TOWARDS NEW TRENDS ON THE ROLE OF USERS OF TECHNOLOGY: A LOOK AT SOME RESEARCH FIELDS

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Nowadays the role of users of technology is being more and more acknowledged and it is becoming crucial for various fields of study to (re)look at it, specifically when concerning working organisations and educational settings. This paper briefly discusses ontological spaces that users of technology are located within the fields of Artificial Intelligence (AI), Human-Computer Interaction (HCI) and Sociology of Technology (ST). It also shows how the awareness of the role of users of technology is gradually changing the focus of such fields. At last, an outline of my PhD studies is presented, which concerns the role of users of technology in the Mathematics Education field.

INTRODUCTION

This paper discusses what came to be new trends in the research fields of AI, HCI and ST, as a result of the growing awareness of the role of users of technology. Following this discussion, an outline of my PhD studies with respect to the use of Excel and Cabri by mathematics teachers is presented. As it meant to be a short paper, the examples in it will be narrowly given.

ARTIFICIAL INTELLIGENCE (AI)

AI had its focus originally on designing and implementing systems whose behaviour appears ‘intelligent’ to the eyes of human observers: looking at the system, observers can legitimately conjecture that its behaviour is due to some kind of reasoning. Then, the term ‘Intelligence’ from the ‘Artificial Intelligence’ means essentially that implemented models enable a machine to solve problems, in the sense that solutions of these problems have not been a priori encoded, but that the machine constructs them originally. For this reason, in AI, computational modelling of a process is meant to be computational modelling of the knowledge underlying it. Consequently, a methodology for an evaluation on a teaching/learning environment designed on the basis of concepts and tools from AI is one of the crucial questions raised in the debate about the development of ‘Artificial Intelligence and Education’ as a research field (see Balacheff, 1993 on this). For instance, one of the first significant project of AI in the early 70s with respect to the field of educational technology and mathematics education was the Logo project (Papert *et al.*, 1979). Logo has been largely used in schools all over the world since its launch. Many research studies have been done about the impact of its use on the teaching and learning processes. Moreover, how Logo is being used and understood by teachers, students and schools (its users). Agalianos’ doctoral studies (Agalianos, 1997) is a good example on this. He took Logo as the unit of analysis, approaching it from a cultural studies perspective to discuss Logo as a cultural product in education. Unfortunately, there is no enough space here to discuss his work, but it is worth saying that Agalianos’ work is an

attempt to develop a sociological language for understanding educational computing and to suggest that the introduction and use of IT in education should also be situated within its social, political and cultural context.

What initially appeared as one of the first AI project, with its focus on designing and implementing systems whose behaviour appears ‘intelligent’ to the eyes of human observers, became to be an object of study, which concerns mainly the role of its users.

HUMAN-COMPUTER INTERACTION (HCI)

Cognitive science has been the dominant theoretical voice in HCI studies since the inception of this field. Cognitive science as a main theoretical framework to technology has emphasised 'mental representations' as its main focus of study. It has concentrated on information, its representation and propagation, ignoring the study of artefacts (Zinchenko, 1986). In the late 80s, some scholars of this field were beginning to feel a theoretical pinch, with the sense that cognitive science is a too restrictive paradigm for finding out, for instance, the users’ differences and choices of using technology (Bannon and Bodker, 1991). A call for a shift to new theoretical perspectives by scholars, who recognised the inadequacy of traditional cognitive frameworks and acknowledged the growing awareness of the role of the user, was explicitly discussed in 1993, during a workshop ‘Rethinking theoretical frameworks for HCI’, in the Netherlands. One of the outputs of this workshop was a book edited by Nardi (1997) that brings activity theory as an alternative answer to the quest for a new background theory in the HCI field. In activity theory, people are not reduced to ‘nodes’ or ‘agents’ in a system; ‘information processing’ is not seen as something to be modelled in the same way for people and machines. In this theory, artefacts are mediators of human thought and behaviour. In this way, in the book one finds practical ways to apply activity theory to technology design. For instance, Nardi (Nardi 1997, chapter 10) reanalyses some data from a study of slide makers (as in PowerPoint presentation) by using activity theory constructs. She argues that the application of some basic concepts from activity theory would have made immediate sense of her data in the first place. Again, due to lack of space it will not be possible to describe the study that Nardi carried out. It is worth having a look at the book about other HCI studies carried out by taking activity theory as a framework.

Activity theory is not a rejection of cognitive science as Kaptelinin (Nardi 1997, chapter 5) stated, but rather a radical expansion of it. One reason that Kaptelinin argues for the need of this expansion is that a key aspect of HCI studies must be to understand things; technology - physical objects that mediate activity (which involves users) - and cognitive science, as Kaptelinin and some other scholars claim, has ignored the study of artefacts, insisting on mental representation as the proper locus of study.

SOCIOLOGY OF TECHNOLOGY (ST)

ST has also a trajectory of different views of treating technology and its users. The technological determinism approach, for instance, does not take into account any social and cultural dimensions, by asserting that the most 'appropriate' innovations survive and only those who adapt to such innovations prosper. This perspective has a long history as well as a radical future (Bell, 1960; Blauner, 1964; Kumar, 1978). This approach holds that humans, i.e. human behaviour and even the course of history, are largely determined by, rather than having influence over, technology. Hence, this approach takes a radical essentialist view about technology by portraying technology as an 'autonomous development', which determines social and economic organisations and relationships. The first signs of response to this approach (Woodward, 1965; Freeman, 1987) came to be a model that became known as socio-technical systems theory. Such a model included different elements to technology like: people, organisations, genders and others. Although this theory had been developed aimed at not taking an essentialist view of technology, it carries the implicit assumption that the nature and capacity of technology remains 'beyond the remit of sociological analysis'. That is, in this theory the nature and capacity of technology is treated as given, objective and unproblematic. A further set of alternatives to the technological determinism approach was developed with a generic label of social shaping approaches suggesting that the capacity of the technology is equivalent to the 'political circumstances' of its production (Williams and Edge, 1991). Such approaches claim that social analysis must take into account the technology itself. Despite these approaches take an anti-essentialist perspective about technology, i.e. technology not being treated as given and unproblematic, there is a limitation placed upon the social aspects of technology. Within these approaches, only the design and implementation processes are treated, causing an underestimation of the significance of users' interpretations and uses of technology. A more ambitious macro-approach, called the socio-technical alignments approach, considers the significance of the alignment between technology and society rather than focusing on the specific level of technology design or technology consumption. Hill (1988), for instance, argued that technology should be considered as a 'cultural text', that is, an artefact can only be brought to life through a cultural text - the rules by which we know how to use the artefact. Another approach, actor-network theory (Latour, 1988; Law, 1991), attempts to meet the requirements above by explaining the development and stabilisation of forms of technology. Whereas the socio-technical alignments approach focuses upon the results of alignments between social and technical aspects, the actor-network approach focuses upon the practical construction of these alignments. Although there is a criticism of 'residual technicism' in the latter approaches, actor-network theory has the distinct virtue of at least pointing to the possibility of an understanding of the machine which does not depend on the presence of a god within (Grint and Woolgar 1997, p. 31).

To overcome the problematic of giving the same significance to designers and users of technology, which seems not to be tackled by the approaches mentioned above, Grint and Woolgar (1997) took a perspective of treating technology as text, designers

as writers and users as readers. They call their perspective or approach an anti-essentialist one to technology, as there is not a tendency, called by them 'technicism', found in the other approaches. In this way, they argue that "what a machine is, what it will do, what its effects will be, are the upshot of specific readings of the text rather than arising directly from the essence of an unmediated or self-explanatory technology. A technology's capacity and capability is never transparently obvious and necessarily requires some form of interpretation; *technology does not speak for itself but has to be spoken for*." (Grint and Woolgar 1997, p. 32).

Within this brief description and narrow references about some of the approaches in ST, one can have an idea how the role of users of technology can be viewed differently within this field.

FINAL REMARK: A PHD STUDY

Several research studies have been carried out in Mathematics Education focusing on teaching/learning situations within microworld environments. A good number of them take, implicity or explicity, software packages as given, unproblematic. Such a position, which could be called an essentialist one, is implied in the findings of the studies when, for instance, showing or justifying what teachers are yet to achieve for best or adequate use of a software package. In other words, it can be said that in these studies 'the software of the teacher' is equal to the 'objective software' minus 'what is yet to be achieved':

software of the teacher = objective software - what is yet to be achieved

In contrast to this picture, my doctoral studies aimed to elucidate what Cabri and Excel were being constituted by mathematics teachers, that is, to look at what was being said by mathematics teachers about Cabri and Excel; and to investigate to what extent this was linked to the teachers' use of Cabri and Excel in the classroom, their teaching approaches. Here, to look at 'what was being said' meant to look at what meanings were being produced by the teachers for Cabri and Excel from an anti-essentialist viewpoint (Lins, 2000a; Grint and Woolgar, 1997). I believe that by treating software packages as texts and mathematics teachers as readers of such texts give room to understand *how* and *why* a software is being taken and used in a classroom in such a way. It is embedded an attempt to avoid an essentialist view of software packages (technology) when analysing the teachers' use of them. In other words, in this doctoral studies, 'the software of the teacher' is to be understood as something different from an 'objective software' minus 'what is yet to be achieved'. One of my assumptions is that the software package which reaches the classroom environment is not the one that once had been designed but rather *a* software: the one that the teacher has constituted. The Cabri and Excel presented in a classroom is a Cabri and an Excel: the Cabri and the Excel of the teacher. In this way, I argue that the use of a software package for teaching is not only, for instance, linked to the school curriculum but strongly linked to what a teacher *sees* in it.

The doctoral studies consisted of four case studies: two teachers with respect to Excel

(Simon and Karine) and another two with respect to Cabri (Camilla and Anthony). Due to lack of space, methodological issues will be not raised here. A discussion about one of the case studies with respect to Excel can be found elsewhere (Lins, 2000b). With respect to Cabri, one of the said powerful features of it, for instance, is the drag-mode that allows deformation of figures, which brings dynamism, where ideas of dependence and independence can be explored by establishing relationships among points on geometrical figures. From the two case studies (Lins, 2001), seeing and treating Cabri as such has shown not to be the case. The drag-mode has nothing to do with the Cabri of Anthony and the Cabri of Camilla at the time they were interviewed. This does not imply that it will never be. New meanings can be or will be produced by each teacher for Cabri, as meaning production is to be viewed and understood as a process rather than something static and fixed. The point is the importance of the awareness of the Cabri of the teacher in order to understand how and why Cabri is being taken and used in a classroom in such a way. The two case studies with respect to Excel will be discussed in my talk.

This PhD study (Lins, 2002) is an attempt to develop a frame to approach the use of technology in Mathematics Education by treating it towards an anti-essentialist viewpoint of technology. It is also hoped to give a contribution to the Mathematics Teacher Education research field, as the study focused on the use of Cabri and Excel by mathematics teachers.

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