



HAL
open science

How the education become virtualized. A French point of view of the distance education history

Pascal Marquet, Yuan Xiao

► **To cite this version:**

Pascal Marquet, Yuan Xiao. How the education become virtualized. A French point of view of the distance education history. 2008 International Conference on ICT in Teaching and Learning: Technoloy-Enriched Learning Spaces, Hong-Kong, Jul 2008, Hong Kong SAR China. pp.584-593. hal-00343553

HAL Id: hal-00343553

<https://hal.science/hal-00343553>

Submitted on 10 Dec 2008

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

How the education become virtualized

A French point of view of the distance education history

Yuan Xiao, Pascal Marquet
Université Louis Pasteur, LISEC
Strasbourg, France

Abstract:

The appearance and the development of distance education are always linked with the evolution of ICT. Each time that a new technology is used in the field of the media and the transmission of information, it gives rise to a new model of distance education. From the 19th century to the 21st century, three phases are identified in this era: paper, mass media and digital. We underline the use of new technologies during the communication of learning. It appears that each step of development of the distance education model along with the ICT footsteps took less and less time; the technology from simplicity to complexity, the media from singleness to diversity, this is the process which the distance education experiencing. With technology and media, it can improve the personalization process and promote the education digitalisation and modernization. Also, the standard to judge whether a new technique can be combined with distance education, is whether it can promote the personalization of distance education. The history of the development of French distance education supports this point of view.

I. Introduction

Every new communication technology has been used to develop the distance education systems from its appearance. The distance education has nearly one-and-a-half centuries' history. Dating back as early as the mid-19th century, the postal service was used for correspondence education. In the 1920's, broadcast education appeared, and then the broadcast and television were applied in the educational fields around the time of the Second World War. Along with the development of new technologies such as satellite, telecommunication, computer and Internet, media has become more and more diverse, the study material provided by distance education has become richer, and also, communication between teacher and student has become less impeded and more diverse.

Concerning the distance education history, there has already been a lot of research on the taxonomy, either on the general system of the ideology, or on the system institutions providing distance education (Nipper, 1989; Keegan, 1996; Glikman & Baron, 1991; Glikman, 2002; Blandin, 2004; Ding, 2000). Each time that a new technology is used in distance education, it gives rise to a new model. According to the evolution of transmitting knowledge and the learning environment, we distinguish three great phases during this long period of French distance education.

- From the 19th century to 1960's, the principal model of the paper phase is correspondence education;
- from 1960's to 1990's is the mass media phase, of which the principal model is broadcast/television education;
- from 1990's, we entered the digital phase, at that time, the virtual campus began.

In order to better describe these various periods, we point out the model, the supports, the disciplines and the establishments concerned, the related public and the learning theories. At the same time, the research on the political, technical and economic constraints are also very important, especially to analyze and understand the difference among the three periods, and to compare them with each other.

II. The paper phase

Distance education is an ancient device that can be traced back to 1840, the same time as the birth of the postal stamp service. It is not a coincidence. Before this innovation, when one sent a letter, one was not sure that the addressee would pay for the delivery and receive the letter. The postal stamp service reversed this logic. Isaac Pitman had used it to send the manual to distant students in 1837. The private institutions then developed this device. Afterwards, it spread in Europe, and was used as a means to implement compulsory schooling for the children who were not able to go to school. The first establishment created by these private institutions quickly spread in order to organise the geographical distribution of the population. This makes it possible to explain why the private sector is still prevalent in the field of distance education today.

II.1. The development in the paper phase

In France, we must wait until 1877 when a private company “Les cours Hattemer” proposed correspondence courses to prepare for the public contests. In 1907, another private institution was born: Universal School (*Ecole Universelle*). It provided multiple subjects.

The development of correspondence education was hindered because of the Wars. After the Wars, during a fast and voluntary industrialization period and the “baby-boom”, the need for qualified personnel appeared more and more obvious and the training of labour seemed necessary.

To mitigate the disorganization of the education system due to the war, the Service of Correspondence Education (*Service d'Enseignement par Correspondance*) was created in 1939. Today this establishment is called the National Centre of Distance Education (*Centre National d'Enseignement à Distance*, CNED). The correspondence education posed as an alternative to the weaknesses of the education system. The public concerned was wider than before. It made it possible to transmit the lesson not only to the children of compulsory schooling age, but also to those who were sick or whose parents worked abroad, or to the adults who continued a higher education and who wished to follow a further professional education. Among the registered, the number of adults obviously increased.

After the Liberation, the Service of Correspondence Education’s mission was confirmed by the name of National Centre of Correspondence Education (*Centre national d'enseignement par correspondance*, CNEPC). It received the high school statute (within the meaning at that time and which is wider than today). It was particularly in charge of assuming responsibility for schooling of sick children, and for the former prisoners and deportees, etc. Then the lessons were widened to include: commercial, primary, preparation for exams and national competition. These offers were just like a “second chance” for those adults who tried to develop their knowledge and qualification for their social and professional careers. They also afforded the opportunity to voluntary people who self-studied with their own resources in their spare time.

II.2. A century of technical evolution

The 19th century and the first half of the 21st century was a technical evolution century that saw the introduction of the stamp post service, stencil, newspaper, radio, telephone and television. Among these technologies, writing and the stencil were very significant for education and human communication. Writing already has a history of several thousands of years. Writing retains, transmits and furthers human knowledge and culture. The stencil method makes writing more convenient and quicker, it also makes study more effective. Afterwards, printed documents became the principal carrier of the transmission of knowledge. In this industrialization period, these developments required every kind of professional and qualified labour. The traditional education alone could not satisfy these requests. The pioneers of distance education organisations occurred to post printed documents, and the correspondence instruction invented the correspondence education. Based on the printing trade and the publishing industry, the reliability of stamp post service laid the foundations of correspondence education. It is important to remark that, the distance education, in its first model, was combined with a new technology, the stamp post service, which assured a reliable form of exchange.

II.3. The communication and the learning environment

Correspondence course was created entirely by the distant educational establishment. At the beginning of this type of course, it is necessary to define the “guides of studies”, called by some schools, which is a type of printed documents copied and distributed to students in order to provide basic knowledge and the collections of directives and advice. The guide of studies resembles a “paper” tutor between the professors and students.

There are two types of professor in this device: the professor-writer and the professor-corrector. The professor-writer takes charge of drafting the courses which include the texts, the tests, the auto-corrected exercises, synthesis exercises and the appendix which is proposed to fill out a precise part of the course. The professor-writer must work in close connection with the educational principal who knows the students more deeply. The professor-corrector is the “true” professor who is better known by the school and the students. He is in charge of guiding the students through. His first objective is to establish the contact between the school, which he represents, and the learners. This contact can be established only by a note that is given with the exercises and tests dispatched by the students.

The school manager controls the time limit of correction (generally a week) during the activity of the professors. The majority of schools exert the checking by survey. These are for good management of the professors’ work, because like all the educational devices, the role of professors is important. The relationship between professor and student is established when the student is registered at school. It is an important educational relationship, which influences the time limit of the return of corrected work. In distance education, the “physical” imperfection of a professor’s absence must be at best compensated by a moral and quality psychological presence of relationship between the professor and student. To solve this problem, some schools organize regrouping of students who have the same objective. Then, they can regulate some difficulties during the learning program. At the same time, it is a chance for students to get to know their professors and to make better contact within an epistolary relationship. It is also a chance for the professors to talk with the students and gain better understanding of their human dimension and character.

In conclusion, in this paper phase, the communication between the professors and the students is achieved by the exchange of the student's work and return of the corrected work, which is sent via the postal service. The shortcoming of this one-way asynchronous communication is a long cycle and low efficiency. Although the telephone and the regrouping of students is the complementary solution to maintain the two-way communication, the travel expenses and the communication costs hinder their application in correspondence education.

III. The mass media phase

From 1960's to 1990's, in the mass media phase, distance education had its rise of development towards the professional training. It is also a period when we should not ignore the technical development influences on distance education. Each development stage corresponds to the appearance and progressive socialization of new technological devices, to their educational implementation, to their confrontation with reality (Bruillard, 1996). From the broadcast, the Hertzain television, the satellite television, to the tape recorder, the video tape recorder, so much as computer-assisted instruction (*Enseignement assisté par ordinateur*, EAO), these evolutions promote the change of instrument in each period.

III.1. The development in this phase

In France, the use of media appeared before the 1970's. The use of media for distance education, however, showed up after the 1970's. The media is not a support unit any more, but a teaching object. From its emergence to its development, media was regarded as a tool to reinforce the effectiveness of education.

Particularly, the "Domerg Commission" was been running since its launch in 1963. The governmental objective is to mitigate deficiencies of the education system. A four-year plan of expanding audio-visual was elaborated. Its public relates to secondary education, adult training and the social class. The disciplines diffused with radio are French and English, German, Latin emissions; with television, they are mathematics and technology emissions.

The point turning towards the professional training is the inter-professional agreement of 1970 and the law in July 1971. The inter-professional agreements on professional training, signed in 1970, are confirmed by the law of July 16, 1971. The system of continuing professional education is governed. Since the provision of this law has been integrated into the Labour Code (*Code du travail*), the law organizes "continuing professional education within the framework of permanent education (*Education Permanente* in French)" and a "national obligation". It is established in the law that, for the employees, to be trained in their working time and still receive their salary. According to Le Goff (2001), it is "a social justice logic", "it makes the permanent education like a 'second chance' for the forgotten or the victims of the educational system¹". The State, the region and the companies mainly finance the professional education. Since the law of 1971, companies are obliged to finance training. Every employee has the right to follow a training leave during his professional life. 1% of the mass salary allocated to training by companies is a formidable dynamic of expansion.

At the end of 1973, the first oil shock is the early warning sign of economic crisis, which reached France in 1975-1976. And they came to accentuate a new oil shock in 1979 and 1980.

¹ In French : « logique de justice sociale, qui fait de l'éducation permanente le moyen d'une "seconde chance" pour les oubliés ou les victimes du système scolaire».

The second oil shock considerably influenced the French economy: investments fall-off, deceleration of growth, acceleration of inflation, rise of unemployment. In the 1990's, the economic globalisation takes its place with the delocalisation of productions that requires few qualifications towards the Third World, where low salaries reduced cost prices. It limits also the available employment for labour with few qualified in the industrialized countries.

The one who needs the distance education is generally the one who needs a chance to develop, or normally counts as low qualified and difficult. Most of the learners adapted badly to the traditional education. The State is in charge of the training, and it is necessary to judge the assiduous attentions control for justifying the training period remuneration by the State or by the company. Then the distance education is organised and institutionalised towards "open training", which has a presence of training place and flexible organisation terms. In this context, the distance education presents many advantages for employees, as well as for employers. For the employees, distance education offers a discretion that contributes to his effective progress. For the employers, distance education can reduce the professional training cost and train a higher number of people. On the other hand, the distance advanced education opens the door to the youth who leave the education system with a diploma to go to university, who need to work for themselves but cannot follow the courses at university.

III.2. The mass media

In 1976, Cormier uses the expression "distance training" (*Formation à Distance*) in the title of his book. Therefore, the system of distance training is gradually constituted. Until the end of 1980's, it becomes a sociological object, equal famous in school or in youth insertion.

The 1980's, with information technologies, it is one period when new tools and new structures appeared in distance training.

If during the 1960's and 1970's, rather the specialists use media in education, from the 1980's, then we can find more application in practice. In education, we pass gradually from the nano-networks² to the local area networks, the CD-ROMs to multi-media, and Internet today. The traditional medium gives little by little place to the hypertext, the hypermedia and the multimedia. This media passion will last till 1994 and prepare the advent of Internet and Web.

This period is also the time of the microcomputer, consumer electronics, and a new "industry of content" emergence (Cartier, 1997). This industry of content touches deeply the distance training because the contents proposed via local or distance computer tools, must take account of new variables: they become interactive and take a dialogued form. Information and knowledge are not proposed any more in the form of consultable databases, but in the form of open and modifiable environment. The computer medium enters the transmission process with a screen that becomes a message element.

The question is always centred on the profitability of the education system. Moreover, in a context of industrial changes and international competition, it appears contradictory between the low profitability and the qualification requirement. The economic and technical constraints appear progressive. It is the increased possibilities connected with the information

² Systems composed of a central computer, which linked up others computers.

and communication technologies, which contribute to modifying the structures and the education mode, and introducing new dimensions, new prospects and new questions.

III.3. The communication

As for the distance education model of this period, the “distance training” has two aspects:

- traditional correspondence education which is supplemented by audio-visual medium;
- the educational radio/television, which is accompanied by printed documents.

Take for example for the second aspect. The extension of the School Radio-Television (*Radio-Télévision Scolaire*, RTS) is addressed to the learners and to teachers, ensured by the National Educational Institute (*Institut Pédagogique National*, IPN). Parallel to the extension of School Radio-Television, other hertzian diffusion sets up and aims at more adult viewers. Each channel speaks to its particular professional social categories viewers.

Just as the *Office de radiodiffusion – télévision française* (ORTF) starts to diffuse educational emissions for adults in 1964. The emissions of *RTS/Promotion* intended the “little or fairly schoolings” adults start at 1963-1964. The emission of *Télé-Promotion Rurales* (TPR) that aim in particular at underprivileged farmers begins in 1966. The emission of *Télé-Promotion Commerçants* is aimed at the small shopkeepers who are confronted with the problems of their company management.

In these educational models, written documents and corrected exercises accompany these emissions. They relate to structured courses and formal validations, except that TV-CNAM (*Conservatoire National des Arts et Métiers*). TV-CNAM proposes the evening course of superior technician and engineer training for the geographically “isolated” adults and not registered in training organization. This type of teaching does not consist of a structured course, and no validation. Moreover, the university television education and the recycling of medicine students are special cases applying to advanced education.

In 1970, resource centres such as the *Institut national de recherché pédagogique* (INRP) or the *Office Français des Techniques Modernes d’Education* (OFRATEME) were set up. They became the *Centre national de documentation pédagogique* (CNDP) in 1976 that indicated the disengagement of the minister of education compared to “modern technologies of education (Glikman, 1989)”.

In this phase, the main support is printed teaching material with radio and television medium. To realize the distance education, we use the broadcast/television special channel or the independent education broadcasting/television station to diffuse the curriculum programme; the study centres offer a learning environment and the servicing facility for learning; learners come here and attend a collective lecture, take part in counselling, and exchange in what they have learnt. All these measures supply a communication between learner-learner and learner-professor, or one way synchronize face to face communication (receive the programme by radio or television), or two way asynchronous communication (post and return the work), or two way synchronize face to face communication (activities in the study centres). Besides, the distance education turns towards the professional training in this period, that absorbs more adults and its dimension is significantly larger than before.

IV. The digital phase

Since the appearance of the Internet in the 1990's, we can transmit course content through the computer network, whereby learners access educational resources through the Internet. On the other hand, Internet applications develop incessantly, the application like WWW, email, videoconference system, between the learners and the professors, between the learners, as well as between the professors, their synchronized or asynchronous communications are interactive. For the reason of the development of computer network technology, distance education entered the digital phase.

IV.1. The development in this phase

Though the unemployment rate was relatively stable, the employment situation remained a problem. Education was generally treated as a human right, the moral and intellectual source, and the condition of the democracy. We do not talk about permanent education or social class any more, but lifelong learning, a term used in the UNESCO Delors Report in 1996. It represented a reaction to an anomaly: if we must learn during all our life, the educational possibilities are limited in great measurement at the first stage of the life, mainly in the regular education. It seems essential to offer a "second chance" to those, which had not benefited instructional possibilities during their childhood and youth. Distance education appears a solution in reply to call for education without multiplying the cost.

Since about thirty years ago, "these cognitive new technologies come directly to compete with education on its traditional ground: what of the transmission of knowledge (Linard, 1996)." Since the computer has been introduced into the French education system, the governments sometimes gave a strong signal in this direction. They were interested in a great number of fields with industrial intentions, which are not concealed (Baron, 1998). For example, the plan "Informatique Pour Tous" (IPT), presented by the Prime Minister, Laurent Fabius, on January 25 1985, aimed to initiate all pupils and students in computing. According to Pélisset's calculation (1985), in less than one year, there would be six times more computers and six times more teachers concerned, and twenty times more establishments equipped than before. At the end of 1985, 120000 machines had been added, there into 40000 had already been installed, a quarter of all teachers received an introduction.

The earlier attempts to use the computer network and multimedia technologies to develop interactive teaching were at university (Miladi, 2006). From 2001 to 2003, the Ministry of Education and Research launched three projects appealing for "campus numérique" constitution. They aimed at offering an open and distant education. The major objective of the project was to manage to build a flexible offer in initial education as in continuing education, which articulates resources, services and logistics at the same time. In this way, these training methods should make it possible for the students, who cannot return to the University for various reasons, to choose the place, moment and rhythm of their studies. The modularity was a pledge of flexibility, an opening for the individualization of courses. E-mail, forum or chat should facilitate the personalisation of the learner-professor relationship. A new operation "université numérique thématique" (UNT) was launched in 2003 and was developed in 2004. The UNT is "Organizations 'without walls', it unites the University campuses installed in several universities or *grandes écoles* on complementary competences. Essentially, they unite

the great disciplinary groups and their production is turned towards the student (Thibault, 2006).” Five UNT³ have been set up in 2005 and there were ten in 2007.

IV.2. Technologies and communication

“Campus numérique⁴” is one device that integrates the online varied accessible resources and the asynchronous communication possibilities, such as e-mail and discussion forums, sometimes chat appointments in real-time. This device tried to re-create a “virtual university” with all its functionalities: courses administration, inscriptions, administrative information, online courses, students/professors contacts, online library and resources centre, exchanges between students and between professors.

On the *Forum français pour la formation ouverte et à distance* (FFFOD)⁵, it uses the term “E-learning” to define all devices of education which use a local, extensive or Internet network to diffuse, interact or communicate. This includes distance education, in distributed environment (other than traditional correspondence education), access to resources by downloading or online consultation. It can utilize synchronous or asynchronous tools, tutor systems, self-training based systems, or a combination of these elements.

The terms like “E-education”, “online training”, “online course”, indicate the part of the device aiming to the knowledge diffusion. “E-learning”, “E-training” are open and distance learning are characterized by resorting to the network for the whole or part of teaching, training, searching and communication activities.

In the 1980’s, along with the evolution of computer network technology and multimedia technologies, the foundation for the multimedia conference system development was established. The personal computer starts to have real-time multimedia data gathering and broadcast ability, the local network developed from its low speed to high speed; the broadband network from public switched telephone network (PSTN) to X.25, ISDN, DDN, frame relay. These have provided the possibility for further development of the network application.

Here are seven forms presented in distance education (Shi, 2000):

- Tele-access: visits online distance information resource and online distance classroom;
- Tele-presence: visits digital library, database, virtual museum, satellite datum, etc.
- Tele-mentoring: obtains professors' tutorship through online call-board, news group, forum, etc. ;
- Tele-sharing: derived from e-mail system that promotes exchanges between learners and professors;
- Virtual Publishing: no-limit publication, it strengthens learners' enthusiasm for study;
- Virtual classroom: the virtual learning environment;
- Computer Supported Cooperative Learning: it called also Educational Groupware System, based on the computer network; it offers synchronized and asynchronous multimedia information service and the sharing learning environment.

³ They are *Université médicale virtuelle francophone* (UMVF), *Université numérique juridique francophone* (UNJF), *Université numérique en ingénierie et technologie* (UNIT), *Université en économie-gestion* (AUNEGE) and *Université numérique d'environnement et de développement durable* (UNED).

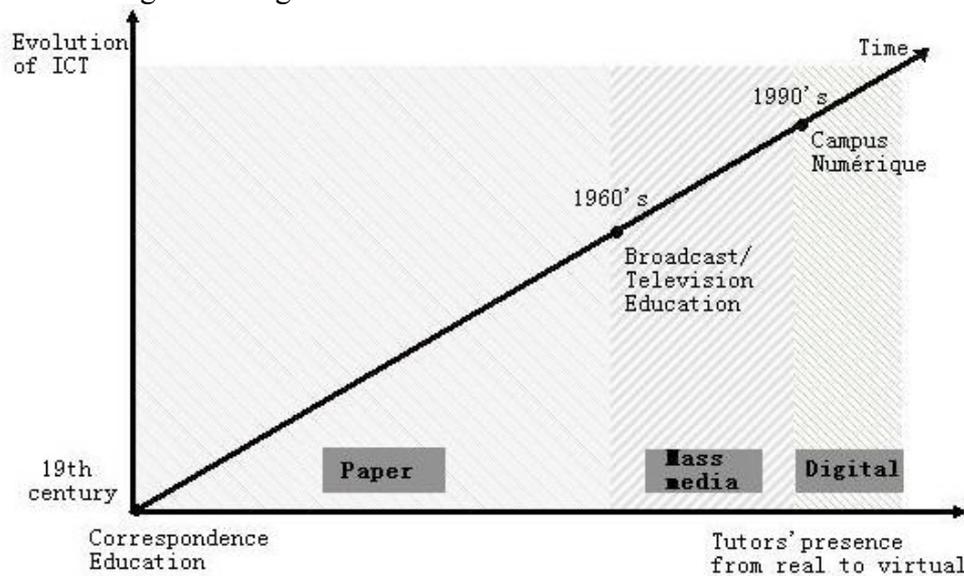
⁴ Equal *Virtual Campus*, *Virtual University*.

⁵ French forum of the open and distance learning. <http://www.fffod.org/>

In this phase, it has no temporal or spatial limit any more; learners and professors are only physically separate. With multi-dimensional exchanges, learners mainly manage their own learning, professors become the mentor and edifier. The education resources can be used and shared by every participant.

V. Discussion

From its appearance at the time when the mail service developed rapidly in the 19th century to its computerization in the course of generalization by the networks in the 21st century, distance education went through its paper phase, mass media phase and digital phase, that now depends on the combination of ICT and distance education, and relies on the evolution of transmitting knowledge.



Through the above schematics and the previous three-phased analysis, we underline the use of new technologies during the communication of learning. It appears that the development of the distance education model along with the ICT footsteps took less and less time; from more than one hundred years for the first phase, to several decades for the second phase, to a dozen years for the third phase. Technology is developing from simplicity to complexity, media from singleness to diversity, this are the processes that distance education is experiencing. Also, when a new technique appears, it creates a new distance education model: the mail service for the correspondence education, the radio and television for the radio/television education and the computer technology and Internet for the Campus Numérique. At the same time, when the new technique has been applied to distance education, it is assimilated and adapted as necessary. When this distance education model then becomes insufficient to adapt to this new technique, the distance education model has to be changed to accommodate it. However, when a technique is no longer able to adapt to this development, it would be eliminated, either withdrawn from the main stage or replaced by another new technique. However, technology and media have both not developed especially for education, its application is for the assistance learning. The distance education uses them as the carrier. Without the technical and media participation, it would not have the distance education. With technology and media, on the one hand, it can improve the personalization process, on the other hand, it can also promote the digitalisation and modernization of education. Furthermore, the standard to judge whether a new technique can be combined with distance education, is whether it can promote the personalization of distance education. The history of the development of French distance education supports this point of view.

Having this retrospective view in mind, a crucial question is still remaining: does the knowledge of the past technologies and their processes of integration within distance education means help us to better predict or adapt emerging technologies or vice versa? For instance, how face-to-face communication with webcams will be or can be used to enhance distance learning? How mobile technologies and handset devices will be or can efficiently exploited for training? The first question is the purpose of our further research and we hypothesize that the face-to-face communication with webcams offers a virtual social environment; its pertinent utilizations could promote the communication among learner, professor and tutor, and assist the learners access to the knowledge which the training they are undergoing at a distance.

References:

- Baron, G. L. (1998). TIC en éducation : nouvelles activités, nouvelles compétences. Les cas de l'informatique. In Deceuninck, J., & Fichez, E. (Eds.), *Industries éducatives : situation, approches, perspectives*. (27-38). Lille: UL3.
- Baron, G. L., & Bruillard, E. (1996). *L'informatique et ses usagers dans l'éducation*. Paris: PUF.
- Blandin, B. (2004). Historique de la formation "ouverte" et "à distance". *Actualité de la formation permanente*, 189, 69-71.
- Cartier, M. (1997). *Le nouveau monde des infrastructures*. Montréal: Fides.
- Cornier, R., & all. (1976). *L'apprenant adulte dans un système multi-médias de formation à distance*. Québec: Institut National de Recherche Scientifique.
- Delos, J. (1996). *Learning: The treasure within*. Report to UNESCO of the International Commission on Education for the Twenty-first Century. Paris: UNESCO.
- Ding, X. F. (2001). Taxology of Distance Education and Its Major Achievements (Part I). *Open Education Research*, 1, 13-16.
- Ding, X. F. (2001b). Taxology of Distance Education and Its Major Achievements (Part II). *Open Education Research*, 2, 12-16.
- Glikman, V., (1989). *Evolution d'une politique en matière de technologie éducative. Histoire de RTS/Promotion d'une expérience française de télévision éducative pour adultes*. Doctoral thesis in Sciences of the Education. Université Paris V.
- Glikman, V., & Baron, G. L. (1991), Médias, multi-médias, technologies et formation à distance. *Perspectives documentaires en éducation*, 24, 63-93.
- Glikman, V. (2002). Des cours par correspondance au "e-learning". Paris: PUF.
- Keegan, D. (1996). *Foundations of distance education*. London and New York: Routledge.
- Le Goff, J. (2001). *Droit du travail et société*. volume I.
- Linard, M. (1996). *Des machines et des hommes*. Paris: Harmattan.
- Miladi, S. (2006). Les campus numériques : le paradoxe de l'innovation par les TIC. *Distances et Savoirs*, 4(1), 41-59.
- Nipper, S. (1989). Third Generation Distance Learning and Computer Conferencing. In Mason, R., & Kaye, A. (Eds.) *Mindweave: Communication, Computers and Distance Education*. Oxford: Pergamon.
- PELISSET, E. (1985). Pour une histoire de l'informatique dans l'enseignement français : premiers jalons. *Système éducatif et révolution informatique*. Cahier de la F.E.N.
- Thibault, F. (2006). Autour des campus numériques français. *Distances et Savoirs*, 4(1), 109-112.
- Shi, M. L. (2000). *The theory and the applications in the computer supported cooperative work*. Shanghai: Publishing house of electronics industry.