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Mathematics Teachers and the Use of Computers Within the Classroom

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Abstract: *Teachers' engagement is fundamental in order to get effective use of computers in schools. This paper presents work involving mathematics teachers and researchers whose aim was to organise and carry out computer-based activities for a group of secondary school students. This practical work highlighted the relevance of the relationship between the mathematical content to be taught and the resources provided by software, sources which can be used for preparing the activities, and classroom interaction.*

Introduction

Researchers in education have pointed out the use of computers as valuable practice to improve learning and teaching processes of different subjects in school. However, much effort is still necessary in order for teachers to incorporate the computer into their teaching (Bottino & Furinghetti, 1998; Laborde, 1995; Sutherlands, 1998). A computer-based environment changes the usual configuration of the classroom bringing about new challenges for teachers' practice. In *Risk Zone: Introducing Computers into Teachers' Practice* (Penteado, unpub.), I refer to some of these challenges and I discuss the idea that in order to exploit the power of ICT for improving learning situations teachers have to move from a comfort zone to a risk zone in their practice. I also argue that an expansion of the teacher's interlocutors by means of co-operative work is a possible way of supporting teachers operating in this risk zone. In this paper I intend to present an example of how I am trying to establish such co-operative work with secondary school mathematics teachers.

Examples from the Practice

This activity was developed in Brazil and involved two secondary school teachers connected to the Research Group in Technology and Mathematics Education

(GPIMEM)[1] at the Department of Mathematics at the State University of São Paulo at Rio Claro.

Stela and Edna teach in a secondary school near the university where I work. Stela had worked with us in the previous year trying to use computers with her students. Edna was using computers for the first time. Both of them were looking for innovation in the classroom. They thought ICT could initiate a new relationship between students and mathematics.

We[2] started working in a study group environment. We indicated software and the topic we would concentrate on. We considered Geometrics[3], dynamic geometry software, as useful "open software" for studying geometry. Stela and Edna found that our suggestion fitted their needs because many government proposals in Brazil have emphasised the importance of geometry teaching. Our meetings were held once a week in the University's computer room.

During the two first months we explored the software, read papers focusing on the link between ICT and geometry, and selected and organised activities for their students. After that, Edna started working with a group of twenty seven 13-14-year old students and Stela with a group of about ten 16-17 year-old students. As there were no computers in their school they came to the university to give some of their weekly mathematics lessons.

In what follows I present some remarks which came out of an initial analysis of this work. The first one concerns how software structures the way we may approach the mathematical concepts. Many times, in addressing some concepts, it was necessary for Edna and Stela to use a strategy different from the one they used before. This was not an instantaneous process, first they tried to adjust the software to activities they were already used to, then, as in many cases this was not possible, they started revising the mathematical content they wanted to approach.

During this process, they frequently tried to simplify the task justifying this by saying the students would be confused and would not be able to cope. In some situations this argument sounded reasonable, but others it revealed an uncertainty about the content.

Another point concerns the relationship between textbooks and computers. Textbooks were used as a support for organising activities. They were the starting point for us, but there was no possibility of direct transference of textbook activities to the computer environment. Adaptations were necessary. For example, usually

1 The Portuguese name of GPIMEM is Grupo de Pesquisa em Informática outras mídias e Educação Matemática. GPIMEM is co-ordinated by Dr Marcelo Borba and comprises students from mathematics, computer science and graduate in mathematics education courses as well as primary and secondary teachers. It is concerned with how ICT are related to: curriculum development, project work, teacher education, analysis and development of software and distance education. (http//www.igce.unesp.br/igce/pgem/gpimem.html)

2 I refer to Fernanda Menino and myself.

3 Developed by Viggo Sadollin, Royal Danish School of Educational Studies, Denmark.

Edna and Stela introduced the formula for calculating the area of a triangle after teaching the formula of the area of a parallelogram. Thus, the area of a triangle was half of the area of a particular parallelogram. Using Geometricks they intended to follow the same sequence, but the software calculated the area of a parallelogram as the sum of areas of triangles. The area of a triangle was given immediately by indicating its three vertex. 'What should be focused on if the software already calculates area of triangles?' they asked themselves. They, therefore, felt insecure when they had to organise activities on this topic. Calculating the area of triangles without the computer was something to be emphasised, but now it lost relevance because the software determined it immediately.

It took some time to identify other issues which could be explored about the area of triangles. Finally we came up with the suggestion of drawing a triangle on the screen and observing what happened to the height related to a vertex when dragging it about. The teachers realised that they could explore the relation between height, length of corresponding base and the area of the triangle. They thought that in this case Geometricks could be used so that the students could observe the variation of area as a function of height and length of base.

Although they had many years of teaching practice, Edna and Stela mentioned that never before had they explored these elements related to area of triangles. In fact, they had taught formulae without thinking about the influence of each element in the final result.

I consider that the software was useful in promoting this kind of effect. It seems that in working with some kind of software, we come to face the necessity of having "new eyes" to look at old contents and being made aware of new contents which can emerge from the situation.

Regarding the classroom interaction, we worked with a very problematic group of students in terms of violence and lack of concentration. The majority of them had never used a computer and everything was new for them. In the first classes they opened different software and changed the configuration of the computers. It was necessary to explain to them the consequences of this act and to make an agreement that they would have opportunities to freely explore of the computer, especially to browse Internet which they were very keen to do.

The activities required students to construct a figure, investigate some properties by dragging it and write down their conclusions. Initially this was not very welcome as they were used to solving exercises and filling in blank spaces in the textbook. This was also new for the teachers. After some attempts, Stela and Edna thought of students working in pairs at the computer. They were guided by a worksheet and individual students would have to report the conclusions in their

personal note book. The teacher walked around the classroom responding to students' doubts. The reports produced in the computer room were discussed during the next lessons at the school.

As an evaluation of this work Edna and Stela considered that their students became more interested in studying mathematics. At least, by means of computers, they spent some time involved with geometrical problems and discussed them with colleagues. Several times Stela showed how surprised she was to notice that some students changed their violent behaviour in those classes. Before that, she had almost given up trying to teach that group. Beyond this practical result, Stela and Edna also found that they too learned new things and considered this experience very meaningful in their professional life.

Final Considerations

The remarks presented above highlight the importance of the relationship between the mathematical content to be taught and the resources provided by software, sources which can be used for preparing computer-based activities, and classroom interaction.

Exploring such issues in a more methodical way is one of the aims of a research I have recently started in collaboration with the Centre for Learning, Knowing and Interactive Technologies (L-KIT)[4] at the Graduate School of Education at the University of Bristol.

I hope the feedback I will receive from the participants of the conference to be valuable in the sense of indicating research projects with similar interests as well as mathematics teachers who are using computers in their classroom. My interest is to establish a connection with different groups in order to discuss further the research I intend to carry out as well as to reflect about the strategies I have been using in my practice.

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[4] L-KIT is co-ordinated by Professor Rosamund Sutherland at the Graduate School of Education, University of Bristol, U.K.

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