Understanding difficulties of learning in Computer Environments of Human Learning from the perspective of the third generation of activity theory – the concept of networks of interacting activity systems

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Résumé

Cet article traite l'application pédagogique du concept des réseaux de systèmes d'activité en interaction. Ce dernier, inspiré de la théorie de l'activité, se présente comme un nouvel outil permettant de comprendre les situations dans lesquelles les êtres humains interagissent ensemble pour atteindre un objectif commun. Dans le contexte de l'e-learning, nous soutenons qu'il existe trois systèmes d'activité en interaction. Ce sont ces systèmes qui devraient, à notre avis, être considérés comme unité d'analyse lors d'un travail de compréhension et d'interprétation des difficultés d'apprentissage à travers les systèmes techniques. En effet, nous examinons, d'une part, le système d'activité didactique, considéré dans ses réseaux de relations avec les systèmes d'activité pédagogique et technique d'autre part. Nous estimons qu'à cause des contradictions émergentes de ces systèmes d'activité en interaction, les apprenants n'aboutissent pas aux résultats attendus en termes d'apprentissage. Pour cela, les efforts des chercheurs devraient se focaliser sur le développement de nouveaux outils pour comprendre et surmonter ces contradictions.

RÉSUMÉ

This paper deals with the educational application of the concept of networks of interacting activity systems. The latter is depicted in the third generation of Activity theory, as a new tool for understanding situations in which humans are interacting together to reach a common goal. In the case of Computer Environments of Human learning (CEHL), particularly in the context of e-learning, we argue that there are three interacting activity systems of learners which must be taken as a unit of analysis when trying to apprehend and interpret difficulties of learning in such environments. Indeed, we identify and examine, on the one hand, didactic activity system, seen in its network relations to pedagogical and technical activity systems on the other hand. We think that due to the emerging contradictions from these three interacting activity systems, learners are prevented from achieving their objectives in terms of learning. Therefore research efforts should be focused on developing new tools to understand and overcome these contradictions to enhance the process of learning when using technological tools.

1 Introduction

For a long time, many changes have perturbed and continue to perturb the lives of humans and their activities in the world. Among these changes, the presence of technology in education and professional training is considered as the most important one. Indeed, our way of thinking learning, teaching and communication between educational actors were widely affected. Momentous implications of that change for how both instructors and learners behave when managing knowledge and developing new competencies are becoming more and more uncontestable. We are witnessing really, at the beginning of XXI century, the emergence of the knowledge society. It is essential for several countries today to seize learning opportunities with technology to ensure the growth and development of the knowledge economy (The World Bank Report, 2003). But are individuals enough prepared to apprehend that new change in teaching and learning situations when using technology? How can we promote and enhance the learning process which is profoundly modified by the presence of technological tools? CEHL are, certainly, extraordinary technological applications which are designed and developed to support the learning process, however their instrumental genesis seems to be anchored in a traditional practices and behavioural patterns of their users who could not understand and assimilate the new challenges of learning with technology.

Marquet (2005) indicates that in the case of CEHL, e-leaning situations are more complex than traditional learning situations because of the association of technological artifacts with the didactic and pedagogical artifacts. He considers that difficulties of learning stem essentially from incompatibility problems and interferences between these different artifacts. This is what he calls instrumental conflicts.

In this paper, we will refer to the third generation of activity theory (Engeström, 2001) to develop Marquet‟s ideas (2005). The aim is to identify the important obstacles and difficulties of instrumental genesis of the three main artifacts existing in CEHL, namely: content, pedagogy, and technology. Furthermore we seek to highlight and to better understand the complex interrelations between the learners and other educational actors in e-learning situations who are evolving continually in context of dynamic change in relationship to didactic and pedagogical artifacts. This is what many researchers and authors have already claimed technologies are modifying profoundly traditional forms of education (Karsenti, 2007).

After a brief presentation of the challenges of learning in CEHL, we will introduce the evolution and the chief ideas of activity theory. This will elaborate on the concept of networks of interacting activity systems of the learners in such environments, in which instrumental conflicts could be applied and expanded by reference to the complex interrelations between educational actors. The emerging contradictions from the networks of interacting activity systems will help us to improve our understanding of difficulties of learning in CEHL. Moreover this will invite us to reconsider our ways of thinking learning when using technological tools in educational situations. As a matter of fact, the use of technological tools in these situations seems to represent a new *«wicked problem»* (Rittel & Webber, 1973) which *«require new ways of confronting* [its] *complexity» (*Mishra & Koehler, 2008).

2 The challenges of learning in CEHL

Traditional forms of education and professional training are essentially focused on face to face interaction between the instructor and learners. The good and competent instructor is the one who knows the pertinent content to be acquired by learners and how to mediate and communicate it to respond to their needs. The role of learners is limited to receive passively the knowledge transmitted to them by their instructor (s). So they behave under the constraints of the contexts‟ rules and the "hidden script" of the instructor. This means that learners‟ activity system is close. In other word, it is necessary for learners to interact directly and indirectly with the instructor through the content which represents the didactic artifact on the one hand, and to abide by the instructor‟s script which constitutes the pedagogical artifact on the other hand. So learners can‟t go beyond the evident limit of the instructor‟s vision of the learning activity system (Figure 1). The success of the learning process seems to be dependent on the instrumental genesis of both, the didactic and the pedagogical artifacts. It is supposed that the acquisition of knowledge and new skills, in this case, happens in optimal conditions thanks to multiple passive interactions with only the instructor as a human resource.

In the case of Computer Environments of Human Learning (CEHL), which are defined as computer tools whose main function is to support the learning process (Tchounikine, 2002), the learning activity system is becoming increasingly complex because of the association of the didactic and pedagogical artifacts with the technical ones (Marquet, 2010). To succeed in e-learning, simultaneous appropriation of the three kinds of artifacts must be realized by learners. The classical relationship between educational actors is now moving from a state of passivity to a state of dynamism because of the active role which must be played

by learners in building knowledge and developing new competencies. This means that learners‟ activity system is open this time. Furthermore, new roles and relations, concerning the teaching process, are generated. For instance, the instructor is no longer considered as the only one who mediates content and pedagogy. This idea involves the intervention of other actors (human resources), namely tutors, whose principal role is to accompany and mentor learners in their learning experience by taking in charge the mediation of didactic and pedagogical artifacts associated with the technical ones throughout the training.

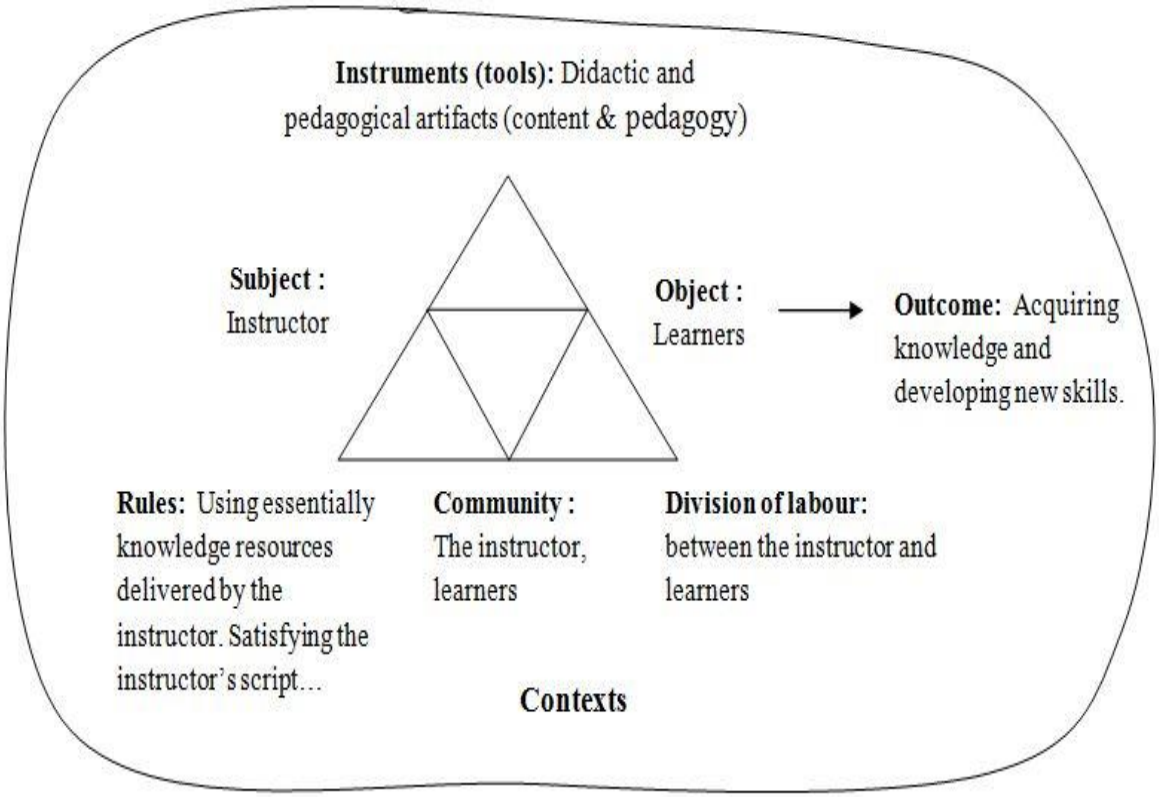

FIG.1. The learning activity system in traditional forms of education.

Therefore, the learning challenges which must be faced in CEHL is, at first, understanding these changes in roles and relationships between educational actors and then acquiring new ways of behaving, with consciousness of these changes, when using such environments. So this means that both the theoretical and conceptual representation of learning activity system must be modified and expanded to incorporate new sub-systems of learning activity by reference to the three kinds of artifacts existing in any CEHL.

3 The concept of networks of interacting activity systems in e-learning situations

3.1 The evolution and principles of activity theory

Having as a main concern the study of different forms of human practices in the world (Nardi, 1996), activity theory seems to be an innovative framework and approach which can lead to better understand difficulties of learning when using CEHL.

According to Engeström (1996), since its initiation by Lev vygotsky in the 1920s and early 1930s, this theory has evolved through three generation of research. The first generation, which had focused on individual transformation of mental functions, had produced the idea of mediation. This idea supports that the relation between the subject and objects of the world is not direct. It is argued that this relation is mediated by cultural artifacts. After that, Leont‟ev who is Vygotsky‟s colleague and disciple had taken the research further by studying the social dimension of human activity. Hence he had made distinction between individual action and a collective activity to shed the light on complex interrelations between the individual subject and his or her community. But this second generation of activity theory had put aside the problem of diversity and dialogue between different perspectives and traditions. This is what had opened up new fields of research on activity theory and led to the development of the third generation which had suggested the concept of networks of interacting activity systems to account for situations in which the object of the human activity is *« a moving target»* (Engeström, 2001).

Moreover, the chief ideas or principles that are underpinning the current shape of activity theory, as proclaimed by Engeström, are listed below:

- The unit of analysis of human activity is a collective, artifact-mediated and object-oriented activity system, seen in its network relations to other activity systems.
- The multi-voicedness of activity systems which results from multiple points of view, traditions, and interests of the community.
- The historicity of activity systems (the transformation of activity systems over periods of time).
- The emerging contradictions or conflicts in activity systems which are considered as a source of change and development.
- The possibility of expansive transformations in activity systems.

When studying the learning activity system in CEHL, particularly in context of e-learning, by reference to the principles of the third generation of activity theory which we have just mentioned above, this will open the door for the construction of new ways of thinking the learning activity system in such environments. Therefore, we will arrive to the model of networks of interacting activity systems (Engeström, 2001) from which the emerging contradictions (Figure 2) will help us to understand difficulties of learning when using technological tools.

3.2 The emerging contradictions from the networks of interacting activity systems in CEHL

According to Marquet (2005), the concept of instrumental conflict, which was inspired by activity theory and by the work of Rabardel (1999) who introduced the concept of instrumental genesis, is an interesting concept that may lead to better analysis of difficulties of learning when using technical systems. Indeed this concept refers to the incompatibility which may exist between the didactic and pedagogical artifacts when associated with the technical ones. This author considers that, in e-learning situations, CEHL connect virtually educational actors (instructors, tutors, and learners) engaged in individual and collective tasks with the purpose of acquiring knowledge and developing new competencies. These tasks actively involve learners in learning through various and successful interactions with not only the didactic and the pedagogical artifacts, as was the case in classical situations of learning, but with also the technical artifacts this time. So the instrumental genesis, which refers to the process of simultaneous appropriation[43] of these three artifacts, may not happen in optimal conditions when one of these three artifacts interferes with at least one of the others. In fact, this is what causes the following instrumental conflicts from which difficulties of learning are originated:

- The incompatibility between the digitalization process and the pedagogical discourse of the selected didactic artifacts.
- The emerging problems stemming from the implementation process of didactic artifacts, particularly related to their modes of presentations,

[43] According to Selwyn (2004), appropriation is a "meaningful use of […] [Artifacts]…where the „user" exerts a degree of control and choice over […] [these Artifacts] and its content, thus leading to a meaning, significance and utility for the individual concerned" (Chib et al, 2015).

when this process is not fitting the available technical conditions (technical artifacts).

- The complete or partial failure of transformation of didactic artifacts when using it with the technical ones.

On the basis of Marquet‟s perspective and by reference to principles of the third generation of activity theory, when analyzing and examining difficulties of learning in CEHL, we should take as a prime unit of analysis the collective didactic activity system, seen in its networks relation to pedagogical and technical activity systems. In these learning activity systems, educational actors (instructors, tutors, learners) carry their own diverse experiences, habits, points of view, traditions, histories…. and activity systems carry also its rules, conventions related to the usage and appropriation of its artifacts which are completely different from those of the former traditional learning situations. This constitutes a source of troubles, contradictions and moreover innovation since it can lead to the transformation of practices and the emergence of new ways of behaving and thinking these activity systems. Indeed, since with learning situations in CEHL, technical artifacts are introduced as a new element (change) in activity system of learners, this produces a collision of old elements (points of view, rules, behaviors…) with the new ones. Such collision, which is necessary for piloting change in the learning process with technical tools, is the root of difficulties felt by learners in CEHL.

If we look at the learning activity system in CEHL, which comprises the three interacting activity systems shown above from the anthropocentric angle, we find that learners are taken as a starting point of analysis and the place of didactic, pedagogical and technological activity systems are defined in relation to them. While the instructor tackles with instructional design problems through technical systems by focusing on finding convenient ways to mediate essentially didactic artifacts which are under the constraints of technical artifacts, he doesn‟t negotiate it in most cases with the tutor who is also involved in the learning process. The latter behaves according to pedagogical script made by the instructor to mentor learners, so he is concerned mainly with pedagogical artifacts. But there is absolutely no real coordination and exchange between the instructor and the tutor about the shared object of learners who are moving and interacting with both of them. Also the two actors are working every one according to their experiences, old practices, representations... Consequently learners can‟t apprehend why they don‟t interact regularly with the instructor like what they used to do in traditional situations of learning. So, they keep on thinking why now they have to communicate all the time with the tutor and other learners.

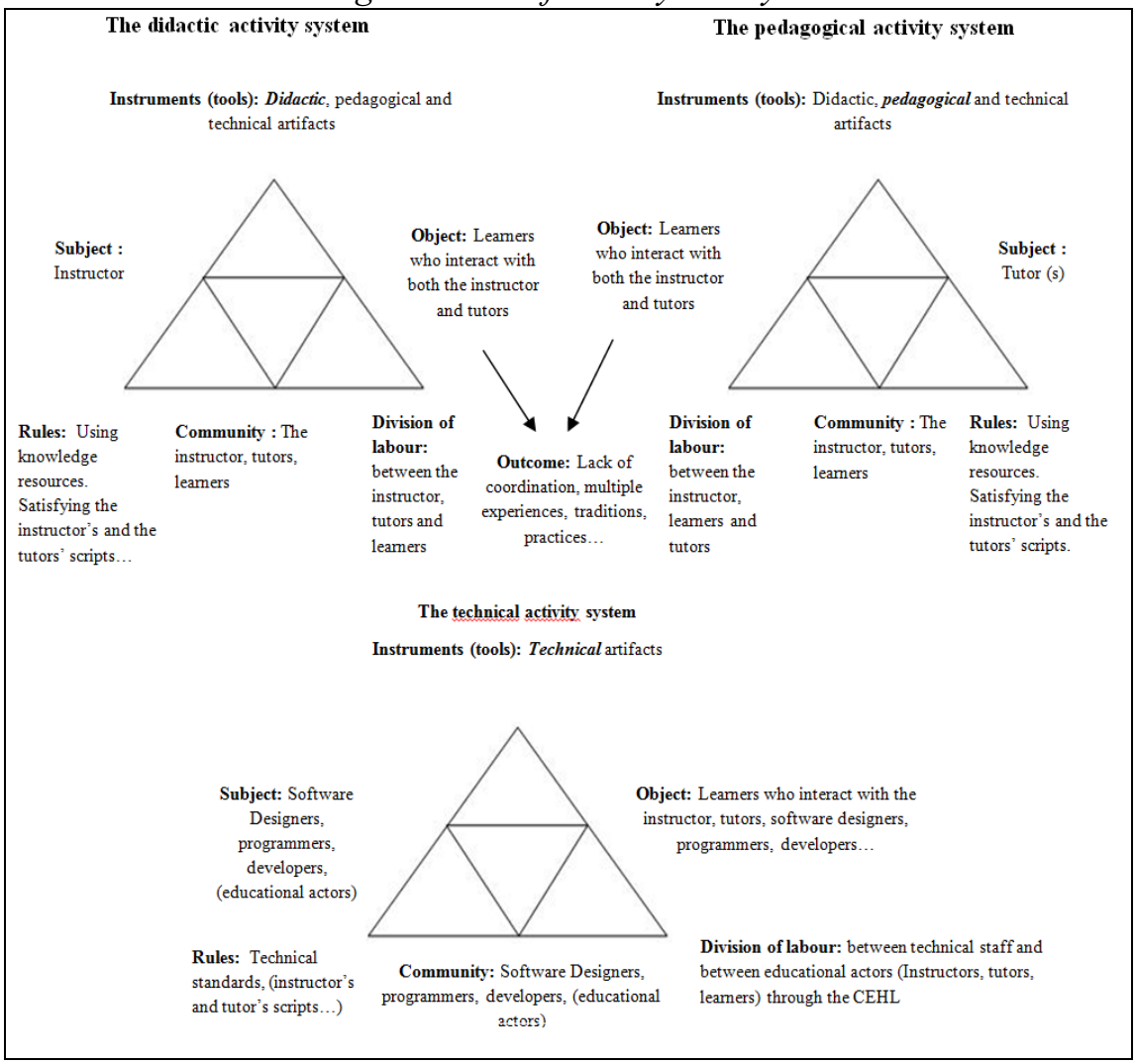

FIG.2. The emerging contradictions from the three interacting activity systems in CEHL

Beyond this first contradiction related to relationships between the instructor, tutors, and learners in CEHL, constellation of tensions (contradictions) arises from interactions with technical artifacts introduced as new tools in learning situations. Being designed, developed and produced by other human actors (software designers, programmers….), these artifacts have as final users educational actors who can participate or not in their productions. Consequently, it‟s quite normal to observe different kinds of catachreses which refer to the deviated usages of tools from their original usages for which they were designed. However, these catachreses lead to difficulties of learning since it prevents learners from making their own didactic artifacts and so developing new competences. In the technical activity system, the contradiction is also between learners, the instructor, and tutors, there is multiple points of view, traditions, practices... concerning the

available technical artifacts. Thus it is rarely when worlds and scripts of them meet and interact to construct uniform actions and activities that can lead to the instrumental genesis of knowledge resources (didactic, pedagogical and technical artifacts). Furthermore it seems incredible to observe identical usages of the available artifacts in CEHL, to those for which they were initially intended.

The particular approach of Marquet related to the interpretation of difficulties of appropriation of knowledge resources suggests that we examine how didactic, pedagogical and technical artifacts are presented and combined together to identify the eventual instrumental conflicts which are responsible of the incorrect usage of these artifacts. But we think that this approach is restricted and should be expanded to include relationships between educational actors and there impacts on the process of instrumental genesis. Thus, in light to what we have already explained, it is necessary to analyze not only the cohabitation of the three artifacts but also multiple interactions between educational actors on the one hand, and between learners and other human actors involved indirectly in learning activity systems which took place in CEHL on the other hand. This is what will really help us to understand more and more difficulties of learning in such environment and let us to rethink otherwise the instructional design when introducing technical systems.

4 Discussion & conclusion

The learning activity system in CEHL should be seen as a transactional model of communication in which educational actors co-create together the meaning of didactic, pedagogical and technological artifacts. Learners, which represent the central part of that system, are engaged in the role of using and producing new ways of learning at the same time of other actors. This is supposed to be in a way that corresponds to the expectations of the instructor, tutors, designers…..But unfortunately it happens under the constraints of the existence of old habits, practices, points of view……of all actors involved in the learning activity system. Thus the emerging conflicts from the collision between the new forms of teaching and learning with the old one prevent learners from achieving their objectives in terms of learning. This also slows or prohibits the passage from the phase of assimilation to the phase of accommodation since in most cases all artifacts are still used as the old ones. In fact these two phases which represent the principal elements in Piaget‟s model of learning and organization of knowledge (Lebrun, 2007) should be analyzed carefully to determine the cause of difficulties of learning.

As we have already mentioned, the concept of networks of interacting activity systems is an interesting tool which can help us to understand difficulties of

learning through CEHL. We have tried to get along with these difficulties by shedding the light not only on the combination of artifacts, but by dealing also with the new relationships between human resources who are taking in charge the design, the development and the diffusion of such learning environment.

Therefore, to enhance the learning process with technological tools, we need to go beyond compatibility problems that may exist between artifacts which are exploited by CEHL, to analyze the emerging contradictions from the following three interacting activity systems: the didactic, the pedagogical and the technical activity systems. These contradictions can be originated from:

- The lack of coordination, negotiation…..between educational actors who are still behaving according to traditional model of learning.
- The eventual technocentric approach in designing technological tools, and its impact on the learning process and relationships between educational actors.
- The difficulties felt by educational actors, namely learners, *«to embrace new possibilities, new ways of looking and being in the world* [of learning with technical artifacts] *»* (Lebrun, 2007).

In CEHL, Learners have to play new roles and establish new relationships with both material artifacts and human resources involved in the learning process. But this will be possible only if they are conscious of the challenges of learning in CEHL and are able to create new meanings and forms of the learning process which are not yet there. We think like other authors, as Mishra & Koehler (2008), that there is no definite solution to the problem of integration of technology in education, we have just to deploy efforts to overcome contradictions in teaching and learning situations and generate new practices that honor the complexity of e-learning situations. Obviously this demands time before the emergence of new effective forms and ways of teaching and learning with technical systems.

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