The interactive knowledge model, knowledge transmission and cooperative learning environment

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Abstract — This paper proposes an analysis of the new pedagogical and knowledge paradigm, and especially of the cooperative learning environment based on Information and Communication Technology – ICT –. First we study the shift from the old pedagogical paradigm to the new paradigm which can be described by the interactive knowledge model. In the new interactive knowledge mediation paradigm the learning process becomes more and more a common construction based on the cooperation between teachers, learners, enterprises... What are the role of ICT and the place of the teacher in the new learning process? We throw highlights on an essential distinction, and yet often ignored, between the “telecommunications” transmission and the “knowledge” transmission. The confusion between these two kinds of transmission will be dissipated thanks to a presentation of the communication and information theories. Then the question of knowledge transmission in a cooperative learning environment is analyzed. We distinguish the catalysts and the reactive principles in the knowledge transmission and we refer to the experiment of an important European project. ICT seem to be a catalyst of the knowledge transmission, but the teaching act and the role of the pedagogue remain crucial. We even advance the idea that the more the environment of information and technologies will develop, the more the role of the pedagogue will be decisive. So we propose a new analysis of the introduction of ICT in higher education.

Index Terms — Cooperative learning environment, Information and Communication Technology, Knowledge Transmission, Information and Communication Theories.

The harmonious development of the information society depends on the coherence of the “triptyque”: technology - education - social diffusion. The technological push made possible to develop networks which store, treat and convey an increasingly significant quantity of information. A new training paradigm appears with the rise of Information and Communication Technologies – ICT –; the usual teaching actors have to make a difficult and long adjustment: training and knowledge are accessible with new methods thanks to new technologies. Remote teaching becomes a distributed teaching in which the learner plays an increasingly active role in interaction with the teacher. Beyond the technological development much more significant breaks become visible concerning “Knowledge” and its diffusion. In the context of the information society the Universe of Knowledge is recombining. According to T. H. Davenport and L. Prusak, knowledge constitutes “a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories, but also in organizational routines, processes, practices, and norms”([6], p. xii). In short, knowledge is a key factor of the firm competitiveness in the new economy based on information. Consequently, work and knowledge which were two relatively distinct values in the taylorist universe are mixing. Then training and the control of knowledge become a new stake. In particular any individual must learn throughout his life. So, beyond the traditional places of knowledge, the Schools and the Universities, new training places are set up: companies develop training structures, such as for example Motorola University, Hewlett Packard or Sun University; one also sees, for example, Microsoft diffusing its own certification labels, equivalent to professional diplomas.

This paper proposes an analysis of the new pedagogical and knowledge paradigm, and especially of the cooperative learning environment based on ICT.

First we study the shift from the old pedagogical paradigm to the new paradigm which can be described by the interactive knowledge model. In the new paradigm the use of ICT is increasing. But there is sometimes a confusion: the transmitting capacities of ICT should not be confused with the capacities of knowledge transmission. While the capacities of knowledge transmission seem to improve slowly, the capacities of “telecommunications” transmission have increased...
considerably. This essential distinction, and yet often ignored, between the “telecommunications” transmission and the knowledge transmission takes root in the origin of the communication and information theories; these theories will be analyzed particularly on the questions of transmission and the role of technology.

The context of “cooperative learning environment” will then be studied especially in the university framework; on the basis of an important European project called Form-Ami it will be argued that the pedagogue and the human relation between the teacher and the learners are in the heart of the teaching process and the knowledge transmission.

THE INTERACTIVE KNOWLEDGE MODEL, KNOWLEDGE TRANSMISSION AND ICT

The pedagogical and knowledge paradigm shift: the Interactive Knowledge Model

The old pedagogical paradigm can be defined as a knowledge push. We refer to the innovation theory to define the old pedagogical paradigm as a knowledge push model. In this framework, which is dominant since the beginning of the Gutenberg's Galaxy, teachers are the holders and have the monopoly of knowledge; they produce and diffuse knowledge with a specific place in the society.

But today this old paradigm is questioned by changes which affect the universities. The whole university world will switch over tomorrow with the development of e-learning and the creation of many training structures by companies.

A new interactive knowledge mediation paradigm is emerging: in the context of the new pedagogical paradigm teachers share knowledge and produce knowledge in collaboration with students and enterprises or training organizations. In this new interactive knowledge mediation paradigm the learning process becomes more and more a common construction and collaboration: “Young people will be guiding their teachers to new kind of learning models”, predicts Mr. Juha Lipianen from Nokia (ED-MEDIA 2001, Hypermedia Laboratory, University of Tampere, June 2001). “Knowledge is not delivered; it grows in unpredictable ways because learners move through this space according to their own needs, intentionally connected to others. Participation in this space makes it grow for you, over time and through your use and interaction.” [4]. In this new pedagogical paradigm, according to D. Jonassen [18], the learning process is efficient if it is organized as a “solving problem” system; students are confronted to a problem and they have to solve it; the only professional legitimated goal of everybody is “problem solving” (decision making, modeling...).

This new teaching model can be interpreted as corresponding to the logic in which the pupil is “at the center” of the education system but, according to L. Ferry ([15], pp. 46-47, our translation), “what it is advisable to put at the center of the education system is not the pupil or knowledge only, but obviously the relation between the pupil and knowledge”; so it is fundamental to take into account the role of the teacher and the work of the student (or pupil) in the knowledge transmission. This analysis is very pertinent; in fact the risk to focus all the attention on the role of the learner is important because ICT have blurred the comprehension of the educational process. With the new teaching paradigm was born the illusion that ICT would have a fundamental role from the point of view of the knowledge transmission. We will show that ICT are certainly useful from the point of view of the “telecommunications” transmission, and can support an extremely interesting cooperative training but cannot in any case be a substitute for the fundamental teaching act impelled by the professor, and for the work of the learner. In other words, ICT can have a positive role of catalyst but are not the reactive principles which actually rely in the system including the professor in relation with the learners.

Information and Communication Technologies and Knowledge Transmission

ICT have played a role in the change of paradigm. If one wants to understand this role it is necessary to reconsider the meanings of “information” and of “communication” compared to knowledge transmission. The concept of information with the “mechanistic” communication theory was originally developed by the engineer C. E. Shannon. This approach was judged too “mechanistic” by many authors and in particular by the Palo Alto school which introduced at the heart of its analysis the communication “relation”. Between the mechanics of information, according to the Shannon theory, and the communication “relation”, according to Watzlawick, the ways became divergent. As Y. Winkin ([31], pp. 31-32, our translation) underlines: “Shannon spoke initially about information, in the very particular meaning of "quantitative measurement of the uncertainty of a message according to the degree of probability of each signal comprising this message" (Petit Larousse). Weaver speaks rather about communication. A confusion between the two terms will settle, which reflects the hesitation between "information theory" and "communication theory" (…) Heinz von Forster, one of the first researchers to use concepts of cybernetics in biology, will say about the concept of information that it is "the most vicious of the conceptual chameleons" (quoted by E Morin [23], p. 290). In fact, it would be necessary to speak of a menagerie of vicious chameleons”.

The theoretical rupture, illustrated by the image of the chameleon, is at the origin of the ambiguity which reigns in the information society: on the one hand it is undeniable that the contribution of information technologies is considerable,
reducing space and offering new possibilities of collaboration, co-operation, construction and division of knowledge, but on the other hand the knowledge transmission is not reducible to a “mechanics” of information.

Knowledge transmission or telecommunications transmission?

Following Shannon the telecommunications engineers have used the term of transmission. In the French reference book on telecommunications written by F. Ducastel [12], in a natural way a complete chapter is dedicated to the transmission function: “The transmission function corresponds to the remote transport of the transmission signals. The signals to be transmitted, coming from the local area networks, are initially treated, if an adaptation of the support appears necessary, they are then transmitted, in an electric or optical form, by using a guided or radiated transmission, from a transmitter towards one or more receivers” ([12], p. 213, our translation). It is clear that the term of transmission is used here with the meaning of telegraphy in the XIXth century, according to the Latin etymology transmittere which means “to send to the other side, to make go beyond”, from which is derived the name transmissio (“way, crossing”); the word “transmission” is then used in various contexts of the scientific and technical field.

The “technical” conception of the transmission differs radically from another interpretation, again according to the Latin origin transmittere which means to pass from one being to another: to transmit life, to transmit a heritage, to bequeath, to give. It is obviously this approach which is here privileged: that of the knowledge transmission, which goes beyond the diffusion of information since it is a question for individuals or/and organizations to acquire and to share already existing knowledge. Thus, beside the mechanics of information of Shannon, and the communication relation of Palo Alto exists a field of analysis relating to the knowledge transmission. Consequently the question of the role of technologies in this transmission arises.

Technologies, communication and knowledge transmission

According to J. Perriault [25, 26], the “machines to communicate” (“machines à communiquer”, in the words of Pierre Schaeffer [29]) have five functions: a function of simulation, a discursive function, an economic function, a function of organization of the relationship with the society and a regulating function. However, behind these five functions, and in particular the last, which proceeds from the dream of the inventors who see in these machines the magic wands working for the wellbeing of the society, the logic of the use reveals resistance, diversions of use. Especially, “to consider carefully the so-called machines to communicate manage more a contact function than a communication function” ([25], p. 229, our translation). Thus the development of these machines would to some extent compensate for lacks, consolidate a deteriorated social link. Obviously the children are directly concerned. However by using the machines, they perhaps learn something else than what was expected at the beginning. The logic of use shows indeed that “the apparatus is not reduced to the only technique” and that difficulties to control the technique reflect more general problems concerning the capacities of an individual. Thus, it is not enough to know how to superficially handle a machine, it is necessary to have a widened culture, including the knowledge of the history of the techniques. “If not, the machines becoming out of date more and more quickly, our children will have less and less memory” ([25], p. 234). The theme of the use inevitably leads to learning, to knowledge transmission; the human dimension is essential.

If there can be knowledge transmission in an environment with ICT as machines to communicate, on the other hand, “there cannot be, and there never was, machines to transmit” ([8], p. 4, our translation). According to R. Debray, transmission is a process which concerns long time and is based on institutions, while communication falls under short time, for example that of the news in the media. “We will say that to communicate consists to transport information in space, inside the same space-time sphere, and to transmit; to transport information in time, between different space-time spheres” ([8], p. 3). Communication is thus a necessary, but not sufficient, condition for transmission. The technical means of communication can not ensure the cultural transmission. Now, it is precisely the “intoxication” (“ivresse”) of communication which characterizes the current society and which corresponds to the privilege granted to the “means of space domestication over the means of time domestication”” [8, p. 6].

Finally, there is on one side the “telecommunication” transmission and on the other the “heritage and knowledge diffusion” transmission. Yet, an illusion was born: it has been believed that the “telecommunication” transmission automatically integrated the “knowledge” transmission: it would be enough to develop technologies and the “telecommunication” transmission so that there would be knowledge diffusion in a systematic way. We will now examine the role of ICT. We will distinguish the catalysts and the reactive principles in the knowledge transmission and we will refer to the experiment of an important European project.
KNOWLEDGE TRANSMISSION AND COOPERATIVE LEARNING ENVIRONMENT

Cooperative work and cooperative training tools have developed in the current educational world. We will show that they have a role of catalyst in the knowledge transmission, but the human relation between the teacher and the learner remains essential. According to the new pedagogical paradigm (see 1) the learners and the teachers produce jointly and share information and knowledge. Each learner commits himself to work with the members of the group in order to reach a common goal. In this collaborative or cooperative approach the human relation is in the heart of the process of knowledge transmission.

The implementation of a teaching approach founded on the “Socratic” method within the framework of a pilot European project made possible to specify the reactive principles in the knowledge transmission. The project which is used as an example was launched by the Information Society Directorate-General of the European Commission over the period 1999-2002. This pilot project, called Form-Ami (“Formation en Art et Mécanique de l’Information”), implemented on the basis of a large European consortium including nineteen academic institutions and information companies, was supported by ICTE (Information and Communication Technologies in Education) to favor a new pedagogy and to ensure the broadest social dissemination of ICT. Form-Ami included a new post-Master diploma, the realization of six multi-media products, an international conference and ten videoconferences.

The cooperative learning environment: catalysts and reactive principles

What are the role of ICT and the place of the teacher in the new collaborative or cooperative learning process? New technologies constitute before all a new environment, but the teaching act and the role of the pedagogue remain crucial. We even advance the idea that the more the environment of information and technologies will develop, the more the role of the pedagogue will be decisive. New technologies may certainly favor a cooperative approach and so the knowledge transmission but in the same time the complexity of pedagogy is increased. New technologies seem to be a catalyst of the knowledge transmission. So we propose a new analysis of the introduction of ICT in higher education.

The concepts of cooperative training and collaborative training are used in an indifferent way by many authors. However these concepts permit to clearly distinguish two types of teaching orientation. Within the framework of the cooperative training the teacher has a very important guiding role: he fixes a goal, for example the realization of a product, and implements a teaching strategy based on co-operation and not on competition. The group, under the direction of the teacher, cooperates in order to create the product. Within the framework of the collaborative approach each participant is responsible for the realization of a part of the work and brings his collaboration. Then the group works according to a logic of mutualisation in which the authority of the teacher may be extremely modest. According to the optimistic version of the use of information and communication technologies in pedagogy many advantages can be emphasized: suppression of the physical limits of the classroom and great accessibility for all, and remote accessibility; joint training which supports the exchanges between the learners; communication between the learners who develop their critical capacities; high motivation of the learners; more effective and individualized teaching; great autonomy of the learners.

Within the framework of this interactive teaching model technologies play a role favorable to fluidity, to sharing and are sources of a great effectivity for the knowledge transmission. It is at this point of the approach that often intervenes a confusion between the technical support, which accelerates the transfer of information, and the teaching reality of the training in which the knowledge transmission corresponds to a long process which relies on human relations.

This aspect was raised by various authors: “the principal problems will not be of technological nature, though their importance is significant, but rather of human nature, cultural and institutional” ([30], p. 171). Some authors even consider that there is no difference between traditional teaching and teaching resorting to the ICTE: according to Russell [28], the author of “The no significant difference phenomenon” more than 355 publications confirm such an assertion…

Finally our working hypothesis is as follows: on the one hand technologies can not be regarded as the fundamental reactive principle of pedagogy, but on the other hand the role which they can play as a catalyst appears undeniable. Of course, “The technology as-magic-elixir approach is dangerous and unjustified by the evidence” ([24], pp. 230-231); clearly “technology is not a panacea for educational reform, but it can be a significant catalyst for change. To those looking for a simple innovative solution, technology is not the answer. To those looking for a powerful support collaborative environment, technology holds tremendous potential” ([16], p. 184). How functions the teaching reaction: the pedagogue is the fundamental reactive principle, the technology an interesting catalyst. We shall try to look further into this assertion thanks to the analysis of the experiment of the Form-Ami European project.

An experiment of cooperative work: the technology (catalyst) and the teacher (reagent)

Through the Form-Ami project we will illustrate the preceding argumentation on the catalyst role of technologies. Indeed, twenty-eight students of thirteen different nationalities were selected and profited from a teaching supporting the exchanges
both between the teachers and the students and between the students themselves. There were an intensive use of ICTE, with teaching in a classroom and remote teaching. And the training in a numerical environment was founded on a “Socratic” teaching approach which ensured the knowledge transmission.

The “Socratic” method or "The Art to be confined": theoretical principles and implementation

"[...] research and knowledge are on the whole only reminiscence" PLATO. Menon, translation from Les Belles Lettres, tome III, 2, 1923

Technological progress modifies radically the relation between man and information and induces a considerable demand with respect to the education systems [27]. Virtues of a “Socratic school” resting on four pillars (on this topic see the publication of the European Commission [13]): to learn how to know, to learn how to make, to learn how to live together, to learn how to be, must be accessible thanks to the use of ICT. Indeed, ICT must help the teachers to set up a teaching approach supporting not only training but also an hypothetico-deductive reasoning mode which will permit the learners to acquire an autonomy vis-a-vis the life events.

The Socratic approach refers to the philosophy of education and to the teaching method presented by Plato. One will retain in particular the idea of the Socratic “maïeutique”, which is an art of obstetrician, and the conditions of the knowledge learning: the role of the teacher is that of a guide and the learner is responsible for his learning, which cannot be an accumulation of knowledge, but rather a search of knowledge by reminiscence.

Within the framework of the Form-Ami project are applied some ideas of C. S. Peirce: we acquire our knowledge as participants and not as witnesses to whom knowledge would be “transmitted”. The theory of “learning by doing” can also be quoted: according to Dewey [10,11], the act of knowledge always starts with the consciousness of a difficulty and education rests on the resolution of problems. The Socratic approach was in the heart of the Form-Ami project: the students worked and learned together by making research in particular on the Web, by asking the teachers, by exchanging their knowledge… Very many discussions and meetings were organized between the teachers and the students so that the students adopt and put into practice the principle of Socratic exercises. This pedagogy was led in a numerical environment, the students using more and more the multi-media tools and solving by themselves the problems which they encountered. The Socratic method allowed the realization of multi-media products by the students themselves on the basis of the teachers’ courses.

Form-AMI was a rich pedagogical experiment because the students, of course with the help of the teachers, had to solve problems: how to apply in practice the courses, how to produce a multi-media product, how to organize their practical training. Teachers had also to adapt their pedagogical approach and the educational organization to help the students to solve the problems. This new pedagogical paradigm is also described, for example, by B. Collis [5]: “What is our first aim? Learning from experiences, from one's own and from those in one organization, and building upon these experiences....”.

The innovative image carried by ICT incontestably attracted the students at the time of their candidatures for the Form-Ami training. From this point of view new technologies constitute to some extent a pretext which incites to training. When the teaching was proceeding, technology was used to support research (on the Web), exchanges (e-mail…), as well as practical achievements (development of multi-media products). However, the sharing of knowledge and the training rested on the Socratic method and the extremely strong implication of the teachers: the influence by e-mail messages or bibliographical orientations is obviously decisive through an expertise. An example will illustrate the process of knowledge transmission: to realize the multi-media product called “Pedagogy”, the teachers asked the students twelve detailed questions. The questions were used as guides for Socratic exercises in very small groups (the students defined themselves 4 groups of 3 students), each group working on four questions with the permanent assistance of different teachers. The ICT obviously allowed remote exchanges in real time, fast data research… as well as a particular design of the contents. The teachers gave the basic bibliography, answered the questions of the students; for all the period of development of the multi-media product, a very significant interactivity between the teachers and the students was favored on the contents as well as on the presentation.

Of course, the questions were not random but on the contrary were strongly structured so that the students rediscovered themselves the answers, in particular through on line information; the essence of pedagogy did not come from technology but from the contents which, apparently in filigree, were actually fundamental. On the basis of this pilot experiment it is possible to affirm that technologies constitute a “catalyst” but not the reagent which remains centered on the pedagogue within the framework of a cooperative work and not of a collaborative work: indeed the autonomy of the students remains limited except if they are already enough experienced researchers, which is rather exceptional and is not the case of students involved in traditional training.

Thus the realization of the Form-Ami project has led us to conclude that the process of knowledge transmission rests, to a very large extent, on the teaching organization, the human relations, the motivation of the teachers and the learners and not on technologies: technologies seem a pretext or a catalyst but, according to us, do not appear fundamental in the training and knowledge transmission system.
CONCLUSION

We have analyzed the question of the knowledge transmission: in a first approach the application of the Shannon theory shows the existence of a transmitter (the teacher) and of a receiver (the learner). Pedagogy permits to transmit knowledge, according to the basic following diagram:

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\text{T (Pedagogy-Transmission)} \rightarrow \text{R (Learner)}
\]

In this basic diagram technology is used to transmit knowledge. With the development of ICT the illusion has been to believe that the technology of transmission is in itself the essence of pedagogy. There has been an assimilation between the technology which is used to transmit (with the meaning of telecommunication transmission) and the pedagogy which permits the knowledge transmission. However the virtues of new technologies are far from being obvious: the specialists in cognition indeed have shown the risks of confusion or/and of cognitive overload. Thus new technologies constitute before all a new environment, but the teaching act and the role of the pedagogue remain crucial. We can even advance the contrary idea: the more there will be information and technologies, the more the role of the pedagogue will be decisive. ICT can favour knowledge transmission but at the same time the complexity of pedagogy is increasing. In this context ICT are a catalyst of the knowledge transmission. A catalyst because they help the mediation between the teachers and the students but they do not constitute the first factor, nor even a reactive principle. Information and communication technologies throw a mist on pedagogy but do not change the essence of the knowledge transmission. What is absolutely decisive is the human environment and the quality of the mediation.

Obviously technologies have improved the telecommunication transmission; they can have a favorable role for the knowledge transmission. To concretize this possibility requires actually an essential action in terms of mediation. That concerns no longer the field of technologies but the human relation: such is the fundamental stake of the knowledge transmission...

REFERENCES


