Using a Vygotskian theoretical perspective to facilitate prospective secondary mathematics teachers' professional development

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Introduction

What follows is a study related to my attempts to create a Vygostkian-based learning environment aimed at promoting both academic and professional development of prospective secondary mathematics teachers. It took place within the context of a two semesters Mathematics Methods course which I was in charge of, at the Department of Pure Mathematics of the Science Faculty, Oporto University, Portugal. The analysis is concerned with three fundamental issues similar to those ones addressed by Vygotsky (1978) in charting children's development:

(1) What is the relationship between the student-teachers and their learning environment, both physical and social?
(2) What new forms of activity were the student teachers engaged in and what were the psychological consequences of these forms of activity?
(3) What kind of learning took place and how has this affected the student-teachers' professional development?

The paper begins by highlighting some aspects of the prospective secondary mathematics teachers' culture of learning how to teach, laying evidence for a need for change. It next offers a speculative reinterpretation of Vygotsky's (1978, 1991) ideas about the development of higher psychological processes on which the social arrangements and ideological orientations that characterise the design and implementation of the Methods course were based. The last part of the paper is devoted to the stories of two trainee-teachers, who had considerably different trajectories throughout the course, thus providing some insights into the kinds of factors that affect their learning and professional development.

The study setting

The current initial mathematics teacher preparation at the University consists of a five years degree. The former four years are exclusively University-based. In line with decades of tradition, the idea of a mathematics teacher being mainly concerned with the acquisition of a body mathematics knowledge appears to have remained greatly pervasive in the department educational thinking and practice. Even the Mathematics Methods course that students have to enrol in their fourth year has missed an emphasis on the teaching of mathematics. The fifth and last year is almost exclusively school-based: trainee-teachers work in a secondary school, teaching two classes of their own, under the supervision of both a cooperative school mathematics teacher and a University lecturer.

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The perceived inadequacies of this kind of preparation have led, in recent years, to a wave of protests of the trainee-teachers. So great was the underlying pressure that the department recognised the necessity of introducing a stronger mathematics education dimension into the teacher training programme. This, in turn, motivated the Department to appoint me in October 1993. It was clear for me that "breaking the wall" was a must. Developing and implementing a renewed Mathematics Methods course was the starting point. And in so doing, I turned to Vygostky for ideological support.

Methodology

The intellectual accomplishment of Vygotsky's (1978) pioneering work was moulded by a method of investigation that aimed at acting as a "telescope" of learner's development -- the "experimental-genetic" method. Such method consists of setting up experiments that provide maximum opportunity for the subject to engage in a variety of activities that can be observed, not just rigidly controlled (Cole and Scribner, 1978, p. 12). In this study, I attempted to follow a similar approach. The course activities, which I describe in the following section, constituted the experiments themselves. Data came from several sources. In addition to participant observation, there were the students' written answers to both the structured and non-structured questionnaires administered throughout the course sessions. The students' written assignments, as well as their portfolios which were made compulsory throughout the second semester were also used for research purposes. Furthermore, prior to the course, and, again, at the end of the academic year, all the 50 students answered a written questionnaire assessing, among other things their motivations for their professional choice and their views about the ideal mathematics teacher.

Analysis of these data underlies the approach suggested by Vygostky too. It emphasised (1) process, not product, and (2) explanation, rather than mere description, and was performed according to both a qualitative and quantitative procedures. On the basis of such an analysis, I build, first, an overall picture of the study results, and, afterwards, the portraits of two students who progressed through the course in a remarkably contrasting manner. These highlight the many forces that affected the way the student-teachers organised their perspectives about how to teach mathematics throughout the course, as well as the complex interconnection between their thinking and actions.

A Vygotskian theoretical framework for designing the course

Although Vygotsky's writings were directed towards the development of higher psychological processes in children, recently, some authors (e. g. Gallimore and Goldenberg, 1992; Lambdin, 1993; Manning and Payne, 1993) have suggested that the ideas of the soviet psychologist are well suited to adult learners. And they extended them, in particular, to teacher education. Some empirical support for the importance of using a Vygotskian perspective in exploring mature students learning statistics is provided by Gordon (1993).

I see four main themes in Vygotsky's work: (1) the primacy of the social; (2) the necessity of reconstructing an initially external activity into an internal one; (3) the systemic character of scientific concepts; and (4) the concept of *zone of proximal development.* Having these ideas as a starting point, I went on to recontextualise them, by postulating four principles to be used as guiding principles in designing the Methods course. Below these principles are distinguished and illustrated with the strategies I used to put these principles into practice.

1. Establishing a mathematics education community.
For Vygotsky the emphasis on social interaction is key to learning. From this vantage point, discussion and group work were important elements of the Methods course. Small group work and small group discussions were highly encouraged. Many of the students' formal assignments took the form of group projects. And even lectures were often transformed into whole class discussion.

A second and successful initiative to establish a mathematics education community was the launching of a series of mathematics education seminars during the second semester. These were held by myself in cooperation with a cohort of students who volunteered to present the mathematical activities they had carried out as part of their assignments in the Methods course in the previous semester (Moreira, 1994). The seminars became a forum for debate in which not only myself and my own students were involved, but also other student-teachers, as well as secondary school teachers and even some of my colleagues at the Department participated.

2. Developing reflective and metacognitive processes
In addition to social interaction, Vygotsky considers that one essential aspect of development is the ability to control and direct one's own behaviour, something that is made possible through internalisation. Encouraging the student-teachers to reflect upon their own thoughts was, therefore, considered vital. Now, the image of educating the "reflective teacher" has become widely spread in recent years, and yet so, it is well known among teacher educators how difficult is to promote it. Kohonen and Ojanen, (1993) report some evidence of the improvement of reflective skills among student-teachers who had kept a portfolio (a kind of journal in which the would keep both samples of their work and reflections). Keeping a portfolio, however, is not without problems. In a recent study carried out with Portuguese teachers (Moreira, 1993), I found out that many of them felt rather uncomfortable in making public their thoughts and feelings, something that I perceive as quite legitimate.

These problems and conflicts suggested that I should develop a new and sound rationale for having the students to write a journal. And that was what I did at the beginning of the second semester. I invited discussion as to whether a portfolio should be kept, and if yes, whether it could be used as a formal assignment contributing to the students' final assessment. Moreover, the students were also provided with guidelines about how to go about the task of writing a journal.

In addition to· journal keeping, the students were asked, in frequent occasions throughout the course sessions, to answer, in writing, to both structured and non-structured questionnaires. (This complete knowledge base was also useful for research purposes). Questions were about, for example, their views about

mathematics, what a mathematics teacher should be, what and how they have learned throughout the course, what they felt they would like to learn and how they perceived their role as teachers. Apparently, the fact that the task was anonymous and did not contribute to their formal assessment made it more acceptable to a variety of students.

Throughout their lives, most of the students had been socialised into a view of mathematics as a fixed and certain body of knowledge and into a perspective of education equated with transmission of information, based mostly upon the authority of a textbook, a teacher or a University professor. It was important, therefore, to develop in the students an appreciation of the contextual, provisional and relative nature of mathematical knowledge. In connection with this idea, the students were encouraged to complement information and to consider rationally and carefully different perspectives, by reading professional and research literature about specific topics.

3. Changing one's personal relationship with mathematics

In my view, a Mathematics Methods course may be regarded as a synthesis of mathematical methods, on one hand, and ideas which are studied by philosophers, psychologists and sociologists, on the other hand. The gap between the two fields of knowledge is well known. Efforts to weaving these two considerably separate fields of knowledge relate to Vygotsky's argument of concepts as systems of relations. This idea lend to a strategy of promoting frequent shifting between mathematics and mathematics teaching related activities, mathematics being always at the center of the stage.

One of the strategies was the setting of learning activities which included mathematical problem-solving and open-ended investigations and involved a wide range of mathematical concepts and processes (Moreira, 1994). In the meantime, the students were also called to examine and reflect upon philosophical and historical aspects of mathematics (Moreira, 1994).

Further efforts to bring the prospective mathematics teachers closer to their subject matter was through significant exposition to a Logo-based mathematical environment. One assumption about computers is that their availability and accessibility are constantly increasing. Surprisingly enough, most of the students had never used a computer before, though they had had a previous course in which they had learnt computer algorithms and the programming language BASIC. Making the students adjust to get in line with the demands of "the inforrnation society" was surely a pressing priority. Most importantly, the Logo environment aimed at challenging the students to engage in active inquiry in mathematics, insofar it encourages greater flexibility and exploration (Papert, 1980).

4. Bridging the theory-practice gap

As I see it, Vygotsky's concept of *zone of proximal development* allows enough room for understanding the way the formal learning of how to teach is achieved, and for possible amendments to be made. In fact, as it happens with many other kinds of learning, the acquisition of teaching competence and the development of practical proficiency does not start from a blank sheet. At the age of twenty and something,

trainee-teachers have spent thousand of hours in schools and have already some ideas of what teaching is about.

Developing proper school-based training to an acceptable level requires that the perceptions of what teaching should be must be open to dialogue with more experienced professionals. But while working alongside a mentor in schools affords a number of important possibilities, it cannot be assumed that these are automatically realised.

To revert to Vygotsky (1978), he expresses that "concreteness is [now] seen as necessary and unavoidable only as a stepping stone for developing abstract thinking -- as a means, not as an end in itself" (p. 89). From this perspective, the way teaching practice has been organised at the University was in need for urgent review. Thus, a *Preparation for Practical Activity (PP A)* was included in the Methods course, in order to allow the students to visit schools and come to grips with the practicalities of mathematics teaching prior to their final one-year teaching practice/induction.

A second, and perhaps even more fundamental initiative, was the inclusion of a *Preactive Teaching Simulation (PTS)* (McNergney, Lloyd, Mintz, and Moore, 1988) activity, later in the course, during which the students had to practise in a simulated form. The PTS is consistent with Vygotsky's idea that in addition to school instruction, action in an imaginative sphere (play) contributes to create a zone of proximal development. The PTS was also to include those practical things that should be done prior and after teaching: (a) finding relevant facts about the topic they were supposed to teach, (b) collecting information about teaching and learning that topic, (c) collecting information about the 'pupils' they were admittedly to teach, (d) planning on the basis of this information a reasonable course of action, and (e) reflecting upon performance, all of which were to be summarised in a written document.

The results

What were the results of my efforts and actions to "breaking the wall"? The answer to this question constitutes the matter of this and of the following section. Overall, the course activities appeared to the students' eyes as exciting, engaging and worthwhile carrying out. Even those activities the students were initially reluctant to engage in (e.g. journal keeping), turned out to be highly appreciated by many of the students. A sample of one student's writing illustrates this:

> *This work {Journal keeping] made me resuming my fondness for writing ... I began to think by myself again ... Since the day I enter to the University I distanced myself from subjects such as Language Arts, Philosophy and Psychology which I enjoyed* so *much, and in which I used to write a lot and express my opmlOns.*

What this student is suggesting is that the University culture in which she had been immersed for at least four years has served not to open up inquiring and thinking critically, but to close it off. The students felt especially uplifted by engaging in the mathematical activities, as the following excerpt illustrates:

> *I learned topics in a way that I never thought I could learn here at the University, such as, the mathematical activities ... The games with triangles, squares, among others, helped me to see how I could teach mathematics to my pupils, in a new and funny way.*

They felt excited about doing what Lampert (1992) calls "authentic mathematics" and many of them demonstrated a high a degree of inventiveness and creativity. Of course, whether these experiences will help these prospective teachers to present mathematics to their pupils in the future in an exciting and meaningful way is a totally different story.

Another activity that appeared to the students' eyes as the most remarkable was the PTS. At the beginning, some confusion reigned. Faced with this kind of assignment for the first time, the students would come to see me and ask for clarification. Their main concern was: "how can we teach if we do not have pupils?". It was clear that the students were most preoccupied with those aspects directly related to the public part of the PTS, the simulated teaching situations. Having clarified the meaning of this component, and reminded the students that this was just one part of the whole activity, the students still tended to focus on that component. The truth is that in so doing, most of the students adopted many of the course proposals: there was a marked willingness on their to experiment and use a variety of teaching approaches, such as small group work, games and computers, in such a way as to challenge traditional practices.

Summing up her thoughts on the activity, one student considered that it was "the greatest event in his professional life". I believe that an activity like the PTS is more coherent and "provides a much wider background for changes in needs and consciousness" (Vygotsky, 1978, p. 102) in candidate teachers than other ways of linking educational theory and research to practice. Student-teachers do not want only to recognise a good lesson when they see it, but to deliver a good one. Even joint teaching, as it was the case of the PTS, is more far-reaching than just observing someone else teaching.

Against this background, it is not surprising that an analysis of the students' answers to the questionnaire, prior and after the course, suggests that, overall, the studentteachers' conceptions about mathematics, the ideal mathematics teacher and their roles as teachers went fundamental changes. The course has raised the prospective teachers' awareness and understanding of what doing and teaching mathematics should be.

Two contrasting approaches

From a Vygotskian framework, the role of formal education is to provide environments appropriate for individual development. Learning, however, is mediated by the acting individual. In order to convey something of the reasons for the differences between the ways the students responded to the Methods courses, two abbreviated case studies are presented in this section.

The case of Maria

Maria, 40 years old, portrays the example of a student who had relinquished the normal course of her professional studies many years ago, to resume them now. She has already had nine years of experience as a teacher in a secondary school. The prospect of a more stable professional life led her to consider the idea of completing her degree Maria (like most of the students in the course) was quite conventional in her ways of conceptualising the role of a mathematics teacher: The two primary competencies of the ideal mathematics are "to command well mathematical concepts in order to transmit them correctly to pupils" and "to deliver clearly the subject matter and to show various examples, so that pupils, individually, can practise thereafter". Her views about mathematics were as much conventional as basic:
"Mathematics is *an exact science, that helps in the reasoning, and that* is *needed in everyday life, since it* is *present in every hour and every moment, ... adding up, multiplying ...* ". Throughout the course sessions, Maria was an active participant, especially by contributing to both the group and class discussions. From the very beginning, she was more keen to exchange ideas and opinions than the other students. In addition to personal factors, her background as a teacher helped her to feel freer than her colleagues to express her views. (The latter were so much socialised in the University dorninant culture of silence that they felt greatly inhibited to talk even when they were asked to do so.) She also was always eager in expressing favourable feelings with regard to the course activities.

Despite these favourable reactions, it seems that Maria was facing some difficulties with the course. After being introduced to the topic of the nature of mathematics and alternative perspectives of mathematical thought (about one and half month after the Methods course started), Maria confessed that she had not got along with the content to be learned yet. Moreover, despite the moves undertaken to leading the students to a more reflective stance, Maria was making little progress towards this goal. Three main aspects may be accountable for this. First, there were powerful cultural obstacles (e.g. limited knowledge of and skills with the English language) in her way that set limits to how Maria could use the tools to foster a reflective mind at her disposition. Second, it appeared that interaction among the students in Maria's team developed in such a way that it did not engender negotiations. By virtue of her seniority, Maria was the social authority of the group. She 'knew everything' about pupil standards, attitudes and behaviour. Another student, in turn (with a stronger mathematical background) would play the role of mathematical authority of the group. The 'correct' solutions to the activities proposed were offered, rather than negotiated, by either of these two 'expert' students. was from the beginning undebatable. Finally, the students in the team build a strong group identity, thus neglecting sense of responsibility for their own individual activities and learning outcomes. Hence, for example, reading journals and books, and an individual Logo project that the students should submit at the end of the second semester became tricky and fluid tasks and easily transformed and presented as shared activities.

Unpacking the dynamics of Maria's work with computers (and mathematics) in the context of the Logo sessions sheds further light in Maria's development (or rather lack of it) throughout the course. Like most of the student-teachers, Maria had no previous computer experience. Because of that (rather than in spite of that), she welcomed these sessions. Maria's lack of experience with computers became, however, to a certain extent, detrimental to her progress throughout the sessions

and an obstruction to her engaging in Logo-mathematical work. It is not unusual that dealing with an unfamiliar tool causes uncertainty, confusion, and anxiety. But I also associate Maria's ineffective learning in the Logo environment to other possible reasons. First, I believe that Maria was less at ease with the whole idea of programming than the other students. She could never pursued the tasks beyond the immediate results on the screen. Second, computers, and the Logo environment in particular, did not fit her style of teaching which ascribes a main role to both the teacher and a curriculum content to be delivered.

Thus, no major evolution appeared to have taken place in Maria's perception of her role as a teacher. For example, in Maria's intervention in the PTS at the end of the second semester, she exhibited pedagogical views and beliefs that she had constructed throughout her experience as a teacher, rather than grounded in the ideas provided by the Methods course. With considerable experience as a teacher, Maria felt that she had a thorough and comprehensive knowledge about how to teach mathematics in schools. The Methods course represented only a necessary step to get her degree. She did not see it as an avenue to point to fundamental changes in the way she used to teach. Despite some small moves, at the end of the course, she was at the same point as she was at the beginning.

The case of Helena

Helena, 21 years old, has negotiated a very successful University career as a student. Indeed, she was one of those rare exceptions who had managed to pass all of the mathematics courses she had enrolled in the former three years. This clearly had important implications for her selfesteem and her own feeling of identity. In contrast to Maria (and in fact to many of her colleagues who have combined their student life with giving private mathematics tuition) Helena has not had any experience in teaching mathematics at all. Interestingly, He'ena's views about the ideal mathematics teacher were very much like Maria's. As often suggested, teachers' beliefs about teaching are often based upon their experiences as pupils in schools. The point needs to be raised that although Helena and Maria's school experiences were considerably distant in time, both were probably acculturalised into the same kind of approaches to mathematics teaching.

Major differences between Helena and Maria were, however, noted in their views of mathematics. Helena's successful experiences with mathematics at the University have strongly influenced her perception of what mathematics is about. She replied to the question about her personal view in the following way:

> *Mathematics is a science that has the number as a foundation.* It *is generally developed from a set of axioms which are accepted as known.* [.. .] *Mathematics has two branches, one is pure mathematics, essentially abstract, and the other is applied mathematics, more related to the concrete and associated with applications to other areas.*

This formalist view of mathematics was to be renegotiated throughout the course. One way to give an account of the evolving relation between Helena and mathematics is to provide a sketch of her work with the computer and Logo throughout the second semester. For Helena, working with Logo not only did call for

more experimentation, but also gave birth to a sense of wonder about her knowledge of mathematics. Here is an extract of Helena's journal writing about her first session with Logo:

> *We were successful in our first attempt to draw a circle. But we tried to specify the meaning of each of the numbers used. In particular, we wanted to know how to draw circles with different radii. We made a series of experiments* [. ..]. *After the analysis of the results, I concluded that there was a relationship between the numbers. Even so, I realised that I continued without knowing the meaning of each of the numbers. Therefore, I decided that it would be better to make new experiments next time.*

As these comments also suggest, the Logo work had a role to play in encouraging a greater commitment to wandering about and searching for meaning. But although keen to explore, Helena was eager to getting the final solution. For Helena, solving a problem was not just a cognitive endeavour, it was a personal challenge. She had to make the problem her own, to take ownership for what she is doing. Thus, Helena's Logo-mathematical work rested on three notions: challenge, control and understanding. In contrast to Maria, Helena's judgement of the course activities were based upon her personal objectives and interests.

The above comments also provide important information about how Helena was able to monitor and regulate her own actions, something that, she reckoned, was greatly improved throughout the course. At the same time, Helena was growing up in professional terms too. Her approach to the PTS is revealing and details more explicitly her view of the teacher's role at the end of the course. Her 'teaching' was centred upon different activities on which the 'pupils' were engaged in groups. Helena (and her team partners) had build models to illustrate the geometrical concepts under scrutiny: cardboard models of polyhedra, a three-dimension reticular network and even a set of embedded platonic solids. In general, at the core of the tasks there was an alternate movement from the figural to the conceptual level. The evidence of this fact leads me to admit that Helena has reorganised her views about what constitutes mathematical activity, giving up of her purely formalist view of mathematics.

The PTS also highlights another important development. At the beginning of the academic year, the pattern of work of Helena's team was, probably, better characterised as one of associative type rather than genuine cooperation. This fitted well with both Helena's style of individualised learning, and her introverted personality. As the year progressed, however, Helena gradually moved from a point in which she avoided sharing her thinking and solutions with others to a position in which she was able to negotiate with her partners the sharing of the task of 'teaching'. In the PTS, Helena (and her team partners) planned to conduct part of the simulated teaching sessions following a team-teaching approach. The different 'teachers' would be interacting with the different groups which were engaged in the different activities. In short, at the beginning of the course, Helen found herself between forces dragging her in opposite directions. She resolved this dialectical situation by moving towards the direction pointed to by the course. At the end, she

has, no doubt moved a great deal. Whether she will continue to move in this direction, or, in contrast, an V-turn remains to be seen.

A **final reflection**

This paper has provided a glimpse of a two semesters Mathematics Methods course for prospective secondary mathematics teachers which endowed Vygotskian-based principles. The core of the paper has attempted to pinpoint what role these different principles played in prospective teachers' learning how to teach mathematics. Here, I would like to summarise the discussion by focusing on the relationship between individual participants' characteristics and the culture of learning embedded in the course as documented by the two contrasting cases of Maria and Helena presented in the previous pages. What caused these two prospective teachers to respond so differently to the course?

A possible response is, in the light of Vygotsky's ideas, that adults, like children, have different zones of proximal development which impose constraints in the extent of their participation in formal learning experiences. A clarification of this answer is better achieved through Valsiner's (1987) extended the model of the Zone of Proximal Development (ZPD) (cited in Oerter, 1992). This endorses two other zones, the Zone of Free Movement (ZFM) and the Zone of Promoted Action (ZP A). Oerter (1992) characterises the latter as the set of activities and objects "the mastering of which is desired" (p. 197) by more experienced partners. The ZFM, in turn, is characterised by the "segment of culturally provided opportunities or objects available to an individual" (p. 197) at a given time. As Oerter (1992) suggests, "development and learning will occur only and when the ZFM, the ZP A, and the ZPD all overlap" (p. 194).

One question stands out, prompted by Valsiner's ZFM. Here the many global forces that bring into conflict the maintenance of existing teaching/learning communities and cultures, on the one side, and the new culture embedded in the Methods course, on the other side, emerge. Certainly, those existing communities and cultures have had a much stronger influence on Maria than on Helena. As a student who has got almost 10 years of teaching experience, Maria is constantly connecting the course activities with the pupils' needs in the classroom. The course activities were only relevant and stimulating for her if they were perceived to be relevant for her pupils. Moreover, Maria was highly confident about her ability to teach. Therefore, she did not want risk moving outside the ZFM where she used to live. When called up to visit mathematics classrooms, she went cherishing her own school, and from there she went on to visiting classes just in her own school. This meant to hold little potential for Maria to challenge her views and judge the reality of mathematics teaching more rationally and deeply.

For Helena, the influence of existing cultures of teaching and learning was also well visible. But, in contrast to Maria, she was not committed to a particular way of teaching yet. Growing maturity in her early twenties, brought with it the realisation that she could live and recreate herself in the new culture of learning within the course. At the same time, the course favoured her journey into a broader ZFM where she got personally meaningful experiences of learning how to teach.

One second question concerns V alsiner' s ZP A. While I had made resources available to students to create such a zone, it is, now, clear for me that they hardly could be used by Maria. For example, she was not able to read the articles and books at her disposal because of her limited knowledge of the English language. Similarly, she could hardly benefit from the Logo based environment, because of her total lack of experience with both computers and programming. The presence of these two kinds of tools, books and computers, gave birth to demands that Maria could not understand and led to situations that she could not control. She felt subjugated by them. Helena, in contrast, felt empowered by the same tools. They figured prominently in the transformation of her views of mathematics, for example, and contributed to her intellectual accomplishments in the course.

An equally instructive issue brought to light by this study concerns the role of social interaction as a basis to foster development within the ZPD. The scale at which cooperative work must operate might have been overestimated. The move to joint ventures was most beneficial in the case of Helena (and in the majority of cases too). Working in a team provided her with a really good opportunity for both information flow and debate about different opinions, but it never concealed a commitment to individual responsibility. It seems, however, that in the case of Maria's group, proper discussion of the problems and possibilities of mathematics teaching and learning among its elements was hardly in agenda. One major reason for this was probably the great differences among the four elements of her group in terms of their experiences, interests and abilities, with two of them playing a strong leader roles. On this process, neither Maria nor, probably, the other three students in the team were able to initiate reciprocal reflection. Moreover, the students in Maria's team appeared to have entered in a kind of contract that locked them into a mode of interaction in which individual responsibility was trapped in the group binding. Such behavioural world inhibits individual reflection, too, and therefore growing up. Looking back, I can see that many of my initial intentions were fully realised; others, only marginally. In addition, I also became aware of some unintended consequences. These may be even more important than my intentions. In particular, this study highlights that it is not enough to verbally endorse a Vygotskian framework to facilitate teachers' professional development. While one is oriented towards to put into practice Vygotsky's ideas, the degree and quality of the context provided can only be measured in the actions of individual learners themselves. This means that experiences provided cannot be set up in a clear-cut, definite manner. There will be always differences among learners. Therefore, there has to be always room to find interpersonal negotiation strategies. Any approach applied without taking this into account cannot be really called Vygotskian.

References

Cole, M. & Scribner, S. (1978) 'Introduction', in Vygotsky, L. *Mind in society: The development of higher psychological processes,* (pp. 1-14). Cambridge, MA, Harvard University Press.

Gallimore, R & Goldenberg, C. (1992) 'Tracking the developmental path of teachers and learners: A Vygotskian perspective', In Oser, F., Dick, O. & Patry, J., (Eds.), *Effective and responsible teaching: The new synthesis,* (pp. 203-221), San Francisco, Jossey-Bass Publishers.

Gordon, S. (1993) 'Mature students learning statistics: The activity theory perspective', *Mathematics Education Research Journal,* 5(1),34-49.

Kohonen, V. & Ojanen, S. (1993) *Facilitating teacher professionalism and autonomy in preservice teacher education through portfolio assessment.* Paper presented at the 18th A TEE Conference, Lisbon

Lambdin, D. (1993) 'Monitoring moves and roles in cooperative mathematical problem solving', *Focus on Learning Problems in Mathematics, 15(2/3),48-64.*

Manning. B. & Payne, B. (1993). A Vygotskian-based theory of teacher cognition: Toward the acquisition of mental reflection and self-regulation. *Teaching and Teacher Education,* 9(4), 361-371.

McNergney, R, Lloyd, J., Mintz, S. & Moore, J. (1988) 'Training for pedagogical decision making', *Journal of Teacher Education,* (September-October), 37-43.

Moreira, C. (1993) *Learning to do research in education: Designing and running a course for teachers.* Paper presented at the 18th A TIE Conference, Lisbon.

Moreira, C. (1994), Reflecting on prospective mathematics teachers' experiences in reflecting about the nature of mathematics. In Ponte, J. and Matos, J. (Eds.), *Proceedings of the Eighteenh International Conference for the the Psychology of Mathematics Education (Vol II!),* pp. 287-294. Lisbon, Portugal: University of Lisbon.

Oerter, R (1992). 'The Zone for Proximal Development for learning and teaching', In Oser, F., Dick, A. & Patry, J. (Eds.), *Effective and responsible teaching: The new synthesis,* (pp. 187-202). San Francisco, Jossey-Bass Publishers.

Papert, S. (1980) *Mindstorms: Children, computers and powerful ideas.* New York, Basic Books.

Valsiner, J. (1987) *Culture and development of children's action.* New York, Wiley.

Vygotsky, L. (1978) *Mind in society: The development of higher psychological processes.* Cambridge, MA, Harvard University Press.

Vygotsky, L. (1991) *Pensamento e linguagem* , (Brasilian edition, translated by J. Camarco). Sao Paulo, SP: Martins Fontes.

Wilcox, S., Schram, P., Lappan, G. & Lanier, P. (1991) 'The role of a learning community in changing preservice teachers' knowledge and beliefs about mathematics education', *For the Learning of Mathematics, 1(3),31-39.*