Using ICT to support reflection in pre-service mathematics teacher education[1]

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Abstract. This paper analyses a virtual supervision setting (e-mail and forum) during the practicum in a pre-service secondary school mathematics teacher education program. It is a study of the authors' own professional practice using a qualitative-interpretative approach and case studies of student teachers. The results show that the setting was significant for pre-service teachers who had a more reflective attitude, but was seen as a burden by the others. The forum enabled fruitful reflections and discussions and e-mail was mostly used for organizational matters. In the future, attention must be paid to the role of the educational supervisor in fostering participation in the forum and use of e-mail.

Keywords. Preservice mathematics teacher education, Information and Communication Technology, Virtual interaction, Reflection.

Resumo. Este artigo analisa um dispositivo de supervisão virtual (e-mail e fórum) durante o estágio num curso de formação inicial de professores de Matemática do ensino secundário. É um estudo dos autores sobre a sua própria prática profissional usando uma abordagem qualitativa e interpretativa e estudos de casos de futuros professores. Os resultados mostram que o dispositivo foi significativo para os futuros professores que tinham uma atitude mais reflexiva mas foi visto como um "peso" pelos outros futuros professores. O fórum permitiu reflexões frutuosas e discussões e o e-mail foi principalmente usado para matérias organizacionais. No futuro, deve ser dada atenção ao papel do supervisor educacional em promover a participação no fórum e o uso do e-mail.

Palavras-chave. Formação inicial de professores, Tecnologias de Informação e Comunicação, Interacção Virtual, Reflexão.

This paper addresses the possibilities of Information and Communication Technologies (ICT) in developing a virtual communication interface between supervisors and student teachers during the practicum. In Portugal, practical experience is an important part of secondary school pre-service teacher education. It gives the candidate teacher the opportunity to teach regular classes, to participate in school activities such as teachers' working sessions and tutoring, and to attend seminars with school mentors and university supervisors. The fundamental motivation underlying the creation of such a virtual interface lies in the interest of the authors, who are simultaneously teacher educators and researchers, in finding ways to achieve closer contact with student teachers and encourage their reflective attitude.

ICT as a support for communication in the teacher education practicum

Newly-qualified teachers face difficult problems. Hammond (2001) states that they can usually identify five key problematic issues: pupils' attitudes to the proposed tasks, pupil misbehaviour, lack of support from colleagues, inadequate lesson planning, and bureaucracy. The practicum has two main resources for dealing with such problems. One is the support of the supervisors, especially the school mentor and the university supervisor through clinical supervision. This supervision places great importance on the classroom and assumes that the student teacher has a critical role in identifying, diagnosing and overcoming the difficulties with the help of the supervisor (Alarcão & Tavares, 1987). The other resource is the practicum group2 and the other participants (student teachers and supervisors from other practicum groups), as they work in a collegial style, discussing, experimenting, and criticizing.

The potential of ICT as a working and communication tool for the teacher, notably as a support for the development of a new professional culture emphasizing virtual learning and sharing networks, has been widely recognized (Ponte, 2000). For example, e-mail has been used as an element of the supervision setting in pre-service teacher education. Yildirim and Kiraz (1999) found that student teachers and supervisors who use electronic mail regard it as an important communication tool, but have a very varying level of use. Also, Souviney and Saferstein (1997) explored the possibilities of electronic communication in clinical supervision of student teachers and found that clinical messages exchanged between supervisors and student teachers could attain remarkable weight within the e-mail correspondence (32% of messages).

The forum has also been used in pre-service teacher education. For example, in a study carried out by Heflich and Putney (2001), the discussion of professional issues in a restricted conversational space was carried on for 11 weeks. They indicated a good level of argumentation but also a great variation in the number of contributions from the 22 participating student teachers (between 19 and 2 contributions each). Also, Bodzin and Park (2000) carried out a study using a public forum and concluded that student teachers' discourse depends on their level of interest in the topic, its immediate relevance to each participant, and on interpersonal factors among participants.

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[2] In Portuguese, "núcleo de estágio". Each practicum group usually includes two or three student teachers, a school mentor, a scientific supervisor and an educational supervisor.

In a study about teaching cultures, Harris and Anthony (2001), refer to two main kinds of collegiality: "collegial interactions that helped produce an emotionally supportive work environment and collegial interactions that truly engendered significant professional development" (p. 384). In their perspective, collegiality that provides emotional support does not necessarily promote professional development. For these authors, "[e]stablishing teacher networks and developing a culture of teacher inquiry, holds some promise for reducing the randomness or serendipitous nature of professional development" (p. 386). In their view, such teacher networks, made up from groups that establish conversations out of school, both electronically and face to face "show great potential as sites for focused, ongoing, and self-directed inquiry by teachers" (p. 386).

This suggests that a virtual supervision setting, including communicating by e-mail and discussing in a forum, involving student teachers and supervisors, holds potential promise. However, the great variety of possible options regarding the objectives and working models of this kind of setting suggests that empirical research is necessary, based on the realities and needs of each particular program.

The virtual supervision setting and research methodology

This experience involved the creation of a virtual supervision setting, including a discussion forum and e-mail communication, during 2003/04, for 3 practicum groups involving 6 student teachers, all in the 5th year of the secondary school mathematics teaching degree at the Faculdade de Ciências da Universidade de Lisboa. This setting worked in parallel with the usual activities of the practicum, which include work in the school (preparing and teaching classes, reflecting on them, participating in school events and seminars), activities with the scientific supervisor (preparation and presentation of mathematics topics), activities with the educational supervisor (reflecting on classes, discussing educational problems, doing an educational project) and activities promoted by the university with all student teachers, mentors, and supervisors. The main aim of the virtual supervision setting was to provide a more permanent support to all student teachers and favour the development of a reflective attitude.

The virtual setting was constructed by the project team. The discussion forum and e-mail were viewed as resources with complementary potential. Both involve a written mode of communication. The forum enables sharing and discussing issues arising from

professional practice as well as wider educational questions within a broad group of student teachers and supervisors. The e-mail aims to strengthen the critical and reflective dimensions of the supervision process. This type of communication, unlike the forum, is restricted to the practicum group or to some of its members. It is the student teacher that must ultimately decide if a given issue should be raised in the forum (wide discussion), sent by e-mail (restricted discussion) or discussed by another means. The forum had two phases, November to February and March to May, and was moderated in each phase by two members of the project team. In order to facilitate the participation of student teachers, some themes were established (Table 1). Also, to clarify expectations regarding contributions to the forum and sending messages by e-mail, some rules were established (Table 2). Student teachers were informed that their performance in this experience would constitute an element for the overall assessment of the practicum. However, it was indicated that participation in this virtual setting would not replace the development of the usual activities of the practicum, including an extended educational project, proposed by the educational supervisor.

Table 1 – Forum working procedures

The participation in the forum is organized according to three main themes:

- Critical incidents (e.g., concerning pupils' behaviour, pupils' understanding of mathematics, managing the classroom);
- Post-class reflection (e.g., suitability of tasks for the pupils, pupils' involvement in the proposed tasks, communication in the classroom);
- General educational questions.

Every two weeks, each pre-service teacher must send to the forum, at least,

- An original contribution (question, experience,…).
- A reaction to a contribution of another participant.

The reactions to previous contributions may be from the group of pre-service teachers. The original contributions will always be individual.

Table 2 – E-mail working procedures

The messages that pre-service teachers send to supervisor(s) by *e-mail* must relate to:

- Sending lessons plans in advance,
- Permanent contact (work planning and development);
- Clinical discussion.

Sending lesson plans is individual. Messages concerning clinical discussion and permanent contact may be individual or from the group of pre-service teachers. The supervisor responds individually to individual messages and collectively to collective messages.

To attain a better perception of the virtual supervision setting in the practicum context, a face-to-face meeting was held halfway through the school year. This meeting had two main points. First, student teachers from each practicum group presented an extended reflection on an activity they had carried out in relation to pupil assessment. This topic was selected because it was widely discussed in the forum. Second, they provided their view on the development, at the time, of the virtual supervision setting. This meeting was held with the participation of all student teachers, school mentors, educational supervisors and members of the project team.

This study follows a qualitative-interpretative approach. Six case studies were carried out, one of each student teacher. Given the roles of some of the members of the team, as educational supervisors in the virtual supervision setting this research constitutes an investigation into their own professional practice. Data analysis included the responses of student teachers to two semi-structured interviews, one carried out at the beginning and another at the end of the study and the messages that student teachers and education supervisors sent by e-mail and to the forum.

Student teachers' views on the virtual supervision setting

Using e-mail

During the year, e-mail was mostly used to set up meetings, organize activities, send working documents and, in some cases, clarify specific questions. However, there was a

range of different ways student teachers related to e-mail. One of them, Francisco[3], has been a confirmed Internet user since his fourth year at university, both for searches and communicating with friends. During the practicum, he used e-mail regularly to contact the educational supervisor – just by himself or with his partner Rogério, he sent 19 messages - an average of 3 messages by month (Table 3). When the messages included his partner, the subjects tend to be general, such as ways of using the practicum web site and the e-mail, the plan of activities, preparing and presenting lesson plans, and working sessions at the school and the university. When he is the only sender, the messages tend to address specific issues such as the pupil profiles, lesson plans, ways to reflect on lessons, pupils' assessment, and discussion of classroom episodes.

Table 3 – Messages exchanged by e-mail between Francisco and his partner Rogério and the educational supervisor

Number of messages	From	To
10	Francisco	supervisor
9	group	supervisor
10	supervisor	Francisco
17	supervisor	group
46	TOTAL	

Concerning the practicum, Francisco and Rogério usually exchanged ideas and files at home by Messenger. By the end of the school year, when he and his partner were publishing their educational project on the Web, they used mostly cell phones and text messages to contact the supervisor because they needed a faster reply.

Another student teacher, Sílvia, used e-mail in the previous year, namely to contact her university instructors. She feels that this is a good way to send them classroom instructional tasks, to discuss, ask questions, or solve small problems. During the practicum, she used e-mail occasionally to communicate and send materials to other student teachers. With her educational supervisor, she used e-mail to send lesson plans and reflections on her educational project, as well as to arrange meetings and clarify details regarding classroom observations. She has no problem in using e-mail to solve

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[3] All the student teacher names are pseudonyms.

minor problems but she does not see it as a good means to reflect about complex and important issues – for those she prefers a face-to-face conversation. Sílvia uses e-mail, as required in this setting, but is not particularly enthusiastic about it.

A third student teacher, Alda, has little interest in ICT. She reports only using e-mail "if it is absolutely necessary". To speak with other people, she prefers to use the telephone or to meet in person, as she finds machines "very impersonal". For her, e-mail is efficient for contacting university teachers and supervisors, but "it is not a way to speak with friends". At the beginning of the practicum she had access to the Internet at home, but after January that was no longer the case, so she only sent one message to the educational supervisor - to arrange details of a lesson observation. The few e-mail messages exchanged between this practicum group and the educational supervisor were sent by her partner Carlota.

All student teachers agree that e-mail interactions should not replace face-to-face interactions in supervisors' visits to schools. In fact, in this experiment, that did not happen, as e-mail was mostly used to help organizing activities and sending documents. It remains to be seen (i) in what circumstances student teachers may develop a willingness to write messages regarding professional problems, and (ii) how to overcome the difficulties in establishing a closer relationship between them and the educational supervisor. These two conditions are necessary to enable e-mail to have a significant role in clinical support for student teachers, when face-to-face contact is impossible.

Using the forum

The forum was designed to discuss questions of common interest to student teachers. In the first phase (November to February), it began with three themes (Critical incidents, General educational issues, and Post-lesson reflection) and, in the second phase (March to May), there were just two themes (General Education and Didactics of Mathematics issues). As we noticed that in the first phase very few messages concerned specific mathematics education issues, for the second phase, we established a new theme to promote reflection on problems related to teaching and learning mathematics (Table 4).

Table 4 - Examples of messages sent by student teachers to the Didactic of Mathematics forum

Message	Sender	Content
1	Project Team	Welcome message to the forum.
2	Estela	This was a detailed description of the initiative of Estela and Silvia in setting up a mathematics laboratory in their school, aiming to motivate pupils towards mathematics through interesting activities and materials. She comments on their initial difficulty in attracting pupils to visit the room and then she describes how those who come got involved with high enthusiasm in the activities. She also asks herself why so many pupils have a negative view of mathematics.
3	Francisco	Reply commenting the involvement of the pupils in the activities and related a similar experience in his school's annual mathematics week, which included a room with mathematical games.
4	Francisco	Introduces a new topic, mathematical modelling. He discusses how this topic is considered in the secondary mathematics curriculum and proposes to address it in a more explicit way than what, in his view, it is usually done by teachers.
5	Sílvia	Introduces a new topic – mathematical essays – that she used in her grade 8 class, in the chapter in similarity of figures. She was pleased with the work of some pupils but sorry because others had not done it. She describes her strategy and the directions given to pupils and reflects on her difficulties, notably in evaluating the essays.
6	Rogério	Describes an experience on using the Internet to do a statistics study. He reflects on the involvement of his pupils in this activity.

Francisco provided quite a significant contribution to all forum themes. He sent a total of 12 messages (2 of them together with Rogério), some as original contributions and some as reactions to issues raised by other participants. However, he feels he participated less than he would have liked to.

His first individual contribution took some time to appear and he speaks of that experience:

I remember that I had some difficulty in the beginning to send the first message. My problem was to find issues that I thought were relevant for the forum. [...] What can I say that is relevant enough for others to answer my question? I felt that problem many times...

In the second phase, he sent two contributions, one original and one reaction.

Sílvia also refers to writing texts for the forum as a difficult task, taking up a lot of time. It was necessary to start by choosing a theme that could be interesting to others. Besides, she had to program her participation in the forum so that she had the time to think and write a message:

At some point I had set up a schedule to reflect and to think on the theme. Because sometimes we have many themes, many things... […] Sometimes it took so much time to answer… In the meantime there were thousands of things that I would like to say but then I had difficulty in coordinating all the ideas so that they were not very confusing [for others] and that was difficult.

She feels that there was some limitation in her participation in the forum because she was afraid of exposing herself too much before her colleagues. She took a lot of care with what she wrote because of the image she might project and she feels that the same was true for the other participants. When asked whether she was afraid that their messages were not well interpreted by others, she replied:

It was more because I felt exposed [...] The student teacher, at some point, draws a limit, isn't it? Up to a certain point we talk but then, perhaps, it is better to stick to my practicum group, to my supervisor...

Another student teacher, Alda, states that her weak participation in the forum is also related to some inability to attain the aimed goals – "the goal was that [we problematize practice]. We couldn't get there". In her view, that happened because of their lack of experience as teachers: "One person is not [...] I mean, has no experience [in teaching] to understand some things and understand that they should be discussed".

All these student teachers mention that they had difficulties in writing to the forum – choosing the topic, deciding on the content, finding the appropriate form, finding the time needed for this task. Three factors seem to contribute to those difficulties. First, the lack of fluency in the written language, as student teachers in

general write little and often have an uneasy relationship with this form of communication. Second, the lack of knowledge about this new way of communication and the fear of being negatively assessed, since writing to a forum is similar to speaking to a room full of people that one cannot see. Third, student teachers still have little conceptual and discursive means to reflect on educational problems and classroom situations, as they are still at the beginning of their professional careers.

Another problematic aspect of the forum was its dynamics. For example, Sílvia indicates that she was disappointed with the interaction that, in general, she had with the supervisors in that context. Because she was permanently in touch with her school mentor, she had a high expectation regarding the feedback of her educational supervisor, given her broader experience and knowledge:

> I expected perhaps more from the supervisors and the other teachers [...], that is, more answers... According to their experiences, according to their work, isn't it? From the student teachers I expected more "Oh, this also happened to me!" or "I did it this way or that way", but not quite as an answer.

We must note that the dynamics of the forum varied with time. In the first phase, some themes had several contributions. But when the forum was not active with new messages from student teachers that had a demobilizing effect. In fact, the role of the supervisors in the forum proved to be a rather difficult issue. Should they wait for the initiative of the student teachers? Should they raise issues and provide comments? There was a permanent tension between the supervisors' non-directive stance and the student teachers' expectations regarding their participation.

Pre-service teachers' experiences

Despite his dissatisfaction with certain aspects of the forum, Francisco elects it as the stronger side of the virtual setting. He considers that the forum provided him a good opportunity to raise and share his questions, doubts and experiences:

> Although I know Sílvia, Estela, Carlota and Alda, perhaps, if I was at the college or on public transports or at the coffee shop with them, I would never raise questions that really worry me in the practicum. Perhaps in that

sense the forum wins points regarding the e-mail and direct contact because [it is] a space targeted for this kind of issues.

As a consequence of his enthusiastic relationship with ICT and his committed and reflective attitude, Francisco had a very positive involvement in the virtual supervision setting. He considers that it enriched the practicum and his partner Rogério has a similar opinion.

Sílvia is also a very responsible and committed student teacher but she is not an enthusiast of communication using ICT. She had a difficult experience in the practicum, dealing with unmotivated pupils, some with special educational needs. During the year, she had trouble in dealing with many situations. She used the forum to reflect on these issues, electing it as a privileged means to problematize her practice. Therefore, the forum provided her with a significant space for reflection. Sílvia was disappointed for not having more comments on her messages but, even so, she reports receiving emotional support and incentive from the forum to continue her work. She mentions her gaining from her colleagues' contributions as to how to act in some situations. In the final interview she says that she finds it interesting to interact with more people and receive more opinions. Although still preferring face-to-face interaction, Sílvia has a positive image of the formative possibilities of virtual supervision.

Other student teacher, Alda, admits that ICT provides an efficient communication means, but she indicates her uneasiness, as she finds it "rather impersonal". She says that "If I don't know what people are thinking about […] I cannot find the proper words". This student teacher recognizes that her use of the Internet increased with the practicum but relates that to a need to search for materials rather than a need to communicate. In general terms, Alda considers that the virtual supervision setting was of "little significance" to her professional development. Even so, she considers that ICT promoted collaborative work among the several practicum groups, which would have been impossible in another way.

Conclusion

The aim of improving the communication between educational supervisors and student teachers was partially attained with this experience. The ICT setting provided student teachers with opportunities for reflection that were important for some of them.

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Furthermore, this study yields interesting contributions regarding the role of virtual interactions during the practicum.

First, it is necessary to clarify what is sought with the setting. If the main aim is to strengthen the possibilities of clinical supervision, the main instrument that the educational supervisor needs to stress is an individualized communication means such as e-mail. If the aim is to promote student teachers' reflective capacity through the development of a virtual community or a learning network, then it makes sense to stress the discussion forum – paying close attention to the quantity and quality of its messages, and to the role of the supervisors in it.

Second, it is also necessary to reflect on the kind of didactic and assessment contract that is established – is participation compulsory or optional, totally informal or used for the student teacher's evaluation? As with any other element of the supervision setting, the contract has strong implications in the way the activity is viewed by participants and in the learning experiences it yields.

Third, no matter what kind of contract is established, it should be noted that there are always barriers that need to be taken into account. As the case of Alda clearly indicates, if access to the Internet is not easy and reliable, it is impossible to expect serious involvement from student teachers in this kind of setting. With the logistic problems overcome, there are other difficulties that arise such as lack of time, uneasiness in writing contributions, as we see for the student teachers that participated in this study. We pointed out several factors that may contribute towards these difficulties and that require the development of writing fluency, familiarity with the new medium and the development of the capacity to analyse and reflect on professional problems. These are factors that the supervisor needs to pay attention to, and help overcome with his or her participation in virtual and face-to-face communication. The problematic activity of this setting shows that the supervisor needs to have a fundamental role, because, besides creating new opportunities of interaction, he or she needs to give an explicit and positive contribution to foster positive experiences of discussion and reflection.

The most committed and reflexive student teachers assess positively the experiences that they had with this virtual setting. The other student teachers' assessment is not so positive, which seems to be related to their lower commitment in the practicum. The challenge, here, is how to turn this kind of activity into a valuable

learning experience for all participants, but that is an issue that goes far beyond the ICT supervision setting and concerns all practicum processes and activities.

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