

## ACTUAL MEANINGS, POSSIBLE USES: SECONDARY MATHEMATICS TEACHERS AND *CABRI-GÉOMÈTRE*

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*By treating software packages as texts and secondary mathematics teachers as readers of such texts from an anti-essentialist viewpoint, this paper discusses the analysis of part of two of the case studies - The Cabri of Anthony and The Cabri of Camilla - of my doctoral studies. Anthony and Camilla, two mathematics teachers from a state secondary school in Bristol (UK), were interviewed both in front of and away from the computer, talking about and describing his/her Cabri and had two of their lessons within a Cabri environment observed. I argue that the use of a software package for teaching is not only linked to the school curriculum but also strongly linked to what a teacher sees in such a software package. By presenting the two cases, such a discussion will be promoted.*

### FIRST WORDS

As this is a short paper, mainly aiming at discussing two case studies, a detailed discussion about some approaches to technology from an essentialist view to a more anti-essentialist one, in order to describe what an anti-essentialism move of technology means, will be left to be found elsewhere (Lins, 2001). Besides Sociology of Technology, new trends on the role of users of technology are found in other fields such as Human-Computer Interaction and Artificial Intelligence (Lins, 2002a). Hoping though to achieve certain clarity, within this paper, a brief discussion about it is presented, leading to a description of the aims and design of the research project with the purpose of discussing the case studies.

### TECHNOLOGY AS TEXT: AN ANTI-ESSENTIALISM MOVE

To discuss such a move, I bring into the picture Grint and Woolgar (1997), scholars from the field of Sociology of Technology, who worked hard on defining an anti-essentialism move by pointing out that though different approaches to technology have taken into consideration social and cultural dimensions of it, they have not succeeded in achieving such a move for two reasons. First, the approaches that propose to view technology from an anti-essentialist perspective remained in their premises elements of 'technicism' (*ibid.* p. 7), i.e. carrying the implicit assumption that the nature and capacity of technology remains beyond the remit of sociological analysis. Second, approaches that overcome such 'technicism', did not succeed at attributing the same significance to designers and users as only the design and implementation processes of technology were treated, therefore underestimating the significance of users' interpretations of it.

It seems that Grint and Woolgar's approach achieved both points: treating technology from an anti-essentialist perspective and giving the same status or significance to designers and users, overcoming such a problematic. By treating technology as text,

designers as writers and users as readers of such a text, Grint and Woolgar believe that an anti-essentialism move occurs by both taking technology not as an essence and attributing equal significance to designers and users, asserting 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" (Grint and Woolgar 1997, p. 32).

Grint and Woolgar argue that "technology does not speak for itself but has to be spoken for" by claiming that "a technology's capacity is never transparently obvious and necessarily requires some form of interpretation" (*ibid.* p. 32). Hence, they point out that one needs to pay close attention to the process of interpretation of technology rather than assuming that we are persuaded by the effectiveness of it.

### **Towards an anti-essentialist view of technology in Mathematics Education**

In the mathematics education research literature on teaching and learning mathematics with computers, one can find studies that are carried out taking the software package used as given, unproblematic. What I find particularly problematic in such studies is their findings based upon students' cognitive abilities, students' cognitive obstacles as well as on teachers' knowledge and teachers' understanding whilst tackling a mathematical problem within a microworld environment. Regarding the software package used as unproblematic, by approaching it from a technological determinist perspective, no room is left in such studies for questions like: What *Cabri* is the teacher talking about? Are pupils understanding *the Cabri of the teacher*? Are pupils *understanding*, for instance, 'the dragging' in *Cabri* as a means of exploring 'dependence' and 'independence' among points on geometrical figures? Are pupils *seeing* in *Cabri* what their teacher does?

Although some other research studies problematise teacher-student interaction, peer interaction and teacher-teacher interaction within a microworld environment by taking into consideration social and cultural aspects, still very little room, or often none, is given to the questions above. On the other hand, other research studies carried out focusing on teacher-computer-student interaction still have, in my view, elements of 'technicism' in their premises.

In my doctoral studies, some of the research studies were reviewed from this light. As this short paper aims at discussing the two case studies, the review can be found in Chapter 2 of my PhD thesis (Lins, B. 2002b). In order to discuss the cases, the research aims and design are presented next.

### **RESEARCH AIMS**

The research aims were to look at what is actually being said by secondary mathematics teachers about *Cabri* and *Excel*, and to investigate to what extent this is linked to the teachers' use of them in and out of the classroom.

Here, to look at 'what is actually being said' means to look at what meanings are being produced by teachers for *Cabri* and *Excel*. One of my assumptions is that the

software package which reaches the classroom environment is not the software package that once had been designed but rather a software: the one that the teacher has constituted. The *Cabri* presented in a classroom is *a Cabri: the Cabri of the teacher*.

By looking at what meanings are being produced by teachers for *Cabri*, I am treating *Cabri* as text rather than an essence, i.e. with no essential properties, and mathematics teachers as readers of such a text, from an anti-essentialist viewpoint. This relates to the framework discussed earlier.

## RESEARCH DESIGN

This is a case-study research project, with a sample of four secondary mathematics teachers from state schools in and around Bristol (UK). Two teachers with respect to *Cabri* and another two with respect to *Excel*. A pilot study was carried out consisting of two teachers, giving a total of six teachers altogether. The data was gathered from December 1999 to December 2000. The contacted schools were selected based on an intersection of three sources: a meeting with 13 secondary heads of mathematics departments, a list of mathematics associate tutors on PGCE courses from the Graduate School of Education (Bristol) and a list of secondary schools which have a license for *Cabri- Géomètre*.

Two of the four teachers of the main study were interviewed and had some of their lessons observed with respect to *Excel*. A discussion about one of the case studies can be found elsewhere (Lins, B. in press). The another two teachers were interviewed and had their lessons observed with respect to *Cabri*. Within this paper, the two case studies are discussed.

The interviews, a total of four for each teacher, include both structured and unstructured ones. All interviews were carried out in their schools. Both teachers with respect to *Cabri* are from the same school and have been using *Cabri* for 3 years in their teaching. In the first structured interview, interview 1, the teachers were asked about their educational and professional background. They were also asked about computers in education and the use of software packages in mathematics education, specifically *Cabri*. A profile of the teacher was provided from the interview 1 as well as information that was used for other outcomes as overlaps were explored in relation to later collection. Composed of 8 questions, the interview 1 was audio taped and lasted around one and half-hours. The second interview, interview 2, unstructured, was carried out in front the computer with the teacher showing *her/his Cabri*, by being asked each time a statement was made about a certain menu and button, for instance, being useful or not and why. The teacher was also asked to show a worksheet, designed by her/him, used in the lessons. The interview was video taped and lasted around one and half-hours. The third interview, interview 3, unstructured, was carried out in front of the computer with the teacher tackling a given problem. The teacher was asked to justify why the problem had been solved in such way. The interview was video taped and lasted around one and half-hours. The fourth

interview, interview 4, unstructured, the teacher was asked to show and talk about the worksheets or any other material available in the school. The interview was audio taped and lasted around one and half-hours. The non-participant classroom observations were audio taped. Each lesson lasted around 30 to 45 minutes. Field notes were focused on pointing out whatever statement the teacher made about *her/his Cabri* to the class; the teacher's approach; possible relevant interactions of the teacher with some of the pupils with regard to *the Cabri of the teacher*. The field notes had been taken as a guideline to the transcription of the tapes.

## TWO CASE STUDIES

The case studies discussed here - *The Cabri of Anthony* and *The Cabri of Camilla* - only concerns: Interview 1 - providing a profile of each teacher; Interview 2 - providing each teachers' *Cabri* and a discussion of worksheets designed by them; and two of each teachers' lessons which I observed - providing the presentation of each teachers' *Cabri* to the class. Hence, the case studies are structured into three sections. The first one, *a short profile of each teacher*, brief information is given about their background, their use of computers and their view about using computers in education. From such summaries, one can notice how familiar the use of computers is for them. The second section, *The Cabri of each teacher*, are presented in an episode mode, extracted from the protocol of the interview 2, which Anthony and Camilla were asked to show and talk about *her/his Cabri*. The episode related to Anthony focuses on the idea of 'tabulate' and 'trace' by discussing what had been said by Anthony about it. I named this episode as *something about his text*. Within this section, the episode related to Camilla focuses on the idea of 'hide/show' in the same way as Anthony's. I named this episode as *something about her text*. In the third section, *the Cabri of each teacher in the classroom*, the focus is upon two aspects. One relates to what the teachers considered as relevant to be said to their pupils about *her/his Cabri* when working the worksheets with the classes. The second aspect relates to my classroom observations on their interaction with some pupils by pointing out what I named as *what is not her/his text*.

### A short profile of Anthony

Anthony is 28 years old and has been teaching school mathematics for three years at the same school. Since Anthony started teaching at this school, he has been using *Cabri* in his teaching. Anthony first used a computer when he was eight. Anthony graduated in Mechanics Engineering and worked, for some years, as self-employee on writing programs in C and Java languages. Anthony has a workstation and 4 PCs 586 at home, but the PCs "are at the shelves...too slow" (int.1, 050). For Anthony, the use of computers in education is still relatively new. In his view, the computers are still used as toys in schools but "as more people set them at home, it is going to lose the impact unless they start using them properly and...showing them (pupils) how to deal with them (computers)...what computers are for...do everything for you...a tool...I don't think schools have grasped yet" (int.1, 120).

### A short profile of Camilla

Camilla is 31 years old and has been teaching mathematics for five years at different schools. Since Camilla started teaching at this school, three years ago, she has been using *Cabri* in her teaching. Camilla first used a computer when she was ten. She graduated in Mathematics. She has a PC at home and sometimes uses it to write worksheets. Camilla finds the use of computers in education very important though she thinks that it is still a kind of "novelty" for the pupils to go to a computer room. She thinks it would be better "to have computers in the classrooms to make its use as more a part of the whole teaching mathematics" (int.1, 046).

### The Cabri of Anthony

When Anthony was interviewed in front of the computer, it was shown that *his Cabri* is mostly based on *tabulating*, which I called as *something about his text*:

“(*tabulate*)...things in tables and tabulate that value and get it...to do calculations using the calculator somewhere...” (int. 2, 186).

“I use it (*trace*) for setting up tables in here so I just save it and tell it to tabulate this number again...” (int. 2, 252).

“...(label, comments and numerical editor) and things like that are all done in these tabulating things, that one of use to tabulating, marking angles, and things...” (int.2, 386).

Anthony was asked to show a worksheet he had designed. Interestingly enough, his worksheet is called "Tangent Table". Anthony says that in such a worksheet “the aim is to draw the circle, measure the angle and put it into a table and produce the result to show them (*pupils*) they’re getting the same answer (*tan*) as on the calculator...” (int. 2, 408). This 'makes sense' from what I had observed about *his Cabri*. A lesson of Anthony giving such worksheet to his class was observed, which comes next.

### The Cabri of Anthony in the classroom

Firstly, Anthony said to his pupils that they would be working on constructing a tangent table as they have previously worked in the classroom but now *the machine* could do it quicker for them and this would be done on *Cabri*. Half of the class had seen *Cabri* previously (to draw geometric faces) and the other half had not seen *Cabri* at all. Anthony concentrated the lesson by telling his pupils, individually, where they *should* draw the circle (left side of the screen) and the importance of following the *instructions* from the worksheet. The struggle for most of his pupils was to place the intersection point of two lines and draw a perpendicular line. When they called Anthony because of such a struggle, Anthony, most of the time, took the control of the mouse and did it for them. Several times, Anthony emphasised to the class that the aim of the lesson was the *calculation* rather than the intersection point and drawing a perpendicular line and therefore they should follow the instructions in order to get it. Any mistake made by his pupils with this respect, Anthony asked them *to undo* it and start again. Placing the intersection point of two lines was the most

problematic part of the lesson and this is one of amongst other commands of *Cabri* that Anthony considers a *very annoying one* because "...it (*Cabri*) doesn't put one on automatically for you...if you don't put an intersection point you can't measure it...these things are lengthy..." (int.2, 408). In the interview 2, Anthony was asked why he finds certain features of *Cabri* not very useful. What comes next I have called as *what is not his text*:

(checking proprieties) "...the fussiness of that which if it wasn't exactly right, so, these aren't parallel or something...hum...so, it wasn't very much use in the classroom environment...you know...it didn't do anything you wanted...the results didn't come out...unless you did it perfectly..." (int.2, 386).

(locus) "...locus is just a waste, it seems to produce funny things...I gave up on using locus, you know, sort of I was hoping to find one point that plots locus but it goes all sorts of...moves the whole shape and plots the whole shape and...produces very nice patterns but not very mathematical..." (int.2, 358).

Generally speaking, Anthony finds *Cabri* partly powerful but also very tedious because:

"...it (*Cabri*) tries to do too many things...it's...and certain things you cannot do, things that you'd like to do and it won't let you do...like constructing shapes...it will the way...do at manually...it won't let you do it...perhaps, it will be useful...you just can't do it...it won't allow you...if you don't do exactly like it should be done it doesn't work..." (int.1, 068).

The only time that Anthony mentioned about 'moving things around' was when he started off the interview 2, but then it went to tangent as it is shown below:

"...drawing things, precisising them, moving things around...hum...adding points later and then moving them around as well...hum...adding them at certain things...what we are looking for...the tangent..." (int.2, 186).

I will come back to this point later. Let's see now the *Cabri* of Camilla.

### **The *Cabri* of Camilla**

When Camilla was interviewed in front of the computer, it was shown that *her Cabri* is very much based on *hide/show* points. She defines it as one of the things she likes most in *Cabri*, which I called as *something about her text*:

"...that's I think (*hide/show*)...that's the thing I've done with it really that worked the best...I did it towards the end of transformation topic, with Year 8 class, quite good ability class and they enjoyed it...so, it was quite fun" (int.2, 182).

Most of the other 'things' she talked about *Cabri*, she pointed out as "something very hard for the pupils to work with". In Camilla's view, even the *hide/show* feature to be worked with rotation requires "quite able pupil to understand it" (int.1, 074). Camilla was asked to show a worksheet she had designed. The worksheet is called "Hide/Show Game in Pairs", which, according to Camilla, has "the aim of helping

them (*pupils*) to see where the centre of the rotation is in relation to the shapes by playing a game in pairs where one of the pupil hides the centre of the rotation for the other one to guess it. After that, pressing hide/show button for checking how close the guess was” (int.2, 182). A lesson of Camilla giving such a worksheet to her class was observed, which comes next.

### **The Cabri of Camilla in the classroom**

Firstly, Camilla explained the worksheet to her pupils in a room next to the computer room, with no paper and computer. Camilla says that she does it in this way because once they are in the computer room it is very difficult to make the pupils listen to her. After explaining what they would be doing in the computer room, as well as linking the rotation topic to what they have worked previously in class, Camilla took her pupils in the computer room, they logged the computers on, and got one worksheet each. Camilla supported her pupils individually for the whole lesson, helping them on how to use the hide/show button in order 'to play the game'. One of her pupils was not so engaged in the activity. Instead, this pupil kept using *animation*, *dragging* the figure he had on the screen and so on. After the lesson, I talked with Camilla about it and she told me that sometimes the pupils keep "playing with it...messing around". I will come to this point later. Next, something that I have called as *what is not her text*:

(a triangle around a point) "it is a lovely idea to do that but they find it quite complicated..." (int.2, 041)

(angle bisector) "...if I do the triangle again and this time I get that angle bisector, so...I think...it is hard to...the kids find hard when they have to point to an angle...they have to go through each vertex and they find that quite hard, I think, to get that, you know..." (int.2, 041).

Generally speaking, Camilla finds *Cabri* quite difficult to use to start with. For this reason, she says that:

“...with a class it might be appropriate to have to put them (*pupils*) together just to have...do something fast to get used to how to use it (*Cabri*) and then go in (*computer room*) again do something which is linked to a topic...I mean, I want to talk about its use to enhance the curriculum” (int.1, 103).

In the interview 2, when Camilla mentioned about 'moving things around', she was asked if she finds it useful. She replied as follows:

“...not really, no...hum...what I've done is I had looked at triangles and you can get the area of the triangle on as well and then changing the shape of the triangle and looking how the area changes when you change the shape of the triangle...” (int.2, 041).

From what had been said by Anthony and Camilla so far, it is shown, for instance, that 'moving things around' seems not having any use in each of the teachers' *Cabri*. Also, for Anthony, though *Cabri* is considered partly powerful, he justifies what is

not in his text as something very tedious because 'things that you'd like to do it (*Cabri*) won't let you do'. Whereas, for Camilla, though *Cabri* is considered a good software package for teaching geometry, she justifies what is not in her text as something 'very hard for the pupils to work with'.

## FINAL REMARKS

One of the said powerful features of *Cabri-Géomètre* is *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. If, for instance, we take *Cabri* as such to be used for teaching, *The Cabri of Anthony* and *The Cabri of Camilla* have shown not to be the case. *Seeing and treating Cabri* as such in order to work notions of geometry has nothing to do with *The Cabri of Anthony* and *The Cabri of Camilla* at the time they were interviewed. This does not mean 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. But, the point I would like to raise here is the importance of such *awareness of the Cabri of the teacher* in order to understand how and why *Cabri* is being taken and used in a classroom in a certain way. I would argue that, in the case of *the Cabri of Anthony* and *the Cabri of Camilla*, the fact that each teacher does not use, for instance, the drag-mode feature in a way mentioned earlier, is an upshot strongly linked to what is not in each of the teachers' text.

As mathematics teacher educators I claim that it is crucial to make explicit what *Cabri* we are talking about when working with mathematics teachers, as much as being *aware* of what *Cabri* are being constituted by them. As mathematics teachers I claim that it is crucial to make explicit what *Cabri* we are talking about when working with pupils as well as being *aware* of what *Cabri* are being constituted by them. I see such awareness as crucial in order to teach and learn mathematics within a microworld environment. I believe that by treating technology as text from an anti-essentialist viewpoint gives room for such *awareness* to be promoted.

## REFERENCES

- Grint, K. and Woolgar, S. (1997): *The Machine at Work: Technology, Work and Organization*. Polity Press.
- Lins, B. (2001): The Importance of Premises: From An Essentialist to An Anti-Essentialist View of ICT in Mathematics Education. *Proceedings of the BSRLM (British Society for Research into Learning Mathematics) Day Conference*, V. 20, 3.
- Lins, B. (2001): An Anti-Essentialist View about ICT in Mathematics Education: What Difference can It make to Mathematics Teacher Education?. *ICTME 2000 - International Conference on Technology in Mathematics Education*, Lebanese American University. Lebanon, Beirut, July 2000, pp. 133-139.



- Lins B. (2002a): Towards New Trends on the Role of Users of Technology: A Look at some Research Fields. *ICICIS 2002 - First International Conference on Intelligent Computing and Information Systems*. Egypt, Cairo, pp. 367-370.
- Lins B. (2002b): 'Towards an Anti-Essentialist View of Technology in Mathematics Education: The Case of Excel and Cabri-Géomètre'. Unpublished PhD thesis. Graduate School of Education, University of Bristol.