

# Distance education and mathematics teachers' professional development and identity

João Pedro da Ponte  
*Universidade de Lisboa, Portugal*  
<jponte@fc.ul.pt>

This paper discusses the influence of an in-service distance education course in mathematics teachers' professional identity, especially regarding their views and practices of reflection and collaboration and their relation with information and communication technology. The course was based in open-learning pedagogy and focused in conducting mathematics investigations in the classroom. Evaluation results show that the perspectives and involvement of the participants depend very much on their previous professional experience and relationship with the Internet. Teachers that use e-mail for collaborative work found this a very stimulating experience whereas those with less professional involvement had some difficulty in adopting the roles and values required for this kind of activity.

What may be the influence of an in-service distance education course in teachers' professional identity? This paper addresses this question based in a in-service course with the format of a "study circle", structured according to open-learning pedagogy (Collis & Moonen, 2001), and focused in conducting mathematics investigations in the classroom (Mason, 1991; Ponte, 2001; Ponte, Oliveira, & Brocardo, 2003; Ruthven, 2001). An evaluation was undertaken to ascertain the reactions of the participants to the structure and functioning of this in-service activity and its influence in the professional development and identity of teachers. Special attention was given to how participants regard reflection and collaboration and relate to information and communication technology. The main issues bearing on the emergence of new aspects of teachers' professional identity are presented in the paper, together with a brief discussion of their potential implications for research and practice.

## Teachers' professional development and identity

During their careers, mathematics teachers change and develop professionally. The professional development of a teacher may be regarded as a process of growing of his/her competencies concerning mathematics teaching practices and other professional practices, and in the self- control of his/her activity as an educator and as an active participant of the school organization. In this perspective, professional development concerns issues related to mathematics education but also includes issues related to every other aspect of the educational activity and personal as well as relational aspects regarding other teachers and members of the community.

Professional development does not just refer to acquiring bits and pieces of fragmented knowledge (Popkewitz, 1992). It is not just learning more mathematics or mathematics education theories and getting able to use them in teaching practice. Rather, it is a complex process in which the teacher is involved as a person in his/her professional, cultural and social context. It includes all the learning experiences of a teacher – natural and planned – that yield him/her direct or indirect benefit that that support the quality of his/her work with pupils and with other participants in educational institutions (Day, 1999).

For a mathematics teacher, the development of a professional identity involves assuming the fundamental roles, norms and values of the teaching profession. The key features of this identity are highly problematic since teachers are not a homogeneous body but encompass several professional subcultures (Feiman-Nemser & Floden, 1986). Furthermore, professional identities have a dynamic nature, evolving along with the changes that occur in the society and in the nature of occupations. For example, in recent years, in many countries, the structure of the teachers' activity has undergone important changes involving new curriculum goals and professional responsibilities. Also, as it happens in many other fields, information and communication technology provides new opportunities to the teachers' work – using such technology in classes, to prepare lessons, to write reports, to carry out administrative work, and to share information and experiences with other teachers.

The professional identity is an aspect of the social identity. For Berger e Luckman (1973), in objective terms, a social identity can be regarded as belonging to a certain world, and can only be understood, in subjective terms, together with that world. The social identity is made of multiple aspects, including language, culture, social group, political and religious beliefs, and the role assumed in the social division of labour. The most important activity systems in the construction of the identity are communication, that structures the interaction among individuals, and instrumental activity, related to the working processes and their underlying technical and organizational means (Dubar, 1997).

In the perspective of symbolic interactionism (Blumer, 1969), the individual is not just a passive element of a group, that internalises its norms and values, but it is also an agent that assumes in that group a useful and recognized role. Therefore, we may speak of a dialectic between an "I" identified and recognized by the other as a member of the group and an "I" that assumes an active role and that participates in the permanent process of reconstruction of the community. For Dubar (1997), the harmonious integration of these two sides of "I" is the key to the consolidation of the social identity.

The social identity is permanently reconstituted in the socialization process. That is, the identity is not given, but continuously constructed and reconstructed in conditions of permanent uncertainty. So, social identities arise as dynamic entities and not as "objective data" or "subjective feelings". As Dubar states, "the social identity is not more than the result simultaneously stable and provisional, individual and collective, subjective and objective, biographic and structural, of the several socialization processes that, together, individuals and institutions construct" (1997, p. 105). In his view, with the notion of social identity we can go further than with the classical notions of group, class and category (of macrosociology) and role and status (of microsociology), as it "introduces a subjective, lived, psychic dimension in the kernel of sociological analysis" (p. 105).

Modern psychological and sociological theorists speak of decentring, displacement, or fragmentation of the subject, a phenomenon that is increasingly occurring in our society, according to which individuals assume multiple identities (Bruner, 1990; Hall, 1999). We have not one but several identities, sometimes contradictory and unsolved. The processes of identification, through which we project ourselves in our cultural identities has become more provisional, variable and problematic.

One of the factors that contribute to this change in the nature of social identities is information and communication technology, specially the Internet. This is a multisided new media. It is an immense assembly of resources with information about events, news, documents, papers, lesson plans, *software*, and so on. It also enables the publication of our own productions, making them available to a wider public. But, more than an instrument of

gathering information and disseminating educational products, the Internet provides the possibility of virtual interaction among people, including teachers, pupils, parents, future teachers, teacher educators, scientists, professionals, politicians, and many other social agents. The participants in these interactions form groups and networks that may be regarded as virtual communities, since their interactions are made through the cyberspace. The Internet constitutes, therefore, a new cognitive and social ecosystem in which individuals may embark in a process of adapting and restructuring their relational and cognitive activity, with possible consequences in the ways they view the world and they regard themselves. The extent to which this may happen and the specific features it may take are issues to be explored, notably as they affect mathematics teachers.

## Methodology

This paper addresses a distance education in-service study circle that was attended by 36 teachers, 34 of who completed it with success. A most prominent feature of this study circle was that teachers were required to register and work in pairs. They had to read mathematics education papers, conduct searches on the Internet and complete several written assignments, some of which involved observation and reporting about their classrooms. Further details about the structure and activities carried out during the course can be found in Santos and Ponte (2003).

The study circle was evaluated by an external team during and at the end of its activity. Data was gathered from open-response anonymous questionnaires responded by the participants. The documents provided in the course and the assignments produced by the participants were analysed. The meetings of teacher educators were observed and the messages exchanged by the participants and teacher educators and sent to the discussion list were analysed as well. To study in detail the experiences of six teachers who participated in the course, there were also in-depth case studies of three groups, based in face-to-face interviews. This paper draws mostly on the results from the questionnaire and two of these case studies.

## Results

### *General evaluation*

As indicated by the responses to the questionnaire, the distanced education course was generally successful in attaining the set goals. Teachers become more aware of the issues involved in carrying out investigations in their mathematics classes, had opportunities to work closely and face to face with the colleagues with which they developed a close collaboration and to discuss at distance with their teacher educators and other course participants. Furthermore, most of the teachers found the structure of the course, the materials provided, and the tasks proposed useful and adequate for their professional development. Some of the responses underline this:

My commitment to the study circle was strong and fruitful. The discussions towards the preparation of each assignment were rich and involving.

This distance format led my commitment in this study circle greater than in any other in-service course that I attended during the school year.

In their responses, there are hints pointing to the development of new aspects of a professional identity. In special, these concern the attitudes of the participating teachers regarding reflection and regarding their relationship with information and communication technology.

In fact, about half of the teachers indicate that, in one way or another, they developed a more reflective stance regarding classroom practice and professional practice. This is illustrated by the following responses:

I reflected, I was questioned, I was commented, and I was evaluated about my views regarding mathematical investigations (...) The study circle represented a reflection about our own conscientiousness; we stopped to reflect about our professional life (...) I feel that the study circle led me to assume my own conscientiousness.

We felt the need to reflect about our own practice. We had already carried out several investigation activities with our pupils (more or less guided) but we had not stopped to reflect in an organized way about such classes.

The teachers also indicate several reasons that promoted such reflective stance. These included (i) working with a partner in team work, what, as one said, “yielded good opportunities to reflect about our activity”; (ii) the material provided, since “in the papers we also found hints to reflect”; and (iii) the questions made by the teacher educators, as those “helped in the development of my reflecting and analysing ability”. As a result of such reflection, two of the teachers indicated that they changed some of their conceptions regarding mathematics teaching:

I was led to reflect about issues already addressed in my master’s course (...) that I ended up seeing in a different way.

I changed the meanings that I ascribed to several things that I had got from the ProfMats [national meetings of mathematics teachers], publications, NCTM Standards...

Most of the teachers who had poor skills in using information and communication technology developed them and others recognized that this was a useful way to get materials to use in their teaching practice:

I learned how to use the Internet.

[I got to know] a lot of information from the Internet (essential in this kind of work), that I was not aware before.

I also learned that it is complicated to do searches on the Internet... Some perseverance is necessary to find good material.

Overall, these results point towards a positive stance regarding reflection, collaboration, and relationship with the Internet. However, there was a wide variation of working experiences in this course, as the following cases show.

### *Case 1*

One of the groups included two teachers, Isaura and Anabela, who worked in different schools. They had met a couple of years before, when Anabela was doing student teaching and Isaura was the cooperating teacher. Since Isaura was much more experienced, we may regard this as a heterogeneous group. They were very interested in getting “practical” ideas, that they could take to their classrooms and regarded with little interest all that they consider “theoretical”. They viewed the discussion list as a place where theoretical

discussions could be carried out and they had little participation in it. Isaura and Anabela showed interest in interrogating some aspects of their practice, notably those more closely related to the mathematical content to be taught. They carried out productive work during the course, although they had a difficult moment when the teacher educator indicated that they had to reformulate one assignment.

These two teachers enjoyed the fact that they could work in a very flexible way and had not to displace themselves to attend meetings in a teacher education institution. However, they indicate that they missed the face to face interactions:

At the beginning I missed the personal contact between us and the teacher educators and the other groups... (Anabela)

This is a weakness. We are used to [direct] interpersonal relationships, to discuss face to face. And we are not used to do this at distance (...) It was difficult to be working and not to have immediate feedback from the other side. (Isaura)

The activity of the course required a lot of writing (messages to the teacher educator and to the discussion list and tasks that had to be delivered at certain times). However, these teachers did not seem at ease to express themselves in writing. Isaura recognized it explicitly: "We find it difficult to express our opinion in front of a computer". The tone of their messages was formal, just saying the strictly necessary. This is in sharp contrast in the warm way they relate to other people in face-to-face settings.

These two teachers see in a very positive way the fact that in this course they do not work in isolation but in groups. In their view, working at a distance could become painful: "One person is completely isolated" (Isaura). In their perspective, groups must be made up of people that like to work together: "I like if it is with someone that I like to work with" (Anabela). That is, they see working with a partner mostly as a motivation to overcome the difficult parts of this course.

These two teachers do not report problems in dealing with information and communication technology. Isaura claimed to be experienced in using this technology, especially "to search things" in the Internet. Anabela recognized to have little experience, but indicated that in the study circle "she could do everything that was required". However, these teachers had some trouble in interpreting what was asked from them in the tasks proposed. These difficulties were solved through e-mail messages exchanged with the teacher educators.

In summary, these two teachers showed interest in questioning some aspects of their professional practice, notably those closely related to the topics that they had to teach. However, they showed little interest in analysing aspects related to the curriculum or the classroom dynamics, that they found as too "theoretical" and, therefore, with little relevance to their practice. They were able to use the information and communication technology to gather information and interact with the teacher educators but felt rather uneasy about this form of communication and reported to miss the face to face interactions of usual teacher education courses.

## *Case 2*

Before they were involved in this distance teacher education course, Julia and Maria, together with two other colleagues, constituted already an informal working group carrying out several professional activities. They used to meet face to face once a week and exchanged constantly e-mail messages among themselves (according to Maria, about ten

daily messages...). They recognize that the participation in the course led them to write much more than they usually do. Julia stated that this was quite positive:

There is an aspect that may be rather specific but that I feel since a long time. Many times we have very interesting experiences and we discuss issues, and so on, and we always postpone writing, passing into the paper, recording. This distance education setting requires that we write.

At first, these teachers reacted negatively to the limit in to the number of words that they could write in their assignments. But, with time, they recognized that such limitation led them to a deeper reflection about what they wrote:

That may be an aspect that created discipline in us, in the sense of reflecting again, improving, and fixing the essential things and also helping us to focus objectives that otherwise would remain somehow diluted (Julia).

Writing does not seem to be for Julia and Maria a natural mean of expression but they recognize its importance in their professional practice. According to the teachers, their dynamic of collaborative work become stronger with this course, which made a significant contribution towards their professional development:

Both as a pair and individually, we assumed our professional personality, and that is deeply gratifying (...) Working in group helps to share the competencies of each person and helps to overcome personal inhibitions because of the friendly and responsible commitment of each one with herself and her partner. (Julia)

Julia and Maria show high interest in reflecting about their practice and in carrying out activities steaming from such reflection. They look for ideas arising from their experience, from the work of other teachers, and from professional and educational literature. They read the papers suggested in the course with interest and used them to analyse what went on in their classrooms. They show great commitment in acting in their classrooms but have also high concern with what happens in their professional community, recognizing that it will take a long process so that it grows in activity and influence.

For us, communicating at distance (searching the Internet, communicating by e-mail, and so on) was already a routine activity. But it was interesting to experience in the study circle the creating of patterns of communication between us (...) and the teacher educator. (...) We felt that it is necessary and urgent to create among teachers a communication culture such as this, in which people feel free to participate, within rules of politeness, without hurting each other.

These teachers had already a strong professional experience and had previously developed many professional projects. They were used to work collaboratively and to make intensive use of the Internet. In this course, supported by the technological media, they were able to assume a productive division of tasks and had the experience of reflecting and writing about professional issues. As a result of this process, they report to become more confident about curriculum and professional issues and developed a stronger sense about their professional culture. Julia and Maria, who are able to take advantage of information and communication technology in a very flexible way, constitute indeed a very unique group, showing strong professional commitment.

## Conclusion

Teachers involved in this study circle experienced a process of professional development in their knowledge regarding mathematical investigations and in their ability to carry such activities in the classroom. As it was shown above, many of them developed a more reflective stance and had a positive experience of professional collaboration. Some

of them also developed their inclination to use information and communication technology for professional purposes. Such evolution may be regarded as pointing to changes in their professional identity.

The professional culture of teachers tends to be strongly individualistic (Feimennemser, 1986; Hargreaves, 1996). However, information and communication technology, used in a formal way in distance education courses and used in an informal way in professional exchanges, provides an opportunity for teachers to develop a dimension of virtual interactions with other teachers. In some cases, these interactions may become strong enough that we may speak of virtual communities. We may also have groups of teachers for which the face to face and virtual interactions are interrelated in a strong and fruitful way, as with the case of Julia and Maria reported in this paper.

Mathematics teachers generally have a difficult relationship with writing. Many of them are used to think that they express themselves fluently with numbers and symbols but not using natural language. However, the stress in written communication was an important feature of this in-service activity. Teachers had to read mathematics education papers, had to turn in written assignments, had to communicate by e-mail with the teacher educators and had to participate in a (written) discussion list. For most of them, this was not a normal way of expressing and some felt rather uneasy about it. But there is ample evidence that the emphasis in writing helped teachers to think professional issues in a deeper way and helped to promote a more reflective stance. Julia and Maria even recognize that this form of expression may become an important feature of the professional culture of mathematics teachers.

The teachers who participated in this study circle were different in many regards. For example, Anabela was just learning how to use information and communication technology; Isaura could do searches in the Internet but did not use it for communication purposes; Julia and Maria were already quite experienced and intensive users. The distance education study circle appeared to help all these teachers to explore new ways of using this technology – downloading papers, exchanging documents, discussing issues by e-mail, and participating in discussion lists. Of course, a deeper involvement in communicating and interacting through electronic media is not a process that develops in just one step, much less just during a single in-service experience. However, the course format, stressing reflection on practice, connection to theoretical ideas, writing about professional issues, collaboration among teachers, and interactions of teachers and teacher educators put an emphasis in professional values that may be regarded as significant in developing a new professional identity of mathematics teachers.

This experience shows the potential of open learning distance teacher education stressing collaboration and writing and opens up interesting issues for the design of in-service activities and resources. It also raises questions for further investigation regarding the tendencies and constraints of teachers changing professional identities supported by virtual learning communities. Other course formats can be designed, with similar or different features, and we can think of more informal ways of using the Internet to support the interactions, written reflections, collaborations and exchanges among teachers as well as interactions and collaboration involving teachers and teacher educators. It will be interesting to know what these media and these forms of work may bring to mathematics teachers who want to develop professionally and what that may mean in terms of developing new sides of their professional identities, perhaps in a stronger relationship with the written word and with a greater appreciation for reflecting and collaborating practices.

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