of written documents resulting from the mechanization of printing, many more people in government and business were required to become literate and analytical, which led to a rapid expansion of formal education in Europe. There were many reasons for the development of the Renaissance and the Enlightenment, and the triumph of reason and science over superstition and beliefs in Europe, but the technology of printing was a key agent of change (Eisenstein, 1979).

Improvements in transport infrastructure in the 19th century, and in particular the creation of a cheap and reliable postal system in the 1840s, led to the development of the first formal correspondence education. The first distance education course in the modern sense was provided by Sir Isaac Pitman in the 1840s, who taught a system of shorthand by mailing texts transcribed into shorthand on postcards and receiving transcriptions from his students in return for correction (Archibald & Worsley, 2019). The element of student feedback was a crucial innovation of Pitman's system. This scheme was made possible by the introduction of uniform postage rates across England in 1840. In 1858, the University of London introduced an external degree program by correspondence and this still exists today in the form of the *University of London Worldwide*³.

From the time its first courses opened in 1971, the U.K. Open University (OU), through the use of advanced instructional design, transformed the use of print for teaching, by creating specially designed, highly illustrated printed course units that integrated learning activities with the print medium, and also by combining the printed materials with broadcast radio and television programs (Weinbren, 2015).

With the development of web-based learning management systems in the mid-1990s, textual communication, although digitized, became, at least for a brief time, the main communication medium for Internet-based learning, although lecture capture and video streaming and video conferencing are now changing that.

Video

Television was first used in education in the 1960s, for schools and for general adult education (one of the six purposes in the current BBC's Royal Charter is still 'promoting education and learning').

³ <https://london.ac.uk/worldwide>

The Open University from its start worked in partnership with the BBC to develop university programs open to all, using a combination originally of printed materials designed by OU staff, and television and radio programs made by the BBC but integrated with the courses. Although the radio programs involved mainly oral communication, the television programs did not use lectures as such, but focused more on the common formats of general television, such as documentaries, demonstration of processes, and cases/case studies (see Bates, 1984). In other words, the BBC focused on the unique 'affordances' of television. Over time, as new technologies such as audio- and video-cassettes were introduced, live transmissions, especially radio, were severely reduced for OU programs, although there are still some educational television channels broadcasting around the world (e.g. TVOntario in Canada; PBS, the History Channel, and the Discovery Channel in the USA).

The use of television for education quickly spread around the world, being seen in the 1970s by some, particularly in international agencies such as the World Bank and UNESCO, as a panacea for education in developing countries, the hopes for which quickly faded when the realities of lack of electricity, cost, securing publicly available equipment, climate, resistance from local teachers, and local language and cultural issues became apparent (see, for instance, Jamison & Klees, 1975).

Satellite broadcasting started to become available in the 1980s, and similar hopes were expressed of delivering 'university lectures from the world's leading universities to the world's starving masses', but these hopes too quickly faded for similar reasons. However, India, which had launched its own satellite, INSAT, in 1983, used it initially for delivering locally produced educational television programs throughout the country, in several indigenous languages, using Indian-designed receivers and television sets in local community centres as well as schools (Bates, 1984).

In the 1990s the cost of creating, recording and distributing video dropped dramatically due to digital compression and high-speed Internet access. This reduction in cost also led to the development of lecture capture systems. The technology allows students to view or review lectures at any time and place with an Internet connection. The Massachusetts Institute of Technology (MIT) started making its recorded lectures available to the public, free of charge, via its OpenCourseWare project, in 2002. YouTube started in 2005 and was bought by Google in 2006. YouTube is increasingly being used for short educational clips that can be downloaded and integrated into online courses. The Khan Academy started using YouTube in 2006 for recorded voice-over lectures using a digital blackboard for equations and illustrations. Apple Inc. in 2007 created iTunesU to become a portal or a site where videos and other digital materials on university teaching could be collected and downloaded free of charge by end users.

Video-conferencing using dedicated cable systems and dedicated conferencing rooms have been in use since the 1980s. The development of video compression technology and relatively low-cost video servers in the early 2000s led to the introduction of lecture capture systems for recording and streaming classroom lectures through the Internet in 2008.

Increases in Internet speeds and further progress in digital video compression resulted in technologies such as Zoom, which became immensely popular for teaching when, because of the COVID-19 pandemic, instructors had to switch rapidly to online learning. The advantage of such technologies for most instructors is that they did not need to change their main method of teaching when moving from in class teaching to teaching at a distance. I will return to this issue later.

Until lecture capture arrived, learning management systems had integrated basic educational design features, but this required instructors to redesign their classroom-based teaching to fit the LMS environment. Lecture capture and video conferencing on the other hand required no changes to the standard lecture model, and in a sense distance teaching reverted back in 2020 to oral communication primarily, supported by PowerPoint or even writing on a chalkboard during COVID-19.

Thus, oral communication remains as strong today in education as ever, but has been incorporated into or accommodated by new technologies.

Computer technologies

1. Computer-based learning

In essence the development of *programmed learning* aims to computerize teaching, by structuring information, testing learners' knowledge, and providing immediate feedback to learners, without human intervention other than in the design of the hardware and software and the selection and loading of content and assessment questions. B.F. Skinner started experimenting with teaching machines that made use of programmed learning in 1954, based on the theory of behaviourism (Skinner, 2003/1968). Skinner's teaching machines were one of the first forms of computer-based learning. There has been a recent revival of programmed learning approaches as a result of MOOCs, since machine-based testing scales much more easily than human-based assessment.

PLATO was a computer assisted instruction system originally developed at the University of Illinois, and, by the late 1970s, comprised several thousand terminals worldwide on nearly a dozen different networked mainframe computers. PLATO was a highly successful system, lasting almost 40 years, and incorporated key on-line concepts: forums, message boards, online testing, e-mail, chat rooms, instant messaging, remote screen sharing, and multi-player games (Woolley, 1994).

Attempts to replicate the teaching process through artificial intelligence (AI) began in the mid-1980s, with a focus initially on teaching arithmetic. Despite large investments of research in AI for teaching over the last 30 years, the results generally have been disappointing (see Bates *et al.*, 2020). It has proved difficult for machines to cope with the extraordinary variety of ways in which students learn (or fail to learn). Recent developments in cognitive science and neuroscience are being watched closely but at the time of writing the gap is still great between the basic science, and analysing or predicting specific learning behaviours from the science.

More recently we have seen the development of adaptive learning, which analyses learners' responses then re-directs them to the most appropriate content area, based on their performance (Moskal *et al.*, 2017). Learning analytics, which also collects data about learner activities and relates them to other data, such as student performance, is a related development (Rientes *et al.*, 2020).

2. Computer networking

Arpanet in the U.S.A was the first network to use the Internet protocol in 1982. In the late 1970s, Roxanne Hiltz and Murray Turoff at the New Jersey Institute of Technology (NJIT) were experimenting with blended learning, using NJIT's internal computer network. They combined classroom teaching with online discussion forums, and termed this 'computer-mediated communication' or CMC (Hiltz & Turoff, 1978).

At the University of Guelph in Canada, a software system called CoSy was developed in the 1980s that allowed for online threaded group discussion forums, a predecessor to today's forums contained in learning management systems. In 1988, the Open University in the United Kingdom offered a course, DT200, that as well as the OU's traditional media of printed texts, television programs and audio-cassettes, also included an online discussion component using CoSy. Since this course had 1,200 registered students, it was one of the earliest 'mass' open online courses (Mason, 1989).

The World Wide Web was formally launched in 1991. Before the Web, it required lengthy and time-consuming methods to load text, and to find material on the Internet. The World Wide Web is basically an application running on the Internet that enables 'end-users' to create and link documents, videos or other digital media, without the need for the end-user to transcribe everything into some form of computer code. The first web browser, Mosaic, was made available in 1993. Several Internet search engines have been developed since 1993, with Google, created in 1999, emerging as one of the primary search engines.

We see then the emerging division between the use of computers for automated or programmed learning, of which the application of artificial intelligence is an extension, and the use of computer networks to enable students and instructors to communicate with each other. The former is based on a behaviouristic approach to learning; the latter reflects a more constructivist approach.

3. Online learning environments

In 1995, the Web enabled the development of the first learning management systems (LMSs) or virtual learning environments, such as WebCT (which later became Blackboard). LMSs provide an online teaching environment, where content can be loaded and organized, as well as providing 'spaces' for learning objectives, student activities, assignment questions, and discussion forums. The first fully online courses (for credit) started to appear in 1995, some using LMSs, others just loading text as PDFs or slides. The materials were mainly text and graphics. LMSs became the main means by which online learning was offered until lecture capture systems emerged around 2008.

By 2008, George Siemens, Stephen Downes and Dave Cormier in Canada were using web technology to create the first 'connectivist' Massive Open Online Course (MOOC), a community of practice that linked webinar presentations and/or blog posts by experts to participants' blogs and tweets, with just over 2,000 enrollments (Siemens, 2005). The courses were open to anyone and had no formal assessment. In 2012, two Stanford University professors launched a lecture-capture based MOOC on artificial intelligence, attracting more than 100,000 students, and since then MOOCs have expanded rapidly around the world (Shah, 2020).

4. Social media

Social media are really a sub-category of computer technology, but their development deserves a section of its own in the history of educational technology. Social media cover a wide range of different technologies, including blogs, wikis, YouTube videos, mobile devices such as phones and tablets, Twitter, Skype and Facebook. Andreas Kaplan and Michael Haenlein (2010, p. 61) define social media as 'a group of Internet-based applications that [...] allow the creation and exchange of User Generated Content', based on interactions among people in which they create, share or exchange information and ideas in virtual communities and networks.

Social media are strongly associated with young people and 'millennials' – in other words, many of the students in post-secondary education. At the time of writing, social media are only just being integrated into formal education, and to date their main educational value has been in non-formal education, such as fostering online communities of practice, or around the edges of classroom teaching, such as 'tweets' during lectures or rating of instructors.

5. Emerging technologies

The pace of new technology developments in education shows no signs of slowing. In recent years we have seen the emergence of online serious games, augmented and virtual reality ('immersive' technologies), and 'modern' applications of artificial intelligence to teaching and learning. These are not well enough established yet to know their ultimate value in education.

What can we learn from the history?

It can be seen that distance education has adopted and adapted technology over a long period of time. In particular, many claims made for a newly emerging technology are likely to be neither true nor new. What we need to understand better are the educational affordances of emerging media: what they can do better than existing media.

Also, new technology rarely completely replaces an older technology. Usually the old technology remains, operating within a more specialised 'niche', such as radio, or integrated as part of a richer technology environment, such as video in the Internet.

In recent years we have moved away from the confines of text, or audio, or video, or computing, to rich, multimedia environments that support a variety of approaches to teaching and learning.

The main consequences of more recent developments in the use of technology in distance education are as follows:

- technology is much cheaper, more user-friendly and more reliable
- as a result, it is more ubiquitous, and no longer the domain of educational or technology specialists: it is being used by everyone, and especially students
- consequently, a great deal of online learning is now informal as well as formal, and educators are still learning how best to work with this
- distance learning is not one 'thing', but an historical development and process that means different things to different people
- educational technology has moved from being something that supported classroom teaching and later distance education, to a force for radical change in our educational systems – but radical change based on the full potential of digital learning is something that still has yet to occur on any significant scale, although the response to COVID-19 will accelerate such changes.
- the challenges for distance learning are no longer technological, but ones of desire, organization and appropriate application based on prior knowledge, experiment, and evaluation.

However, what distinguishes the digital age from all previous ages is the rapid pace of technology development and our immersion in technology-based activities in our daily lives. Thus, it is fair to describe the impact of the Internet on education as a paradigm shift, at least in terms of educational technology. We are still in the process of absorbing and applying the implications.

Above all, we need innovative teachers and administrators, and thinkers to continue to push the boundaries of what is possible, while at the same time not ignoring the lessons from history. As George Santayana (1998/1905, p. 82) wrote: 'Those who cannot remember the past are condemned to repeat it.'

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