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Bianca Maria Varisco

Psychological, pedagogical and sociological models

for learning and assessment in virtual communities

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Introduction

The keywords in this collective work include community of learning, inquiry or work, virtual environments and identity. This volume presents the results of a biennial Italian research project (PRIN 2005-07) which was coordinated nationally from the University of Padova, with Bianca M. Varisco as principal investigator. The research involved five units with local coordinators (Padova – B.M. Varisco, Bari – M.B. Ligorio, Roma, Sapienza – D. Cesareni, Milano Cattolica Sacro Cuore – C. Galimberti, Macerata – P.G. Rossi) and also the Universities of Trieste, Milano Bicocca, Valle d'Aosta, Bologna, Udine, and Cassino.

The *interdisciplinary* nature of the research meant close collaboration between pedagogists, educational-, communicational- and social-psychologists, and ICT technologists and scientists. The aim was to analyse, develop and verify online environments. The study was focused on virtual communities and their internal actions and interactions. These communities vary greatly in nature, and were formal and informal, academic and professional, and comprised graduate students, post graduate students, teachers, patients and psychotherapists. The research developed, and the models studied also surveyed, deepened and reported on, the educative, cognitive, social, affective-conative and evaluative aspects of virtual communities. Indeed, from a theoretical point of view, an attempt was made to combine the psychological, pedagogic and social perspectives, identifying useful inter-connection points and deepening the cognitive, meta-cognitive, inter-subjective, identity creating and cultural aspects which take shape in the online community. Working tools and environments were studied, developed and field tested for supporting and promoting virtual communities. The modalities of personalization, co- self-assessment and skills improvement were also invented or planned for these communities.

In Chapter 1, the Unit comprising Roma Sapienza, Milano Bicocca and Valle d'Aosta Universities carried out research into *tutorship styles and knowledge building* in online communities. The inquiry involved students from the same three universities. Two tutoring styles were investigated: destabilizing and supportive styles. The second style was

found to give better results regarding student achievement, and also in supporting *metacognitive processes* themselves.

In Chapter 2, the Bari University Unit focused its inquiry on *identity building in virtual "communities of practice"*. Formal and informal online forums were investigated, and online and offline interactions were also compared. Building and sharing positioning, participation strategies, *intersubjectivity* and sense of belonging were observed. The latter aspect was found to be the product of an ongoing opening of the *self* to the *other*, with the transformation of references to "me" and "you" into references to "we".

In Chapter 3, the Unit comprising the Universities of Padua and Bologna again took up the topic of identity, in particular *professional teacher identity in pre- and in-service students* attending academic courses in primary school teacher education. Various student groups were involved in an online forum: full time students, beginner student teachers and advanced beginner student teachers, with or without "supportive" tutoring. The forums regarding dialogical *process* (case-work) and *product* (individual reflections on teacher identity) were investigated using an *integrated mixed method*. The outcomes suggest the adoption of an innovative online education methodology for in-service teachers: emergent and participated "self-analysis" in *virtual communities of dialogic practice*.

In Chapter 4, Macerata and Udine Universities identified *indicators artefact to supporting academic tutors and teachers in a real time analysis of interaction in online courses*. These indicators and tools were tested in the online Masters course at Macerata University. The outcomes also give some *guidelines* about the use of IT tools for monitoring the learning process.

Finally, in Chapter 5 the Unit comprising Milano Cattolica "Sacro Cuore" focused their attention on the *mobile use of immersive 3D virtual environments* where patients and psychotherapists interact in the therapy and treatment of anxiety disorders. The immersive virtual environment is defined as *user-centered* and developed in a *preventive ergonomic* function.

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Bianca M. Varisco, University of Padova
Padova, December 2007

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Chapter 1

Tutorship styles and knowledge building in an online community: cognitive and metacognitive aspects

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Abstract. This chapter reports research conducted within the strand of inquiry that investigates the educational efficacy of online learning environments. It is mainly concerned with definition of the optimal forms of tutoring within collective discussion, and with possible changes in the cognitive and metacognitive skills of students. The introduction at three Italian universities of courses designed for collaborative knowledge building enabled the collection of quantitative data by means of questionnaires which surveyed the students' self-regulation skills and study goals, while qualitative data were collected by examining the students' interactions in forums and their final reflections on the course. The data were analysed by considering variables relative to tutoring style (supportive versus destabilizing), the way in which

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the e-learning activity was organized (presence or otherwise of metacognitive reflection), and participation by students (high versus low). Analysis of messages to the online forum depicted a tutor who encourages students to participate by intervening to a limited and sporadic extent, and using a mainly supportive style. The online activity did not seem in itself to increase the students' metacognitive skills as measured by the questionnaires, but such skills were apparent in the students' final assessments of the experience. The quality of the online interaction was also influenced by the presence of opportunities to reflect upon it.

Keywords: e-learning, e-tutor, metacognition, knowledge building, virtual communities.

1. Introduction

Online learning (or e-learning) is a form of distance instruction and training which affords new educational opportunities to both academic institutions and students – especially those who cannot attend on-site courses for various reasons. E-learning has spread widely in recent years, especially in North America, where in 2001 some 80% of universities offered online courses (American Federation of Teachers, 2001). From the economic point of view, in Europe in 2002, investment in e-learning amounted to more than 6 billion dollars, and it then almost quadrupled in 2006, so that the prospects for the future are obvious (Bonaiuti, 2006).

As regards the situation in Italy, recent surveys (Riccio, 2003; Cantoni and Esposito, 2004) on e-learning initiatives report that in recent years increasing numbers of Italian universities have set up centres for the design and management of courses delivered online. Currently, 54% of the 45 (out of 77) universities replying to the Cantoni's and Esposito's survey state that they have introduced e-learning schemes integrated with study programmes, while 46% have introduced them experimentally. E-learning is therefore spreading rapidly in higher education, and for this reason has been the subject of numerous studies.

Indeed, there is by now a large body of research, both national and international, on the efficacy of online learning environments. Such environments, based on web forums for university online tutoring, have been trialled both internationally (Scardamalia and Bereiter, 1992; Scardamalia and Bereiter, 1994; Muukkonen Hakkarainen,

Lakkala, 1999) and in Italy (Cesareni, Ligorio, Pontecorvo, 2001; Cacciamani, 2001; Cesareni and Martini, 2005). According to these studies, web forums enable efficacious and productive learning only if they are centred on collaborative knowledge-building: that is, only if the students work together to develop ideas, to compare them, and to solve shared problems (Lakkala, Rahikainen and Hakkarainen, 2001). Indeed, numerous studies stress the advantages of using online environments for educational purposes. They emphasise in particular that online discussions can do the following (Hsu, 2004):

- enhance learning through the integration of conflicting viewpoints, information, and ideas on a shared topic of study (Clark and Slotta, 2000; Hoadley and Linn, 2000; Linn, Davis and Bell, 2004);

- foster conceptual change (Fishman and D'Amico, 1994) and metacognition (Park, 1999; Cacciamani, 2003) by means of cooperative activities;

- encourage students to use new problem-solving strategies by having them collaborate on authentic tasks (Herrington, Oliver and Reeves, 2003);

- develop social interaction skills useful for group work (Edelson, 2001; Hsu, 2004).

The use of online forums has prompted study of the processes by which knowledge is collaboratively constructed. Models have been designed to describe and explain how these processes come about as, for example, the Progressive Inquiry Model (Muukkonen et al., 1999); or, to define the psycho-pedagogical conditions or principles that sustain such processes, as the Knowledge Building Community model (Scardamalia, 2002).

However, contrasting with these positive results emphasised in the literature is a high drop-out rate from online courses, higher than that recorded for on-site instruction, where drop-out frequencies are in any case substantial (Martinez, 2003). Research in this area is therefore particularly concerned to reduce drop-out rates and to identify the conditions that facilitate meaningful learning by distance students (e-learners). Such research, moreover, reports that success in online learning seemingly depends on a variety of factors.

A first element of importance in reducing drop-outs from online courses is the tutor, who performs what is by now a consolidated role in distance training. There are several studies in the literature on the functions, tasks, and skills required of this important professional figure, as well as on the interaction and management style that facilitates exchanges within a forum.

Berge and Collins (1996) define the tutor as an Instructor, Moderator, or Facilitator, distinguishing at least four conditions necessary for successful online tutoring (Luciani, 2007): pedagogical, social, organizational-procedural and technical. Drawing on Berge and Collins, Calvani and Rotta (1999) define the online tutor as: instructor e-tutor, facilitator e-tutor, and moderator/animator e-tutor. Rotta (2002) writes that the first type of role is more oriented to work on content, the second to the management of work groups and open discussions, the third to various forms of the scaffolding of group work provided by the online environment.

Typically, the tutor/instructor interacts with the community of students by preparing structured materials in the form of Web pages or some other type (for instance Power Point presentations), published online. The students access these materials, consult them, and perform the assigned tasks or tests according to a fixed schedule. The role of the tutor/instructor is not substantially different from that of a teacher using a markedly 'instructivist' approach. The tutor/instructor 'teaches' by exploiting the Web infrastructure as a means to deliver and distribute content. The tutor/instructor may create synchronous activities for the production of materials through which she/he addresses the community of students: for instance by using the increasingly common techniques of audio and video communication in streaming format, or by developing asynchronously usable resources which allow greater flexibility of access times by students. It should be borne in mind that the tutor's principal task is to support the students' self-learning. She/he must therefore seek to act at the metacognitive level by proposing not only content but also work strategies which enable the students to re-process the course's contents at personal level.

The tutor/facilitator fosters three kinds of interaction. The mode mediated by the materials with which the tutor qua instructor delivers the contents of the course is flanked by two other forms of interaction

between tutor and participants. The first is one-to-one communication between tutor and student, which typically takes place by e-mail. When the tutor responds directly and personally to an individual student's requests for clarification or help, this is a tutorship situation in the narrow sense, because the student's work is facilitated by the tutor's support. The second mode consists of small-group interaction taking the form, for instance, of 'chat' to examine and discuss materials. This activity is nevertheless targeted on individual learning.

The animator/moderator tutor should be conceived in terms of a more general blended model able to sustain the birth and development of a real community which operates collaboratively, but also with a certain amount of organizational and operational autonomy. The interaction is typically many-to-many. Hence, the tutor is no longer necessarily the central node or reference point for the learning process but tends to be one among the many actors involved. His/her role may assume different features according to how the activity is planned, and according to how much importance is placed, in the ongoing dynamic of the course, on collaboration and interaction among the students, and on methodological/didactic reflection rather than on content.

Besides these studies describing the function of the e-tutor (Tallent-Runnels et al., 2006), others focus on the style of interaction and information management which facilitates the participation and cognitive presence of the students (Edwards and Fintan, 2001; Garrison and Cleveland-Innes, 2005; Kim and Gil, 2007; Koh et al., 2007; Moshinskie, 2002). Yet other studies analyse the actions that the e-tutor can perform to reduce the e-dropout rate (Booker and Rebman, 2005; Moshinskie, 2002), starting with the delicate problem of lurking (Preece, Nonnecke and Andrews, 2004), which arises when some members of an online course only read the communicative exchanges without taking part in them. Beyond the manifold aspects that a tutor can assume, it is essential to define behaviours efficacious in fostering interaction with and among the students, doing so on the basis of the fundamental axiom of online interaction: a moderated online community is preferable to an unmoderated one (Wise, Hamman and Thorson, 2006). However, such moderation is still to be quantified in terms of the frequency of the tutor's intervention. Without going into details on the methodologies used to analyse the phenomenon (certainly most notable among which is Social Network

Analysis, e.g. in Cho et al., 2007; Mazzoni, 2005; Zhu, 2007), we note that of crucial importance is a pragmatic approach which relates the empirical data not only to a theoretical model but also to practical considerations. In this regard, Wise et al. (2006) identify as a good quantitative target the different modes of moderation/intervention adopted by the tutor and the indexes of response by the online group. One realizes on reading these studies that the tutor's interaction style has been subject to research largely focused on quantitative aspects. Decidedly less explored have been the qualitative aspects of the modes of interaction: for example, the option available to the tutor of adopting a more 'supportive' rather than 'oppositive' style. By the former expression we mean the style of a tutor who encourages students to participate in the forum; by the latter we mean a style intended to stimulate socio-cognitive conflict among the participants, to encourage them to produce increasingly composite arguments during the online discussion.

Another factor playing an important role in the educational efficacy of online courses is the student's metacognitive skills, particularly those of self-regulation (Choi, Land and Turgeon, 2005; Sánchez-Alonso and Vovides, 2007). The self-regulated student is able to plan and produce thoughts, feelings, and actions which she/he cyclically adapts in order to achieve a purpose (Zimmerman, 2002). On this view, self-regulated learning entails an active role by the subject in planning, monitoring and evaluating action (Zimmerman, 2000; Pellerey, 2003). But e-learners are confronted by a further metacognitive challenge which requires them to restructure their activities so that they can find their bearings among a multiplicity of usable contents (Mayer, 2003; Narciss, Proske, Koerndle, 2007). Monitoring, learning strategies, and the organization of knowledge give support to – and at the same time are promoted by – the e-learning activity (Scardamalia, 2003b).

Several authors maintain that metacognitive skills – defined as knowledge about one's own cognitive processes, and about the processes and strategies involved in tasks – are enhanced by interaction among peers (Palincsar, Brown, 1984; Scardamalia et al., 1989). In effect, the cognitive conflicts unlikely to arise when someone works and studies alone are facilitated in an interaction among peers (Brown, 1989; Webb, Palincsar, 1996). The virtual environment organized into

discussion forums where e-learners meet and discuss, exchange and build knowledge generates such cognitive conflicts, which require metacognitive skills for their resolution (Berge 1997; Chan, Burtis, Bereiter, 1997; Scardamalia, Bereiter, 2006). The participants in such learning environments can appraise different points of view on a problem, argue their positions, and negotiate with the other participants so as to produce shared knowledge. Asynchronous online discussion is accordingly a strategy frequently used to tutor university students because it can foster cognitively stimulating interactive processes while at the same time facilitating meaningful interaction among equals (Choi et al., 2005).

In short, this study analyses the role of the e-tutor, and the student's self-regulation skills stressed by the literature as key factors in e-learning, in order to determine under what conditions these factors may assist the design of successful online courses.

2. Description of the research

The aim of the analysis that follows is to contribute to reflection on the use of online environments for university-level teaching. It draws on research conducted at three different universities – the 'Sapienza' University of Rome, the University of Milan-Bicocca, and the University of the Valle d'Aosta – and it consists of three interconnected strands of inquiry.

The first strand investigates the tutorship process as it develops within online courses. It focuses on the frequencies of intervention by the tutor in such activities, and it seeks to highlight, from a purely quantitative point of view, different interaction styles, which it relates to the discussion activity by students. The aim of this first strand of analysis is therefore to determine to what extent, and with what frequency, a 'good tutor' should intervene in discussion in order to obtain participation by students. Deliberately omitted is analysis of content and of tutor editing styles, because the intention is instead to identify factors connected with the pattern of intervention and response, regardless of the context. This makes the results easier to apply to contexts and discussions different from those investigated here.

The second strand of analysis links with the literature on the relationship between metacognitive skills, particularly those of self-regulation, and online learning. The studies examined suggest that participation in online discussion forums is significantly able to develop metacognitive skills. In this part of the analysis, therefore, we examine the effects of participation in online discussion groups on certain metacognitive skills. We hypothesise that good metacognitive skills can favour efficacious use of forums, and that active participation in collaborative knowledge building can in its turn stimulate metacognitive reflection.

The third strand of analysis seeks to describe the structure itself of the knowledge-building process in groups. It focuses in particular on the concept of 'epistemic agency' defined by Scardamalia (2003) as a basic principle for creating a knowledge-building community. As participants construct knowledge, they are induced to mobilize their energies to improve their ideas, negotiating their adjustment to those of the others. They endeavour to understand, not by passively following the path set by the others in the discourse, but by actively developing new knowledge (episteme).

The analysis is based on data collected in regard to two different types of activity:

- ❑ the interdisciplinary support and online guidance provided to students on distance degree courses at the Faculty of Psychology of the University of Milan-Bicocca;

- ❑ the knowledge-building through online discussion organized as part of teaching modules at the Universities of Rome and the Valle d'Aosta, and at the Faculty of Education of Milan-Bicocca University.

The first strand of analysis draws on data concerning both the above types of activity. The other two strands are based solely on data regarding knowledge-building activities.

There follows an overview of the methodology used in the research project pursued at the three universities. Thereafter, corresponding sections describe the methodology employed in the above-outlined strands of inquiry.

2.1 Participants

The data examined in the first strand of analysis – which focuses on the frequency of intervention by tutors – concern both the knowledge-building activities conducted at the Faculty of Education of the University of Milan-Bicocca, and the interdisciplinary support and online tutoring services furnished by that University's Faculty of Psychology to students following wholly distance-based degree courses. The survey that collected these data was conducted on a total of 1107 students (males 221, females 764, not stated 122) attending three-year and specialist degree courses and on a total of 25 tutors.

The data examined in the second and third strand of analysis derived, as said, from a 'blended' activity conducted both on-site and at a distance, and organized at the three partner universities in the project. This activity involved a total of 153 students (20 M, 133 F). Surveyed at the first centre, the 'Sapienza' University of Rome, Degree Course in Psychology, were 72 (13 M, 59 F) students enrolled on the third and fifth years of the course. The participants at the second centre, the University of the Valle d'Aosta, Degree Course in Psychology, were 26 working students (6 M, 20 F) attending the first year of the Degree Course in Primary Education. At the last centre, the University of Milan-Bicocca, Degree Course in Primary Education, 55 students (1M, 54F) enrolled on the first year of the course were surveyed.

Online activity in all these courses was focused on collaborative knowledge building, and it centred on the course syllabus.

2.2 Activities

As said, it is possible to distinguish two types of activity: a spontaneous one (related to the first strand of analysis), and a guided one in 'blended' format whereby on-site instruction is flanked with online discussion moderated by the lecturer or by a tutor acting as animator/moderator.

In the 'spontaneous' activity, students using the tutoring service freely participated in the counselling and tutoring activities, without prescriptions or particular tasks. Moreover, their tutors were not given specific instructions, so as to facilitate the analysis of spontaneous interactions. Tutor and students were entirely free to begin discussion on any academic or interdisciplinary topic, and to participate in any

discussion. The only operational intervention was the regular (around once a month) provision by the tutors of prompts for discussion on study methods, on how to cope with examination stress, on how to choose programmes and courses, etc.

During the 'blended' learning activity, meetings were held on-site to discuss the contents of the course and ways in which to use the various virtual environments and online discussions on topics regarded as important by the tutor or the students and relating to the course syllabus.

The participants were distributed into discussion groups comprising between 13 and 28 students according to the university. Each student was registered for the platform used and then assigned to an online group – a group, that is, which had a single online workspace. The discussion was organized slightly differently at the three universities. At Aosta, each module began with a problem raised online to stimulate discussion, and to which a tutor contributed in the role of facilitator and experienced participant. At the University of Rome, problems were identified by the students themselves, following an online brainstorming session, and specific open workspaces, moderated by a tutor, were created for each topic selected. A similar scheme involved the students on the degree course in Primary Education at Milan-Bicocca. The students identified what they thought were the most significant theoretical issues treated in lectures and which they wanted to explore, and then discussed them online.

Activity at the different contexts investigated also differed in relation to the variables considered in the research, which are now described.

2.3 Purposes and procedure

As said, the main purpose of the research was to analyse the different forms of tutor intervention by relating them (in terms of the number of interventions and their frequency) to the students' activity in the forum.

Following previous studies (Castelli, Vanin and Brambilla, 2006; Castelli, in press; Vanin, 2006; Vanin, Castelli and Brambilla, 2007a; Vanin et al., in press) on the prevention of drop-out from distance learning schemes, investigation was made of the relationship between the number of messages posted by the tutor and the relative

interaction among the students. Both aspects were divided between 'initiation of new discussions' and 'replies to previous discussions', according to the following scheme:
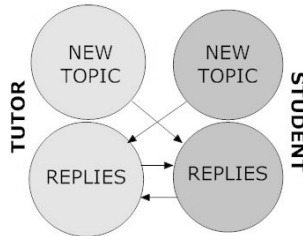
Figure 1. Scheme of analysis.

The analyses reported in section 3 therefore investigated the relationship between the number and the frequency of the tutor's messages and the relative interaction among the students, concentrating on frequency (number of tutor's messages vs. students' messages) and on temporal distribution (daily frequency of interventions by the tutor).

A second objective was to investigate the relationship between metacognitive skills and participation in knowledge-building groups which use online forums.

It was hypothesised that participation in such activity may enhance the students' self-regulation skills. It was also hypothesised that it is possible to foster the development of such skills by organizing specific course activities where metacognitive reflection is made on the strategies used and the results achieved by the group. Such reflection may, moreover, influence the cognitive aspects of the online discussion.

Students' participation in a forum and their knowledge building may also vary in relation to different strategies of intervention in discussion adopted by the tutor. We therefore considered two different tutoring strategies: one termed 'destabilizing', the other 'supportive'. In the former case, the tutor stimulates the student to question his/her ideas, producing cognitive conflict; in the latter, the tutor encourages participation by mirroring interventions and valuing the knowledge acquired by the group. The hypothesis was that these two strategies exerted differing influences on the cognitive and metacognitive aspects of the online discussion.

The research design now outlined was devised to investigate these various aspects.

At the beginning and end of the activity the students compiled questionnaires which surveyed metacognitive study skills and the students' representations of their motivations for learning.

The students were therefore divided into groups, and each group was randomly assigned a different mode of intervention according to the research variable considered. The design variables were tutoring style and the presence or otherwise of metacognitive reflection.

a) tutoring style

Two groups of students at the University of Rome completed the activity by participating in a forum where the tutor adopted what we have called 'destabilizing' behaviour. She/he acted with the intention to produce cognitive conflict and thereby stimulate the students' argumentative skills. The tutor deliberately disputed the concepts introduced and often uncritically accepted by the group ("*Why must the Internet be synonymous with danger and above all paedophilia? Why would it 'distract from the real pleasures of life'???*"), eliciting greater depth of discussion or clearer explanation ("*You should avoid trite slogans, superficial generalizations of the type 'we were better off when we were worse off'"; "I reckon this discussion should be placed on a more scientific footing: it doesn't seem to me that it rests on a sound definition of the term 'bullying'*").

Two other groups of students, again at the University of Rome, participated in the activity where the tutor mediator performed a 'supportive' role and sought to encourage participation ("*Rosaria, the lecturer tells me that you're a teacher... Why don't you tell us something about your experience of using computers (and internet) at school. What do you do? What do you think are the advantages and disadvantages?*"), to foster the group's knowledge building by furnishing prompts ("*With reference to the discussion on writing, I'd like you to consider an excerpt from a discussion among elementary-school children on 'paper and pen' and 'computer' writing*"), to relaunch ideas previously expressed ("*It seems that interest is returning to the technologies and children topic, when mobile phones and video games were discussed. Do you agree?*") or to emphasise constructive contributions ("*Good, Giovanna, that's certainly useful for our knowledge building*").

b) presence of metacognitive reflection

At all three universities, a design variable was the organization of spaces for discussion which elicited personal metacognitive reflection on the online course. This reflection took place in some groups midway through the activity, when the following questions were asked: "*What do you think are the two most interesting ideas to have emerged from this module?*"; "*What learning strategies have you used?*"; "*What were strengths and weaknesses of these strategies?*". The students discussed these prompts, providing personal replies and commenting critically on those of others. At the end of the activity, the groups assigned to the 'metacognitive reflection' variable conducted a final discussion by answering six questions about the experience. The other groups engaged in the activity without metacognitive reflection either during the course or on its conclusion.

Table 1 synthesizes the general research plan, showing the number of subjects in each city assigned to the two different design variables considered.

Students	N°	Metacognitive reflection		Tutoring style	
		YES	NO	Destabilizing	Supportive
Milan-Bicocca	27-28 (2 groups)		*		
	27-28 (2 groups)	*			
Rome-Sapienza	14 (1 group)	*			
	30 (2 groups)			*	
	28 (2 groups)				*
Valle d'Aosta	13 (1 group)		*		
	13 (1 group)	*			

Table 1. General research plan.

A final research objective was to describe the forum discussions by paying particular attention to processes of Epistemic Agency. Consequently, the messages written by the students were analysed to verify the presence of indicators of activities performed to propose and process information, to explore and to evaluate problems and theories.

2.4 Online environments

Used at the three university centres were three different platforms (Knowledge Forum, Synergeia and PhpBB) designed to support collaborative learning processes by enabling students to create notes, answer the notes of other students, to attach and to share file and resources.

Knowledge Forum (http://www.knowledgeforum.com) is an online collaboration environment created to support the work of a community. Its origin dates back to 1983, when a research group at the University of Toronto coordinated by Bereiter and Scardamalia designed a first prototype and then piloted it on a university course. The key feature of Knowledge Forum is the 'knowledge building' philosophy which guided its design. The entire environment is designed to support and foster the building of new knowledge by the group. In its database, in fact, users can generate notes (written texts to which graphics or images may be added) and also cite other notes or highlight keywords in their own text: the user's own note is easily identified by a search tool which enables reading of the entire database by topic. The notes can be also be interconnected by means of links. In this case, they are denoted with the term 'build-on', which indicates that they represent developments in the knowledge building activity. To facilitate discussion, also present are predefined linguistic structures to foster expertise in writing. These are 'thinking types' (or thought labels) which act as 'scaffolds' in the sense that they serve to create shared categories of discourse construction. These structures are flexible and personalizable.

Synergeia (http://bscl.fit.fraunhofer.de) it is a web-based platform designed to support collaborative learning processes. It was developed and piloted within the European ITCOLE project. The features of the Synergeia software which most closely concern collaborative learning are document sharing and knowledge building. The software permits, in fact, the rapid uploading and downloading of documents in any format, textual or multimedial, organizing them and commenting on them in the common space. The knowledge-building areas are discussion forums in which each participant can post messages to start a discussion and/or reply to other posts, contributing to the collective construction of meanings. This asynchronous communication tool clearly evinces the socio-constructivist inspiration that drove the

design of the entire platform. In particular, these areas have been designed in accordance with the Progressive Inquiry Model (Muukkonen et al., 1999), in which learning is conceptualized as a search process undertaken to gain better understanding of a concept or a question through group discussion.

PhpBB (http://www.phpbb.it) is one of the most widely used open-space bulletin boards written in the PHP programming language. The base versions do not comprise specific functions for collaborative learning or e-learning. However, the program's ease of use allows its application in a wide range of contexts. In fact, through simple changes to the codebase, further modules ('MODs') can be added to enable distance teaching functions. The version used for the experiment, in fact, comprised specific functions enabling the attachment of files and insertion of material in the download area; the construction and moderation of interaction groups; the delivery of support materials and online tutorials; the creation of personal blogs; Dokuwiki (construction of shared documents in Wikipedia style); and statistics on use.

2.5 Tools and procedures of analysis

Different tools and procedures of analysis were used in each of the strands of analysis, and will now be described in individual sections.

3. First strand of analysis: tutorship

3.1 Method

This section starts with exploration of spontaneous online interaction within a group of 21 tutors who worked in 10 groups involved in various online guidance, prevention and interdisciplinary counselling activities. The groups corresponded to the six degree courses at the Faculty of Psychology and four groups at an experimental online laboratory. The number of tutors in each group was not uniform because the number of students enrolled on the degree courses differed (Table 2). The teaching activity was diversified between interdisciplinary support and online counselling for six groups, and scaffolding and online tutoring (for a course in development psychology) for the remaining four groups.

   The contribution of each tutor to the online interaction and the relation between frequencies of intervention by the tutor and the activity were analysed.

3.2 Sample

Examination was made of a total of 7972 messages, distributed among 389 discussions, as follows.

	Number of tutor	Number of students	Number of messages	Number of discussions
Degree course 1	7	162	3074	97
Degree course 2	3	33	277	43
Degree course 3	2	23	293	21
Degree course 4	2	19	71	12
Degree course 5	1	40	16	10
Degree course 6	2	12	32	8
Laboratory 1	1	28	846	67
Laboratory 2	1	27	844	40
Laboratory 3	1	27	916	41
Laboratory 4	1	28	1603	50
TOT	**21**	**399**	**7972**	**389**

Table 2. Messages and online groups distribution.

As regards the sample, the forum from which the data were collected had anonymous registration, so that inserting data on gender, age and residence was optional. Nevertheless, a sufficient number of subjects provided personal data for a quite realistic estimate to be made of the composition of the sample. Out of the 1107 users of the forum in total, fully 90% (N=993) stated their gender, with the result that 77.7% of users were females (N=772) and the remaining 22.3% were males (N=221). They declared ages ranging between 19 and 51 years old (m=23.58), and the majority were resident in the province of Milan.

3.3 Data analysis

The threads were referenced to the tutor who had initiated them or had most frequently taken part in them, compared with the other tutors.

Calculated for each tutor were indexes of productivity (initiation of new threads, participation/replies to messages/discussions by the students), of presence (ratio between the number of tutor messages and the number of student messages), of temporal dispersion (which could be 'distributed' when the tutor's messages were amply distributed over time, or 'clustered' when they were concentrated in particular periods), distinguishing between push-type mechanisms (initiating new discussions and prompting reflection) and pull-type ones (responses to discussions and students' messages).

This information was compared with general indexes of participation by the students (replies and opening new threads), with variables relative to the tutor's popularity (how many of his/her messages were read on average, and how many of them received a reply on average), the aim being to identify interactive behaviours and practices which enable a tutor to foster interaction among the students.

Although the small number of tutors substantially reduced the representativeness of the data (particularly as regards the small number of tutors), structural equation models (analysis conducted with LISREL VIII) were used to compare groups of independent and dependent variables. The variables relative to frequency and standard deviation were dichotomized on the basis of the median in order to conduct comparisons among averages within the groups.

3.4 Results

T-tests were performed at the first level of analysis and they yielded interesting data on the variables investigated. The analysis revealed significant differences in regard to what we have called 'presence', i.e. the frequency of intervention by the tutor, and in particular to the starting of new threads ($p < .05$; $F = 6.366$; $t = 2.251$) and the frequency of replies received ($p < .05$; $F = 26.082$; $t = -2.313$). A tutor who initiated few threads in comparison to the total encouraged the students to start discussions, and on average received more replies.

This relation was also apparent in the frequency of replies by the tutor ($p = < .01$, for all the variables investigated except the introduction of topics by students, for which $p < .05$). In general, moderate intervention (a high ratio between posts by the tutor and by the students), which left ample space for inter-student interaction,

was positively correlated with participation by the students and with the likelihood that they themselves would propose new topics for discussion.

Besides the factor 'presence', temporal dispersion was investigated as well. On the basis of the previous results, estimation was made of structural equation models relative to the frequency of the tutor's intervention in online discussions with and among students, the temporal dispersion of such intervention (calculated on the basis of the daily standard deviation of messages by each tutor), and reactions to it by students in terms of replies posted, start-up of threads, and general participation.

Consequently selected for the data analysis were variables deemed to have particular practical implications. These variables, for which the matrix of correlations is given below, were treated with structural equation models using the LISREL VIII software.

	m	s.d.	T_YES_R	M_Replies	M_Views	Tot_R_Stu	Tot_NT_Stu	Dispersion_R	Dispersion_NT	Perc_R	Perc_NT	Ratio S/T
Ratio S/T	12,97	11,90	0,320	0,300	0,317	0,678**	0,538**	0,345	0,045	-0,433*	-0,090	-
Perc_NT	22,75	24,96	0,646**	0,394*	0,326	-0,449*	-0,623**	-0,166	0,708**	0,357	-	
Perc_R	8,94	16,82	-0,180	-0,306	-0,296	-0,427*	-0,452*	-0,219	-0,068	-		
Dispersion_NT	0,12	0,07	0,866**	0,783**	0,728**	-0,264	-0,362	0,156	-			
Dispersion_R	0,20	0,06	0,266	0,452*	0,473*	0,589**	0,577**	-				
Tot_NT_Stu	37,76	31,66	-0,231	0,042	0,115	0,939**	-					
Tot_R_Stu	1138,86	1178,23	-0,078	0,096	0,147	-						
M_Views	93,97	40,36	0,739**	0,944**	-							
M_Replies	10,51	6,96	0,817**	-								
T_YES_R	5,95	8,71	-									

N= 22 cases
$\quad$ * p<.05
$\quad$ ** p<.01

Ratio S/T= Ratio Students' Post / Tutor posts
Perc_NT= Percentage Tutor New Thread on the New
Perc_R= Percentage Tutor Replies on the total
Dispersion_NT= Time Dispersion Tutor New Thread
Dispersion_R= Time Dispersion Tutor Replies

Tot_NT_Stu= Total of Students' New Threads
Tot_R_Stu= Total of Students' Replies
M_Views= Tutor Views Mean
M_Replies= Tutor Replies Mean
T_YES_R= Tutor receives replies (Prob. for tutor to receive replies)

Table 3. Mean, standard deviations, and correlations among the variables examined.

The aim of the first phase of the analysis was to determine the extent to which a tutor should intervene in an online discussion in order to favour interaction among and with the students. Specifically addressed were the questions of how frequently the tutor should intervene and, at a second level, whether she/he should adopt a more push-type approach (proposing discussions) or a pull-type one (replying if called upon to do so).

The model (Fig. 2) presented below excludes the influence of tutor's reply (PERC_R) because it is not statistically correlated, but it highlights some interesting variables. First to be noted is that the variable RATIO S/T (ratio between the number of messages posted by the students and number of messages posted by the tutor) is closely connected with participation by the students, both in proposing new threads (Tot_NT_Stu) and in simply replying to the other participants (Tot_R_Stu). But this (somewhat counter-intuitive) finding refers to sporadic intervention by the tutor (given that a high value of RATIO S/T corresponds to a small number of messages by the tutor). On the other hand, a high percentage of new threads initiated by the Tutor (PERC_NT) seems negatively to influence intervention by the students, inhibiting their participation.
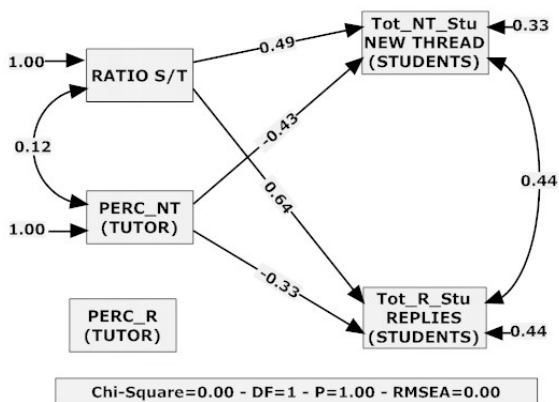
Figure 2. Mod. 1 S/T ratio, percentage of new threads started by the tutor and student participation.

In short, this first model shows that the start-up of new threads by students depends (among the variables investigated) on a high ratio between messages posted by the students and messages posted by the tutor (RATIO S/T). The less the tutor intervenes, the greater the participation by the students. If we then consider the two possible forms of action available to the tutor, we find that simply replying to students (PERC_R) does not have any particular effect, while a high number of new threads started by the tutor (PERC_NT) seems to inhibit the students from proposing new threads. As regards the

number of replies by students (Tot_R_Stu), one finds once again that a small number of messages by the tutor (RATIO S/T) is a push factor, and that frequent start-up of new threads by the tutor (PERC_NT) further impedes responses by the students.

The tutor should therefore intervene in moderation, leaving ample space to the students, and she/he should largely refrain from initiating new threads. Besides being borne out in the literature (Wise et al., 2006), this result is confirmed by empirical observations: students prefer to participate in discussions which they themselves have initiated and which are moderated parsimoniously by the tutor (research in progress).

Next analysed is the time variable in the posting of messages by the tutor. With the expression 'temporal dispersion' we distinguish between tutors who intervene with a certain constancy over time (e.g. a message posted every day) and tutors who intervene sporadically (e.g. once every fifteen days) posting several messages at a time.

These variables were cross-referenced with various indexes of participation by students (in particular the start-up of new threads and replies also investigated by the previous model), and with two variables indicating the tutor's 'popularity': the average of visit received (Mean Views, that is the mean of the times that tutor's topic are read) and the average of replies received (Mean Replies).

The model (fig.3) presents a particularly interesting scenario, which is complementary to the one illustrated above. According to our data, a marked temporal dispersion of replies by the tutor (i.e. a constant presence in time, DISPERSION_R) fosters interaction among students in terms of both new threads started (tot NT_Stu) and replies (Tot_R_Stu). This effect also impacts on the extent to which materials produced by the tutor are read (Mean Views).

A positive effect also seems to be exerted on this variable by the high temporal dispersion of new threads started by the tutor (DISPERSION_NT), which increases his/her visibility and popularity, and consequently his/her probability of receiving replies.

In this second model too, although viewed from another angle, intervention by the tutor tends to be moderate and restrained, its purpose being to encourage the students to participate.
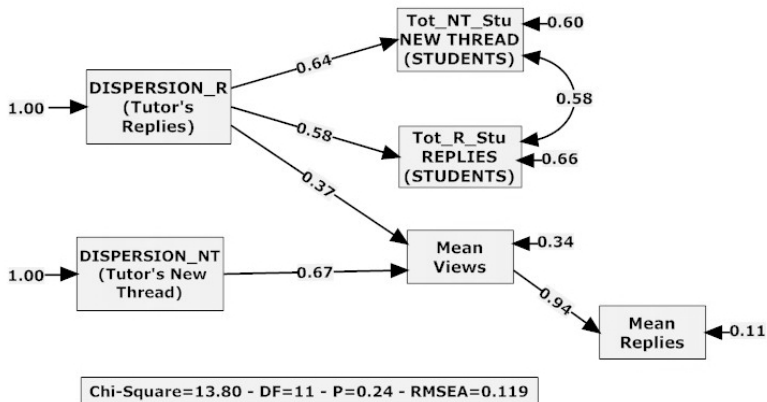
Figure 3. Model 2 – Temporal dispersion of tutor's interventions, his/her popularity (average of visits and replies) and likelihood of receiving replies.

The two models therefore furnish complementary readings of the possible interactive behaviours adopted by the tutor in online teaching and counselling. Firstly, they show that the tutor should restrict his/her amount of messages posted in a forum, in terms of both replies (which judging from our data do not have any effect) and new threads proposed. Accordingly, the ratio between the number of messages posted by the tutor and by the students should be tipped towards the latter, with a low percentage of tutor postings in the total. Secondly, the second model integrates this information with a temporal finding: the tutor must intervene uniformly over time.

These two findings yield interesting insights which are discussed in the last section of this chapter.

4. Second strand: metacognitive activity

Studies on the relationship between metacognitive skills and online learning suggest that participation in discussion forums is a meaningful experience (Scardamalia, 2003). Moreover, various studies have reported a reverse relationship whereby possession of self-regulation skills enables an e-learner to make better use of these complex learning tools.

The discussion forums run experimentally by the three university centres (Rome, Milan and Aosta) were intended to furnish students with opportunities to develop and exchange their opinions; to stimulate them to argue their points of view; and to foster active participation in knowledge building. A student cannot be inactive in a discussion forum, for it constantly solicits reflection on both the contents to be learned and the processes involved in such learning. We consequently hypothesised that – given good basic metacognitive skills enabling efficacious use of the forum – the students' involvement in collaborative knowledge building would enhance their metacognitive reflection.

We accordingly examined strictly metacognitive dimensions connected with self-regulation skills, and a motivational dimension – the goals pursued by the learner – bound up with meaningful and reflexive learning. We analysed these dimensions by administering self-report questionnaires, and by examining the students' written reflections on the course. This section sets out the quantitative results relative to the questionnaires. The next section, the fifth, will analyse the students' written reports.

Our second concern was to verify whether specific aspects of the online course (supportive/destabilizing tutoring style, and level of participation in forum discussions) were somehow tied to development of the student's metacognitive skills.

4.1 Instruments

On their entry to and exit from the course, all students compiled two questionnaires designed to collect information on, respectively, three metacognitive skills constituting a learner's self-regulatory competence, and four goals which guide and motivate students. These instruments were Moè and De Beni's (2000) Self-Regulation Questionnaire (SRQ) and Elliot and McGregor's (2001) Achievement Goal Questionnaire (AGQ), both of which are self-evaluation questionnaires using Likert scales. The SRQ measures three areas:

❑ Organization: the student's ability to plan his/her time and study activity;

❑ Elaboration: the student's ability to elaborate and deepen study materials;

❑ Self-evaluation: the student's ability to monitor his/her learning, to appraise how much she/he knows and to draw the consequences for further study.

The AGQ appraises learning goals according to the 2X2 model proposed by Elliot and McGregor (2001). It identifies the following four goals defined by the intersection between the mastery/performance and approach/avoidance axes:

- Mastery approach: the tendency to engage in situations which develop mastery and competence;

- Mastery avoidance: an effort to avoid situations which induce a perception of incompetence;

- Performance approach: an orientation to achieving positive results;

- Performance avoidance: a tendency to avoid failure and negative performance.

4.2 Results

Only considered were students who had completed and returned both the questionnaires. This gave a total of 141 students (18M, 123F), of whom 59 (11M, 48F) were enrolled at the University of Rome, 26 (6M, 20F) at the University of Valle d'Aosta, and 56 (1M, 55F) at the University of Milan-Bicocca.

The questionnaires enabled us to identify the initial metacognitive level of the student participants in the research project: the group as a whole proved to possess medium-to-high self-regulation abilities in line with the findings in the literature on students of equivalent grade (Moè and De Beni, 2000; De Beni, Moè, Cornoldi, 2003). As Table 4 shows, there were significant differences among uses of the different strategies [$F_{(2.140)}=24.28$, $p<.001$]. The strategy that seems to have been mastered best by the students was organization, followed by self-evaluation. Instead, the students reported less frequent use, though still generally high, of personal elaboration.

	Mean	Standard Deviation
Organization	3.76	.52
Elaboration	3.44	.47
Self evaluation	3.72	.50

Table 4. Descriptive statistics of self-regulation skills in study activities: results on course entry.

As regards study goals, to be observed is the predominance of two different goals among the students: Mastery approach and Performance avoidance [F(2.140)=24.28, p<.001] (Table 5).

	Mean	Standard Deviation
Mastery approach	18.78	2.73
Mastery avoidance	10.07	4.37
Performance approach	7.31	4.60
Performance avoidance	15.16	3.64

Table 5. Descriptive statistics of achievement goals in study activities: results on course entry.

The above findings depict students driven by goals functional to learning. They endeavour to understand and master the discipline, but they must simultaneously prevent their activities from having negative repercussions on their final performance.

In sum, it is not necessary to excel with respect to others; but unsatisfactory results must be avoided. The students pursued these goals by making significant use of self-regulation strategies. They therefore possessed the metacognitive skills required to make the best use of online educational delivery, in which they had to be the protagonists of their learning, use the resources available, organize them, restructure them, propose new ideas, and evaluate their work and that of others.

On this basis, we wanted to establish whether involvement in collaborative online knowledge building further enhanced students' skills. To this end, we first compared the data collected by the questionnaires administered on entry to and exit from the online course. Analyses (mixed factorial design ANOVA) did not reveal significant entry and exit differences, either in self-regulation strategies or in learning goals.

The second aspect – the existence of changes due not to simple participation in the activity but to specific modalities of such participation – was verified by analysing data collected by the questionnaires. Our intention here was to determine whether the level of participation in the online forum and the supportive or destabilizing tutoring style correlated with the metacognitive indexes (tutoring styles were analysed only for students at the University of Rome, where they had been established a priori).

We first compared students who had posted numerous messages against those who had written only a few of them. We calculated the number of messages posted by considering only those related to discussion's content, not those asking for help in using the online tools, or those expressing simple agreement or disagreement.

We therefore assigned a score equal to the number of 'meaningful' messages posted and calculated the percentiles for each of the three universities.

We defined students below the 25th percentile as low-level participants, and those above the 75th percentile as high-level participants. An ANOVA conducted with the level of participation as the variable between the subjects, and the metacognitive indexes (Self-Regulation strategies and Achievement goals) as dependent variables, showed a statistically significant difference [$F(1.66)=6.14$, $p<.05$] in the mastery goal (Table 6).

	Participation	Mean	Standard Deviation
Mastery approach	Low	18.15	2.41
	High	19.50	2.08
	Total	18.82	2.34

Table 6. Descriptive statistics: the mastery goal in students with high and low participation.

The high-participation students gave higher scores to the mastery goal than did the low-participation students, while the level of participation did not generate differences in the scores given to the performance goal. One may consequently conclude that those students who played an active role in the e-learning course (high participation) tended to set themselves mastery objectives at the beginning of the course.

We also analysed the correlations between the number of messages posted and the metacognitive indexes upon exit. The results showed a significant relationship between the self-evaluation index and the number of messages posted (r=-.17, p<.05). Given that this is a negative correlation, it appears at odds with the results reported above and warrants closer examination. The students who wrote numerous messages were those who regarded themselves as less competent in self-evaluation. This finding suggests that high strategic skills may have induced students to hypothesise and develop new strategies in their use of the online teaching resources: for example, an attentive reading of messages and careful selection of whether and how to intervene, in order to make more incisive interventions rather than a large number of them. This interpretation, however, would require more specific and deeper verification.

Finally, a MANOVA was conducted with the tutoring style as the variable between the subjects and the metacognitive indexes as variables within them. A significant interaction effect was apparent between the variable 'tutoring style' and self-evaluation [F(1.45)=5.64, p<.05]. This finding suggests that self-evaluation skills tended to improve among students with a supportive tutor, and to worsen among those with a destabilizing tutor (Table 7). Thus highlighted is that the manner in which discussion is mediated by a competent participant influences the individual's capacity to evaluate his/her performance on the course.

	Tutor	Mean	Standard Deviation
	supportive	3.77	0.42
Self -evaluation (pre test)	destabilizing	3.91	0.43
	Total	3.84	0.43
	supportive	3.85	0.42
Self -evaluation (post test)	destabilizing	3.76	0.38
	Total	3.81	0.40

Table 7. Descriptive results: self-evaluation with a supportive and destabilizing tutor, pre-test and post-test results.

To conclude this part of our analysis, we summarize our findings as follows:

- metacognitive questionnaires can be used to survey and analyse only one aspect of metacognitive competence: knowledge of strategies and goals. These instruments cannot grasp the real processes and the true motivations that characterize students in their study activities;

- active and frequent participation in forums correlates with mastery-oriented goals. But it is not always the self-regulated student who writes the most; indeed, students who self-evaluate at the end of the course tend to write less, perhaps because they employ different strategies to exploit the online resources.

This preliminary quantitative analysis of the data must now be flanked by a more descriptive and qualitative examination of the inter-student verbal interactions stimulated by the tutors, and of the students' written reflections on their experiences.

Studies on the characteristics of verbal exchanges in collaborative learning situations report that they elicit cognitive conflicts, requests to explain one's point of view, and personal reflections. In practice, they foster the conscious co-construction of knowledge (Palincsar, 1986; Webb, 1991). Such interactions help the students fill gaps in their knowledge, negotiate meanings, and modify their opinions.

Dillon (1994) explains this well when he writes as follows about discussion in class: "where members join together on addressing a question of common concern, exchanging and examining different views to form their answer, enhancing their knowledge or understanding" (p. 8).

Starting from such premises, analysis of online discussion can shed significant light on cognitive activity and its transformations during e-learning activities.

5. Third strand: cognitive activity

The aim of this third strand of analysis is to furnish a description of the knowledge building process at the three different course centres. It first provides an overview of the types of contents discussed and of participation by students in the forums. It then focuses on the courses at Rome and Aosta, the object of analysis being the content of forum messages.

To this end, we shall concentrate on the knowledge building model on which the teaching activities were based. We shall refer in particular to the Knowledge Building Community model (Scardamalia, 2002) and to the concept of Epistemic Agency, in order to verify whether the students were oriented to knowledge building in their discussions: or in other words, whether they actively explored problems and evaluated contents and strategies in order to improve collective knowledge and gain better understanding of the phenomenon discussed. Finally, we shall analyse the reports written by the students on conclusion of the forum, using an interpretative frame which highlights both possible repercussions of the activity on the students' self-regulation skills, and their understanding of the Knowledge Building Community model, which they were implicitly invited to implement during the activity.

5.1 The completed activity

As said, the blended teaching activity carried out at the three university centres involved 153 students, divided into 11 discussion groups, with an average of around 14 students per group.

At all three centres, the activity was based on the interconnected Knowledge Building Community model (Scardamalia, 2002) and the Progressive Inquiry model[1] (Muukkonen et al., 1999). According to these models, knowledge is socially shared and can be built, manipulated, and increased through collective activity by a group of people. The construction of new knowledge within a group of students is similar to that performed by a community of scientists: problems must be defined, research theories constructed, contents and strategies evaluated, support information sought, and new problems redefined, on the conviction that every idea is useful to the community and that ideas can always be improved.

Thus, within the teaching activities which we implemented, the students started from research problems (in some cases previously defined by the tutor, in others by the students themselves), put forward their theories, evaluated their ideas and those of others, and sought information to support or disprove theories, thereby participating in the group's construction of knowledge.

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[1] See page 86.

A total of 57 discussion spaces dedicated to issues concerning the students' courses were opened. At Rome, the 5 groups on the course in educational technologies could participate in a total of 17 discussion spaces concerning, for instance, the use of the Internet at school, the relationship between technologies and handicap, the use of video games and the Internet by children and adolescents, and other topics relating to the use of technologies in education. At Aosta and Milan, discussions centred on topics relating to the course in Developmental and Educational Psychology. In particular, at Milan the students stressed a number of theoretical aspects treated in lectures which they thought important and wanted to deepen. Among these topics were, for example, 'attention and perception', 'emotions and affective development', 'reading comprehension and writing'. At Aosta, discussions started from issues raised by the lecturer regarding the submodules on learning theories, study motivation, collaborative learning, and observation in educational settings.

The students wrote a total of 2748 notes discussing the topics considered, with an average of around 19 notes per student. Not calculated here are notes concerning organization of the course or informal exchanges among the students.

The activity accomplished in the 11 forums is summarized in the following table.

Forum	No. students	No. thematic threads	No. thematic notes (students/lecturer/ tutor)
Rome 1	16	3	192 (186 s – 6 t)
Rome 2	14	3	173 (165s – 8 t)
Rome 3	15	3	161 (145 s – 16t)
Rome 4	14	5	560 (548 s – 12 t)
Rome 5	12	3	248 (236 s – 12 l)
Aosta 1	13	4	332 (217 s – 32 l – 73 t)
Aosta 2	13	4	201 (115 s – 36 l – 50 t)
Milan 1	13	8	221 (170 s – 51 t)
Milan 2	14	8	286 (250 s – 36 t)
Milan 3	14	8	410 (366 s – 44 t)
Milan 4	14	8	385 (350 s – 35 t)

Table 8. Work groups, number of participant students, number of thematic threads opened, number of notes relative to those threads.

5.2 Epistemic agency

This strand of analysis sought to determine the level of the students' Epistemic Agency, or in other words, their commitment to improving their ideas and negotiating adjustment between them and those of the others, in an endeavour to achieve deeper understanding of issues and to elaborate new knowledge.

5.2.1 Instruments of analysis

This dimension was operationalized by means of a coding scheme for the analysis of content which had already been used (Cacciamani and Ferrini, 2007) with good results in terms of agreement among independent judges, and which distinguished between categories of first and second level (Table 9).

Epistemic Agency	Second-Level Categories (Activities)	First-Level Categories (Contents)
Advanced	E = Exploring problems	**C1** Research questions or problems: questions regarding the contents of the course, presence of question marks or interrogative expressions. E.g.: *I wonder how the attachment bond develops*
		C2 Hypotheses concerning contents: proposed explanations of questions discussed E.g.: *This fact could be explained by ...*
	V = Evaluating contents and strategies	**C3** Comments (evaluations of contents): expressions of agreement or disagreement, positive or negative judgements on an idea expressed by another participant
		E.g.: *According to me what you have said is very useful ...*
		N.B. this category does not include global judgements. E.g.: *It seems me that the level of debate and the capacity for analysis are considerable.*
		C4 Metacognitive reflections: evaluations or comments about study strategies used during the online course. Explicit reference is made to cognitive activity.
		E.g.: *I want to concentrate on... This post has made me reflect.*
		These also include metacommunications. E.g.: *I shall now briefly reflect on my work as an educator.*

Basic	I 1 = Proposing information	**C5** Practical examples: examples drawn from the participant's experience
		E.g.: *It's happened to me that …*
		C6 Information obtained from reliable sources, and data relative to experimentation: theoretical information whose source is explicitly cited. E.g: *I've read in the book that...*
		Also belonging to this category is information drawn from sources containing research data. E.g: *As Cole shows in his study*…
	I 2 = Elaborating information	**C7** Repetitions of ideas expressed by other members of the community: explicit statement that reference is being made to someone else's idea. E.g: *It reminds me of your message in the previous module about the language developed to achieve distant goals (freedom)...*
		C8 Syntheses of the ideas of several participants: assemblies of several ideas (e.g. indented or bulleted lists). E.g.: *Experience has shown:*
		- that MDUs can be characterized differently in different contexts ("he's a child spoiled by his family" is typical of the school);
		- the effects that they have on people in such contexts;
		- the ways and means to change them.

All segments not pertaining to the above categories are allocated to the residual category "**C9** = Other"

Table 9. The coding scheme used to analyse content.

The first-level categories in the above coding scheme focus on the content of messages. They were constructed on the basis of the 'thinking types' utilized as 'scaffolds' (supports) for discursive interaction in online Knowledge Forum environments. They refer to a similar scheme developed by Cesareni and Martini (2005) in order to identify the different types of intervention made by the members of a knowledge-building community. The second-level categories, which group the first-level ones together, are defined in terms of activity, as follows:

- Proposing information: this category comprises messages categorized as 'practical examples' and 'information drawn from reliable sources and data relating to experimentation';

- Elaborating information: this comprises messages categorized as 'repetitions of ideas expressed by other members of the community', 'syntheses of several ideas';

- Exploring: this comprises messages categorized as 'research questions or problems', 'hypotheses about contents';

- Evaluating: this comprises messages categorized as 'comments' and 'metacognitive reflections'.

The first two activities (proposing and elaborating information) were considered to be indicators of a basic level of Epistemic Agency. This is exemplified by a student whose response to a question posted by the lecturer takes the form of information drawn from the course handbook and/or of an example drawn from the student's own experience. The last two activities (Exploring and Evaluating) were considered indicators of advanced Epistemic Agency. They are exemplified by a student who replies to a question by the lecturer by formulating his/her own hypothesis or proposing a further issue for discussion.

The coding scheme was applied to 'segments' of the forum messages: that is, to units of meaning identifiable by the punctuation used by the message writers (full stops, semi-colons, colons, suspension dots, exclamation and question marks). Independent judges codified the segments for both the Rome and Aosta forums. The degrees of agreement (Cohen's k) were 0.92 for Rome and 0.80 for Aosta, values which are considered in the literature to be indicative of satisfactory agreement among judges.

Selected to analyse the messages, for each online course run at Rome and Aosta, were 2 students considered 'central' in the posting of messages (above the 66% percentile with respect to the number of messages posted in the forum by each participant), and 'peripheral' students (below the 33% percentile in respect to the number of messages posted in the forum by each participant), for a total of 24 participants.

5.2.2 Results

A first set of results from which we may usefully start concerns the type of content identified in all the messages examined (Table 10).

First-Level Categories								
C1	C2	C3	C4	C5	C6	C7	C8	C9
148	898	173	150	463	592	112	12	165
5.5%	33.1%	6.4%	5.5%	17.1%	21.8%	4.1%	0.4%	6.1%

Table 10. Contents of the message segments for the courses at Rome and Aosta. C1 = Questions, C2 = Hypotheses, C3 = Comments, C4 = Metacognitive reflections, C5 = Examples, C6 = Information, C7 = Repetitions, C8 = Syntheses, C9 = Other.

Formulating hypotheses (33.1%), proposing Information drawn from sources (21.8%), and introducing Examples (17.1%) seem to be the three main activities involved in the knowledge-building process. Synthesis of contents emerging during discussion seems to be a very infrequent activity (0.4%).

If we consider the distinction between 'central' and 'peripheral' participants in relation to the level of Epistemic Agency exhibited by their messages, we observe the situation represented in Table 11.

	Basic Epistemic Agency	Advanced Epistemic Agency
Peripheral participation	202	193
	51,1%	48,9%
Central participation	937	1176
	44,3%	55,7%

Table 11. Basic and Advanced Epistemic Agency among 'peripheral' and 'central' students of Rome and Valle d'Aosta Universities.

The table evinces more marked Advanced Epistemic Agency among students who participated more 'centrally' in their community, and predominantly basic Epistemic Agency among the more 'peripheral' students (Chi square (2)=6.2, p<.02). It therefore seems that high participation in the online course is associated with Exploring (i.e. formulating questions or problems and hypotheses) and Evaluating the knowledge developed and the strategies used to elaborate it, rather than merely Proposing and Elaborating information. Those students who play a central role in interactions do so not only because they make a large number of postings, but also because they stimulate the knowledge building process.

If we consider tutoring style, we may compare the messages posted by the students who participated in a forum moderated by a destabilizing tutor with those of students in a forum moderated by a supportive tutor (Table 12).

	Basic Epistemic Agency	Advanced Epistemic Agency
Destabilizing tutor	336	381
	46,9%	53,1%
Supportive tutor	316	506
	38,4%	61,6%

Table 12. Basic and Advanced Epistemic Agency among the Rome students who had destabilizing or supportive tutors.

The table shows more marked Advanced Epistemic Agency among students with supportive tutors, and largely basic Epistemic Agency among those with destabilizing tutors (Chi square (2)=11.1, p<.001). It therefore seems that the tutor's supportive style can foster greater exploratory orientation towards new problems and new hypotheses associated with evaluation of the knowledge produced and of study strategies. The destabilizing style seems instead to induce an orientation more centred on proposing and elaborating information, with closer adherence to the problems set at the beginning of the discussion. Still to be explained, therefore, is why the cognitive conflict provoked by the destabilizing tutor does not induce participants to adopt more Advanced Epistemic Agency.

We now consider the Epistemic Agency of the students in relation to the presence or otherwise of opportunities for metacognitive reflection during the courses (Table 13).

	Basic Epistemic Agency	Advanced Epistemic Agency
With meta-reflection	239	296
	44.7%	55.3%
Without meta-reflection	248	186
	57.1%	42.9%

Table 13. Comparison between central subjects in the two Aosta courses with and without metacognitive reflection.

Table 13 shows that subjects who participated in courses with opportunities for metacognitive reflection tended towards Advanced Epistemic Agency, while those who followed the course without metacognitive reflection tended towards Basic Epistemic Agency (Chi square (2)=14.9 sign with p<.001). Therefore, frequent metacognitive reflection during the course – which required students to select the most important ideas emerging from the discussion, and to indicate the strengths and weaknesses of their learning strategies – is likely to have induced their greater orientation to exploring problems and formulating hypothesis. It thus engendered greater evaluation of the contents and strategies that emerged from the forum.

5.3 The students' reflections

As illustrated above (section 4.2), notwithstanding the hypothesis that the students' involvement in the online activity would enhance their metacognitive skills, our quantitative analyses did not reveal significant differences between self-regulation strategies upon entry and exit. On the one hand, in purely quantitative terms, it therefore seems that the activity did not improve the students' ability to organize their study time (Organization), to process the materials (Elaboration), or to monitor their learning (Self-evaluation). On the other hand, though, when qualitative analysis was made of the considerations expressed by the students who engaged in the final metacognitive reflection, it was found that they explicitly stated the benefits of the online course for their self-regulation skills.

Firstly, the students stated that they had learned how to 'pace' their studies. Rather than studying the course contents solely in view of the final examination, they learned how to divide up the materials and study them in sequence. "*With the KF I was able to study the topics one by one with a lot more attention and not waiting until the last moment*" (Sar, Aosta). "*Not a new strategy but one well suited to learning through the forum ... is 'gradual' studying ....a topic for each module, with, yes, a specific schedule to respect, but well organized*" (Mon, Aosta). The online mode of study therefore seems to have positively influenced the students, enabling them to adopt a new strategy of study. "*In order to post messages on the forum, divided among various modules, each with its time limit, I had to arrange my study of the interesting parts in a more structured and*

efficient manner, organizing my free time in the most suitable and profitable way possible" (Dan, Aosta). The participants therefore seemed aware of the benefits of the online activity for organization of their studies: "*Usually, because I have little time for study [...] I only later study the materials given to us and the books. This space for debate has instead enabled me to take stock of the ongoing situation and rework the main concepts of the topics proposed by the lecturer*" (Dan, Milan).

The students also perceived participation in the activity as enhancing their personal elaboration skills. "*Finally, this experience has helped me to summarize my ideas better, and to express them clearly so that the other members could understand my opinionson the various discussions in the forum*" (Ice, Milan). They thus pointed out that the activity had enhanced their personal elaboration of ideas.

Reflecting on their ideas and those of others enabled the students to reorganize the course contents and to propose them to the others in personally restructured versions. The reading of comments by others activated reflection and a search for further information, then to rejoin the others in the collective knowledge building process: "*Perhaps it cannot be called a strategy, but I found that that the 'best' way to study was to analyse all the opinions of the others before posting mine in the forum... so that, besides study, I also did comparison and 'research' work, also expanding my points of view*" (Mon, Aosta) and "*The strategies that this forum has allowed me to experiment with have centred on Divergent Thought. None of my reading of comments was an end in itself; all the comments induced me to search for information, to reflect, and then resume discussion*" (Ade, Rome). In order to make a relevant contribution to discussions, a student had to explore topics both by studying the textbooks and by surfing the Internet: "*It has certainly allowed me to try out a new kind of thought; that is, it has enabled me to deepen my knowledge on some topics by seeking new information*" (Ade, Rome).

Finally, the students stressed the importance of the forum in increasing their capacity for self-evaluation: "*Participating in the forum has therefore helped me in this sense, because I have been able to check my progress in learning about the topics treated*" (Nic, Milan), "*Even by only reading the comments of others I have been able to check that I have taken notes correctly*" (Ali, Milan).

Interaction in the forum seems therefore to have positively influenced the students' capacity to evaluate their knowledge and to draw the consequences for their study activities: "*Having had to discuss the opinions of the others has made me improve and increase my knowledge, informing myself about the topics treated; it has been an excellent way to study and to get to know topics I had no idea about*" (Lua, Rome); "*A factor that motivates you to do your work consistently is always having in mind that someone is going to read your messages, so you try to avoid making blunders, where possible. When you work independently of KF, this does not happen*" (Mic, Aosta).

Examination of the students' reports suggests that the online activity may have been beneficial to metacognitive skills in general and self-regulatory ones in particular, even though this feature was not evidenced by the quantitative instruments.

Of interest is the 'purpose' that the students attributed to the strategies which they said that they had employed in order "to participate actively and constructively" and "to carry the forum forward". The experience therefore enabled the students to experiment with new study strategies and to develop new self-regulation skills. However, such strategies seem to have increased not only the cognitive assets of the individual student but also and above all collective ones, becoming a 'language' learned with and for the community. The students' final reflections can in fact be viewed from a different perspective in terms of whether and how the students understood the knowledge building community that they had been invited to enact.

When the students wrote their final reflections, they were asked to identify the motivating and demotivating aspects of the online activity. The motivating elements cited by the students largely concerned the 'participative' and 'active' nature of the experience. The activity was motivating because knowledge was constructed collectively through expression of one's own ideas and the sharing of materials and resources "*The motivating aspects were: the opportunity to interact with several people...; having a common interest; feeling that you were doing something together with others; being able to select interesting information*" (Gia, Rome). Also appreciated was the possibility to build knowledge, and not

merely to study what had already been said by others. "*I was motivated by the idea of 'actively constructing' this exchange of knowledge and learning; in a search to which each contributed a different building block, and the sense of belonging which it created*" (Nee, Rome).

Also interesting is the motivation induced by the use of media which are now integral to our culture, and which for many represent a more 'congenial' way to study. "*The motivating elements certainly had to do with the fact that I could study and use my PC at the same time! I personally use the latter a great deal, and Internet, and combining the forum with paper-based materials certainly motivated me much more to go in search of things to read for the examination, and also for my personal interest*" (Man, Rome).

Demotivation was due mainly to situations of 'standstill' in discussions: when, that is, contents already expressed were merely reiterated, with no new contributions being made. "*The demotivating aspects were moments when the discussion came to a standstill, with the same points being constantly repeated, so that it became almost redundant*" (Nee, Rome). "*I sometimes felt demotivated in stalemate situations, of repetition, when signals from the others were ignored, and the same ideas kept on being repeated*" (Dan, Rome). Also demotivating was the feeling of "not being considered", of not receiving feedback from colleagues or tutors. "*The demotivating aspects were not receiving feedback on materials or reflections, which instead I thought interesting for the development of the discussion*" (Nee, Rome).

The students' reflections seemingly grasp the fundamental features of the experience of collaborative knowledge building, in which the participants deploy information search strategies, reflect upon their ideas, and organize them so that they can be discussed with others, the goal being to construct shared knowledge in the group. This takes place within a motivating activity where all can express their ideas, and improve them through documentation, reflection, and comparison. The online activity allowed participants to experience, as a student wrote, "*an interactive study strategy with manipulation of information in constant progress*" (Fra, Rome).

Conclusions and future directions of inquiry

The three above-reported strands of inquiry yielded interesting results in regard to the use of online environments for collaborative knowledge building.

We sought to determine the optimal kinds of tutoring for collective discussions, and to identify possible developments in the cognitive and metacognitive skills of the students involved in the research project.

The research questions that we sought to answer were the following: can we offer students forms of experience which help them improve their skills? Can we help students maintain interest in the activity, making the best use of what we offer them, so that the risk of drop-out is reduced?

To answer these questions we collected both quantitative and qualitative data. The former were used to analyse the relationship between the number and frequency of messages posted by the tutor and the relative interaction among students. And questionnaires were administered to investigate self-regulation skills and learning motivation. The qualitative data were drawn from online discussions among the students involved in the project, and from the final reflections written by a group of them.

An important variable considered was the activity of tutorship in its quantitative and qualitative modes. The results show that the optimal tutor intervenes in discussion constantly in time and to a moderate extent, using a mainly supportive style which encourages the students to contribute, mirroring the participants' opinions in order to foster participation.

Analysis of the questionnaires showed that the presence of the tutor and his/her mode of interaction with the students are factors that make the difference in improving individual metacognitive skills. The way in which the tutor moderates the discussion seems to influence the students' perception of their ability to evaluate the results of the learning process. We may presume that a supportive style by the tutor 'reassures' the students about their abilities and gives them confidence in their capacity to monitor learning. The different modes of interaction by the tutor also influence the quality of the discussion. Students who participate in a discussion where

the tutor tends to dispute the group's ideas, with the intention of producing cognitive conflict and stimulating argumentative abilities, orients the collective discussion towards basic epistemic agency (proposing and elaborating information), whereas a supportive tutoring style tends to activate advanced epistemic agency (exploring problems and evaluating contents and strategies). A large body of studies (e.g. Orsolini e Pontecorvo, 1992; Pontecorvo, Ajello e Zucchermaglio, 2004) stress that cognitive conflict and opposition are able to activate argumentative skills and to 'animate' the discussion. It seems, however, that the destabilizing function should not be assumed by the actor with the 'dominant' role in the community, because interventions intended to cast doubt and destabilize may inhibit some subjects from producing new ideas and bringing them 'into play' in the discussion. Opposition probably has a positive function when it is performed by peers: in this case, the ensuing cognitive conflict may activate argumentative skills and produce new ideas and hypotheses.

The quality of the interaction seems also somehow to be influenced by the presence of opportunities for discussion of the online activity. The contributions of the students who had taken part in the courses with metacognitive reflection were more epistemically advanced than those of students who had not conducted reflection on the course. Stopping to think about the knowledge inquiry process performed by the community seems to have enabled these students to discuss more constructively.

In light of numerous studies which consider participation in discussion groups to be a factor which facilitates metacognitive reflection (Cacciamani, Giannandrea, 2004; Choi et al., 2005), we also expected clear signs to emerge of an increase in the metacognitive competences verified using the questionnaires (SRQ and AGQ) also in the pre and post e-learning comparison (section 4). This was not what we found, however. Nevertheless, the discordance between expectations and findings prompted further reflection and more careful integration among the sources of the data collected. In fact, added to the quantitative data were the qualitative data relative to the students' reflections: these were far richer, and, unexpectedly, they at first sight contradicted the questionnaires (section. 5.3).

In fact, although the results of the questionnaires did not show an improvement in metacognitive skills between before and after the online experience, the reflections written by the students after the online activity highlighted that the course had overall been beneficial to metacognitive skills in general, and self-regulation ones in particular.

A possible explanation for this discordance resides in the nature itself of the instruments (the SRQ and the AGQ) used to measure and monitor the metacognitive skills of the students participating in the course. These were self-report instruments which asked the students to express their degree of agreement with the statements proposed. By their nature, they were predisposed to bring out metacognitive knowledge, or in other words, what the subjects believed to be the most effective strategy for study, or what goal they deemed best suited to learning, or thought that they would pursue. However, an instrument of this kind cannot determine the strategies actually employed, and the processes really activated in the learning, or in verbal interaction for learning. The gap between these two dimensions – which constitute the nature itself of metacognitive competence (i.e. metacognitive knowledge and metacognitive control) (Flavell, 1979) – has been stressed by several authors (Brown and Campione, 1978; Cornoldi, 1995). We cite in particular the study conducted on 7038 university students by Schneider, Borkowsky, Kurtz and Kerwin (1986), which reported a lack of correlation between what the students said that they did to organize their study activity and what they actually did for this purpose.

It seems necessary to introduce a further degree of complexity into the interpretation of the data. The questionnaires referred in fact to self-regulation skills generally deployed when studying, and they did not make explicit reference to online activity. Vice versa, the reflections drawn from the online conversations made explicit reference to the activity performed, not to cognitive processes acquired and generalizable to traditional study activity as well. It is therefore likely that the students perceived the intrinsic value of the online activity in enhancing self-regulation skills to be used in the specific context in which they were working. But they were not able to generalize the new skills to activity not online, so that the new acquisitions were not surveyed by the questionnaires.

A final interpretation concerns the time factor. The time elapsing between administration of the questionnaires on entry to and exit from the course was about two or three months, which was perhaps not enough for metacognitive change to come about. On the one hand, we may recall Flavell's (1979) discussion of the metacognitive experiences possible when someone is confronted by a problem, a new situation, and comparison with other points of view, and therefore consider discussion in web-forums as favouring metacognitive experiences. On the other hand, however, it should be borne in mind that experience of such situations does not necessarily modify the functioning of reflexive processes.

This aspect may be particularly important if we consider that university students possess long experience of education and the application of personal study methods, as well as consolidated self-evaluation and elaboration strategies. Consequently, a training course aimed at fostering change must take account of the time factor: that is, of the time necessary for the students to deactivate consolidated processes and strategies and adopt new ones. The cognitive effort and the costs-benefits calculation intrinsic in a metacognitive change (Moé, De Beni, 2000; Cornoldi, 1995; Schneider, Pressley, 1989) require a longer time to be performed.

We developed our analyses further by relating different modes of participation to the metacognitive indexes yielded by the questionnaires. This investigation was carried out on the entire sample as regards the metacognitive questionnaires, and on a smaller corpus of subjects as regards the analysis of epistemic agency.

The results show that students declaring mastery goals at the beginning of the course tended to assume a central role in the discussion in terms of the quantity and quality of their contributions. The mastery goal pursued by a student therefore seemed to exert considerable influence on his/her level of participation in the activity, with a conspicuous number of contributions at an advanced level of epistemic agency. On conclusion of the course, however, these students declared lesser self-evaluation skills. This unexpected finding can be explained within a more general interpretative framework. More participative students were also those exhibiting a stronger mastery goal at the beginning of the course, and at the same

time a higher level of epistemic agency. That is to say, they were more focused on exploring problems and on evaluating the knowledge produced during the course and the strategies used to elaborate it. It may be that being at the centre of the community, and contributing quantitatively and qualitatively to the collective construction of new meanings, induced these students to perform a strongly 'situated' evaluation of the task which was not transferred to the overall study activity analysed by the questionnaire, and eventually strongly differentiated itself from it.

The results of the three strands of analysis open up interesting further directions for research. The data on the level of epistemic agency were collected on a small number of subjects. It would be interesting to extend such analysis to the entire sample in order to verify the hypothesis concerning the reduced sample: namely students with a greater orientation to mastery from the beginning of an online course engage in discussions with a higher level of advanced epistemic agency than do the others. It is in fact likely that the motivation to become really competent (more than appearing to be so) induces the student to be more active in exploring problems and evaluating the knowledge produced by the community. It is accordingly likely that mastery-oriented students are readier to accept the shift of perspective proposed by an online course based on the principles of the knowledge building community, or on the organizational frame of the progressive inquiry model: the need to abandon the view of learning as the individual acquisition of knowledge, and to adopt the perspective of a real community whose members build knowledge collaboratively. It is therefore important, when organizing an online course, to make the principles of the models which have inspired its design immediately clear to the students, in order to bring about this change of perspective. An important role in this regard can be performed by the tutor, who can encourage, as we have seen, participation and the opening of discussions by students through constant and moderately frequent intervention. Moreover, she/he can favour an orientation to advanced epistemic agency among the students to the extent that she/he adopts supportive rather than destabilizing strategies of interaction. Another aspect of the 'knowledge-builder' tutor style of interaction could then be explored: the positioning of his/her action

vis-à-vis basic or advanced epistemic agency, with analysis of the relative effects of the one or the other.

Sustaining an advanced level of epistemic agency in contributions seems also to require moments when the students can reflect metacognitively on the developing online course. Giving the students an opportunity to 'discuss the discussion' seems to be beneficial to interaction. Moreover, the comments made by these students on conclusion of the course stressed its benefits for their self-regulation skills. These are therefore elements which suggest that such metacognitive skills are developed by online courses. However, in the research reported here, such development is restricted to the final comments of the students who participated in a course with metacognitive reflection. It would therefore be interesting in the future to introduce moments of collective reflection for groups mediated with a different tutoring style, so as to study its possible effects on the participants' interactions and self-regulation strategies.

Chapter 2

Building intersubjectivity and identity in online communities

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Abstract. The starting point of the research discussed in this paper is the fact that the variables of identity and intersubjectivity have an important effect on learning and also have a very specific role in online communities. Both formal and informal forums were analysed. In some cases, online and offline interactions were compared. Innovative tools (a content analysis codebook and an original application of Social Network Analysis) were designed to analyse the data. Transverse dimensions such as: a) building and sharing positionings; b) participation strategies c) sense of belonging and d) intersubjectivity were observed.
Participation strategies were found to be complex and never linear, very fluid or flexible. The sense of belonging to a community is co-constructed by interweaving I- and We- positionings. Individual and collective positionings could be displayed at three levels: individual, interpersonal, and community.
Intersubjectivity seems to be the overall architecture holding identity and community together. However, intersubjectivity is never fixed, rather it is constantly re-negotiated. The extreme fluidity of the phenomena observed calls for deeper understanding. Deeper discursive analysis and finer ways of blending online and offline contexts should be performed with future research.

Keywords: intersubjectivity**,** identity, forum, community.

1. Introduction

Virtual environments are increasingly widely used to devise educational contexts. These environments offer useful possibilities

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for conducting investigations to be subsequently used in effective learning and participation processes. Specifically, the involvement of identity-related aspects and the creation of intersubjectivity between physically distant users take on an interesting specific nature, which will be examined in this chapter.

Before proceeding with a description of the research project as regards these aspects, we believe it to be useful to answer one question that the reader might ask: What function do identity and intersubjectivity play in learning processes and in defining educational models? This is a valid question and we believe that the answers imply a number of interesting considerations.

Learning is an experience that promotes changes, that alters the way we see ourselves and our abilities. It brings us into contact with new areas of ourselves (zones of proximal development, to use Vygotskij's term), it forces us to imagine ourselves in the future as professionals, people, social actors able to manage different roles, to contribute to changing the society we live in (Wenger, 1998). In this sense, learning is an identity-changing experience and training contexts cannot therefore merely aim to "draw out" who we are, but rather must undertake to offer the possibility of "building" the self. This takes us beyond the etymological definition of the term "identity", in which *id* stands for identical and shifts attention from the need for confirmation and temporal continuity of the self to the multiplication and fragmentation of I- positioning; from the "centre" of the self towards the perimeter of the person one could and would like to be (Fasulo, 2004; Gergen & Shotter, 1989).

This vision of identify correlates well with the social-constructivist suggestions that consider the world and knowledge on which we feed as being socially constructed rather than provided by nature. This contrasts with the idea of an objective situation or at least the human ability to access it, to emphasise the cultural, rather than purely social, nature of the human being having to constantly and inevitably build or negotiate new meanings, starting from those available in his/her cultural and historical context. The "objects" built and negotiated also include the sense of self. The way in which this negotiation of meaning takes place in an educational context plays a decisive role in the personal history of each individual (Ligorio, in press).

We believe that social and cultural negotiation of the sense of self is part of the intersubjective architecture. Building intersubjectivity is nowadays widely considered as a crucial element for the success of educational contexts that go beyond a mere transfer of information to set as objectives cultural development and critical thought (Biesta, 1999; Guilar, 2006; Grossen & Perret-Clermont, 1991; Osberg & Biesta, 2007).

Focusing on identity-related aspects and on the construction of intersubjectivity is not considered as alternative to the analysis of cognitive and metacognitive aspects. The point of connection between the cognitive and identity dimensions lies precisely in the value that both attribute to social aspects.

The social dimension and interaction with others constitute the load-bearing axes of the process of identity building and intersubjectivity. Overcoming the vision of learning as an individual act and considering it a social event has made the contribution of social psychology fundamental in understanding the learning process. If learning takes place through the participation in the life of groups and communities, the methods and constructs of social psychology become essential to defining effective educational models (Annese, 2005). In fact, this entire chapter is pervaded by the constant interweaving between the psychoeducational and the psychosocial perspective.

Having specified these underlying premises, we will now move on to clarify the specific characteristics of technological mediation. Talking and meeting on the Web and activating processes of learning and participation in a virtual community are experiences with a number of particular features. In the research presented in this chapter, we have focused primarily on asynchronous communication environments, mainly forums, and analysed several such environments dedicated to university students, teacher training, researchers and self-help forums. Although forums do not entail non-verbal aspects, the centrality of text and asynchrony in writing, reading and rereading offer new opportunities for participation and reflection. Furthermore, the encounter with the "Other", mediated by the screen and written text, would appear to generate completely new interaction and interconnection patterns.

The emotional and intellectual reaction of many participants in

our forums calls to mind a letter that Tabucchi received from a reader and included in the wonderful novel "Auto-biografie altrui" (2003):

> "You have written my story. You have told a concise version of that autobiography that I never managed to write. [….] As you talked of me without knowing it, you were undoubtedly talking about yourself, because all novel-writing – especially that which passes through the ego of the epistolary form – is always an image of the Self. Without knowing me, you dressed as me to talk about yourself. Something that I, when talking about me as me, have never managed to achieve" (Tabucchi, 2003; pp. 89-91).[1]

As in a novel, the effect of identifying with the words written by others often characterises our forums. The comparison with a novel is a valid one: in fact, when considered as a whole, forum entries compose a story in which each individual interweaves with the other, in which the Others complete the missing pieces and enhance the stimuli given by the Selves. The whole text of a forum discussion therefore becomes a plot narrated by several voices and written by several hands, a tale in which the self and the other interweave and merge to describe learning and social participation processes and trajectories that cannot be repeated in other contexts.

2. Theoretical background

The technical setting of the research presented here is in part the same as those that inspired the general framework of the national project. We refer in particular to the socio-constructivist vision of learning (Gergen, 1995; Varisco, 2002) and the consequent reformulation of learning in terms of participation and acculturation (Bruner, 1966; Wenger, 1998). In addition to this broad framework, we share with the rest of the text the interest in those branches of study that deal with the role of technology in supporting cooperative and socioconstructivist learning. These include Computer Supported Cooperative Learning (CSCL) (Koschmann, 1996) and the more recent studies on e-learning (Hung & Nichani, 2001) and blended learning, in which online and offline are cleverly integrated to

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[1] Our translation.

create complex teaching models (Bersin, 2004; Ligorio, Cacciamani & Cesareni, 2006).

We then split this broad framework into two specific aspects: the theories dealing with identity and those studying communities. In both cases, we were particularly interested in those theories that showed a profitable declination of the internet contexts and that therefore allowed us to talk about online identities and virtual communities.

Our investigations on the ways in which identity and learning interweave are inspired by the work of Bruner (1984) and hinge on a Bakhtinian dialogical perspective (1930). We found it particularly useful to define identity as a series of I-positionings (Harrè & Van Langenhove, 1991), all of which are provided with "voices" and therefore capable of dialogue. The confluence between the positioning theory and the dialogical approach generates Hermans' Dialogical Self theory, according to which the self comes from the intersection between the "I" and the "Me" and produces polyphony of voices and a dynamic multitude of relatively autonomous I-positions.

Thematic environments like forums offer particular options that seem to support the dialogical nature and social and cultural negotiation of identities (Annese, 2002; Spadaro & Ligorio, 2005), which makes dialogical self theories particularly well-suited to studying the evolution of online I-positionings.

The centrality of negotiation processes characterises both the identity and the community trajectories. According to Wenger (1998, 2000), a community exists when a set of individuals negotiates the conditions of its existence inside an intersubjective discursive space. The negotiation is therefore founded on the process of social participation, whose fundamental components are: the *community*, the social configuration within which the involvement of individuals can be recognised; the *practice*, a set of psychosocial resources that support mutual involvement in the action; the *meaning*, active relationship with the world built up as something significant; and the *identity*, the outcome of the participation process that changes personal stories, supporting the developing context of the community.

The thus-configured community trajectory embodies the interweaving of a number of theories. Those that privilege the study

of the situated experience as an interactive relationship between person and environment (Suchman, 1987); conceptualisations on the production of the meaning in its methods but also as an interweaving between social power and participation (Berger & Luckman, 1973); and above all the psychosocial theories on the formation of the identity as a product of the social relationship between individual and group (Annese, 2001; Gergen & Shotter, 1989).

Participation, sense of belonging to the community and identity are woven together in a single weft by the interacting individuals, through the artefacts. The common matrix is intersubjectivity, the agreement reached by the individuals in relation to the meaning of the context (Rommetveit, 1979; Wells, 1993) and acceptance of their own and others' individualities (Matusov, 2001). Intersubjectivity is both the starting point and the constant landmark throughout the growth of the individual and the community, guaranteeing the cohesive and flexible character of individuality, acquired through participation, as well as the acquisition of new skills and the construction of new identity features.

In learning contexts it is even more important, if we consider that learning implies attributing meanings to the context, diversified in line with the activity (Colomb, 1999; Lemke, 1990), but also interiorising a Me able to observe the world from new and multiple points of view.

3. Web-forum cases

The studies that we conducted regard various cases of web forum use. These contexts use varying degrees of technological pervasiveness in accommodating communities of people who meet to achieve shared objectives. In general, each case was analysed using a mixed qualitative and quantitative methodology (Creswell, 2003; Creswell & Plano Clark, 2007), although they were each studied further using specific analysis methods that will be described along the way.

3.1 Web-forum for university students

A number of important results were obtained through the analysis of communities of students attending Psychology degree courses at the

Universities of Rome and Bari between 2004 and 2006. The analysed communities followed Educational Technologies or Educational and E-learning Psychology courses. These teaching experiences in some cases implied very complex course structuring. In any case, the students had to integrate traditional study activities with group activities performed online, using the Synergeia platform (Ligorio & Veermans, 2005) (see Annex no. 1).

3.1.1 Totally online university courses

Two of the analysed courses, which we will call "technologies 15" and "technologies 18", were held at the University of Rome and designed for students not attending lectures, therefore constituting totally online courses. All the learning and interaction activities took place using the Synergeia platform (see Annex no. 1), which constituted a space in which students had access to examination texts and other study materials. Having studied the various materials, the students were asked to discuss them using a specific pedagogic technique, the Progressive Inquiry Model (PIM; Muukkonen, Hakkarainen & Lakkala, 1999 – see Annex no. 2). This is a student-centred educational activity, where the role of the teacher consists in setting up the context and in supervising the discussion between students, guiding it when necessary.

The context is set up by creating a space for informal encounters and introducing the study material. Students are then invited to take part in brainstorming sessions in order to choose the subjects to be investigated during discussion. Thematic discussion commences following collective negotiation of the topic and continues according to the PIM. At the end of the discussion, the professor evaluates online activity according to participation, the quality of an individual dissertation and the contribution of each student to the development of the activity.

These two courses were analysed by observing the characteristics of interactions in terms of the negotiation of I-positionings, construction of the collective identity, and the cultural processes relating to collaboration strategies and artefact production. The research examined two different thematic discussions: the first composed of 98 notes written by 9 students on the "technologies 15" course and the second consisting of 148 notes written by 20 students

attending the "technologies 18" course. The analysis method used involved three steps:

- a discourse analysis (Gee, 1999; Gee & Green, 1998) used to identify the identity characteristics expressed by the individual and by the group;

- a content analysis using a tool called GAct (Annex no. 5), developed after the first step to analyse asynchronous online activities, which allowed us to identify and calculate the frequency of indicators relative to the psychological processes studied;

- a sequential analysis (Gnisci & Bakeman, 2000) that allowed us to verify the existence of a systematic sequential relationship between identity processes and cultural processes.

3.1.2 Blended university courses

Two further, blended courses held at the University of Bari, which we will call "e-learning 05" and "e-learning 06", were also analysed. Students were asked to attend classroom lessons in addition to participating in the online activities using the Synergeia platform (Annex no. 1).

Unlike the two courses described previously, the organisation of these courses envisaged a high degree of structuring provided by the professor, consisting of:

- a *breakdown into weekly teaching units* on the topics contemplated in the syllabus. During offline lessons, the lecturer explains the key concepts of the weekly topic and launches a question-stimulus that the students develop in the online activities;

- *a set of online activities* that include: theoretical reflection based on reading of articles proposed by the professor; group discussion guided by the PIM (see Annex no. 2); collective production of conceptual maps; mutual evaluation and self-evaluation of the trajectory followed during the week;

- *systematic distribution of roles* such as e-tutor, weekly programme synthesiser and, lastly, critical friend, namely the evaluator of the trajectory followed and of the products

generated during the week. The testing of these roles involves the simulated assumption of various study and group work skills and professional profiles typical of e-learning.

Within our research programme, these two courses were analysed to pursue the following objectives:

1. the analysis of I-positioning process;

2. the description of the individual participation trajectories and the structure of the community;

3. the differential analysis of the online and offline contexts in terms of identity and participation.

The complexity of the objectives to be achieved required the use of different kinds of data and various analysis methods:

- content analysis, supported by the GAct tool (Annex no. 5) applied to three online discussions, consisting of 72, 66 and 148 entries. The first two discussions took place in the "e-learning 05" course attended by 10 students; while the third was part of the "e-learning 06" course involving 14 students;

- conversation analysis of the 778 turns taking emerging during a final session of focus group discussion performed by 7 students attending the "e-learning 05" course. The specific objective of this analysis was to identify similarities and differences between online and offline interaction;

- social networks analysis, applied to the online and offline discussions of both courses, in order to understand the students' participation strategies and the dialogical relationships between the I-positionings assumed during interactions (Annex no. 6).

3.2 Web forum for researchers

Web forums also proved to be popular in the scientific community. The *Collaborative Knowledge Building Group* (CKBG; www.ckbg.org) is an association of researchers and lecturers conducting collaborative research since 2002, by organising scientific events of various kinds. The CKBG's aim is to investigate the relationship between educational technologies, culture and

knowledge building. The virtual environment chosen for interaction by the CKBG is the *Knowledge Forum* (KF; see Annex no. 3). This platform is based on a specific pedagogical model called Knowledge Building Communities (KBC; see Annex no. 4), devised by Bereiter and Scardamalia (1999), that guides participants towards a collaborative model of interaction. The CKBG community may have different types of online interactions: informal; based on a theoretical topic put forward by one or more community members; aimed to organise scientific events.

The study of the CKBG consists in analysing two discussions: one dedicated to members' self-presentation, composed of 105 notes written by 25 authors; the other, which we considered thematic, aimed at organising a scientific seminary and consisting of 104 notes written by 11 authors.

The interactions were analysed in the same way as those in the totally online courses for university students. The following were therefore examined: the strategies of I-positioning and participation through discourse analysis; the specific positioning of individual and group, cooperation techniques and products, through content analysis and lastly, the sequentiality between I-positioning and cultural processes connected to cooperation, through the use of sequential analysis.

3.3 Web forum for teachers

The third context analysed in our research was a training course organised by the Italian Institute of Educational Innovation and Research Documentation (Indire) dedicated to teachers. We studied a training course for recently hired Catholic religious education teachers. The learning activities were performed within the Puntoedu environment (http://puntoeduri.indire.it), a platform dedicated to teachers and devised to support professional learning activities. Compulsory course attendance followed a blended model, broken down into 15 hours of classroom lessons and 25 hours of activities to be performed online. The online activities involved preset topic areas, leaving the teachers free to choose those they found most interesting. Each activity envisaged specific learning objectives (acquisition of theoretical skills, teaching techniques, interpersonal skills that are useful in the school environment and reflections on subjects) pursued

through individual study of syllabus materials and participation in practical activities to be performed as a group in the forum. Each activity included both discussions on course-related topics (which we called In-Topic; IT), and discussions whose topic was negotiated by the teachers themselves (which we define Off-Topic, OT).

The study of these communities focused on the analysis of online discussions performed by three groups of teachers. The first and the second group, composed of 17 and 25 teachers respectively, had commenced OT discussions of 17 and 25 notes respectively. The third group was composed of 17 teachers who discussed an IT subject, with 18 notes.

The research was guided by the following objectives:

- identification of the positioning emerging from the interaction;

- analysis of the construction of a sense of belonging to the virtual community;

- identification of the effects of the nature of the discussion topic (OT vs. IT) on the collective and individual positioning strategies.

Data was analysed using content analysis, with the support of the GAct tool (Annex no. 5).

3.4 Web forum for informal participation

The online communities described thus far are formed on the basis of prior mutual knowledge of some of the members or an implicit pre-membership in well-defined social groups (for example students on a specific course or religious education teachers). In addition, the activities analysed present a certain degree of structuring and in general they envisage closed-term participation.

On the other hand, many spontaneous forums accommodate informal communities, composed of people who meet online without ever having had prior contacts, motivated by an interest for a specific shared subject. The objectives of such communities are autonomously defined by participants and vary from simple discussion to information sharing to mutual support.

This is the case of a community called "Il gioco della vita" (The game of life) (www.ilgiocodellavita.it). Its purpose is to inform users about psychological disorders through the publication of articles and online meetings with specialist psychologists. Within the website users can participate to self-help groups that interact through discussion forums. Online discussions are broken down into macro-areas corresponding to the types of disorder dealt with. Inside each macro-area, a tutor, usually a psychologist, opens an initial discussion by setting the topic. Subsequently each user may open a parallel discussion on a more specific subject. The users are not stable over time; new members are free to join the forum at any time and at any point in the discussion and anyone may abandon the forum at any time.

A discussion of a 25-member self-help group for eating disorders was analysed. The research aimed to answer the following questions: how are individual and collective positionings characterised in a self-help forum? How does participation activity change over time?

Data analysis was performed using discourse analysis method, applied to the whole discussion, and content analysis, applied to a sample of 108 notes and supported by the GAct tool (Annex no. 5).

4. Identity & community

4.1 Participation strategies

The community of practice model (Lave & Wenger, 1991; Wenger, 1998) considers participation as an evolutional process that can be metaphorised as a continuous trajectory from the periphery to the centre of the practice. The studies conducted by this research group show that the strategies of participation in online communities depend on a mixture of various dimensions such as personal identity, collective identity, and type of practice performed. This crossroads determines both the sense of belonging and the construction of a sense of community that, in turn, are influenced by the specific features of the objectives and context of the interaction.

The study of the university student and researcher communities showed characteristics and features assumed by the participation trajectories during the activities. First and foremost the objective of the interaction would appear to influence the participation

trajectories of newcomers. In fact, when the objective of the activity is self-presentation, the newcomer succeeds in taking part in community life by immediately taking a central position, whereas the same phenomenon is not observed in discussions with formal objectives. In this latter case, the style of participation is closely connected to past experiences of participation, to how expert members feel in relation to the perceived objectives of the new community as well as to how much the community itself is willing to grant the newcomer. Socialisation appears to be a negotiation process in which the newcomer and group interact and mutually influence one another. Newcomers may use proactive socialisation tactics and earn themselves their own area of competence, which modifies the structure of the community. However, at the same time, the community plays a fundamental role in supporting the newcomer integration process.

Lave and Wenger (1991) assert that the active participation of a newcomer is possible when the community legitimizes his/her belonging, offering a broad "observation horizon", which defines the space of opportunities for learning and practical action granted to him/her (Hutchins, 1995). A fundamental role in this sense is played by the community's expert members who may, through effective "scaffolding" (Wood, Bruner & Ross, 1976), help the newcomer to discern "what and where to look" (Goodwin, 1994) and to learn new and more competent ways of participation. In the researcher community, the expert members often implement strategic alignment and redirection strategies that serve to support the newcomer in understanding the implicit rules of participation in that community (Spadaro, 2007a). This type of interaction between community and newcomer triggers a negotiation aimed at finding a balance between accommodating new members - without running the risk of fragmentation - and prompting an identity change process that allows newcomers to feel increasingly part of the community.

One interesting result concerns the variety of individual participation trajectories of members of the same community. The study of the "e-learning 05" students community in particular showed the presence of at least four potential, not always linear, trajectories, characterised by:

a) *Stability*: some students tend to maintain the same level of centrality over time, regardless of whether it is high or moderate;

b) *Progressive centralisation*: this is the linear trajectory, from the periphery towards increasing centrality, described by Lave and Wenger (1991);

c) *Progressive decentralisation*: indicates an inverse linear trajectory to that above, towards ever-less centrality;

d) *Non linear stability*: characterises the trajectory of decentralisation in the middle of the discussion, before adopting a central position at the end of the discussion; or, conversely, central position in the middle of the discussion, before decentralising.

These diverse trajectories influence the structure of the community. In fact, those students who have a stable centrality trajectory over time are also those around whom the community builds a reference nucleus for the exchange of communication.

The structure of the community, in turn, influences the strategies of participation of individuals, thus determining, in the case of a community well structured, more uniform strategies and therefore the absence of central or peripheral figures. Conversely, in the presence of a less compact structure, certain subjects implement more active participation strategies than others, to become the functional leaders or counter-leaders of community life. Inside the "e-learning 05" and "e-learning 06" student communities, it is possible to track the co-presence of leaders, charismatic and popular figures who enjoy the consensus and respect of the community, and counter-leaders, who conversely try to oppose the leaders by imposing themselves on the community. However, the community does not always recognize and legitimize their prestige. Counter-leaders are active participants in addressing messages both online and face-to-face but they are not equally central in receiving messages. This demonstrates the poor respect in which they are held by other members, who prefer to give their consensus to participants recognized as leaders. Conversely, leaders are characterised by an interaction profile that integrates in a balanced manner a high prestige index, indicated by centrality in sending notes and in the self-selection of offline conversations, with

an equally high popularity index, indicated by their centrality in the receipt of both offline and online discussion.

The participation strategies used by the individual participants also strongly depend on the interaction context. The study of the two blended student communities showed that the participation strategies of their individual members do not remain unchanged but rather participants appears to adapt their style of interaction to the communication environment (online and offline), thus generating specific participation trajectories. For example, some students who are peripheral during the face-to-face discussion seem to find space in the online discussion, becoming active and perfectly integrated into the community's participation network. Needless to say, there are also participants who follow stable participation trajectories, activating the same strategies in different interaction contexts. For example, some members maintain the same popularity and prestige in both offline and online discussion; they are always crucial reference points for the whole community.

Studying the group dynamics is useful for understanding how the mediation of technological artefacts changes interaction patterns. The results we obtained allow us to affirm that the communication environment tends to characterise interaction, creating highly distinctive participation networks differing from those created by the same participants when interacting offline. Discussion environments such as these seem to afford the adoption of compact and cohesive participation strategies, through a more democratic distribution of communication resources; whereas offline discussions offer a less equal network of participation founded on the centrality of certain members and the presence of numerous subgroups within the community.

4.2 Community and sense of belonging

According to Wenger (1998), participation in a community entails a mutual engagement, a common enterprise towards which everyone assumes specific responsibilities and the presence of a shared repertoire. Negotiated participation generates a sense of belonging characterised by engagement, imagination and alignment. Whereas engagement refers to a concrete involvement in the community, imagination dilates this involvement beyond spatial and temporal

boundaries and alignment triggers the same involvement in broader perspectives. It can therefore be said that such characteristics do not act on the basis of territorial belonging, but rather develop on a symbolic and cultural level, as they imply the sharing of values, habits, lifestyles and symbolic and cultural models (Pollini, 2000).

A strong sense of belonging to the community is generated by the perception of familiarity (Wenger, 1998), strong interdependence and "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together" (McMillen & Chavis, 1986; p. 5). The sense of belonging does not therefore require co-presence in a specific physical place and consequently the development of a community of practices is possible even in virtual environments.

The research experiences presented here demonstrate that in all the asynchronous environments analysed, users are able to build a "sense of community" (McMillan & Chavis, 1986). Each member sees him/herself as part of a unit in which to negotiate a form of collective identity, in addition to an individual identity.

The study of the use of specific discursive markers in all the analysed communities shows the existence of a strong sense of belonging to the community and the constant reference to the other as an essential part of one's own identity. For instance, analysis of the students' forums demonstrated that, despite keeping a distinction between "I" and "you", community members continue to consider themselves as part of a "we". This marked sense of community prompts them to involve the others, getting them to share their opinions, through the collaborative construction of the structure and contents of the discussion (Cucchiara, 2006). This process involves the community, the individual and the context, interweaving past and current experiences. In the "technologies 18" community, the sense of 'we' developed exponentially from the start of the course, despite the fact that members also belonged to other communities. Furthermore, the consolidation of the sense of belonging occurs when the community identifies a common goal (Spadaro, 2007a). In fact, by meeting to negotiate the meaning and aims of online discussions, the students inevitably find that they consolidate the sense of belonging to the group. Working together

to build products for the course requires the sharing of a vast repertoire of practices and languages that allows community members to act on the basis of an intersubjective weft.

In contrast with a simple aggregation of people, in communities the continuous interpersonal exchange and negotiation of meanings and sense creates a shared culture and vision, rich in social contents and future expectations. The intersubjective weft allows an evolution along a double track: the construction of a group culture and the involvement of individuals in that culture.

The sense of community is a constitutional part of the construction of individual identity. It is no coincidence that in the e-learning courses analysed, alterity is essential for the construction of the self. In fact, by applying the Positional Network Analysis (PNA; see Annex no. 6) one can observe that, despite the positioning trajectories of the members centred on the individual dimension, there is a very strong openness to alterity represented by the presence of more 'social' positionings. In fact, when describing their individual identity trajectory, the participants often refer to collective experiences that reveal a very strong sense of belonging: *"I became an e-learning expert through the course that we followed"*. With this statement, the student acknowledges the importance of the experience of belonging to the community which has allowed him/her to develop better e-learning skills and to consequently restructure his/her own identity according to a new status enabling him/her to position him/herself as an "e-learning expert".

Thanks to the sense of belonging, each member becomes "someone", with his/her own way of being, inside the weave of experiences generated by the community. The individual's identity is therefore constructed through his/her involvement with the fabric of the community. Such fabric can be particularly complex and structured when the community is made up of various subgroups, thus creating various community levels and consequently different levels of belonging. Our results showed that the belonging to a community subgroup creates collectively complex positionings, an expression of the sense of belonging to both the specific subgroup and the larger community. The users adapt their positionings to the interaction context and the specific situation. In fact, when interacting in a discussion space restricted to the members of the subgroup,

reference to "we" expresses the belonging to that specific restricted community. In contrast, during collective discussions in which there is no longer any breakdown into subgroups, the "we" broadens its boundaries to take in the whole community. Identity therefore develops integrating the many different forms of belonging to the community that previously appeared.

The constant reference to the other as an essential element around which identity is built leads to an ongoing reconstruction of the individual's social identity, as well as the possibility of negotiating a collective identity, which represents the outcome of negotiation between single identities of the members of a community. Participation in and belonging to a community implies the sharing of a common space inside which it is possible to make one's individual character available to the other, overcoming the boundaries that separate the individual from the group. Research on e-learning courses has shown how blended communities are able to favour and support the construction of such space, and in fact, individual identity trajectories graft with the community fabric to create a two-way flow between individual and collective identity. In this sense, the participation strategies of the individual community members take on a meaning as the essential part of a collective participation network that defines the very structure of the community, manifested through group dynamics.

The community structure is based on a positional logic that defines the individuals in terms of social power and popularity, always according to the interactive context and changes in group life. For example, by analysing the "e-learning 06" community, different styles of leadership emerge according to the presence of subgroups: a directive style produces fragmentary participation strategies that structure a strongly centralized group, whereas a distributed leadership style favours more balanced strategies that create a uniform group structure. The positioning of the leader is measured on the positioning of the other participants, all of whom contribute to defining the community as a whole.

Even the participation strategies of more peripheral subjects contribute to modelling the structure of the community. By studying the "e-learning 05" community, we observed how the structure of the group changes according to the presence or absence

of marginal participants. The absence of more peripheral subjects or those that are particularly central in the online discussion generates a more even participation of all members, producing balanced group dynamics (see fig. 1); in contrast, the presence of a marginal participant in the offline discussion triggers a lesser degree of cohesion, thus creating unbalanced group dynamics (see fig. 2).

| **Figure 1**. Structure of the community in online discussion: density =1. | **Figure 2**. Structure of the community in offline discussion: density=0.80. |
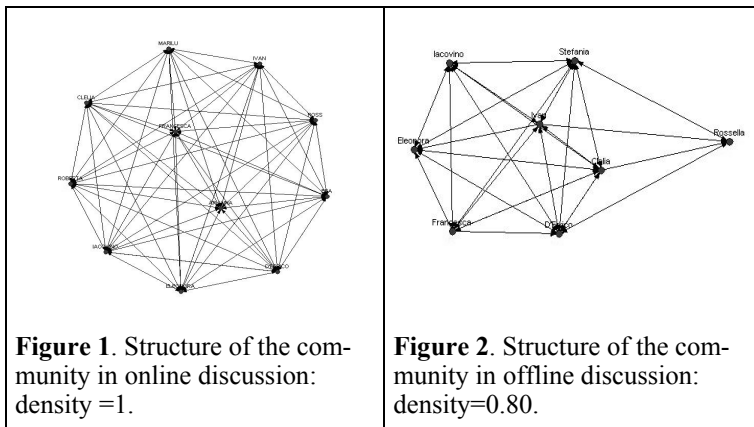
In practice, all participants, both central and marginal, make their own individuality available to the others, contributing to the formation of a common space and of intersubjective dynamics, which build the community. The individuals' belonging to the community supports the creation of a collective identity, marking the boundaries of individual identities; the sense of belonging mediates the definition of the collectivity through the definition of individuality.

4.3 Identity and positioning

The dynamic approach to identity provided by the Dialogical Self theory (Hermans, 1996; 2001; Hermans, Kempen & Van Loon, 1992) well meets with the social perspective of groups proposed by the "communities of practice" model (Lave & Wenger, 1991; Wenger, 1998). Conceptual articulation can be performed on the basis of the latter theory, according to which the negotiation process is the central nucleus of identity, which itself derives from the sense of belonging developed through participation in the community. The social, situated and cultural nature of identity takes into account that

repertoire of positionings, those multiple voices in a dialogical relationship that constitute the weft of the self. The combination of these perspectives therefore allows a theoretical slide from an identity belonging exclusively to the individual to an identity built intersubjectively.

Our analysis of blended experiences confirmed the potential of theoretical integration through the identification of new and structured definitions of identity. The results show a high complexity of the possible identity trajectories that can be identified through three aspects: multiple levels of positionings that can be arranged along an individual-community continuum, a vast array of identity positions and, lastly, an interaction between the definition of identity and situational elements connected to the activity context.

4.3.1. Types of positioning

The analysis performed on the community of researchers and on totally online university courses showed that the positioning occurring during interaction can reflect far more complex identity dynamics than the internal-external dialogical interaction put forward by Hermans. Discourse and content analyses reveal a rich taxonomy of potential positionings.

First and foremost, they can categorized in types that can refer to a personal identity or a social identity:

1. the first type, which we will call "individual", includes both internal and external positionings identified by Hermans: internal positionings refer to emotions or descriptions of characteristics that are felt to be peculiar to the self; external positionings refer to people, places or experiences that have been important to the formation of the self. Furthermore, the individual identity is expressed through characteristics perceived as desired or potentially acquirable through social interaction. We termed these latter positionings "open" to emphasise their strategic function in creating a receptive space in which the other can be welcomed for interaction. These are often positionings which straddle the interior and the exterior, in which one more or less explicitly invites the other to intervene in the co-construction of a more defined identity;

2. the second type, which we called "collective", highlights the importance of an integration of the Dialogical Self theory with psychosocial theories because it interrelates the individuals and the community. The emerging group positionings are used by members to talk as community spokesperson or to define themselves as belonging to a 'we'. Again on this type, the dialogical aspect straddles the interior and exterior, however these are spaces that are no longer restricted to the individual sphere of action, but are dilated in the social context:

    - Interpersonal positioning: the members of the analysed communities often explicitly refer to one or more group members, for example through the use of the singular "you" or by referring indirectly to the designated person. This positioning, by implying a relationship with another group member, contains a seed of belonging to the community;

    - Boundary positioning: this kind of positioning lies on the border between individual and community. It is characterised by linguistic expressions that indicate the member's temporary distancing from a central belonging to the community, to occupy a more peripheral or individual position in which he/she sees him/herself as an individual against the group (e.g. "I think that [...], what do you all think?") (Traetta & Annese, 2007);

    - Multi-membership positioning: some interactional contexts make it possible for the participants to put the multi-memberships that characterise them into play. In some cases, multi-memberships are inside the same community, thus characterising more or less organised subgroups that can interact with one another (spontaneous alignment with other members, structuring into subgroups, inter-group positioning).

4.3.2 Positioning levels

Analysis of the blended university students' communities in particular allowed us to observe that positioning takes place on different dialogical levels. These range from an individual to a community dimension, following a constant, not always linear, trajectory:

- Individual level: this refers to the dialogue between positionings expressed by a single individual, recalling Hermans' Dialogical Self theory which talks about a continuous interior dialogue between the voices of the different I-positions;

- Interpersonal level: refers to I-positioning elicited by others. The explicitation of a positioning by a social actor in the interaction systematically recalls an I- positioning by his/her counterpart;

- Community level: refers to a dialogue between all the individual and interpersonal positionings of the subjects belonging to the community. In both online and offline group discussion, the various positionings elicit one another to generate a collective identity that no longer distinguishes the individual contribution.

In the blended contexts we studied, the network of positionings seems to be enhanced as we move away from the individual level towards a community one, passing through the interpersonal level.

Specifically, in the "e-learning 05" course it was possible to identify a funnel-like trajectory, especially in the online discussion context. Here the network gradually opens up from an individual orientation at the individual level, represented by the predominance of the individual internal positionings, to the social dimension. The boundary positioning was integrated into the interpersonal level not merely through the identification with others but also through the opposition to others and to the group.

Lastly, the network becomes even more structured in the community level, where the identity space is dilated in the social context, making the internal collective positioning pertinent.

The offline discussion context also produces a funnel network, but one that proceeds in the opposite way to that encountered online. In

fact the offline discussion is oriented towards collective positioning on all levels.

The predominance of the collective positioning inside the individual level is therefore attenuated by the relevance of the boundary positioning in the interpersonal level and further tempered in the community level with a greater frequency of individual internal positionings.

The "e-learning 06" course on the other hand presents a far more similar setting, between the online and offline contexts. In both cases, the network of positionings appears to be oriented, on all levels, towards the individual internal positioning with receptiveness towards the alterity. Such alterity is represented in online discussion by internal collective and direct interpersonal positioning and, in offline settings, also by boundary positioning, which acts as a mediating element between the individual and collective dimensions.

The study of blended communities therefore confirms that the individual's identity trajectory is constructed in a dialogical manner, contributing, together with the practice, the artefacts and the objectives of interaction, to the construction of the community's identity trajectory.

4.3.3 Positioning, objective of interaction and artefact construction

Especially in studying the researchers' community, by comparing discussions with different objectives, we found that the purpose of the conversation considerably influenced the positioning activated by participants. In a discussion dedicated to participants' self-presentation, several positionings emerged. These positionings emerged revealed that participants are able to develop different degrees of sense of belonging to the new community. Interaction is often restricted between two people exchanging mutual titbits on shared interests and interact using the weave of open individual positioning. In a view focused on a thematic objective, there is greater tension towards the negotiation of a collective identity. The objective of each view, therefore, draws out specific positionings, produces different strategies of building a sense of community and different negotiation processes underlying the construction of a collective identity. The multiple aspects of I-positioning also seem to influence the community's ability to produce relevant cultural

instruments for the practice itself. At the same time, the sharing of knowledge and the artefact construction process drive the consolidation of I-positionings that are advantageous for the construction of a collective identity for the community.

On the other hand, in the teachers' forum, the users' positionings repertoire varies according to the content of the activity. In off-topic (OT) discussions, the participants privilege external positionings. Conversely, in in-topic (IT) discussions, they preferentially activate internal positionings. These repertories are supported by individual and autonomous conceptual processing in OT discussions and by reprocessing of concepts shared by the virtual community in IT discussions. This difference can be essentially traced back to the mutual engagement produced in handling subjects more pertinent to the learning programmes conducted in the training course. In fact, the mutual engagement is supported in the IT discussion by the construction of a local "we", and in the OT views by continual references to communities outside the forum.

The relationship emerging between individual, practice and community would therefore seem to be strategic for the creation of the community's objectives. The positionings repertory, expressed by types and levels, and the interaction objective and construction of artefacts represent the elements of mediation between the self and the community. The positionings of the individuals as well as the objectives and artefacts of the community are constructed in those negotiation processes that form the vital nucleus of the new notion of identity. The Self and the community follow an interwoven identity trajectory that lives thanks to the dialogical weft of both.

5. Intersubjectivity

During our research, we observed that the studied contexts are pervaded by psychological dimensions that change constantly and affect on one another. Talking about identity and group as separate analysis units is a difficult descriptive task as the situation shown by our results proved to be far more complex. This paragraph describes those results that, in contrast with those above, best give the idea of how the individual, the alterity, the group, and the context interweave to form a difficult-to-define weft, which we call *intersubjectivity*. In

the studied communities, constructing intersubjectivity meant creating a multifaceted reference system with the objective of guiding members during interactive activities. It has never been established at exactly what point intersubjectivity arises, maybe because, as Rommetveit believed (1979), a state of complete intersubjectivity is never reached. However, we did succeed in following a number of processes that revealed its complexity of development and multidimensional nature.

Considering intersubjectivity as the product of a weave between the psychological processes of a number of interacting individuals (Spadaro, 2007b), we went in search of these weaves and their results in the interaction process.

The most interesting results undoubtedly derive from the analysis of the weaves between the I-positionings of the interacting individuals. Discourse analysis conducted in some of the examined forums showed the presence of I-positionings, termed "open", which appear to depend directly on the construction of a space in which personal identity meets the other to enrich itself, thus generating new I-positionings. The latter are usually connected to a personal change, i.e. they represent bridges across which the individuals go through their personal histories and project themselves into the future. We can therefore postulate that the intersubjective product will be the result of the personal change, which will carry with it a social graft, developed through past interaction.

Analysis of the self-help forum also demonstrated that the "open" positionings act as an antechamber for a reconstruction of the perception of the self based on an interpretation that is returned by the counterpart. The identity repositioning process, in this specific case, is interwoven with the process of participation in community activities. In fact, the individual who shows that he/she is willing to change I-positioning, accepting identity interdependence with others, is also perceived by the members of the community as a central participant. Therefore, identity as social participation becomes an intersubjective construction in that it is negotiated by the community and by the individual. In the CKBG community, the process of collective construction of individual participation emerges as being significant: the members who ask for the group's support on their first entry into the community are pushed by the

others towards a linear trajectory that leads from the periphery to the centre of the collective activity. In contrast, those members who enter the community showing a lesser sense of receptiveness to personal change are pushed by the group to follow an opposite trajectory. The participation process is therefore connected to individual predispositions, as shown in the paragraphs above, as well as being the product of an interweaving with the group's implicit rules.

The community's rules are in turn influenced by their connection with the multiple memberships the individual brings into the group. The community's values and standards are constructed on the basis of the integration of the rules of other groups that each member brings with him/her, as the individual already possesses his/her own history of belonging. In particular, as demonstrated by the analysis of online university courses, the community's rules would appear to be constructed parallel to the revelation of the members' multiple memberships. The community's foundations are thus also constructed on the basis of an intersubjective integration between external communities, in which each member is his/her own spokesperson.

Even when a shared sense of community has been established, which could suggest a mature and stable state of intersubjectivity, the community tends to undergo a growth process based on the disruption of this stability. PNA (Annex no. 6) applied to the "e-learning 05" community forum confirmed this hypothesis by demonstrating a particular role played by boundary positionings. Through this type of positioning, the individual temporarily cuts him/herself off from the community, re-proposing him/herself as spokesperson of his/her own voice that can enrich the community with narrations other than those already shared by other members. These positionings elicit new I-positionings in other participants in 77% of cases, causing a temporary disruption in the sense of community.

The results of our research give a picture of intersubjectivity as a product of multidimensional weaves but even more importantly, they give practical evidence of Rommetveit's theory of a state that is never fully achieved, showing a process that is constantly travelled over to allow the growth and enrichment of the individual and the community.

Conclusions

How are intersubjectivity and identity constructed in virtual communities? What role do these two dimensions play in supporting and developing educational communities? These questions inspired our research and their implications were explored in an effort to satisfy the need to define psychological, pedagogical and social models that support virtual communities of practice, which aimed the larger research framework of this project.

Identity and community were the keywords that guided the various research activities described in this chapter and proved to be the warp and the weft of the intersubjective fabric that emerges, consistently and specifically, in each of the virtual communities we observed. In this pathway, the situation-related aspects such as the practice, the interaction objectives and the features of the technologies represent the loom on which the intersubjectivity fabric, which varies continuously following the flow of interaction, is shaped. The sartorial metaphor is used here to overcome the sense of rigidity provided by Rommetveit's (1979) geometrical metaphor, in which intersubjectivity was described as a communication *architecture* in which the interactors construct communication meanings by founding the expectations of each one on those of the other. A fabric recalls the sinuosity of the human movements that produce it and when finished, it remains a malleable and fragile object that can be continuously reconstructed and remodelled on the basis of the functions that it will take on.

Our results consist in the description of flexible and dynamic processes, similar to thin fabrics rather than stable and geometrically defined structures like architecture. This is true to the extent that despite having attempted a breakdown into thematic paragraphs, it was not possible to handle identity and community separately and from time to time we focused the magnifying glass on identity or social processes. Certain concepts - such as participation and belonging - allowed us to overcome the problem of a modular definition of study objects, partly because they emerged from the results as dimensions that can well represent the weaves between social and individual.

The processes of participation in the practices are dictated by both individual factors and community dynamics. I-positionings are built around the possibility of modulating the relationship between past experiences and new forms of participation proposed by the new community. The construction of new I-positionings aimed at personal change appeared to be consolidated during this process. At the same time, the community is transformed on the basis of interactions between positionings that take place simultaneously on individual, interpersonal and collective levels. At the same time, the community structure changes on the basis of individual participations and through leadership dynamics.

The sense of belonging was observed to be the product of the ongoing opening of the self to the other, of the transformation of the references to "Me" and "You" into references to "We". The construction of community values passes through the revelation of multiple membership to the many communities contributing to the formation of the individual's identity. In this way, the community provides the individual with a sense of continuity useful for tackling the construction of a new belonging.

The context in which the interactions take place seems to provide important elements for shaping the interactions. Specifically, the technological mediation between a communication context not of a purely recreational type (but educational and allowing interpersonal comparison) offers the possibility for highly personalised and diversified community participation and construction of the sense of belonging. We observed that the same groups of people produce different community models according to whether they interact in online or offline contexts. In this sense, discussion forums confirm their potential as tools for supporting a dialogical and democratic interaction, as though usually unexpressed voices had found new communication settings.

In our opinion, it would be worth developing research studying in depth the dialogical dimensions and the strategies of discussion and communication. In fact, we intend to better explore the discussion strategies that characterise the educational environments with a strong technological pervasiveness. The intention is to study both classical discussion strategies pertaining to discursive psychology and the discussion dimensions ascribable to Bahktin's constructs

(voices, polyphonies, heteroglossia, and chronotope). We also believe that greater attention should be dedicated to blended dimension, in order to understand how offline and online interactions may act as reciprocal and mutual fulcrum and amplifiers of their effectiveness, especially in educational contexts.

APPENDIX

Annex no. 1 - Synergeia

M. Beatrice Ligorio

The Synergeia platform (http://bscl.gmd.de/) is designed to support collaborative knowledge building processes guided by the PIM model (Annex no. 2).

In addition to allowing document sharing, Synergeia makes it possible to set up discussion forums. Participants contribute to them with entries that are necessarily provided with *Thinking Types*, namely labels that help make visible the categories of thought guiding entry writing. Synergeia has various sets of thinking types corresponding to different ways of discussing in a forum: from highly educational discussions, called Collaborative Knowledge Building with clear reference to the constructivist theory, to Informal Discussion in which greetings and ideas are exchanged. Each set of *Thinking Types* corresponds to specific objectives of the discussion and is composed of a set of categories to be attributed to the entry. The system "forces" the author to attribute a category to the entry that briefly describes the content, the intentional value, and the relationship of the note to other entries. The software enters the label before the subject of the note.

Annex no. 2 - Progressive Inquiry Model (PIM)

Francesca Martini

The Progressive Inquiry Model (or *PIM*) (Muukkonen, Hakkarainen, Lakkala, 1999) is intended to guide the knowledge building process that can take place in an online forum for discussing a scientific topic, based on the underlying assumption that knowledge is not simply absorbed, but is built up through exchange with others.

According to the PIM, the first phase of the process consists in *setting up the context* by clearly identifying a field of inquiry. The subsequent step is *presenting research problems*, questions to

which one must give an answer in order to analyse the problem. In order to respond to such questions, attempts will be made to *create working theories,* i.e. personal explanations of the problem, assumptions, suppositions and reasoning around the problem discussed. These theories will be *critically evaluated* by the community: problematising the theories presented and identifying any contradictions or inadequate explanations will facilitate understanding of the concepts illustrated. In fact, to answer the questions on the proposed operative theories that others will ask, each individual must scientifically support his/her own thought through theoretical examination (*Searching Deepening Knowledge),* looking for connections with the concepts found in literature on the subject. In the light of the new information gathered, increasingly specific study problems can be developed (*Generating Subordinate Questions)*, to respond to which it will be necessary to formulate increasingly structured new theories *(Developing New Working Theories).*

All aspects of the cognitive inquiry process will be developed in an ongoing sharing with the entire community, thus favouring *distributed expertise.*

Annex no. 3 - Knowledge Forum

M. Beatrice Ligorio

Knowledge Forum (KF) (www.knowledgeforum.com/) is a discussion-based environment that was developed by the research group coordinated by Scardamalia and Bereiter (2006). In developing the KF, the authors attempted to operationalise certain moments pertinent to the idea of learning intended as collaborative knowledge building.

One of the characteristics that makes KF a knowledge building tool is the possibility to write *Rise Above* entries, summarising the intermediate endpoints or steps in the development of the knowledge built up by the community. A *Rise Above* can even be a simple summary of points emerging during the discussion activity, however, in its more refined forms, it contains emerging ideas that community members recognise as real progress of the common knowledge.

Another function of KF which helps knowledge building is the presence of preset linguistic structures to support writing, known as *Thinking Types,* acting as scaffolds for the development of the conversation through shared categories.

Annex no. 4 - Knowledge Building Community: rethinking training contexts such as research communities

Stefano Cacciamani

The *Knowledge Building Community* model (KBC) (Scardamalia & Bereiter, 1999; 2006) is based on the assumption that in the knowledge community setting, people will have an ever greater need not merely to update existing knowledge but also to handle it creatively, to generate new knowledge. Using these ideas as a base, Bereiter and Scardamalia (1999) stress the difference between learning and knowledge building, making use of the distinction made by Popper (1972) between three different Worlds: World 1, constituted by the concrete elements of the physical situation; World 2, which regards the personal knowledge of World 1, intended as a system of personal representations of the single individuals; and lastly World 3, which referees to socially shared knowledge, as an intersubjective system of ideas, i.e. the culture of a community. When we talk about knowledge building, we therefore refer to a process that takes place in World 3 and has a dual social dimension: firstly, on a finalisation level, oriented towards improving the knowledge of the community rather than that of the individual; secondly, on a method level, because this kind of elaboration can only be triggered at group level. Undertaking a knowledge building activity naturally involves individual learning (World 2) that is however not the end of the activity, but rather an intermediate process: one learns in order to obtain contents and strategies that can be used to produce new knowledge.

The distinction between learning and knowledge building is one of the premises that lead to the construction of the Knowledge Forum (KF – see Annex no. 3).

Annex no. 5 - Grid for activity analysis (GAct)

Paola F. Spadaro

The GAct tool was developed for in-depth analysis of the dimensions that intervene in the development of an intersubjective state. The theoretical analysis that preceded its construction revealed the multidimensionality of the intersubjective phenomenon and therefore the need to study it in its various components, whilst maintaining a situated overview of the interaction context (Spadaro, 2007b). The GAct grid supports the content analysis of notes exchanged between participants in asynchronous interactions. It consists of the six dimensions of the Activity Theory (Engeström, 1987), which are examined in depth by breaking them down into categories built using literature (in particular Hermans, 1996; Pontecorvo, 1999) and the examination of data obtained from asynchronous interactions of various kinds (Spadaro, 2007a). The categories (shown in table 1) were defined in a sufficiently general way to enable their application to interaction activities based on a variety of purposes (e.g. scholastic, professional, self-help, etc.).

Dimensions	Categories	Description
Subject	Self-referentiality	Personal opinions or beliefs
	Cognitive uncertainties	Uncertainties regarding personal opinions or beliefs
	Open identity	Uncertainties of own identity, desires for the future
	Internal identity	Characterisation of the self, emotions.
	External identity	People who have assisted the formation of the identity
	Embodiment	Material characterisation of self in the context in which one writes.

Community	You	Reference to a specific person in the forum.
	Local We	Reference to the group of forum participants.
	General We	Reference to general communities of which one is a member.
	External We	People, communities, institutions, etc., which two or more forum participants have in common.
	Embodied We	Reference to the forum community through the use of metonyms (e.g. "the discussion") or reference to the forum itself.
	Others involved	General communities that the writers consider involved in the subject being discussed.
Rules and Values	Moral and social rules	Using a moral key of interpretation without (moral) or with (social) justifications.
	Work rules	Relative to the specific activity of the discussion or organisation of the forum
Modalities of Labour	Individual elaboration	Personal elaboration of discussion subjects.
	Re-elaboration and problems	Re-elaboration of entries made by other, problematisation towards other participants.
	Sharing	Sharing of personal experiences or emotions or informal information.
	Difference	Individual differences (e.g. of opinion) or differences between subgroups present in the forum.
Purpose	Process	Community's discursive purpose
	Product	Community's specific purpose
Artefacts	Primary	Bibliographic references or references to the opinion of external experts.
	Secondary	Construction of a "forum theory", systemisation of individual contributions into unitary ideas.

Table 1. Grid for activity analysis (GAct).

Annex no. 6 - SNA and Positioning Network Analysis (PNA)

Marta Traetta, Paola F. Spadaro

In the analysis of online interactions, Social Network Analysis is usually used to automatically identify the senders and recipients of messages in the log files of the server hosting the interaction environment. If sender encoding is always clear, by tracing the author, the recipients are not always those indicated in the log file. One alternative to automatic encoding consists in identifying the recipients using a qualitative content analysis procedure taking into account the following dimensions:

- identification of a specific recipient through reference to the explicit or implicit recipient that can be traced in the text content;

- identification of multiple recipients through: the absence of reference to a clear, specific recipient, explicit reference to more than one recipient, or explicit reference to the whole community.

The qualitative use of SNA allows innovative applications, for example for the analysis of dialogical networks between positionings. Positioning Network Analysis (PNA) is split into two complementary stages:

- the building of a positionings category grid combining theoretical suggestions (Hermans 1996; Spadaro, 2007a) with discursive data reading;

- identification of the bonds between eliciting and elicited positionings and the consequent processing of an adjacency matrix. In this type of analysis, the classic SNA indices take on a specific meaning: the density index reveals the complete repertory of positionings used by each participant and by the community; the index of centrality identifies those strategic positionings able to activate the greatest number of positionings of others and to be elicited by most of the other positionings.

Chapter 3

Building and sharing teacher professional identity in virtual communities

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Abstract.The main objective of the present research is the elaboration and validation of online workshop models aimed at the university training of *primary school teachers*. The research was carried out over a two year period (the 2005-06 and 2006-07 academic years) in the University of Padova. Two different types of students were involved: *pre-service* and *in-service* (professional *beginner* and *advance beginner*) *teacher students*. Collaborative casework activities were offered to all students who attended online workshops with direct reference to Communities of Inquiry by David R. Garrison and Terry Anderson (2003). The research was based on integrated mixed methodology: *multi strand multi method* (Teddlie and Tashakkori, 2005). The data, provided from pre-post individual activities (*profile protocols*) and forum activities (*forum protocols*), was analysed using quantitative approaches (specificity and correspondence analyses etc.) and quantitative-qualitative approaches (protocols of forums) using categories of David R. Garrison and Terry Anderson (2003; Garrison et al, 2006), Helen L. Harrington (Harrington et al, 1996), Richard F. Bales (1950; 1970) reviewed and analysed using a new "integrated" SNA model, and narrative interviews carried out with selected beginners and advanced-beginners teacher students. The results obtained confirm the effectiveness of online workshop models only for student and beginner teachers, and also a

tendency towards a functional fixedness and self-reference of in service teacher students, especially in advanced teacher students. The positive results of narrative interviews carried out also confirmed an increased awareness and deeper comprehension of personal and professional identity in the subjects involved. These results lead us to consider the prospect of a *new model of teacher education* that may be promising especially for the advanced-beginner teachers and other levels of competent or expert teachers, categories which have proven to be the most resistant to professional identity conceptual changes.

Keywords: pre- and in-service teacher education, professional identity, online education, Social Network Analysis, virtual community, online interaction.

1. Introduction

In the introduction to their book *E-learning in the 21st century*, David R. Garrison and Terry Anderson explain that the aim of their research is to analyse e-learning applications in higher education to assess their real potential. Indeed, the wide-spread and increased use of internet-mediated communication «cannot be ignored by those who are seriously committed to enhancing teaching and learning» (Garrison, Anderson, 2003, p. 4). Reflecting on their findings, the authors assert that «it has the real potential to enhance the traditional values and ethos of higher education by fostering communities of learners and through integration of research into the curriculum e-learning can substantially enhance these processes and outcomes» (ibid, 2003, p. 106).

Starr R. Hiltz, Ricki Goldman clarify that «not all online courses use learning networks; some simply post materials (e.g. lectures and quizzes) on web pages, and then collect tests and homework from individual students. [In this way] there is no interaction among students, no "class"» (Hiltz, Goldman, 2005, p. 4) In this case – as it was in the first distance learning experiences – the learning contexts are characterised by transmissive and one-way communication (from teacher to learner).

Many authors think that it is within a community of learners that the potential of e-learning can be realised. In the same way, Garrison and Anderson stress that «re-evaluating the traditional

ideal of a community of learners is at the heart of the e-learning transformation» (ibid, p. 24).

There is a long theoretical history of the concept of "community" in educational sciences and especially in social psychology. Social researchers have characterized communities in various ways, and based on different underlying social "philosophies", in order to understand different social phenomena. In educational and e-learning contexts, three main successful models of communities are known and currently adopted: the "Community of Practice" (CoP) or Community of learning, the "Knowledge Building Community" (KBC), and the "Community of Inquiry". Variations in explanatory models of community-based learning reflect variations of focus within the notion of community.

The social construction of knowledge is a common principle of the three models (Varisco, 2002). Knowledge is inherent in social practices and in the tools and artefacts used in those practices. In this light, learning is a process of moving from peripheral to full participation in cultural practices, and knowledge lies in the relationships among the people engaged in a practice, the tools they use, and the environments in which the practice takes place.

The first model, described by Jean Lave and Etienne Wenger (1991), originated in real life contexts (e.g. working and day-to-day contexts such as shopping, etc.), and was later interpreted also in the light of educational needs by Wenger (1998). The term community of practice (CoP) was advanced to capture the value of "practice" in making the individual part of a community, and to assert the importance of a community in legitimising individual practice. "Participation" reflects both action and connection, which can be individual and social. The characteristics of participation define an identity of participation, «that is an identity constituted through relations of participants» (Wenger, 1998, p.56). Within the CoP, learning is conceived as a trajectory in which a learner moves from legitimate peripheral participation, to a more central position in the community. In the passage between different communities, individuals share (appropriate and disseminate) knowledge, values, beliefs, practices and histories. At the same time, they construct and modify their own and the community's identity. In this light,

learning is a progressive appropriation of identity that individuals build while participating in the community's practices.

The second and third models, the KBC and the Community of Inquiry are directly constructed for educational contexts.

In considering the importance of knowledge in the Knowledge Age, Carl Bereiter (2002), the main theorist behind this model, focuses his attention on the knowledge construction process and describes the Knowledge Building Community (KBC) as one in which the primary goal is knowledge creation (rather than the construction of products or the completion of tasks) and knowledge progress. Specific to a KBC is the embodiment of knowledge artefacts, that is, if in a "traditional" class, questions, ideas and discussions are personal and ethereal constructs, in a KBC classroom, or e-learning environment, they are public artefacts that have a permanent presence in a digital format, usually a classroom database. For this reason, they can be analysed, indicated, talked about, and progressively refined over time. Knowledge-building communities support discourses that aim to advance their members' knowledge collectively, while supporting individual growth, with the aim of producing new experts and extending expertise within the community's domain.

The "Community of Inquiry" model has its origins in the academic context of e-learning. D. R. Garrison and T. Anderson explain that «considering the ubiquity of e-learning, and the enormous opportunities and risks that it presents for higher education, [it needs] more than a fragmented approach to study and understand this phenomenon» (Garrison, Anderson, 2003, p. xii). They propose that it is not the content, but the context and processes of e-learning that make it a significant learning practice. They describe the Community of Inquiry as a framework for evaluating the quality of online learning experiences, and explain that «an educational experience has a dual purpose. The first is to construct meaning (reconstruction of experiences) from a personal perspective. The second is to refine and confirm this understanding collaboratively within a community of learners» (ibid, p. 13). In short, educational experiences should foster critical and creative thinking. In this light, e-learning should promote critical discourses within critical communities of self-directed learners (i.e. community

of inquiry). In other words, a community of inquiry provides the environment in which students can take responsibility and control of their learning by negotiating meanings, diagnosing misconceptions, and challenging accepted beliefs.

Many authors are in agreement with Garrison and Anderson and assert that communication technology provides a unique support for the construction and work of a community. S. R. Hiltz and R. Goldman sustain that «building a learning community, a social and mutually supportive network of learners, is perhaps the greatest challenge and the greatest opportunity offered by ALN [Asynchronous Learning Networks]» (ibid, 2005, p. 7).

Most online tools (e-mail, forums, blogs, collaborative writing) have some key features that are an "added value" in supporting community discourses. These features include text-based communication, network and asynchronous communications. The first key characteristic is that text-based communication has particular attributes which facilitate critical discourses and reflection: «writing has some inherent and demonstrable advantages over speech when engaged in critical discourse and reflection» (Garrison, Anderson, 2003, p.26). The second characteristic is that online tools «support students "learning together" in a cooperative and collaborative manner, that ideally leads to the development of a learning community or "learning network"» (Hiltz, Goldman, 2005, p. 6). Asynchronicity is an important factor «in creating a collaborative teaching and learning environment. It means that every participant may contribute at the times, places, and pace that is most convenient for him or her» (Hiltz, Goldman, 2005, p. 6).

Distance communication has been criticized for the lack of "social presence" of participants and its insensitivity to the emotions (which in face-to-face interactions are communicated through para-linguistic codes, kinetics, proxemics, etc.). Garrison and Anderson explain that «it has been shown that students can and do overcome the lack of non-verbal communication by establishing familiarity through the use of greetings, encouragement, paralinguistic emphasis (e.g. capitals, punctuation, emoticons) and personal vignettes (i.e self-disclosure)» (Garrison, Anderson, 2003, p. 50).

The conclusion is that the apparent limitations of online written communication may have advantages which cannot be found in face-

to-face educational contexts. In this light, with Sasha A. Barab, Rob Kling and James H. Gray we can assert that «building online communities in the service of learning is a major accomplishment about which we have much to learn» (Barab, Kling and Gray, 2004, p. 4). As more and more of these communities are being designed, promoting and utilising virtual communities in educational contexts, a central question is to understand the educational value of such a community in cognitive, social and affective perspectives. In agreement with the previous authors, we think that in order to evaluate the educational significance of each community, it is necessary to recognize the community trajectories and to capture the effective nature of the relations among individual, group and community since Internet communities are not defined by space or time, but by patterns of social networks built and sustained over time (Job-Sluder Barab, 2004).

In higher teacher education, research into the modalities and effects of e-learning is a field of study in progress. Many authors (Moon, 1997; Admiraal et al, 1998; Kling, Courtright, 2004; Williams et al, 2007) have discussed the potentials of virtual communities for enhancing teacher education and the professional training of teachers.

It seems that «telematics offer the opportunity to instruct, mentor and supervise student teachers in a more flexible way with respect to time and place than common face-to-face conversation methods» (Admiraal et al, 1998, p.59). In four Dutch teacher education projects, telematics have been used to construct a site where pre-service teachers and supervisors, after their "field experience" in classes, are asked about realising their expectations and professional ideals in terms of perceived outcomes. In these spaces they provide "effective scaffolding" for peers. An analysis of messages shows that exchanging emotional and informational support, and sharing reflections about field experience give student teachers the feeling of not being alone in encountering problems in their first teaching experiences. In this case, the main function of computer conferencing is "social", and affective aspects of learning must not be underestimated in the training of teachers (Korthagen, Verkuyl, 2007).

Oliver Dreon Jr. and Scott McDonald (2006) show that an integrated, multi-featured online environment is a functional educative resource for future teachers. This online environment incorporating several tools (web forum, online journal space, digital library, chat) was used by a professional community of teachers (including students, expert teachers and university faculty teachers) to discuss inquiry as "science pedagogy". In their research, the authors analysed the weekly "reflection journals", where students described and discussed an inquiry event they had experienced each week while working in a school, in response to prompts proposed by their mentor teachers (senior teachers). An analysis of the protocols of student teachers working within a community of expert teachers showed that social collaboration helped to develop student teachers' understanding of the integration of theory and practice of inquiry pedagogy.

Rob Kling and Christina Courthright (2004) highlight the value of virtual communities for the professional development of in-service teachers. Having observed that in-service teachers have limited opportunities to discuss teaching practices with other teachers during work time, the authors, in the context of their research, created a web site providing a set of interesting teaching materials and an online forum, where teachers could discuss and reflect on their own teaching practices. The E-ILF (electronic Inquiry Learning Forum) appears to encourage reflective discussion on teaching via inquiry and to sustain the development of communities of practice in support of inquiry teaching. These types of context have the potential to enhance partnerships between schools and universities in terms of a teacher's lifelong learning and professional development.

The characteristics of online network technologies in promoting reflective discussions in wider communities is a significant step in sustaining the process of professional identity construction. In fact, professional identity is currently receiving increased attention in the field of teacher education (Grion, Varisco, 2007; Grion, in press).

In the 1980's, the issue of teacher beliefs about teaching began to attract increased attention. In reality, those beliefs regarding learning and teaching seemed to strongly determine teachers' actions. Many scholars suggested that most knowledge attained

during professional training was annulled and replaced by experience, role models, needs, and routines that constituted teacher beliefs. Recently we have seen a shift within these studies. Initially it was considered important to discover how and what teachers thought about education. Today, more attention is given to the beliefs people have about themselves and how one sees his/her role as a teacher (professional identity).

Korthagen (2004; Korthagen & Verkuyl, 2007) considers professional identity as a central dimension in the search for the essence of the "good teacher". In his "onion model", he defines six levels for the essential qualities of a good teacher: the outer levels (environment and behaviour) are easily changeable while the inner levels (teacher identity and mission) are linked to the self and are extremely resistant to change (other levels are competencies and beliefs). Since teacher educators, until recently, have paid little attention to the inner levels of the model, the author emphasizes the need for educational projects aimed at these levels.

J. Alsup (2005) thinks that forming a professional identity is a central part of becoming an effective teacher. Pre-service teachers need an education that provides opportunities to develop a satisfactory professional identity. They have to take care of themselves first, in order to take better care of others later. For this reason, teacher educators «must bring issues of identity into the methods class [… and…] must talk to teachers about the difficulty of professional identity development» (Alsup, 2005, p. 7).

J. Loughran (2006) explains that to know how one's self image and professional identity have been shaped and influenced by beliefs helps prospective teachers be more aware of their actions and address their professional development in a personal way.

In this light, we think that it is important to offer educational contexts where participants challenge themselves, describe themselves as future teachers, reconsider their beliefs, elaborate professional consciousness and thus work on their professional identity. In this context we have offered students laboratory activities.

Another perspective of the application of online networks is the creation of web sites to support learning through discussion on cases or video-cases.

Case studies have been successfully used in Teacher Education. In stressing the need to integrate theory and practice in teacher education, Miriam Ben Peretz and Irit Kupferberg, following Shulman's thinking, claim that «learning from cases is one way of effectively integrating learning with practice. Case-based learning experiences provide vicarious encounters with practice that can be negotiated by discourse communities of pre- and in-service practitioners» (Ben Peretz, Kupferberg, 2007, p. 127). Case-based education seems to support a disposition to reflect on various elements of practice.

In fact, since the early 1980s, Shulman has paid attention to case-based methods for the professional development of teachers, suggesting that cases can play a critical role in learning from experience: «a case resides in the territory between theory and practice, between idea and experience, between normative ideal and achievable real» (1998/2004, p. 543).

Working on cases, learners are active agents in the process of learning. They can reflect on their own thoughts and actions and can analyse how and why their thinking has achieved (or failed to achieve) certain ends; they are engaged in collaboration and are scaffolded by the community and the community culture. When new or veteran teachers work on a case, they are actively engaged in their own understanding and are stimulated to reflect by the act of re-cognition of turning around on one's own lived experiences and examining them; the thought process of cases is also dialogic and they become educative for teachers within teaching communities. By analysing and commenting on other cases, drafting one's own case, and relating stories, the principles or theories emerge.

Furthermore, in suggesting that at the core of teaching is the capacity to respond to the unpredictable, Shulman asserts that «cases – as the narrative manifestations of chance – offer teachers the opportunities to contemplate the variety of ways in which the unpredictable happens» (Shulman, 1996/2004, p. 480).

Helen Harrington believes that «dilemma-based cases [are] intended to provide students of teaching with opportunities to recognize specific events as problematic; gain an understanding of them; reflect on them and on the consequences of action; and devise sensible moral, and educative ways of acting. In doing so, dilemma

based cases provide insight into multiple aspects of critical reflection» (Harrington et al., 1996, p. 26). Case-based pedagogy should stimulate students to develop critical and complex thinking and case-based discussion should provide a favourable setting for developing reciprocal teaching and peer support, and constructing depth of thought. In other words, case-based discussion should promote experiences that generate cognitive dissonance and stimulate shifts in personal perspectives (ibid).

In this light, the curricula of courses should be organized around study teams and focus on the development of «conceptual understanding of teaching, peer learning and debate or exchange, studying and working out authentic teaching problems and cases» (Tillema,1997, p. 292).

Shihkuan Hsu (2004) highlights the educational potential of online case-work. She argues that student teachers became aware of their assumptions, considered multiple perspectives, developed an understanding of problems and attained the knowledge and skills to deal with them while discussing their own problem cases in the so-called "Case Forum". That is, they took on a positive attitude towards the teaching profession. The Case Forum seemed to provide positive support for opening cases to scrutiny and for promoting discussion of the problems encountered during teaching practice.

2. Research design

2.1 Aims and methodology

Our research has two types of aim, the educational and the methodological research aims.

The educational aim is to project, develop and confirm "models" of online workshops for primary teacher's further education to produce and scaffold professional and identity conceptual changes in students. The precise educational aims are to analyse and identify the effects of our educational online activities in different categories of student, pre-service and in-service teachers, hypothesizing that the students (pre- and in-service) would behave differently and the experience of teachers in service could pose a didactic problem in academic teacher education. We think that in-service students need a specific "model" of an online teaching workshop in university

courses, as the European educational policy requires (European Commission, 2005) within a lifelong learning perspective. However, in Italy this has not yet been realized. In this regard, we would like to suggest a possible model, as the final outcome of our research activities.

The differences between pre-service and in-service students are studied in two ways: first, by exploring different constructions of professional profiles in pre-service and in-service teaching students, through profile protocols, which were used in pre-post educational collaborative online activities of case-work; second, by analysing (through forum protocols) the nature of web forum interactions among future teachers and in-service teachers and specifically social cognitive processes.

The methodological aim is to apply and deal with a very complex research design, the "Integrated Mixed Model Design" outlined by Abbas Tashakkori and Charles Teddlie (2003; Teddlie and Tashakkori, 2005). This design includes the "multi-strand and mixed method". A strand is an independent phase of study that includes:

- a conceptualization stage;

- an empiric (or experimental) stage, with two sub-stages;

- methodological (e.g., methodological operations, data generation);

- analytical (data analysis);

- an inferential stage.

The *Integrated Mixed Model Design* has some fundamental principles. In 1998, four principles of an "Interactive *Continuum* - qualitative quantitative- Model" were outlined (Newman and Benz, 1998), e.g., "the research question dictates the selection of research methods" and "consistency between question and design is the standard criterion for planning studies of high quality and scientific value". In 2005, six principles of mixed methods were identified: «methods should be mixed in a way that has complementary strengths and non overlapping weaknesses [first principle]» (Johnson and Turner, 2005, p. 316); «mixing may occur in any stage of a study [… second principle]. Research design determines data collection procedures in mixed methods but is also independent of those

procedures [… third principle]. Data collection procedures are independent of data analysis techniques […] Collection data may be transformed at any point in a mixed methods study and may be analysed both quantitatively and qualitatively [fourth principle]. If the data does not represent the theoretical phenomena or attributes under study, then nothing else in the design of study matters [fifth principle…]. Data quality is a necessary condition for inference quality but is not a sufficient condition for it. The criteria for evaluating the quality of the data and the quality of inferences are not the same [six principle]» (Tashakkori and Teddlie, 2003, p. 696). Finally, we also think that «the mixed methods movement is a "quiet" revolution in that its orientation has been to resolve conflicts between qualitative and quantitative inquiry» (ibid, p. 697).

2.2 Subjects

The research is entirely ecological, taking place in a real situation of academic didactic activities, and including subjects who choose to take part in online workshops.

In the first year of research (2005-06), 12 in-service teaching students, and 29 full-time students (Only Student OS), all female, were involved in the research. Of the in-service student teachers, 6 were Beginner Teacher Students (BTS) with less than four years experience, 6 were Advanced Beginner Teacher Students (ABTS) with at least four years school experience. During the virtual forum activities, subjects worked in 7 groups:

- 5 groups of OSs *(29 subjects)*;
- 1 group of BTSs (*6 subjects*);
- 1 group of ABTSs (*6 subjects*);

The proportions of participants in the work groups reflect the numbers of students admitted to the three courses.

In the second year of research (2006-07) there were 6 OSs, 6 BTSs and 12 ABTSs involved in the same workshop activities; there was only one male in the BTS group.

Two adjustments were made to the composition of groups in the second year. In the light of poor changes in the ABTS group in the previous year's pre-post activities: we included an expert

social/cognitive scaffolding tutor[1], with a "supportive" tutoring style, such as that presented in Chapter 1, in the groups of in-service teacher students (BTS and ABTS) a new "mixed" group (pre-service students and advanced beginner teacher students) was formed.

The groups were:

- 1 group of OSs not tutored (*6 subjects*);
- 1 group of BTSs tutored (*6 subjects*);
- 1 group of ABTSs tutored (*6 subjects*);
- 1 mixed group not tutored (*2* ABTSs and *4* OS).

In this report we will analyze all first year groups (2005-06) and the first three second year groups (2006-07) since the mixed group did not give significant results.

2.3 Data collection

In both years, the subjects worked online for three months. There were two types of online activity*: individual activities* (using a personal online writing space), and group activities in the forum (collaborative case-works). Pre-post forum activities, each subject in the individual activities wrote a personal profile of what it means to be a "good teacher" (*profile protocols*). In the forums, each subject looked back to school experiences to present a personally problematic scholastic case. Together, the subjects in each group then shared or constructed one problematic case and discussed and justified various solutions (case work) before writing a synthesis (*forum protocols*).

2.4 Data analysis

Using the *Integrated Mixed Method* (§ 2.1) a data analysis was conducted by applying qualitative and quantitative methodologies to common data (*profile protocols* and *forum protocols*), making reference to multiple categories and perspectives of analysis.

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[1] Another technical-logistic tutor was presented in both years for technical scaffolding and the observance of assignments and work time.

- Specificity and Correspondence Analyses (*quantitative and qualitative analyses*) were applied to the *pre-post* profiles, using text analysis software (T-LAB).

- Two researchers coded the social, cognitive and teaching discussion segments (*qualitative analysis*) using Garrison and Anderson's content categories. Density figures were calculated for each forum (*quantitative analysis*).

- Specific aspects of subjects' critical reflection in the written synthesis of cases (*qualitative analysis*) were identified using Harrington's coding system (1996).

- By means of a new coding system referring to the Interaction Process Analysis (IPA) in small groups of Bales (Bales, 1950; Hare, Bogatta and Ball, 1955; Bales, 1970) (*qualitative analysis*), and a new "integrated" SNA (traditional statistics and new content modes) forum protocols were analysed (*quantitative* and *qualitative analyses*).

- Professional identity characteristics in background self history were analysed for pre-service and in-service teacher students (*qualitative analysis*) by means of *a narrative interview* with all subjects in only two groups (OS and ABTS) in the second year (2006-07).

3. Three levels of research: community, group, individual

3.1 Community level

We analysed the protocols of "good teacher" profiles individually elaborated pre- and post- forum activities, from students of *all groups* involved in the 2005-06 and 2006-07 academic years.

The pre-post profiles were compared using T-Lab, software comprising a set of linguistic and statistical tools to extract, compare and map the content of texts. The specificity and correspondence analyses were applied to the texts.

Specificity analysis applied on all profiles of "good teacher" elaborated pre- and post- forum activities, show relevant changes in

teacher profile constructions. At the end of activities, students wrote more articulate profiles that were marked by various dimensions typical of a teacher's role which were not found initially, findings which were very evident in the research carried out in the first year (2005-06).

At the start of activities, the figure of the teacher which emerged was characterised by the dimensions of his/her relationship with students (first year) and relational and didactic dimensions (second year). The typical terms which stood out in the first year regarded character and personal attitudes rather than competence or professional knowledge. It is significant that terms such as "love", "transmission", "sweetness" (df=1; p<0,001), "patience", "passion" and "sensitivity" (df=1; p<0,01) were statistically more frequent. The analysis in the second year verified the significance of terms regarding the relationship with students such as: "students"(df=1; p<0,01), "passion", "values" (df=1; p<0,05), and the technical dimensions of teaching, for example "knowledge" (df=1; p<0,01) and "techniques" (df=1; p<0,05).

The results of the final description (at the end of activities) showed that terms were significantly linked to the skills, characteristics and professional competences of a teacher . In the first year (2005-06), the writings cited specific profession-related skills and means such as reflection, professional ethics, open-mindedness (df=1; p. 0.01), assessment-evaluation, technologies (df=1; p. 0.05). In the first and especially in the second year (2006-07) the idea emerged that communication and collaborative skills were key elements in the professionalism of a teacher. The school should be seen as a community in which teachers are able to interact not only with students, but also with colleagues and families. In the first year, the lemma "group" represented the lexical unit of this dimension and was also the most frequent (df=1; p<0,001) compared with the others. In the second year, the terms "relational", "families" and "collaboration" (df=1; p<0,001), "team" (df=1; p<0,01) and "communication" (df=1; p<0,05) were statistically significant.

Using correspondence analysis we noted the differences between the groups (ABTS – BTS and OS). In the first year (2005-06), the findings of this analysis showed advanced teacher fixedness. The

position of the students, beginner teachers and advanced teachers is reported in the graphs (see figs 1 and 2) where the relationship can be seen between typical lemmas used in the profile descriptions (in small letters) and variables in capitals (the groups ABTS, BTS and OS), in pre- (see fig 1) and post- (see fig. 2) forum activities. At the start of activities, the Beginner Teacher Students (BTS) and Only Students (OS) were near the axes (meaning a low professional identity) while Advanced-Beginner Teachers Student (ABTS) had well-defined positions showing their professional preparedness. Between the pre- and post- forum activities, the advanced beginner teacher students (ABTS) did not change their position in the graph, while only students (OS) and beginner teacher students (BTS) took on a more defined position.

Figure 1. Correspondence Analysis at the Start of the Activities 2005-06.
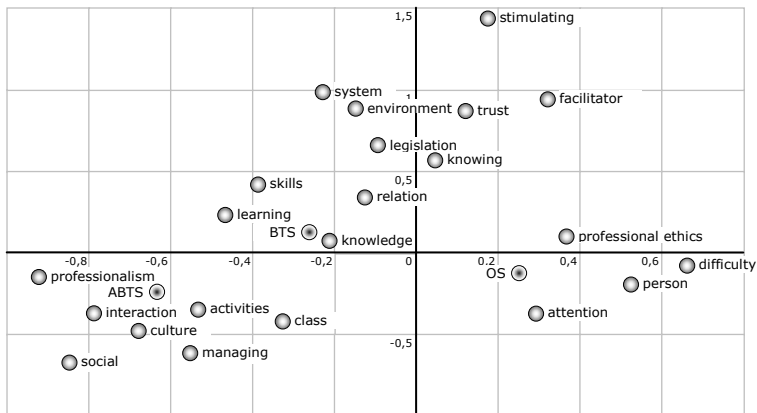
Figure 2. Correspondence Analysis at the End of the Activities 2005-06.

Also in the second year, the correspondence analysis showed differences between the groups. The distribution of groups on the Cartesian diagram (see figs. 3 and 4) seems to show a situation in which advanced-beginner teacher students (ABTS) and only students (OS) are placed, pre- and post-, in diametrically opposing spaces, which could be called "affectivity/relational space" and "cognitive/flexibility space" respectively. In particular, the advanced beginner teacher students (ABTS), at the start of the online workshop, seem to be characterised by an identity which is very close to the traditional model of a teacher who transmits knowledge by means of various materials, appealing to his/her own passion, empathy with the students and his/her values. At the end of the activities the teacher identity in the profiles of advanced-beginner teacher students (ABTS) was characterised by terms indicating relationship and dialogue (in fig. 4 the variable ABTS are near words such as "relationship", "collaboration", "families"). The students (OS) identified themselves from the beginning with a teacher figure characterised by typical aspects of professionalism. The common lemmas were "motivation" and "evaluation" but there was still a strong link to technical didactic terms such as "discipline" and "knowledge". At the end of the workshop, however, they had elaborated a more flexible professional identity characterised by words such as "reflection", "building", "communication" and "team".
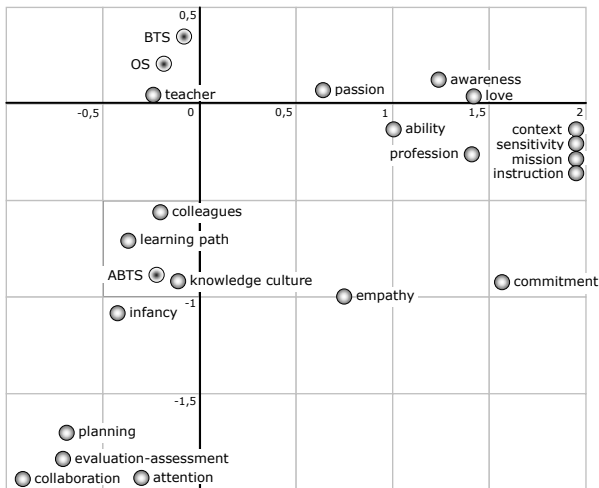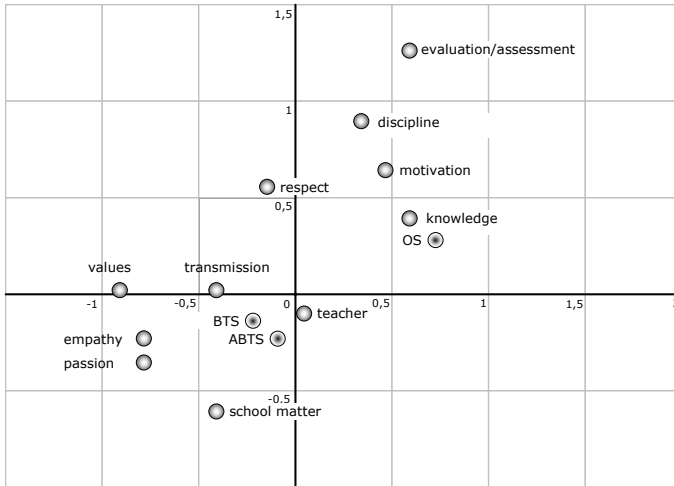
Figure 3. Correspondence Analysis at the Start of the Activities 2006-07.
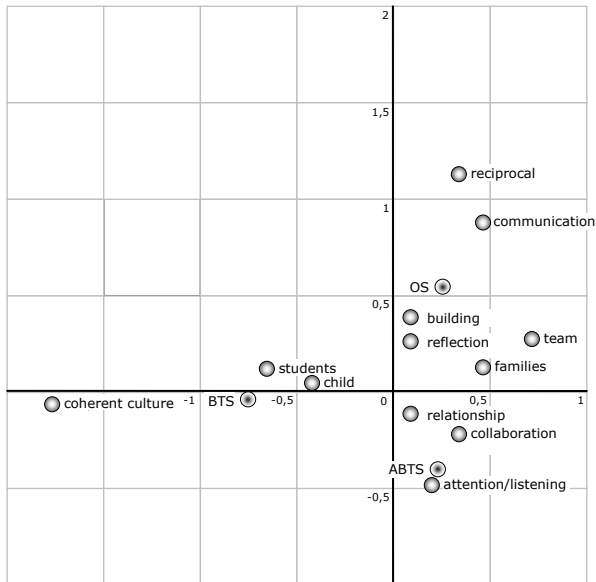
Figure 4. Correspondence Analysis at the End of the Activities 2006-07.

The beginner teacher students (BTS) could be placed in an indefinite area, (identity construction in progress) no longer characterised by the peculiarity of the students (OS) nor identifiable with the advanced-beginner teacher students (ABTS).

If we consider the results of the research over the last two years in terms of specificity and correspondence analyses, the major changes in initial and final profiles are evident in the students most receptive to change and disposed to reconsidering their professional identity and reconstruction in the light of group negotiations.

3.2 Group level

3.2.1 The Garrison Anderson categories: analysis and application

We analysed the forum with Garrison and Anderson (2003) content analysis categories: social presence, teaching presence, cognitive presence. In this framework, these presences are the core elements that reflect meaningful learning activities essential in an e-learning environment. At the same time, they constitute a tool to value the nature and quality of an e-learning experience. The Garrison and Anderson theoretical framework consisted of three elements, *social, teaching and cognitive presences*, as well as categories and indicators to define each of the presences and to guide the coding of transcripts (see Table 1).

ELEMENTS	CATEGORIES	INDICATORS (examples)
Social Presence	Effective Expression Open Communication Group Cohesion	Emoticons Risk-free expression Encourage collaboration
Cognitive Presence	Triggering Event Exploration Integration Resolution	Sense of puzzlement Information exchange Connecting ideas Apply new ideas
Teaching Presence	Design & Organization Facilitating Discourse Direct Instruction	Setting curriculum & methods Sharing personal meaning Focusing discussion

Table 1. Garrison and Anderson categories and indicators.

Analyses were undertaken by means of descriptive statistics, content analysis.

We analysed the frequencies of the Garrison and Anderson categories in the messages of the groups (ABTS, OS, BTS). We compared the values found for each group in both years, but no statistical significance was found, however, some tendencies were noted.

In the first year (2005-06) we saw that all groups of participants engaged in a high level of social activity (45.8% ABTS, 44.7% OS and 38.1% BTS), higher than both teaching activity 33.3% ABTS, 36.2% OS, 33.6% BTS) and cognitive activity (20.8% ABTS, 19.1% OS, 28.3% BTS).

In the second year (2006-07) the findings did not show the same linearity as those of the previous year. The groups were engaged differently in the activities. The social presence showed higher percentages than other presences in the group of students (OS = 46.2%) and in the group of beginner teachers (BTS = 45.4%), while in the group of advanced beginner teachers (ABTS) the social presence was 33%, less than the teaching presence (37%). The percentage of teaching presence was 25.3% in the students group (OS) and 35% in the beginner teachers group (BTS). The percentage of cognitive presence was 29% in the advanced beginner teachers group (ABTS), 28.6% in the students group (OS) and 19.7% in the beginner teachers group (BTS).

In comparing the data of two years, we noted that:

- The levels of the three presences are balanced, for each group and in both years;

- The social presence always has high values, higher than the other presences (except for the ABTS group of 2006-07). In effect Garrison and Anderson (2003) acknowledge the importance of the social element in CMC discussion; they argue that «social presence is an important antecedent to collaboration and critical discourse» because «it means creating a climate that supports and encourages probing questions, scepticism and the contribution of more explanatory ideas» (Garrison and Anderson, 2003, p. 50);

- The higher percentages of teaching presence in the groups of advanced beginner and beginner teachers (ABTS and BTS) in the second year than in the previous year, are explained by the "cognitive scaffolding tutor's interventions. In this case we noticed the function and the relevance of this figure in the context of case-work activities;

- The two groups of beginner teachers (BTS) faced up to the work in a similar manner, with high levels of social activity, higher than teaching activity and cognitive activity.

3.2.2 The Garrison Anderson categories: qualities, limits and perspectives

Garrison and Anderson identified their categories with indicators and descriptors through "bottom up" work carried out in online forums with an educational aim, conceptualised forums such as virtual communities of inquiry, which is a type of practice community in which teaching and leadership are "distributed" among all actors. The authors do not intend to offer a systematic guide but rather a guide of principles to use in specific contexts according to an approach closer in nature to Conversation Analysis (CA) than Interaction Process Analysis (IPA). During our application of the Garrison-Anderson categories on the forum protocols produced in our first year of research, the following main points were underlined:

- the inclusion and inseparability of the three dimensions or presences of analysis (i.e. social, teaching and cognitive) presented by the authors;

- the consideration in each presence of two dimensions, intra-personal and inter-personal, which means a specific individual expression (e.g. "affective" in the social presence) and also a "social" expression ("cohesiveness" in the social presence).

These elements also have unfavourable effects, such as problematic inter-rater reliability since the social, teaching and cognitive categories can be misunderstood and mistaken for one another.

Furthermore, during our analysis we also identified some weak points in Garrison and Anderson's model. In particular they did not foresee the agreement/disagreement dichotomy present in some other

models and did not offer the possibility to identify and distinguish these opposite poles in a "discourse analysis". The authors' model is also exclusively centred on the "community", and loses sight of the processes and identity of the single actors in the community itself. These omissions often render the application of this system insufficient and unusable for a deeper epistemic analysis.

For a better analysis and to be able highlight the reasons for the socio-cognitive success or failure of interactions within the single groups (whether it regards the density of the communicative exchanges or the connectivity and articulation of the epistemic work developed), during the second year of research, as well restructuring inter- and intra-groups, we decided to form a mixed group of pre-service and in-service teacher students and introduce a social/cognitive scaffolding tutor to the new beginner teacher and advanced beginner teacher student groups (see §2.1.2). To avoid the limits posed by Garrison and Anderson's categories we used another system and method of analysis (see the next paragraphs).

We would now like to focus on the new system of categories that were elaborated in the second year of research and applied to new and previous data research.

The further categories identified had a double genesis. On the one hand, they were formed because of the deficiencies and difficulties evidenced by the Garrison and Anderson system (bottom up process), and on the other hand it was considered necessary to draw on the indicators of a categorical system elaborated by R.F. Bales and collaborators to observe interactions in small groups (top down process). The following categories were derived from the integration of the two processes which was applied in the subsequent "integrated" network analysis (§3.2.4) which uses and develops the classical SNA method.

We tried to integrate a quantitative approach, typical of the classical SNA, with one which allowed greater discrimination and greater coherence of the analysis categories which seemed to be more functional in analysing the forum protocols.

The categorical "system" proposed and applied to protocols produced during the two years of research sets out the monodimensional and undifferentiated "one to one" of the classical SNA in four possible forms of discursive interaction which can

compare members of small single groups.

- *Direct interaction* between two members of the group.

- *Indirect interaction* (**I**)between two group members respecting the "correct distance" at which messages are sent indirectly.

- *Evocative interaction or Citation* (**C**) which assigns popularity to the quoted or epistemic importance of the quotation.

- *Interaction one-to-All* (**A**) that in small groups, if reciprocal and recognized, identifies an implicit leadership behaviour.

This categorical "system" links these four basic forms of interaction to the typology of effective communicative acts.

In this case reference is made to Bales' (1950; 1970) Interaction Process Analysis (IPA) which was recently supplemented by a new (and different, also regarding aims) Systematic Multiple Level Observation of Groups (SYMLOG) by Bales and Cohen (1979).

The psycho-social system proposed by Bales is reduced here to four modal articulations which structure the 12 categories identified by the author:

- *Task Oriented interactions* articulated in a proposing (**TO+**) and a requesting sense (**TO-**);

- *Social-Relational interactions,* articulated in a positive (**SR+**) and in a negative sense (**SR-**).

By uniting and articulating the analysis categories cited above with the four dimensions already mentioned, we obtain what could be defined as an *Integrated Social Network Analysis* (ISNA), an analysis system which will become clear in the next paragraph. By first analysing the *contents* of the messages, it categorises the *sender*, the *receiver* and the *type* and *quality* of their *relationship*.

It is necessary to consider interactions and citations (C) separately since citations are not necessarily a true and appropriate form of interaction. It is expressed as:

- a simple recall of the actor cited (rather than the sender him/herself), or *Recall Citation* (**RC**);

- an *Epistemic Citation* (**EC**).

Both types of citation include *self-citation*.

The "system" is expressed as follows (Table 2).

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┌────────────────────────────────────────────────────────────────────────┐
│                              INTERACTIONS                                │
│  TO+ = direct interaction, Task Oriented, proposal (+)                   │
│  TO− = direct interaction, Task Oriented, requesting (-)                 │
│  SR+ = direct interaction, Social Relation, positive (+)                 │
│  SR− = direct interaction, Some Relation, negative (-)                   │
│  ITO+ = Indirect interaction, Task Oriented, proposal (+)                │
│  ITO− = Indirect interaction, Task Oriented, request (+)                 │
│  ISR+ = Indirect interaction, Social Relation, positive (+)              │
│  ISR− = Indirect interaction, Social Relation, negative (-)              │
│  ATO+ = one-to-All interaction, Task Oriented, proposal (+)              │
│  ATO− = one-to-All interaction, Task Oriented, request (-)               │
│  ASR+ = one-to-All interaction, Social Relation, positive (+)            │
│  ASR− = one-to-All interaction, Social Relation, negative (-)            │
│                               CITATIONS                                  │
│  RC = Recall Citation (only reference to peer test)                      │
│  EC = Epistemic Citation (reference to peer test with expansion,         │
│       articulation, argumentation, explanation)                          │
└────────────────────────────────────────────────────────────────────────┘
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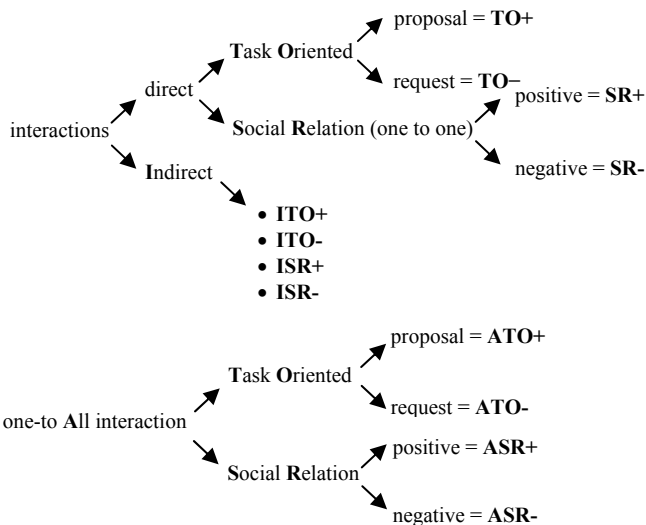

Table 2. Integrated "System Analysis".

3.2.3 *From web forum to Social Network Analysis: critical issues*

Web2 is an important internet conception in which one of the prerogatives is sharing and collaboration between members of different groups, communities and networks on a broad basis. From this point of view, the web is rediscovering the spirit of sharing and collaboration which characterised its first steps back in 1969 with the Arpanet network (Mazzoni, 2006a).

Understanding the way in which online education derives from socio-constructive currents and essentially responds to the logic of social interaction and sharing of resources characterised by virtual communities and networks is central to this conception. Web forums, *the blackboard for collaborative writing, blogs and social networking systems* (1) are examples of these virtual communities[2]. It is therefore necessary to widen the focus of investigation to allow a quick and efficient monitoring, analysis and evaluation of the evolution of the group/community/network. The quality of contents constructed, exchanged and learned and the relationships therein must be considered as well as the role of the individual in the growth of the group/community etc. (Mazzoni 2006b, 2007). An efficient investigative technique which allows this broadening to take place is the Social Network Analysis (SNA). Compared with classical analysis models based on the characteristics of single subjects (from which comparison groups can be constructed if necessary), the SNA focuses attention on relational data such as links, contacts or ties between a group of people or organizations such as family, associations, societies, nations etc[3].

When applied to network relationships and interactions, the SNA permits this type of analysis characterising not only a particular group or community, but also the role and relevance of the individual within the group. Application of the SNA starts with

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[2] A Social Networking system promotes the construction of online social networks between people sharing particular interests and activities. Each user is asked to define his/her own network of relationships (choosing known users already subscribed, known users who have not yet joined, but who have been invited to do so, and unknown users) and to characterise the types of relationship e.g. work, friendship, hobbies etc. Those who are "chosen" by a particular user to become a contact receive notification of the request and can choose to accept or refuse the invitation.

[3] For more details about the Social Network Analysis, readers should refer to Scott's (1991) volume and Wasserman and Faust's (1994) manual.

the creation of an *adjacency matrix*; and in the case of the present research, with the inherent data, contacts, connections or exchanges within a particular web forum. The relational interaction network data is presented in the resulting adjacency matrix where each line corresponds to the sender of a message and each column the recipient. The interaction box between sender and receiver shows the number of messages exchanged, or the existence (1) or absence (0) of a contact. Despite the apparent simplicity, creating an adjacency matrix is strongly influenced by the type of communication found in the web models used.

The first important aspect to consider in creating an adjacency matrix is a correct understanding of the terms *sender>recipient.* In the case of an e-mail, it is not difficult to identify the sender/receiver, as well as the contents of the message, for whom it is explicitly intended and, therefore, the connection between a reply and the message it refers to. This is more complicated when considering the adjacency matrix referring to web forum exchanges which have the essential characteristic of sharing information, contents and resources between participants, with the aim of reaching a common objective. Many important consequences arise regarding the definition of sender/receiver. Above all, the opening message in a discussion is sent to a forum without explicitly specifying the recipient; similarly, anyone can reply to the message. Furthermore, it cannot be taken for granted that the receiver will even read, let alone reply to a message. Replies often do not refer to a single message but to a series of postings within the discussion as a whole, or are sent to different receivers referred to implicitly or explicitly in the contents of the reply. Discussion will follow of the effects of the characteristics of web forums on the creation of an adjacency matrix and the subsequent application of the SNA.

Gathering relational data to create an adjacency matrix in relation to web forum exchanges can be carried out in two principal ways:

- tracking the web data in its specific data base e.g. *a log file*[4];

- based on a content analysis, which allows recipients of web forum messages to be identified.

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[4] The log file is a database which tracks all the requests from a client's computer to the server managing the particular web service.

As far as tracking is concerned, the correct identification of senders/receivers must take into consideration two important factors in the creation of an adjacency matrix: 1) the opening messages in a discussion are not tracked as they do not have a specific receiver but are posted to a common area; 2) the display interface of messages posted on a web forum influences the way data is tracked.

Regarding the first factor, it has already been noted that web forums are based on the idea of sharing and collaboration within the group or community. Therefore, unlike e-mails, these messages do not explicitly identify a receiver but are posted to the entire group or community. New messages posted within the web forum pose the question of who the message is 'sent' to. Is it sent to everyone, only those who read it, or only those who answer it? Within the perspective of social networks, the choice which best represents the interaction structure within the web forum is to overturn the adjacency matrix of *sender>receiver* and to start with the relationship *reader>sender*.

Although it is possible to track the data regarding the display[5] of a message on the screen, understanding it depends on the type of display interface used by the web forum. Two different interfaces are considered:

- SI (Sequential Interface of messages);

- DDI (Deep Discussion Interface).

The SI web forum presents a list of discussions on its main page. Clicking on a discussion, all the messages are immediately and fully visualized on the screen. This method of message presentation, from a tracking point of view, makes it impossible to identify which messages a user has read since he/she clicks on the discussion only to open all messages, and not on the single messages. It is therefore not possible to create an adjacency matrix *reader>sender* for an SI web forum. The DDI web forum, on the other hand, shows the thread sequence of messages (sender, receiver, object, date and time) without immediately displaying the contents. This poses two

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[5] Since it is impossible to verify a subject's actions, reading a message is usually understood as the message displayed on the screen, even if this is not entirely evident.

important consequences: first, the user has to click on the message to display it, thus facilitating the creation of an adjacency matrix on the basis of messages read. The user is also well aware that the reply command refers only to that message and the answer is linked to it.

As can be seen, a rather critical picture emerges regarding the use of relational data from tracking to create an adjacency matrix and applying it to the Social Network Analysis. Despite the criticisms outlined, in our opinion the adjacency matrix built on the DDI basis of reading messages is a reasonably efficient way to represent the network of information and contents created within a web forum. Alternatively, the researcher can always base his/her research on an analysis of the message contents.

Compared with tracking, the analysis of message contents allows a much more precise definition of sender, and above all receiver. As outlined above, the SI web forum often has single messages or replies which in reality have more receivers than the one who is automatically linked to the message through tracking. The content analysis allows an adjacency matrix to be created starting with the sender, and therefore re-establishes the correct direction of the interaction, i.e. *sender>receiver*. A content analysis also makes it possible to differentiate between the types of message content and therefore to create adjacency matrixes with multiple factors regarding the information and content networks activated (e.g. social support, help requests, information, awareness building etc.).

Despite these positive aspects of content analyses, it should be borne in mind that this type of analysis cannot give information about who has opened and read a message since it is taken almost for granted that the message has influenced only those who have answered it, while at the core of web forums are the presuppositions of total sharing and collaboration. Therefore, even the simple reading of a message can have a profound influence on the reader, albeit in a latent manner, and on any of his/her subsequent postings. Therefore the reading of messages appears to have a bearing on understanding how information and content is propagated within the group/community/network considered.

3.2.4 Beyond SNA: Application of an "integrated" SNA and discussant

In our research, we used the SNA "integrated model" based on *content analyses*, as illustrated in the previous paragraphs. In this way we were able to identify the different, often unvoiced *receivers* of messages and, in so doing, were able to build adjacency matrixes starting with the specific senders. Most importantly, we were able to differentiate the typology of messages depending on the strength of the *content* and the *communicative purpose*, which could be of a *social*, or a *cognitive* or *affective* nature.

For a manual analysis, we relied on the categories specifically defined for online contexts after a partial revision of Bales et al.'s categories (see § 3.2.2). In this way, we were able to analyse the messages and forum contents, through specific and functional categories useful for this research. Therefore, we were also able to build adjacency matrixes related to different and complex aspects (not only those of a social nature) of dialogic networks activated by the participant groups during the two years of activity (2005-06 and 2006-07).

In applying this "integrated" analysis, we were aware that not all the potential of such an articulated categorical "system" could be appreciated because of context limits i.e. a low number of forums each year; few participants in each group (about 6) and limited time for forum activities (about 2 months of online dialogic activities each year).

With this new type of forum analysis we were able to take further the preceding analysis that was carried out with the Garrison-Anderson system. It was also possible to compare the results of this latter analysis with previous findings. It was noted that in this more recent analysis, inter-rater reliability was higher (96%) than in the previous one (85%), and during the evaluation of forum messages, the independent raters immediately arrived at a broad agreement. To this end, we think that the new system of analysis was more effective and less ambiguous than the previous system used.

It should be clarified that the low number of subjects per forum and per professional category (OS, BTS, ABTS), forced us to group together some categories in our system (e.g. the data related to task categories - TO+, TO-, ITO+, ITO-) and to eliminate data related to

the "one-to-All" category (ATO+; ATO-, ASR+, ASR-). If we had included this latter data, we would have obtained unclear findings and illegible sociograms (elaborated by NetMiner3 software). In this light, we must specify that in all forums, in both years, the "one to All" messages were always more than all the others. Their exclusion had a certain influence on the proportions between social messages and cognitive messages.

This latter analysis corroborated the previous findings concerning the different styles of social and cognitive behaviour of the three professional categories of subjects, and on line collaborative work styles or "models" that will be shown later in sociograms analysis.

The SNA data gathered during the two years of research (see tables 3 and 4) show that the participants in the 2005-06 groups worked more, and on a better qualitative level (greater participation, cohesive and homogeneous work in the forum) than subjects in the 2006-07 groups.

Table 3. ISNA 2005-06.

	OS in	OS out	BTS in	BTS out	ABTS in	ABTS out
DENSITY	**0.7**		**0.567**		**0.767**	
DISTRIBUT. DEGREE						
summa	21	21	17	17	23	23
mean	3	3	2.83	2.83	3.83	3.83
STD.DEV.	1.71	0.76	0.69	1.34	0.90	0.90
min	0	2	2	1	2	3
max	5	4	4	5	5	5
isolate	1	0	0	0	0	0
pendent	0	0	0	1	0	0
INCLUSIVENESS	**83.33%**	**100%**	**100%**	**100%**	**100%**	**100%**
CENTRALITY	36%	12%	28%	52%	28%	28%
CLIQUE	2 1x5; 1x3		4 3x3; 1x4		4 4x4	
		%		%		%
TOTAL IN/OUT MSS	**439**		**316**		**333**	
TASK ORIENTED MSS	213	48%	150	47.47%	133	39.94%
DIRECTED MSS	34	7.74%	25	7.91%	59	17.72%
DIVERGENCE MSS	84	19.13%	30	9.50%	72	21.62%
CITATION MSS	30	6.83%	10	3.16%	20	6.0%

Table 4. ISNA 2006-07.

	OS in	OS out	BTS* in	BTS* out	ABTS* in	ABTS* out
DENSITY	**0.6**		**0.524**		**0.401**	
DISTRIBUT. DEGREE						
summa	18	18	22	22	17	17
mean	3	3	3.14	3.14	2.43	2.43
STD.DEV.	0.58	1.53	1.12	1.96	2.19	0.49
min	2	1	1	0	0	2
max	4	5	5	6	6	3
isolate	0	0	0	1	2	0
pendent	0	1	1	1	1	0
INCLUSIVENESS	**100%**	**100%**	**100%**	**85.714%**	**71.429%**	**100%**
CENTRALITY	24%	4812%	36.118%	55.55%	69.448%	11.11%
CLIQUE	3 2x4; 1x3		3 3x4		4 3x3; 1x4	
		%		%		%
TOTAL IN/OUT MSS	**260**		**625**		**293**	
TASK	95	36.54%	258	41.28%	138	47.1%
DIRECTED MSS	18	6.82%	28	4.48%	15	5.12%
DIVERGENCE MSS	38	14.61%	57	9.12%	39	13.31%
CITATION MSS	22	8.46%	35	5.6%	14	4.7%

* Groups with socio-cognitive scaffolding tutor

Although there were a total of 1098 in/out *messages* in 2005-06 and 1178 in 2006-07, in the second year 625 messages were in the BTS group, only 260 in the OS and 293 in the ABTS. The total in/out messages in BTS 2006-07 was high because they were mainly one-to-All[6] in an undifferentiated manner or, more probably because of a high sense of group membership, as shown by the sociograms. In 2005-06, the *distribution* of messages between groups is however more balanced (see table 3). The *density* of messages is also more positive in 2005-06, in the OS and ABTS particularly, and is instead very low in the ABTS group in 2006-07 (see tables 3 and 4). Other academic teachers and tutors have confirmed the difference in achievement between subjects attending the two academic years. Academic teachers usually speak of "a lean didactic year" or "a good didactic year", similar to wine!

In both years (eliminating the one-to-All messages) the Task Oriented messages (in/out cognitive messages) have pre-eminence over all others (all types of one-to-one in/out message).

The "divergent" in/out messages (including both the in/out request and negative messages), which could promote positive or, for the most part, negative social and cognitive conflicts, were less in 2006-07 than in 2005-06, and less in BTS than the other groups (see tables 3 and 4). There were very few citations (recall or epistemic citations) in both years.

In a deeper analysis of SNA, the best group in 2005-07 (for all: density and distribution of degree – summa, mean, STD.DEV., min, max, isolate, pendent, inclusiveness – centrality and clique) were ABTS, immediately followed by OS and BTS.

In the second year, a social-cognitive scaffolding tutor was introduced into two groups, the BTS and ABTS, with very different achievement effects. The BTS and OS were the best groups, while the ABTS was the worst in this year.

It was only possible to fully understand the qualitative analogies and differences between the socio-cognitive processes in the different types of subjects involved in the two years of research through an analysis of sociograms.

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[6] In the SNA, the one-to-All messages greatly increased the number of messages received and the total in/out messages.

OS 2005-06

OS 2006-07
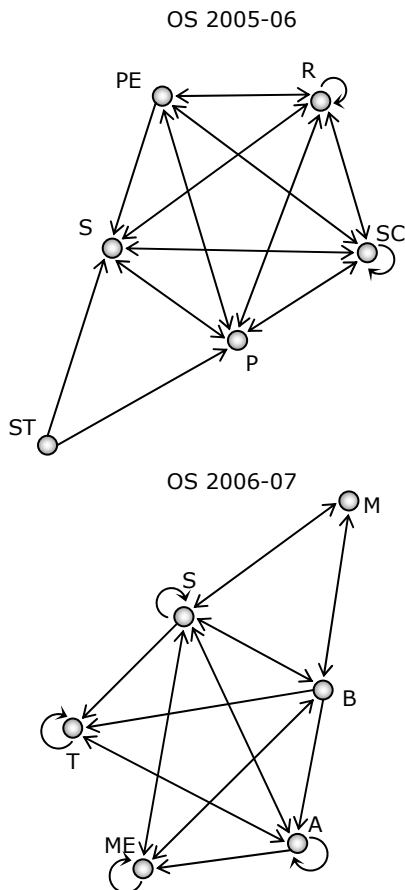
Figure 5. OS sociograms.

When the sociograms of each category are compared, we can see that the two OS sociograms are very similar, except for the *pendent* subject in 2005-06 (ST-subject)[7]. In the OS 2005-06 sociogram (6 subjects) it is evident that the S-subject's case was chosen by this group. There is a good distribution of relations between subjects (except ST) and leadership is shared. The OS 2006-07 sociogram (6 subjects) is very similar: T-subject's case was chosen and leadership was better shared, also in the sub-groups or *cliques* (see also table B).

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[7] This pendent subject produces unlikeness in in/out STD.DEV (see Table 2).

BTS 2005-06
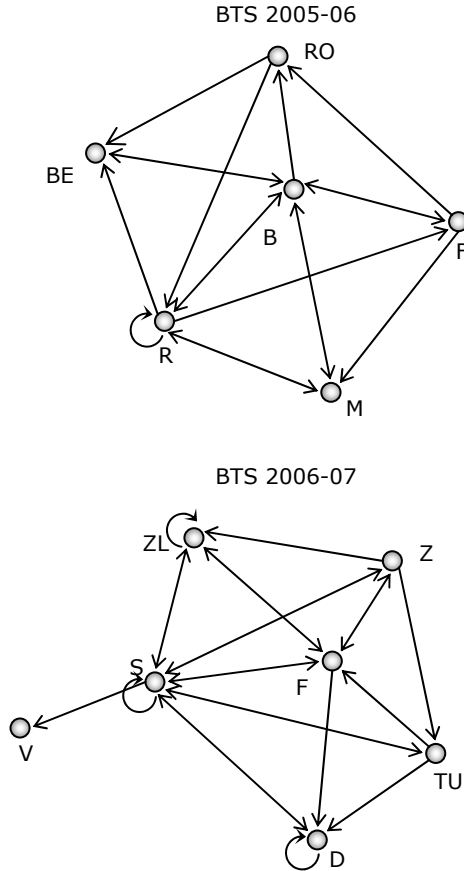
BTS 2006-07

Figure 6. BTS sociograms.

The two BTS sociograms were also very similar. The relation-net of BTS 2005-06 (6 subjects) shows the B-subject's chosen case. It is a very extended and connected net. The relation-net of BTS 2006-07 (6 student-subjects and 1 *tutor-subject*) is very similar, except for the V-subject (the only male!) who did not participate in the forum. The chosen case is Z-subject's case. This group was able to profit from the presence of the *tutor* (TU-subject, female gender), they listened to her and took on her scaffolding and suggestions. This group was a very comprehensive net that involved all subjects as in a "community of learning" (e.g. *Community of Inquiry* or *Building Knowledge Community*) (see Introduction).
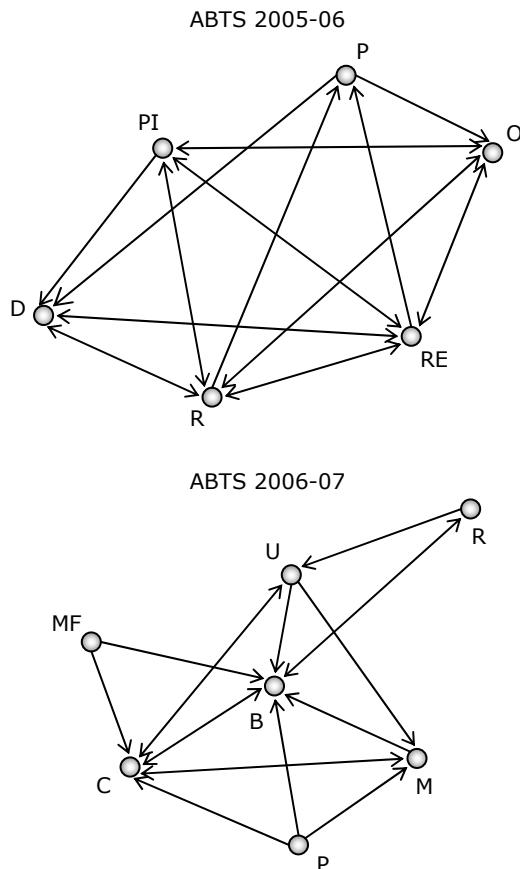
Figure 7. ABTS sociograms.

The two ABTS sociograms present very different situations, are different from the other groups and also between themselves. In the ABTS 2005-06 net (6 subjects) the chosen case is O-subject's. A full qualitative analysis of the contents of the work group was effectively managed by two subjects, PI and R, without taking on the role of leader. The sociogram appears to report that another subject (RE), an experienced teacher, has the function of leader. In reality (in particular in the first half of the forum) she participated in discussions with the direct or indirect criticism of her peers, or talked about herself, her personal opinions, perspectives, experiences, or was

judgemental and tended to pontificate. During the second half of the forum, in which her peers did not answer her, she changed her style of communication, becoming more open and very interactive with her peers. Finally the differences between the 2006-07 ABTS group (6 student-subjects and 1 *tutor-subject*) and the other ABTS group, and other groups, can be seen. In this group, the chosen case is B-subject's. Two other subjects competed for leadership (C-subject and M-subject), with the B subject prevailing. But the most surprising fact in this group is the almost *complete lack of interest in the tutor's scaffolding and her suggestions*. Only one subject noted and cited her presence, and the others all ignored her.

Other reflections about the outcomes of our "integrated" SNA application are found in the Conclusion, although we now make an abstract of the previous discussions by linking them with the two aims of our research.

At the methodological level the deep comprehension of complex social, cognitive, and affective relations and interactions, which may emerge and develop in a virtual forum, appear to be sufficiently examinable only by means of an integrated mixed method (§ 2.1). In the case of SNA, the in-depth analysis of the content, which can never be entirely classifiable and quantifiable with any categorical model (Garrison-Anderson, Harrington, Bales revisited etc.), becomes a key element, although it may be difficult to manage. Moreover, in our case, the online forum was studied in formal, but highly "ecological", educational situations. In these cases there is the risk of having too small a number of actors interacting online for too brief a period (2 or 3 months or less in our research). In this type of context it is impossible to fully appreciate the content analysis carried out with reference to categories which is too articulated, such as those we identified, with the risk that emerging data can be assimilated in too many different categories.

At an educational level, we can conclude that the online workshop proposed, based on a sufficiently authentic task of collaborative case-work in small group forums, was demonstrated to be an effective teaching strategy, but only with pre-service students (OS) and beginner teacher students (BTS). In these contexts, the subjects were able to reflect on their own beliefs and "latent" professional identity, and rethink or change them. The re-occurrence, in the OS and BTS

forums of similar patterns of interaction online (see tables 5 and 6) and the resulting effective and significant professional identity changes, showed the impact of the educational proposal and its effectiveness.

This incidence and effectiveness proved to be problematic with advanced beginner teacher students (ABTS), subjects who behaved in a different and unpredictable manner in the two years studied. This problem is demonstrated by their different sociograms, by the different nature of the socio-cognitive processes activated (which emerged from the content analysis of messages as described above) and by inexistent beliefs and professional identity changes (see §3.1).

We can hypothesize that our online educational workshop, effective with OS and BTS subjects, was much less so with ABTS, that is, the group of subjects with longer service and professional competence (an exception for us, but the norm in daily scholastic life!), the group of teachers who make greater use of their professional experience rather than theoretical and practical academic proposals.

In-service teachers need other contexts, activities, and very "personalized" educational experiences. These preferably must emerge from their professional life that are linked closely to their personal life: it takes place through jobs such as teaching, which imply a high level of human interaction, especially with junior subjects.

The difficulties found in the ABTS 2006-07 forum[8] also persuaded us to carry out narrative interviews with subjects of two in-service student teacher groups (BTS and ABTS), which confirmed our hypothesis. This has opened alternative forms of online in-service teacher education, in a perspective of "self-analysis" (see § 3.3).

3.2.5 Harrington categories: the reflexive teacher

The written case study syntheses were examined using Harrington's coding system (1996) to determine if aspects of critical reflection – "open-mindedness", "responsibility", "wholeheartedness" – could be identified in students' work. The critical interpretive analysis was refined by means of multiple readings of the students' written case

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[8] Lack of beliefs and professional identity conceptual change, inadequate achievement and ignoring cognitive scaffolding given by an online tutor.

studies, by two researchers who discussed and negotiated a common interpretation. In the specific setting of her research, the author acknowledged some descriptors which express these indicators.

Regarding being open to more perspectives, open-mindedness can be recognised in the written texts of students involved in a discussion of a case referred from a primary school in the form of the prevalence of (a) the teacher's perspectives (teacher focused pattern), (b) those of the student (child-student focused pattern), (c) an inclusive perspective (inclusive pattern). The students placed themselves in this last perspective supporting their own opinions and interpretations by multiple sources of evidence including experience, views of university professors and mentors, quotations from texts, articles, and lectures experienced at university; the connections between authoritative sources and reasoning were clearly expressed. Parents and the wider community were considered as resources which could contribute to resolving the problem rather than as individuals whose behaviour would have to be changed.

The second definable indicator: awareness of the consequences of an action (responsibility) was linked by the author to ethical aspects of the profession. Three ways of considering "responsibility" emerged from the students' writings.

Consequences for the students only: the only action taken into consideration is one which impacts on the students and often the short term consequences are not considered in a wider context.

Consequences for students and teachers: despite taking the two points of view of educative interaction into consideration, students who take this position lack awareness of their responsibility towards (and the relationship of the educative act) in a broader context.

Consequences for teachers, students and others and broader social consequences: the relationship between those who attend school and those who are "extra curricular" is taken into consideration in this perspective, both in the short and long term. Future teachers consider the problem to be much more than simple scholastic failure due to wrong didactic practice. They discuss the implications of practice for the particular student, considering also the complex and multidimensional nature of the consequences of actions which characterise educational practice.

In light of the wholeheartedness with which students and teachers assume their professional role and responsibilities, it will reflect, in significant ways, how they make meaning. When students begin to understand that their historical and cultural contexts influence who they are and who they will become, they have the potential to step outside of those influences, to criticise them, and move beyond them. Harrington argues that teachers in training begin to take on their real role when they become aware of their own affirmations, by which they interpret the world, and which are normally "taken for granted".

Student's assumptions can fall into three patterns that reflect their beliefs about the educative process and the role of teacher:

Teacher directed learning: discussions of these cases reflected the idea of the teacher being uniquely responsible for the education process; teaching as opposed to learning is the dominant idea. The class is the prevalent reference point rather than the school or community etc.

Education as an interactive process; from this perspective it is considered that the students' needs represent the range of the teachers' choices and that the education process is reciprocal. Teaching is considered as an indeterminate process which requires the ability to understand students' knowledge and the flexibility to move in and around a variety of techniques and methods.

Education as a complex interactive process; this is a reading of education as part of a complex social system open to multiple interpretations. From this perspective the teacher is not considered solely responsible for "all things", and a wider context can support educative action. Above all, it is awareness of systemic factors which sustains a certain vision of teaching and consequently didactic practice, or an awareness of factors which influence the reading and analysis of the problem being discussed.

For the analysis of writing cases using Harrington et al.'s (1996) framework, researchers followed the indications for applying the model given by the author herself.

At the first level of analysis, the researchers analysed the statements that account for the different student-teacher perspectives (teacher-focused, child-focused, inclusive). At the second level, the texts were examined for statements that provided information about the limitedness or inclusiveness with which the participants recognized

consequences of action (for students only, for teachers and students, for teacher, students, others and broader social consequences). The third level of coding gave information regarding the taking for granted and awareness and non-awareness of students' assumptions about teaching.

Finally, in the light of the previous levels of analysis, the researchers identified each text with patterns of 'wholeheartedness' (*teacher directed learning*, *education as an interactive process*, *education as a complex and interactive process*) with which pre- and in-service teachers in each group consider their professional role.

The analysis of writing case studies during the two years' research shows that there are similar styles of resolution of a case between groups of the same "professional status": between the two groups of students (OS group 2005-06 and OS group 2006-07), the two groups of beginner teachers (BTS group 2005-06 and BTS group 2006-07), and the two groups of advanced-beginner teachers (ABTS group 2005-06 and ABTS group 2006-07).

In both years the students, novice teachers and teachers solved their cases using different styles.

1. *Students* (OS). In light of their *open-mindedness*, students' writings are *student-centred*, their assertions focus on the needs of students and this guides their analyses of the case. Parental point of view and the importance of their role in the situations is sometimes recognized and their validity is acknowledged. The student's awareness of the teacher's *responsibility* are focused on the consequences for students more than on other types of consequence (for the teacher and other members of the school community). The students' writings reflect assumptions that teaching and learning are an *interactive process*. There is a clear sense of the reciprocal nature of the teaching and learning processes, but they are lacking in a deeper awareness that education is embedded in a complex social system. In general we noted that the students elaborate their problems using a co-constructive process and with reference to authoritative and theoretical sources. They show that they are able to elaborate their emerging professional identity.

2. *Advanced-beginner teacher students (ABTS)*. The teachers' perspective is more holistic. Their writings reflect an *inclusiveness perspective* and show that expert teachers view education as a

complex, interactive processes, but the in-service teachers' analyses, as well as the solutions, are strictly based on experience and practical knowledge with no attempt to link the issue to theoretical concepts. Their discursive explorations lacked theoretical considerations and are grounded in local professional environments. They show an embedded and rigid professional identity.

3. *Beginner teacher students* (BTS). The participants in these groups show a holistic perspective of teaching/learning processes. The beginner teachers constructively work together to solve case study problems. They have more educational awareness than students and, at the same time, they are more open to change themselves by means of the contributions of colleagues, than expert teachers.

We investigated the degree to which case based pedagogy encourages a shift to more complex and critical ways of thinking and reflecting about teaching.

In examining the findings of the 3 types of groups we found:

- the emergence of a professional identity in the student groups (OS), correlated with flexible, personal and social identities;

- a flexible and open-to-change professional identity in the beginner teacher groups (BTS);

- a professional identity rooted in advanced-beginner teachers (ABTS), who are unable to modify themselves because their professional identity is extremely embedded.

In respect of the results for advanced beginning teachers (ABTS), our research corroborated the findings of Ben-Peretz and Kupferberg (2007). The expert teachers lack theoretical reasoning in their writing. In this light we agree with these authors that, especially in in-service teacher education contexts, we need to provide a space for supporting these students to reflect more, and to create possible links between theory and practice.

3.3 Individual level

3.3.1 The narrative interview

The narrative[9] interview does not provide absolute and certain rules; its hermeneutic values and methodology feed on experience. Often the subject "interviewed" narrates personal events that are unexpected and which require further clarity. New queries arise, as in this inquiry, even though they relate to the specific plan of the research. The importance given to some aspects, rather than others, depends on the criteria chosen and the hermeneutic process involving the interviewer (Atkhinson, 2002). In any case, the interview must be conducted in accordance with the logic of dynamism and flexibility. A key factor concerns the reciprocal *relationship* between interviewer and interviewed, co-constructors of multiple meanings, witnesses of indefinite "linguistic games" (Wittgenstein, 1953).

There are "unique and unrepeatable" profiles in the interviews to be presented, the result of authentic qualitative ethnographic research, remote from any objective of generalization.

3.3.2 In search of professional identity

In our research we felt it necessary to collect the testimonies of students who attended the workshops. They were six advanced beginner teacher students (ABTS) and six full-time students (OS), who attended the workshop during the year 2006-07. Our attention was turned to the ABTS and OS groups who demonstrated different characteristics, such as different beliefs, behaviours, styles and outputs. Prior to the interview, the researchers read, analysed and evaluated processes and products exhibited online by the students involved. Through the recorded interview, conducted at the conclusion of workshop activities, we attempted to investigate in depth the reasons for those events and their possible origins in the background of the personal history of each subject. Through indirect verbal prompting female students were invited to comment on educational philosophy, their conception of the teacher's role, their personal assumptions therein, the reasons for their choice to become a teacher, the sense attributed to their experience in the online workshop

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[9] It would perhaps better to call it "talk" narrative.

(the individual cases proposed, the shared choice and division of tasks etc.), and the image of herself as a person, woman, student and teacher.

The interviews were focused on two main topics:

- The influence of *personal history* in choosing to become a *teacher*, the importance of a *prototype* or an *ideal* in the design of the teacher's function (style of holding the role), the social and affective aspects in the relationship with peers during the workshop, and with teaching/university colleagues, family and friends etc.

- The *relational dynamics* experienced, proposed, played or suffered in the online workshop group, involvement in the activities and any problems with the procedure, logic, contents, etc.

Particular attention was paid to examining the *social-affection aspects* (elements which crossed over the addressed issues) and the concept of *personal* and *professional identity*.

We verified that the interviewees identified teaching with "taking care". To teach means, *in primis*, to take care of students: «I take care of the students because I don't have objects in my hands, they are persons. So, I try to educate them in the best way. I try to be a good teacher!», says MF2006-07 (ABTS). «If somebody doesn't take care of the child, in my opinion, they don't get anything from the child. The child, who comes to class, comes from home and brings everything to school. If we do not take care of him, also when perhaps he hasn't done his homework, maybe it's because there is something wrong, because he is growing... That is, we must understand him, because he is a person! Then I immediately notice if something is not going so well», says R2006-07 (ABTS).

Some teachers admitted that, not having been as well cared for as they *may have wanted* themselves or as they *should have been*, they transfer this desire to be loved to young students, trying to fully satisfy their own needs for affection. «Perhaps what my mother transferred to me with difficulty in some way I project in school. Yes, yes. I am conscious of this. I believe that this has been one of the reasons why I became a teacher: the fact, of course, of

not being cuddled. So that's... I try that especially with children, because you feel more motherly with children of three or four years of age. So, yes... I then project this probably in school», asserts MF2006-07 (ABTS).

The teacher is equivalent to a person with "talent", with pedagogic and didactic skills and with methodology, who for passion, love, "dedication" and "spirit of sacrifice" *takes care* of children.

Most of the students in both groups also argue that they have been inspired by people who personify a certain educational philosophy: family teachers, teachers met during their schooldays, historical educators. The *sense of responsibility* to teach and/or study is strong in both groups, often accompanied by a fear of not "being up to" the task of overcoming obstacles along the way: «I study as I work: responsibly. In this sense, when I have to study, I have to study and… there are no distractions», says B2006-07 (ABTS).

One difference between the two groups lies in the conception of the university curriculum. The ABTS, in fact, say that the real reasons for their study mainly reflect the need to achieve *qualifications*, necessary for the institutional acknowledgment of the profession. Everybody also insists on declaring a sort of *inadequacy* between university training and the concrete personal necessity of progress, of *life long learning* (Alsup, 2006). The less than optimal success of this group (ABTS) in the 2006-07 workshop could therefore also be attributed to the disappointment in academic expectations.

Many teachers, during the narrative interview, said however that they appreciated the opportunity to communicate online and to compare a personal and professional point of view with fellow students. Their need is to «create an *area for relationships*, perhaps where students [OS] can talk, or where teachers, who are doing university [ABTS] and are teaching and are eager to make comparisons, can pass on suggestions, and do some *relationship building*. Because you then also take this contact, the way you are with others, to work. I say this because other colleagues think these things. And, in my opinion, [*these areas*] are really useful tools», R2006-07 (ABTS) says during the interview.

The OS, for their part, perhaps because they are not yet worried about being real teachers, seem to live university as highly educational, interesting and, in some ways, priceless: «I like what I

study. I love it. I like what I do, I like the subjects; I study willingly», says EM2006-07 (OS). «During secondary school I studied the bare minimum, just enough to get through. From high school onwards I have seen an increasing growth in my studies. And then, at university… If I know that there is an exam, I focus, I let everything else go, but I want... Yes, I want to do things well… I'm committed enough. I said: "No, look. Me! an accountant! an office worker! I don't really want to do that". And I always returned to my initial dream: to be a teacher. I have always enjoyed being with children, to help them, to do activities with them… In other words, this is really my dream. It is being realized a little at a time» AB2006-07 (OS).

A common theme that comes up and should be emphasized is that the "profession of teacher" involves a "*choice*" and the "willingness to *work on themselves*" (Cerri, 2002). All the interviewees (ABTS and OS) expressed similar thoughts, such as the need to overcome the dichotomy between *theory* and *practice* and an awareness (gained especially during narrative interviews, as they declared explicitly) of the strong tie between professional and personal identity. One desire specifically regards the possibility to undertake personal training intended as "global attention" to the *persons*, their wishes, their resources, their personal-professional identities, as a "diversification of the proposals" (Lisimberti, 2006).

«In my opinion, to be a good teacher, there must be a commitment to continuous training. In the sense that we must not abandon study or books, reading, all that is useful to remaining active in this aspect. In addition we must work hard on the person, i.e. I am not a teacher only from eight to four. In my opinion this is a way of being, a way of life! When I am at school, I don't pretend to be a good teacher. I must have this way of existing in my head. It is the relationship with children, with parents and with other teachers, but also my way of thinking, my way of being with people, continuous study, keeping myself informed. It's all this together, a set of things», says EP2006-07 (ABTS).

Moreover, through the deepening of online relational dynamics, we found that both groups indirectly confirmed the figure of the *leader/driving force*, intent on orchestrating and supporting workshop activities.

We still wanted to see if there was a dichotomy or assonance between the narrative of self in the university context and the image of self in real life. It was also established that the interviewees did not admit to being the leader in group interactions. This was only indirectly acknowledged as a characteristic in relation to personal and professional life, and was linked explicitly however to the concept of "duty". To be and to perform as a leader is experienced by the protagonists as acting *responsibly* towards the lives of others.

C2006-07, a proven leader in the ABTS group, also evidenced by the SNA, does not seem to realize the role she carried out in her group. She argues, in fact, that she lived in a favourable climate of absolute democracy, cooperation and genuine live interest in the virtual community, harmoniously shared (shared leadership). Regarding her experience as a teacher, she admits: «a positive episode is when I alone see something. Only me… because I have other abilities». And, in respect to the rapport established with teacher colleagues, she says: «I strongly esteem one colleague because for me she is a mentor», and laughing, «The others? They are important but often it leads to gossip, senseless talk». This ABTS appears as a determined woman not destined to occupy a marginal role, but to live fully the roles of being a woman, person, student, teacher, mentor in herself and undisputed but unacknowledged leader.

S2006-07 (OS) shows her tendency to leadership, already found in the online workshop in the OS 2006-07 group, provoking, inspiring and spurring action from companions. But even she does not admit to having played a key role: «Instead negotiating in forum and then writing down what we shared, we all re-grouped by means of collective writing… I tried to conform, because if 90% of the group goes in one direction, I can't say: "No, hold on! We must do it this way!". It is not my role and I didn't want to do that». It should be added that when invited to talk as a woman, as a person and as a student, she also offers an overview of the situation which varies little from that of C2006-07, leader of ABTS group. Her life is marked by a strong sense of responsibility that leads her to interpret non secondary roles. In this regard, the will to act beyond barriers is seen as a primary virtue to be disseminated in the name of an implied philanthropy.

It should be made clear that the interviewees explicitly expressed the need and genuine "desire" *to express themselves*, not only from a *professional* point of view, but also and above all, from a *personal* point of view. In other words, although it was possible to trace the common denominators, the particularities of subjects, their personal experiences, their private, intimate and critical lives emerged overwhelmingly.

C2006-07 (ABTS) talked about (mainly to herself, with the opportunity of a narrative interview) an inconvenience, attributed to a strong sense of *responsibility*, experienced as a neurosis: «I see me as dynamic. I never stop, but this is both positive and negative, because sometimes it leads to a type of neurosis. And it's a little strange that, sometimes, I do not realize immediately that I am passing the limit, where I need to stop and cry, to speak, to be supervised. I have my moments, too. I noticed, however… and it's a thing that hurt me personally. I hurt myself! I realized I was escalating into neurosis and I wasn't able to stop it. This was the case with *herpes*[10]: I did not notice being nervous, somebody pointed it out to me. This is something that I don't forgive myself for».

ME2006-07 (OS), however, expresses a clear desire to describe an important experience (her work in Africa), to which she attributed the causes of her *existential transformation*, that removes her from old friends and that sometimes makes her feel lonely: «This has changed my relationship with these people, in the sense that they are frivolous, I instead… These experiences are very strong and have left a mark on me! Now, sometimes when I speak with them, I disagree with almost everything».

M2006-07 (OS), in turn, places at the centre of her life story, an almost imperturbable *necessity* for *certainty* and *stability*. It is not always a feasible plan: «Yes, I am afraid of being wrong and perhaps even a bit of anxiety leads to this. And after I try to act and, usually, everything is fine. But... it's at the beginning; after that I manage quite well… But I must overcome this initial thing, saying: I will go on. Then you let go. But clearly, when new things happen to me, I have this fear».

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[10] Herpes is a skin disease transmitted virally resulting in reduced immunity, as a result of stress.

A widespread fear in the two groups is that of *not considering themselves strong enough to keep emotions at bay*. C2006-07 (ABTS), in fact, says with feeling: «I am glad that I was able to managed my emotions… some (interview) passages that are a bit delicate, perhaps at other times, would lead me to cry… [*Grief is heavy*] for those who know nothing about this medium of expression, for those who think that you can use it as a way to attract the attention of others. Grief is a way for me to genuinely express myself. You can gesticulate or cry a lot. But in the world of work, grief is not often considered as a good thing. Sometimes, indeed, it is not an expression of maturity. You never know who you have in front of you, therefore you must control events of this kind».

R2006-07 (ABTS) says she is a very *committed* person, but at the same time, *satisfied* with her life: «I am a woman like many others, but a very sensitive person, able to change things when they are not the way I want. I can act on what is my context. I'm a very diplomatic person, because I relate to everyone without problems. I am married and try to do many things. I always pursue my dreams, and want to realise one (a dream) but don't want to lose contact. I never focus only on work, in the sense that I always have a finger in many pies. I do not know! I'm like a spinning top that keeps running and that goes a bit here and a bit there, that puts things together, that does, that creates. Like a bee!». All this is said in an interesting way, even through body language, that sometimes leaves out the need for the person to break the rules of conformism and respectability, often symbols of prejudicial manners when relating to an interlocutor. From this rebellion comes the *fuzzy* element and multiform chromatic crystal.

Finally, the narrative interview was explicitly seen by all students as a valuable opportunity for storytelling and introspection. After her personal experience of storytelling, C2006-07 (ABTS) says: «The interview was a welcome surprise. I am happy to see that, compared with six years ago, when I graduated in Educational Science, there is an increased sensitivity towards those like us who choose this profession (the most beautiful one).Thanks again».

The purpose of the narrative interview should be to promote a "plural dialogue" with the peculiar interior face (Demetrio, 1996).

The self sometimes becomes irrepressible, or comes out of hiding and wants to talk.

The "I" - says psychoanalysis - is no master in his own house, being at the mercy of unexpected, of changed occurrences, of *lapsus*, missed opportunities or lucky events that sometimes make it inept, a caricature and totally insecure.

All this has been extensively lived and testified at length in narrative interviews, particularly when the discourse on professional and academic self also involved aspects of personal life, the inviolability of which we can claim to be guards and defenders, but only up to a certain point. The desire to talk, meet, face, reflect in depth, and to improve in perspective is irresistible. It sometimes overwhelms even those individuals who were reluctant to trust, resistant familiarization with others considered as *outsiders*, - and we are deeply convinced of this aspect. Only by assessment, construction and negotiation of meanings, empowerment and life long learning, does humanism unfold explicitly, even among those who were or who felt less involved in the online workshops.

This "revealing" of the professional and simultaneously, the intimate self, has made us reflect extensively on the potential inherent in a narrative interview (and in the autobiographical methods "tout-court"), especially regarding the future of Italian higher education of in service teachers, the ABTS who, during our two years of research, were less enthusiastic for, and/or involved in online training proposed (case-work activity). However this model enthused and involved the OS and BTS, who also demonstrated excellent outcomes.

Conclusions and perspectives

It should be noted that this *empirical* research, carried out using an integrated and mixed method is very "ecological research". The subjects and their distribution (in each group, in each professional category) are what real academic life offered to our research. In effect, they are the students enrolled in our online workshops, which are part of the ordinary didactic activities of teacher education university courses. For this reason there was a great dissimilarity between subjects (different ages, pre- or in-service *status*, previous

different curriculum etc.), but together with a common academic educational aim: being or becoming "a good primary teacher"!

To summarise, this research had two major aims.

- An *educational aim*: to develop and to assess pre- and in-service teachers' online workshop "models" within primary teacher higher education. Workshops were aimed at supporting and scaffolding conceptual changes in professional identity in different groups of students (Only Students, Beginner Teacher Students and Advanced-Beginner Teacher Students) *hypothesizing* different behaviours and outcomes for each group.

- A *methodological aim*: to apply and deal with a very complex research design, the "Integrated Mixed Model Design", also called "multi-strand and mixed method".

The research *strands* included:

- one strand of individual activities, that produced pre-post *profile protocols;*

- one strand of group activities in forums (collaborative case work), that produced *forum protocols;*

- one strand (in the second year of research only) of individual *narrative interviews* with the two "critical" groups of subjects (BTS and ABTS).

The three strands justified the discussion of our research on three levels: *community level* (analysis pre- post all profile protocols), *group level* (analysis of each type of group interaction), *single level* (interviews with selected subjects in two critical groups).

Methods and techniques used were:

- *specificity* and *correspondence analyses* (quantitative and qualitative analyses) to the pre-post profiles;

- a *qualitative analysis* of forum protocols using Garrison and Anderson's content categories;

- a *quantitative analysis* calculating density figures for each forum with reference to Garrison and Anderson's content categories;

- a *qualitative analysis* of forum protocols using revisited Bales et al. content categories;

- *quantitative* and *qualitative* analyses with "integrated SNA with reference at the revisited Bales et al. categories;

- a *qualitative analysis* of narrative interview protocols for 12 subjects (6 OS and 6 ABTS, 2006-07 academic year).

The *first aim has been confirmed* by *pre-post protocols analyses*. The online workshop activities produce different effects in different group types. In both years the OS and BTS groups improved most. Both outcomes (professional beliefs and identity) changed in the pre-post forum – a result which was more marked for OS, and less marked for BTS -. The OS group made more use of theoretical and practical academic resources in online collaborative case work (see the qualitative analyses of *forum protocols*).

The ABTS groups (especially in the second year) did not show professional identity and belief changes in pre-post forum activities. Their stories, and their professional and personal identities are scarcely defined and they are not open to change themselves, their beliefs, ideas and experiences. In the case-work they made more use of their work experiences and made less reference to academic resources than the OS and BTS groups.

Using *quantitative* and *qualitative analyses* of *forum protocols* with Garrison-Anderson's and Harrington's content categories, we found that in the first year there is a prevalence of important social presence in all groups. In the second year, the priority of social presence is only for the OS (not tutored) and BTS group (tutored), but not for ABTS (tutored). These differences are not confirmed by *quantitative* and *qualitative analyses* of *forum protocols* with the revisited Bales and al. categories or through the "integrated SNA". In both years, and in both types of group, a "cognitive presence" (Tasked Oriented interactions) is predominant. This difference became clear after the necessary exclusion of "one-to-All" messages from SNA elaboration.

From the content analyses of the forum and pre-post profile protocols, we found that in both years a natural tendency appears: the opposing position (in achievement, beliefs and identity changes) of OS and ABTS behaviours. The OS groups are more open to

academic activities and offers, than the ABTS group. In the middle area the BTSs are found, that is the groups who, on some occasions more than others during the workshop, model a "community" and are also conscious of doing so: "It seems to me that the work carried out has been good thanks to the commitment and collaboration of each person" (S. 2006-07). "Girls… I wanted to thank you for your support! Many thanks to all, I could not have been in a better group!" (Z. 2006-07).

The most interesting outcome is the different interaction profiles for the different subject types in the online case-work forum (see SNA sociograms). These differences between groups and the similarity between years for OS and BTS subjects also seem to indicate the problematic nature of academic didactic activities (even if online and more interactive) for in-service teacher education. The problem of different, specific and innovative educative activities for in-service teachers (advanced beginners, competent, advanced competent or experts) or the problem of suitable, effective and personalized lifelong learning in the workplace is the real problem that emerges from this research, and was hypothesized initially.

A solution to this problem could perhaps lie in an *innovative online methodology* in in-service teacher education: *an online sharing* "self-analysis".

Finally at the *methodological level* (the *second aim* of this research) no single method of analysis (quantitative or qualitative) can capture, show and interpret the very complex and dynamic nature of a dialogue-epistemic network, or a virtual forum which, together with online dialog, *attempts to build* knowledge and competence through real collaborative case-work or another educational work method.

Chapter 4

Linguistic indicators for the knowledge building analysis and the interaction in online learning processes

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Abstract. The text describes research aiming at identifying linguistic indicators and at building artefacts to support both the tutor and the teacher in real time analysis of the interactions in an online course.

In order to identify the indicators, we have applied an approach to communication analysis and online learning by integrating communication psychology and Conversation Analysis, Communication Accommodation, Speech Acts and Text Theories.

A model was built according to these theories as well as a long-term experience in degree and post-degree courses. This model connects the quantitative analysis, inferred from the tracing, with the qualitative analysis surfacing from the texts analysis. The IT artefacts were planned and built according to the model.

Both the models and the arranged tools were tested in the online Master called "Didactic models and strategies" where 116 teachers were involved, particularly in 96 active forums.

The experimentation enabled one to point out the effectiveness of the indicators and to give some guidelines about the use of IT artefacts for monitoring, useful for teacher/tutor in order to come in along the course's development or to build the evaluation at the end of the course.

⬥ The present article has been jointly discussed and elaborated by Macerata University research Unit. Prof. Pier Giuseppe Rossi is the project coordinator of Macerata Unit. Giuseppe Alessandri has written §§ 2, 6.1 and 8; Lorella Giannandrea has written §§ 3, 5, 7, 9.8, 10; Patrizia Magnoler has written §§ 1, 9; Carla Canestrari has written §§ 4 and 4.1; Ilaria Riccioni has written §§ 4.2, 4.2.1, 4.2.2; Ramona Bongelli and Andrzej Zuczkowski have written §§ 4.3; Marta Accorroni has written §§ 6.2.

1. Introduction

There are two models widely used for describing didactic in eLearning (Paulsen, 1993; Guba & Lincoln, 1994; Manca, 1999). The first model is inspired to a "positivistic" approach or, in other words, an instructivistic one. The classic structure of the didactic module, taken as a model by SCORM, foresees an introduction where the process' objectives are proposed; some materials are then supplied and finally the learning is tested through structured tests. The contents are organised in Learning Object (LO) defined by specific meta-data according to which the Learning Management System supplies the didactic path automatically. In the positivistic model the LO is a closed box defined by static descriptors. The model's success comes widely from the broad availability of deterministic algorithms to atomize the system, supply materials and make tests. In other words technologies have favoured a reference model that is not only a technological one, but also a didactic one for eLearning. Many authors have highlighted that SCORM proposes an industrial model (Friesen, 2006) easily transferable but that can scarcely be personalised or linked to the context (Hodgins, 2006).

A training process based only on an instructivist model has been argued for a long time, especially when the objective of the path is meaningful learning requiring pedagogic-didactic models mindful of the valorisation of the individuals and their expertise (Illeris, 2004; Mezirow, 2003). Such a change requires the shift from push structures, that is to say stiff programmes set forth at the beginning, to pull structures where the individual cooks up the path and can develop both self-evaluating expertise and flexibility (Brown, 2005). Jonassen (2006) proposes the CLE (Constructivist Learning Environment): rich and motivating environments and activities based on real tasks (Collins, Spiro, Resnik). In the same direction Attwell (2007) proposes the Personal Learning Environments characterised by a "dynamic personalisation".

Nevertheless there is another problem. The technologies often used in eLearning are not always suited to support such a perspective. Tools to communicate and interact with groups are improved, whereas there are rarer examples of tools made to support knowledge building, monitor the process in a dynamic way, and provide scaffolding in group production.

Such scarce attention comes from the fact that many of the expectations, generated by researches about the I.A. in the 60s and the 70s of the last century, were disregarded and nowadays the operators in the e-Learning field are not always knowledgeable of new research on IT algorithms supporting fuzzy logics that are both non deterministic and complex.

An interesting perspective towards new paths was stated by the third issue in 2006 of the British Journal of Educational Technology Vol. 37 called *Advances of the Semantic Web for e-learning: expanding learning frontiers*, remarkably framing the state of the art of the research in the field and providing some guidelines. The article highlights how necessary experimentation is in e-Learning, moulding "technologies, tools and applications" already used in fields such as the Semantic Web and IT, to knowledge management for pedagogic needs. The direct relationship between Semantic web and e-learning, on which Web 3.0 is founded, matches the traditional processes of contents' production with "the critical objective of the expression of meaning". Problems like semantic mark-up, semantic filtering, personalised and semi-structured notes, kaleidoscopic composition of contents (Tasso, Rossi, 2006) require innovative tools with a high technologic content that can only be realised by workgroups that are transversal to the individual scientific communities with expertise both in the didactic and the technologic fields.

At the same time in the field of instructional design there has been a shift from a "description oriented" approach to a "design oriented" one (Reigeluth, 1999) or from a model based on data filled by LO (where strategies are incorporated in the data base and clear both to teachers and students) to an instructional transaction system operating on knowledge object linked according to knowledge structure.

2. State of the art of research

Both national and international researches have followed different ways for conceptual artefacts building to support the online learning processes. Such indicators must supply accurate information in an overall quick way. The direct reading of online materials would certainly supply a complete analysis but it shows two problems:

1. It requires a long time and does not guarantee timely interventions of the teacher/ tutor useful to mould both objectives and strategies along the path;

2. It hardly enables both a holistic vision as well as a complete comparison.

2.1 Indicators and artefacts for monitoring

The first source of indicators highlighting either the participation, the absences, or, most of all, the conscience and the interaction evolution is given by the outlining or counting of the individual's activities carried out while learning: entries in the environment, reading and writing in the single tools, material's loading and downloading, structures tests' results, and linking time. These indicators are present in the majority of the online environments even if reports enabling a fast reading are not always supplied.

Nevertheless, the quantitative data of the outlining, on its own, does not always disclose the qualitative characteristics of the process. The research has then focused on researching and experimenting with some indicators linked to the linguistic and semantic sides of the writings, as well as to the relational sides. Consider in particular the social network, the latent semantic and the computational linguistic analysis.

2.2 Artefacts for the semantic research, the mapping and kaleidoscopic aggregation of contents

There is a need for a semantic approach aimed at both the analysis and textual organisation. The need for tools for the aggregation of textual fragments comes from the fact that the knowledge building activity can be described as a kaleidoscopic re-composition of materials and concepts coming out of the interactions, the collaborative writings,

and the study of the subjects. In addition, a dynamic re-mapping of the materials enables one to offer personalised paths and for this reason it is connected to the presence of a autopoietic environment that is re-organised according to the existing process and interactions.

In literature there is an open problem of shaping adaptive, automatic and unobtrusive systems, automatically enabling the filtering and classifying of all the information present in the didactic material and outlining of the users' interests through a semantic representation (Tasso et al., 2005). There are some artefacts for the semantic filtering of texts (Tasso, 2003) able to "label" the "core ideas" of each text, to understand the debate's evolution, to identify a new concept present in a message (e.g. of a forum) and absent in the previous ones, and to identify concepts with a co-occurrence relationship among them. The algorithms used in the Latent Semantic Analysis comply with this goal and those present in *Carrot2*[1] can, for example, label block texts and group similar concepts through the generated labels.

- ❑ The approaches present in literature for the materials' mapping can be joined together in three categories: top down process: one starts from an ontology and according to this, the contents are mapped (Pirrone et al., 2007) and personalised paths are built (Cantone, et al. 2007);

- ❑ bottom up process with the individual's intervention: the users are asked to tag both the messages and the texts and then the materials are organised according to the tags (folksonomies);

- ❑ Automatic bottom up process: the automatic analysis of the materials through semantic filtering systems (Brodnik et al., 2006) labels the materials and the material is organised according to the labels.

The project called *Me-aggregator* (Lundqvist, 2007), blog building including semantic tools (Cotterill, 2007), research about different materials present in the learning environments (Dahn, 2007), adaptive hyper-medial systems (Brusilovsky et al. 2004), zz-structures (Nelson,

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[1] http://project.carrot2.org/

2004) and the building of tools for the ePortfolio realisation (Ravet, 2007; Barret, 2001, 2005; Rossi et al, 2006) move in these directions.

3. Research hypothesis

The experimentation made in the last few years by the research unit of Macerata has had the aim of identifying indicators and building conceptual artefacts for the monitoring of both online interactions and knowledge building.

   The research hypothesis consists of the identification of meaningful indicators for the analysis of the activities in an online learning course and in the building of suitable artefacts to draw on and represent the necessary data. The artefacts have to be seen as supports for both tutors and teachers as well as useful to take an immediate picture, moment by moment, of the learning process in the virtual class and to highlight both the general and single individuals' trends in training. For this reason we thought it was necessary to care for ease of use of the artefacts and indicators and, at the same time, to propose a visualisation enabling a suitable and overall immediate understanding of the obtained data.

4. Integrated psychological approach for communication analysis and online learning

We propose, as a starting point, an approach to communication analysis and online learning that integrates studies about the CMC and the psychology of communication with some contributions from linguistics (Text Theory), sociolinguistics (Conversation Analysis, Communication Accommodation Theory), and philosophy of language (Speech Acts Theory).

   In paragraph 4.1 the analysis of illocutionary acts is introduced; in paragraph 4.2 the attention shifts to the negotiation, dialogic building of meanings and goes on to the interpersonal dynamics of agreement/disagreement; in 4.3 some relationships among perceptive and cognitive linguistic indicators, learning processes and knowledge organisation are investigated.

4.1 Analysis of the illocutionary acts

As an example, we synthetically report here the main aspects of an analysis of the illocutionary acts (Austin 1962; Sbisà 1974, 1998; Searle 1975) carried out on the interaction drawn from an under-thread of discussion of a forum centred on the relationships between new technologies and didactic strategies[2].

The analysed sequence opening with an intervention by B, the tutor moderator, follows:

1B: In this forum we will discuss about the ideas and the doubts coming out after having looked through the proposed materials.

2C: in the 90s they spoke about "multimedia reality"…they were really confident, weren't they?

3D: Reading your comment I thought about the IT classroom that I have available at school with only 4 computers working, 3 of which networked. In addition, a renewal of this "set of machines" as they are all but one really obsolete.

4C: last year I worked a lot at a primary school and I realised that only few schools had "expert" people who kept everything for themselves! It is baffling that what is written cannot be compared to the truth!

5F: I am working at the primary school of XXX and in comparison to many other schools we are lucky to have a good IT classroom. Unfortunately, the problem is another one: there are many teachers who do not have a clue about basic IT alphabetisation and, as a consequence, they do not have the tools to be able to teach children how to use a computer. I think it would be necessary to have a series of courses of basic IT compulsory for all teachers of any subject and at every level of education.

6G: Hi F, in the school I am working at there are a dozen computers of which six working and just one could be defined as "less obsolete" the telephone network cannot support the Internet and few teachers can use the computer. Is it really the case of teaching IT only to children if the starting situation is like that?

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[2] The forum was an integral part of the Master called "Didactic models and strategies", aimed mainly to training teachers, set up during the Academic Year 2006/2007 by the University of Macerata.

7C: Hi G, I am working at a nursery school with three year old children and the computer is in my section! Only one learning support teacher can use the computer and she would like to come 4 times a week! Do you think it is possible to programme and work like this? Where are the schools with environments?

8H: Dear C, one gets accustomed to it, you shouldn't think that in all the schools there is a multimedia classroom, sometimes like in our school where there is no computer at all!!!

So what does one do? We adapted: we brought some computers to school we did not use any longer as we had changed them and some parents did the same – Conclusion: we now have 5 computers that are not of the latest generation but are "valuable" anyway both for us and for our children, ours is a small school and the pupils are 45 in total, so for the moment the PCs are enough with the great joy of our pupils. Bye. H

9C: Adapting? I think that we the teachers are already adapting enough! I know the situation in the schools, as I had the pleasure of visiting many, but I think it is absurd to place the computer in a classroom of three-year old children!

One of the global aspects of remarkable interest in the sequence concerns the subjects of the interaction. The participants are five and only one of them, C, intervenes more than once, carrying out the active constant participant's role.

From the point of view of illocutionary acts, C's moves can be interpreted as accusations or polemics: playful at the beginning and generalised almost until the end; in the last intervention the targeted butt is H, with whom C gets in a direct disagreement. The interventions of both participants seem to be aimed at their mutual disqualification; H anyhow, differently from C, proposes a solution. As far as the linguistic acts carried out by the participants are concerned (F, D, and G), we can notice a certain homologation: definition of the problem, argument, proposal of a solution. Among these ones only G enters a criticism towards the solution proposed by F, without getting in a disagreement with her. The interactive aspect of the verbal turns is inferred not only at an evident level (e.g. through the use of allocutives) but also from the point of view of the acts carried out: from the first verbal turn onwards the definition of the problem is central (formulated at various times by the participants

without getting to a shared agreement), then there is the proposal of solutions, carried out by the majority of the participants, and the critical behaviour, undertaken by some of them, that becomes an accusation in C's words.

There seem to be two goals moving the interventions of the two speakers: 1) for most of them, debating on a problem to find one or more solutions; 2) accuse, criticise and pouring out leaving the problem open, as far as C is concerned.

4.2 Negotiation and dialogic building of meanings between agreement and disagreement

The discussion thread we have analysed turns out to be, in our opinion, a particularly interesting example of the joined building of an image of reality shared by the involved individuals (here specifically the IT level at school), a building that takes place through the dialogue and the negotiation; within it the dynamics of agreement/disagreement play an important role, permeating the contents' dimension as well as the relationship's (Mizzau 1995, Stame 1999).

Within such a discussion the sharing of experiences, the decription and the narration of common situations and personal experiences play an extremely important role. Someone is extremely critical towards the contexts she is operating (2, 3, 4, 7, 9); others place proactive elements side by side to the criticisms (5, 6); others try to dim the critical component to valorise the actual resources counting on the teaching personnel's creativity (8).

In this section we would like to underline how through the comparison (and sometimes through the clash) of both ideas and experiences, the negotiation and the building of meanings are realised (Lapadat 1995, 2002; Rovai 2001). In particular, we notice the high level of interactivity characterising the sequence. Some indexes of such a phenomenon can be seen in two dimensions: one content and the other relationship, respectively. We consider these two dimensions as strictly correlated within the context of phenomena like textual coherence known as *hetero-continuity* (Galimberti 1992), the inter-textual cohesion, the expression of agreement and disagreement.

4.2.1 Inter-textual coherence and cohesion

The overall impression, reading the messages making up the thread, is one of a strong connection at the level of both contents and topics. For this reason we have tried to isolate some observable textual indexes trying to explain and analyse such an impression.

First of all we recognise as macro-factors – built by a set of signals to which we can assign a metatextual[3] value as well as interactional and relational[4] ones - responsible for the perception of organicity in the textual sequence, the coherence and the cohesion among the messages.

By inter-textual coherence we mean organicity: the connection among different interventions considering in particular, the level of contents expressed and the argumentative structure. The sense is the one proposed by Galimberti (1992) talking about hetero-continuity in face-to-face communication, but also – with reference to studies concerning the CMC – the one suggested by Herring (1999).

By inter-textual cohesion we mean the completeness and the organicity of the semantic-syntactic structure and, in this particular case, the formal connection among the messages, which goes together with argumentative coherence.

As a matter of fact, coherence and cohesion are closely related, as are closely linked the more properly textual dimension and the pragmatic-relational one (see 3.2).

In the analysed sequence it is possible to identify semantic and lexical elements as the main signals of inter-textual coherence, together with the illocutionary force (Austin 1962, Searle 1975) and the argumentative structure of the interventions.

Among the inter-textual cohesion we can notice in the semantic question-answer structures[5], the use of allocutives, vocatives, other

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[3] Functional to the text's structuring, so to establish a connection among the elements within itself.

[4] Functional to define interpersonal perceptions and relationships, the agreement and the disagreement etc.

[5] Most of the interventions show interrogative structures (2, 6, 7, 8, 9): sometimes they are real questions or indirect invitations to the discussion; other times the rhetorical value prevails. We notice anyhow both the phatic and the conative values implied in those linguistic actions.

phatic signals[6] and the syntactic resumptions[7]; they are all elements linking the different messages among them at a formal level.

Such data can also be read as an expression of accomodation by convergence (Giles, Smith 1979; Giles, Coupland 1991; Giles, Coupland, Coupland 1991).

4.2.2 Agreement/disagreement dynamics

The analysed sequence enables some interesting observations as far as relational dynamics are concerned, linked both to the interpersonal power and maintaining face (Goffman 1967; Brown, Levinson 1978, 1987) as well as to the agreement/disagreement[8] building.

We can ideally identify two blocks inside it: the first one, (2-7) where agreement, convergence, and affiliative structures seem to prevail and the second one, (8-9) where the expression of disagreement, undertaking the characteristics of the open conflict clearly comes out (Mizzau 1979, 2002), involves the relational plan and outlines the traits of a veiled fight for interpersonal power[9].

4.3 Perceptive and Cognitive Linguistic Indicators (ILPEC), E-Learning and Knowledge Management

Through the expression *Perceptive and Cognitive Linguistic Indicators* (*ILPEC*) we want to refer to the linguistic indicators revealing the *perceptive or cognitive attitude* that the person who is either speaking or writing has towards what s/he is saying or writing, that is to say, the *perceptive and/or cognitive system* s/he activates in the moment

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[6] The use of allocutives and vocatives is rather spread (3, 6, 7 and 8). We have to highlight another phatism (2): the discourse marker weren't they (tag question)? (Stame 1994) with the double function of both a strengthening of the ironic value of the message, and the affiliative strategy, aimed at looking for the confirmation and the involvement of the participants to the discussion.

[7] We refer to the syntactic resumption at the level of punctuation as the use of the inverted commas appearing in messages 2, 3, 4, 6 and 8.

[8] We consider disagreement as disapproval when it concerns the contents' field, and as outdistancing, when it concerns the relationship one; the same way the agreement begins to look as an approval at the contents' level and an approach towards the other at a relational level (Stame 1999).

[9] Among the observable factors in the sequence of controversial dynamics we notice: the false misunderstanding of the rhetoric value of the questions and the use of exclusive we (8); the functional repetitions to the disagreement expression, the technique of adapt adapting (Cattani 2001) (9).

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s/he either speaks or writes (Petöfi 2004). The main qualitative and quantitative results from our researches show that:

1. the ILPEC are mainly of two kinds: (a) *lexical ILPEC*, that are composed of words (verbs like *remember*, *believe, know , suppose* etc. (Nicolini 2000); adverbs like *maybe*, *probably*, *surely* etc.; nouns like *certainty, conviction, opinion* etc.; locutions like: *according to me*, *in my opinion*, *as far as I am concerned* etc.; adjectives like *possible*, *probable* etc.); (b) *syntactic-grammatical ILPEC*, made of verb tenses (past, present and future), the verb moods (indicative, subjunctive, conditional), the syntactic types of sentences (declarative, interrogative, imperative);

2. both the lexical and the syntactic-grammatical ILPEC normally **interact**; nevertheless, while the second ones are always present in texts, the first ones can also be completely **absent**.

In order to show some possible relationships between ILPEC, on one side, and E-learning and Knowledge management, on the other side, we can use the three categories of epistemic logic (Hintikka, 1962): the Known (it is Known *p*), the Unknown (it is not Known *p*), the Believed (it is neither Known nor Unknown *p*) (Zuczkowski, 2004) and considering learning as a transition from the Known already possessed to a Known partially new, re-structured, going through the Unknown and the Believed.

Those categories can be related to the lexical and syntactic-grammatical ILPEC the following way:

1. the declarative sentences at the present and past indicative usually communicate the **Known**, that is to say what the speaker/writer (=P/S) *knows, remembers, sees…* As the ILPEC function is carried out by the above-mentioned sentence structure, P/S in general does not need to use lexical ILPEC (e.g. the first sentence by 3D); if s/he uses them, it is to restate, underline etc. that s/he is referring to the Known (see the third sentence by 5F);

2. the **Unknown** is normally signalled by the negative form of the Known verbs (*I don't know; I don't remember, I don't see…*). It can also be communicated through the use

of "literal" interrogative sentences (that is to say "to be followed to the letter"), that can be drawn back to the following deep structure: *I don't know p* (*and I expect you tell me p*, that is to say I expect to know p from you; see for example the question in 6G, if considered literally). Failing the lexical ILPEC, the literal questions do signal the Unknown and at the same time P/S expectation of filling the epistemic gap;

3. the **Believed** is normally signalled by the presence of verbs like *I suppose, I think, I imagine, I hypothesise…*(and by their negative form) and/or the verb moods as conditional and subjunctive or by the future tense, which differently from present or past indicative open the way to the Possible (see for example last sentence by 3D and by 5F);

4. the "rhetorical" interrogative sentences are not real questions but they do correspond to statements, that is to say they can be drawn back to a deep structure where P/S states that s/he *knows* or *believes* the contrary of what s/he is asking for (Sadock 1971; Chung-hye Han in press); in the first case they are linked to the **Known,** in the second one to the **Believed** (see for example the questions in 6 G and 7C);

5. the imperative sentences deal with the *expectations* P/S has towards the interlocutor (*let's discuss* = I expect we are going to discuss), so they refer to the **Believed** (see for example 1B, if *discuss* is interpreted as an imperative and not as a present indicative).

From what we have stated in points 1-5 it comes out that the Known, even if it is communicated, does not need to be lexicalised, it is enough the use of the declarative sentence with either present or past indicative (see for example the first two sentences by 5F); the Unknown and the Believed, on the other hand, need to be lexicalised (see for example the closing part by 9C where she states she *supposes* that teachers have already got accustomed and that she *thinks*, that is to say she *finds* some things are absurd).

5. The research: identification of the indicators

We will now describe the applied research activity. The explorative search was made concrete in the realisation of a focus group with different tutors who constantly followed the online teaching activities in different university courses and tutors of specialisation courses or master courses. This was done in order to find out the actions they had in common in looking at an online community, by understanding which elements were considered as important to adjust the online activities' flux and by identifying some elements considered important for carrying out the final course evaluation.

Other information was noticed through the collection of non-structured interviews of the teachers working online to find out the criteria used to build the final evaluation. The check of the collected answers enabled us to build some categorisations according to which we used to define the indicators we considered useful for supporting the predisposition of a representation of the functioning of a virtual class and of indicators useful for the global evaluation of both the process and the product. The possible representation we obtained had to be effective in order to suggest to either the tutor or the teacher how and in which field he/she had to intervene either to solve problems or to create support situations.

5.1 The indicators

The hypothesis leading the identification of the indicators are:

- the monitoring and the evaluation of both qualitative and quantitative data coming from both automatic analysis and "manual" ones;

- the areas on which one has to focus the indicators' search are the **commitment and the participation** (1), the **sharing and the building of a community** (2), the **individual and collective learning** (3);

- the building time of a representation and the functioning of a class is important to enable the tutor or the teacher to intervene in a suitable time.

The first area of search: the **commitment and the participation** (Table 1).

Indicator	How to identify it
Presence online and regularity in the entries. Participation time line.	Entries counting. Time distribution of the entries per person. Time distribution of the entries per person in a given interval.
Constance in studying.	Date and performing of the materials' download.
Presentations' carrying out Punctuality in the scripts' presentation.	Date and performing of the materials' download, of the activities' carrying out.
Participation in the collaborative activities.	Tracing of the made writings (where and what someone has written in a day).
Carrying out of facultative activities	Tracing of either the activities or the research systems per title with closing date. Materials' analysis
Care in the materials' elaboration	

Table 1. Commitment and participation.

Second area of search: **sharing and building of a community** (Table 2).

Indicator	How to identify it
Types of relationships. Direction of the relationships. Continuity of the relationships along the path.	Data concerning the sending and the receiving of messages in the different tools Density and inclusion (SNA) Comparison of the data from different tools
Use of common words, concepts, expressive ways. Uniformity of communication in class.	Use of a shared vocabulary. Length of the messages in forum or in the other tools. Length of the sentences in the different tools.
Type of the syntactic and grammatical structure in the writings	Presence of the moods, of the tenses and the verbal persons. Percentage of names, verbs, adjectives and adverbs.
Attention to the relationship and the listening	Presence of ILPEC
Difference between spontaneous communication and communication for work.	Compared analysis of the writings in the different tools: café, personal sms, forum.
Types of interventions of mutual help/ support. Ways of solving difficulties or contrasts.	Identification of strings stating mutual help. Presence of interrogative sentences.

Table 2. Sharing and building of a community.

Third area of search: **individual and collective learning** (Table 3).

Indicator	How to identify it
Presence in the personal production of quotes either from materials or from personal elaborations according to the stimulus present in the materials. (It enables to understand if the materials have been looked through).	Search through regular expressions of meaningful words' strings for the concepts present in the texts. Clusters search. Identification of concepts-words changing along the discussion.
Change in the use of certain concepts, procedures.	Search through regular expressions of meaningful words' strings for the concepts present in the texts. Clusters search.
Presence and solution of cognitive problems.	Search through regular expressions of strings significant of cognitive conflicts.
Attention to reflection and awareness of the change in learning.	Search through regular expressions of sentences highlighting consciousness and reflection.

Table 3. Individual and collective learning.

6. The research: artefacts used and built

We have used 4 different artefacts: student log tracing in the learning environment, Tal Tac for computational linguistic analysis, Cyram Ucinet 6 for Windows[10] for the Social Network Analysis and most of all PatternSearch a tool suitably built for the research by Giuseppe Alessandri.

The environment used in the online courses of the University of Macerata described in this work has a log tracing that calculates the main variables (entries in the environment, in the single modules and in the single pages, entries in the single tools, readings and writings in the single tools, files download and upload). In both the data representation and visualisation have been well-cared both in the forma of a chart and graphic, exportable in Excel. In particular the entries and the writings/ readings visualization is made through a table with a double entry (participants/dates) enabling an immediate visualisation of who did something.

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[10] Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.

6.1 Pattern Search

The realised artefact searches for the presence of either given linguistic expressions or textual segments. The main problem one faces when searching for strings is due to the synonymy and to the pluri-expressiveness of the terms used when communicating. It is essential then to build artefacts enabling the introduction not of terms but of composed structures, to disambiguate the search.

Two specific problems in the eLearning sector are:

1. The semantic proximity of the analysed strings. In the eLearning and in training in particular the differences to be examined are extremely "slight".

2. The training time. The algorithms for the research have to be "trained". In other words, they need long periods of preparation and are needed for searches that are repeated in time. In the eLearning sector one needs tools that can be fine-tuned in short time.

The choice made consisted in realising an artefact operating as a help for the tutor and not as a replacement; the tutor, according either to the knowledge of contents or a partial reading of the texts, identifies the textual segments to be searched for and inserts them in PatternSearch.

Interacting with the software, the tutor can reformulate the suitable requests.

For the realisation of this artefact the choice was focused on the Perl language due to the possibility offered for using the **Regular Expressions** (ER)[11].

In IT and in the programming languages the ER are expressions composed of a series of symbols, belonging to a given set, enabling the definition of structures representing the possible models of a string[12] to be searched for in a text. These structures are called *patterns*. A programme, using a set of *patterns*, goes through textual bodies searching for segments that are superimposed to them. The search then takes place through a comparison procedure. For

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[11] The artefact developed in Perl also due to its interoperability, can be indifferently used either on a Windows environment and in a Linux/Unix.

[12] By string we mean a whole of characters included the space, that means that by string we can also mean a whole of words.

example if one wants to look for the word "amore" in a text, which can start either with capital or lower-case letter, the search string is the following one /[Aa]more/[13].

The ER were proposed, in 1956, by the Logic Mathematician Steve C. Kleene (1909-1994) and were also used to represent the languages generated by grammars by Chomsky of type 3.

The ER are also a great help to trace a group of words or also verbal forms; for example if one wants to trace the complete inflection of the present indicative of a set of verbs of the first conjugation in Italian, the *Pattern* to be set is the following one (Lenci et al, 2005, p. 121):

\b(pens|cammin|am)(o|i|a|iamo|ate|ano)\b/

If one wants to add a new verb it is enough to add its root in the first set. The use of ER to trace complex expressions is more interesting. We can see the application composed of the two blocks interacting with the textual body represented by the set of the interventions in the web forum (Fig. 1):
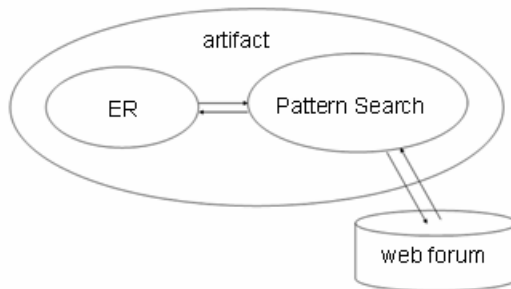
Figure 1. Pattern Search.

The research procedure traces in the web forum all the superimposing occurrence to the *patterns* and visualises them in a suitable way.
The application has been made thinking to the realisation of two different operative ways: the whole of the *patterns* can be provided by specific literature and permanently inserted by the user in context.

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[13] The character '/', inserted either at the beginning or at the end, defines the search string; 'Aa' in square brackets defines an alternative between A (capital) and a (lower case).

In the second case the user can insert his/her requests according to two ways:

1. Inserting either words or sentences to be traced
2. Inserting some ER directly.

When inserting words or sentences, the application is in charge of changing them in suitable *patterns* which are then used by the procedure to carry out the search. Inserting some *patterns* directly rather than words and/or sentences gives more flexibility in the search itself.

The application enables a visualisation of all the results in a text form through tables and a visualisation through graphs dynamically created exploiting the necessary presence of Excel in the client PC.

Having a graphic visualisation available enables to catch the aspects and the trends which often risk of not being perceived when reading the data. For example, having a tool extracting meaningful data from the text and representing them in graphs is essential, especially when you want to compare the activities of many virtual classes and when you want to point out a good path development and its evolution in time.

If the search that takes place through the normal search engines, gives some data with 30% approximation, the obtained data through Pattern Search have shown a level of precision higher than 90%. The check has been made on some forums. One had to search for sentences denoting reflection and change of perspective. The difference among the strings highlighted by PS and those highlighted by the tutors though a direct reading is less than 10%.

6.2 Automatic linguistic analysis

For the automatic linguistic analysis the texts were analysed through the TalTac software. The automatic linguistic analysis becames easier thanks to the Tal, that is to say the automatic treatment of language, the interpretation of the information contained in the text.

The Tal seems to supply to the IT systems an access semantic key to build ontologies, able to define concepts, that according to their grade of greater or littler complexity give origin to some taxonomies (Calzolai e Lenci, 2004).

"The language technologies make the development in an environment for the dynamic creation of ontologies possible by starting from the linguistic analysis of the texts. That way it is possible to quicken the indexation's management process as well as the classification of the documental base one, reducing the grade of arbitrariness of the classification criteria".

From a multimedia analysis of the corpus we can obtain a representation of the syntagmatic structure present in the text.

The sense subtended to a text/discourse is in fact made of a system of meanings based on the whole of the co-occurrences in the whole corpus of the textual data.

More exactly it is possible to observe how the interventions of the single authors within a forum have a mark determined both by the author himself/herself and the context (topic/text content) as well as by the situation of generation of the text, by the transmission means and by the addressee or addressees.

A text's profile can be outlined then (that can identify either a single author or a group of authors) both according to the different distribution of the words both grammar categories and morphologic characteristics, and in relationship to the incidence of the frequency, the different class of words, the punctuation or other elements.

This set of information defined as imprinting of a text, are some proprieties that, if measured and analysed enable both the identifying of a text in relationship to the author and the comparing of it with the textual profiles of other authors.

The information extraction goes also through the metadata collection on textual data through:

- ❑ the extraction of terms of a peculiar vocabulary of the writing of either the forums or the chats;

- ❑ the categorisation of lexical units;

- ❑ a description of the texts constants enabling to outline its imprinting;

- ❑ a description of the differentiation grade and the likeliness one of the texts as to either identify the tone or to select the code of the textual material (e.g. lexis belonging either the spoken language or the written one).

In the search the textual analysis was applied to the web forums and it was used to identify a peculiar language and both lexical and syntactic constants which enable to catch the characteristics and similarities among the elements of the language used.

Some indicators have been chosen signalling the presence of a shared repertoire and a common language.

7. Work method

The data was collected through different tools and was put together according to the class and the kind of activity. For example the activities carried out by a small or by a big group were different.

For the indicators, the **Pearson variability coefficient (CVP)** was examined even when not explicited, to verify the indicators' coherence in similar contexts. Both similar activities in other classes and different one in the same class were used as parameters of comparison.

In addition the correlation among series of data was analysed when verifying if data determined by a particular variable was considered important: for example, the numerousness of messages in the analysis of a forum.

7.1 Context

The research was carried out on the Master in *Didactic models and strategies* realised almost entirely online by the University of Macerata and by the IFOR of Matera in the academic year 2006-07. The participants were 116 teachers working at different levels of education coming from different Italian regions, divided in 4 virtual classes with 4 different teachers/tutors. The path's goal was the development of the competence in the didactic planning and took place from the 16th October 2006 and the 1st May 2007. It foresaw 12 modules organised in three areas (starting, intermediate, finale). The activities foresaw the use of web forums, chats, scricolls, maps, personal page, ePortfolio, blog, upload documents. The people attending the course had "fast messenger" and a cafè available.

The use of such a path for the research is due to the following factors:

❑   a high number of participants coming from different geographic regions;

❑   the presence of four classes that enabled to analyse different groups carrying out similar activities;

❑   a high number of activities;

❑   a meaningful duration of the path that enabled to analyse the changes in time.

8. Data analysis. Part A: participation

The analysis starts with the data coming from the counting of the activities carried out online. The tracing supplied total data concerning the entries in the environment, in the single tools, the writings in the different tools and the readings, the material download.

   The data reading (Table 4) shows four classes inhomogeneous both among them and within them. One evince that class 1 is very active and participates while class 2 is the opposite. Classes 3 and 4 have an intermediate behaviour between these two even if they show a behaviour improving in time (Fig. 2).
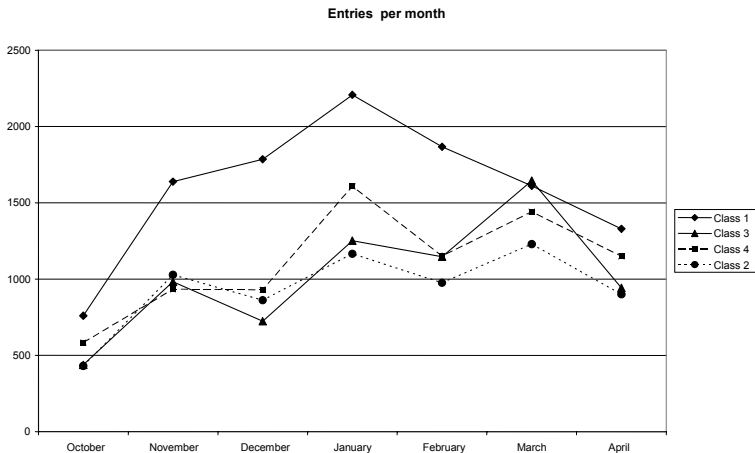

Figure 2. Entries per month in the four classes.

	class 1	class 2	class 3	class 4
total entries	11198	6591	7130	7797
average entries per person	373	227	255	269
average quadratic discard	197	98	104	205
CVP	53%	43%	41%	76%
max value	817	475	460	1112
min value	69	73	45	48

Table 4. Entries in the environment per class.

8.1 Writings and readings in the forums

The data of the readings and writings in the forums (Fig. 3) is iconically visualised in a table with double entries with in abscissa the days and in ordinate the participants' names. For each participant there is a box in red with the number of writings and a box with the numbers of readings per day.

From the table's reading, the tutor catches the class participation and the one of every single participant. In this case from the table emerges a compact class discussion in seven days. There are only 2 participants inserting messages in a further period.

The relationship readings/writings noticed from the examination of 96 forums has turned out to be a revealing indicator of participation and it gives some information about the relationship between listening in the group and the rendering personal positions explicit. A low value of the relationship shows a community that reads and listens to itself but that does not express, a typical behaviour of the starting phases of a course in a forum. A high data shows a class that writes but often without listening nor reading carefully the present documents. The data shown in Table 5, concerning the two forums of the starting area and the forums of the final phase, enable the supplying of the values the indicators should take as highlighted by Table 6.

A second analysis was carried out on the daily data and not on the total values of the forum: for each day the relationship reading/writing was calculated; the indicator can be used to understand when in a forum the debate starts after the starting phase. The threshold value in case has to be placed to 5%.

Figure 3. Writings and readings per day in forum.

	ut	tot	16-gen	17-gen	18-gen	19-gen	20-gen	21-gen	22-gen	23-gen	24-gen	25-gen	26-gen	27-gen	28-gen	29-gen
Ab	2	41									4	1				
ap	12	83				6 26	2 9				15					
Bo	13	352		12	2 17	1 23	3 59		30	7 155	27	1				
Bri	5	137	2	13	4 54		10	7 20	5	1 22	11					
C	5	153	9	23	5 77	16	6		1	3	2	12				
C	2	12		1	4		3		1							
C	1	29	1					1 9	5			1				
D'	2	35	5						2 30							
D1	5	137		1					5 121		14					
FA	6	154	1	9	1 47	1 9	11	1 11	2 24	1 29	1	1				
far	2	11						1 3		1 8						
fra	5	64						4		5 56						
G	6	208	5	8	1 24	57	3 43	16	1 41	1 10	3					
La	3	220	1	3				1 36			6					
Ll	3	58	1	15	10	4			2 23		1					
Lo		6														
M	8	68				1 12	2 9	2 13	3 20	3						
M	6	49	1	5	6			1	1 9			7				
M	7	161	1	10	1			5 127	2	2 31						
m	9	117	1	1 10	2 19		2 20	2	2 24	2 33	2	2				
m	3	70		6		3 29				34						
Pe	6	188	1	7	2 41		25	4 65	31	19	2			6		
Po	4	344	1	1 19			2 144	19		1 87	72			4 32		

	class 1	class 2	class 3	class 4
Forum a (starting area)	1,68%	2,78%	2,08%	1,99%
Forum b (starting area)	2,27%	3,58%	2,76%	2,34%
Forum c (final area)	4,00%	3,87%	4,34%	4,25%
Forum d (final area)	4,89%	5,28%	4,08%	4,76%

Table 5. Relationship writings readings in 4 forums developed in the starting and final areas of the 4 virtual classes.

	More than	Up to
Much listening and reading but low interaction, waiting phase		3,5%
Balanced relationship between writing and reading, productive phase	3,5%	8%
Low listening and much writing	8%	

Table 6. Reference values to examine the relationship writings/readings of a whole forum.

It is not possible within this context to state all the data concerning the four classes' participation even if some of them shows some useful hints, for example, the different behaviour among different tools.

9. Data analysis. Part B: concepts and operative ways' sharing

The second part of the analysis aimed at pointing out the sharing of concepts and operative ways in the virtual classes and its change in time. The indicators examined for the sharing could also highlight the process building a virtual community.

9.1 Average of the words per sentence and per message

The first indicators examined were the average number of words per sentence, the average number of words per message, the average number of sentences per message (Fig. 3).

From the analysis of the graph words per sentence (Fig. 3) some hints come forward. The first and most interesting one is that the relationship depends on the type of forum more than on the class.

The forums called AT CLASSE require the explicitation of one's own thought and its argumentation while the forums called LAV GRUPPO require a pragmatic type of communication for the realisation of a project. In the AT CLASSE forums one can notice higher values and growing trend. The analysis per class is interesting too: class 2 highlights the highest values in comparison to the other classes in the group works and the lowest values in the class activities. Finally the data concerning the PW forum was inserting, showing an average of the minimum values: in such a forum information was required concerning the ways of realising project works.
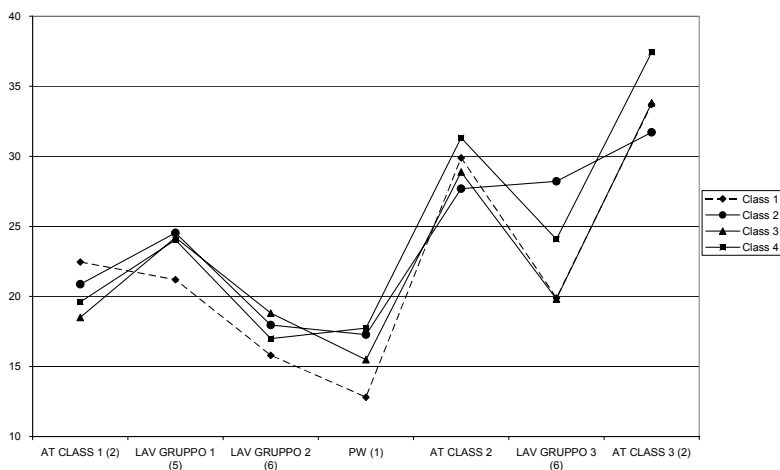

Figure 3. Words per sentence (each line states a class; in each column the data of similar activities are placed; the number of analysed forums per class in brackets).

The graph words per message is similar (Fig. 4). The data concerning the relationship sentences per message shows less compact data. The three indicators (words/sentences, words/ messages, sentences/messages) supply different information. Very high values of the relationship words/messages and sentences/ messages show on average denser messages and less attention to the listening and the interaction while a high relationship words/ sentences shows a more complex and argumentative linguistic structure. Bearing in mind the CVP as well, the relationship words/

sentences is considered as being more relevant. The conclusions were confirmed by the analysis carried out by the tutors reading through the posts.
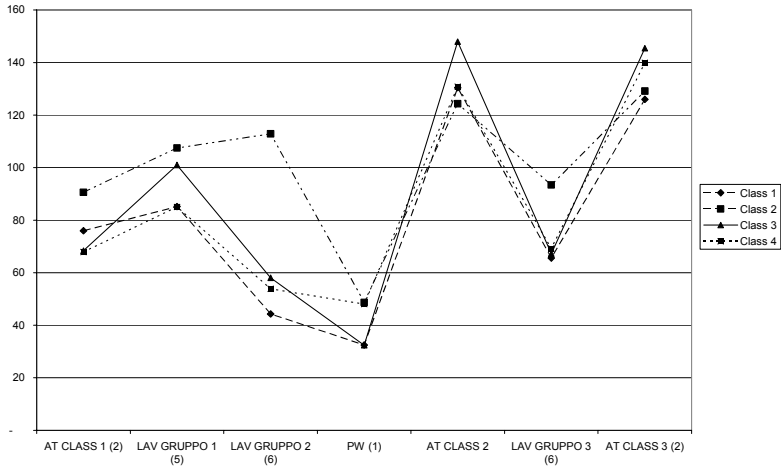

Figure 4. Words per message.
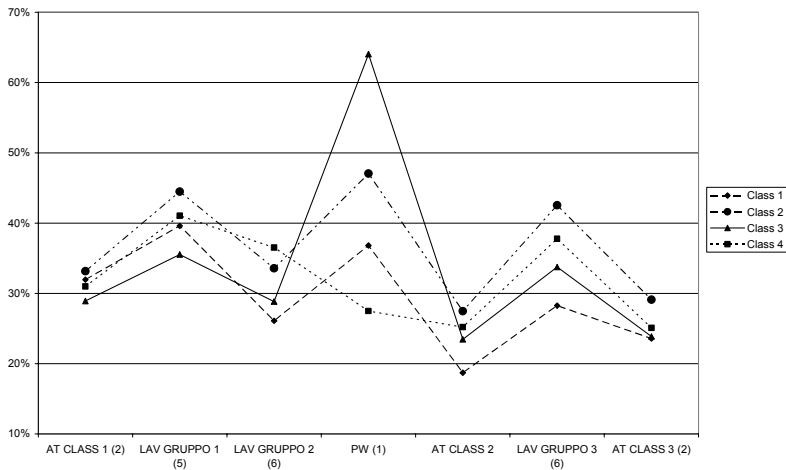
9.2 Relationship vocabulary/words

Figure 5. Relationship vocabulary/words per type of activities and per class.

The graph of Fig. 5 shows in the ordinate the relationship vocabulary/words (V/P) and in the abscissa the types of activities. By vocabulary we mean the number of words used without counting the recurrences; that is to say each term is counted just once. The values of words instead is given by the sum of all the terms present including the recurrences.

The indicator should detect the presence of a shared repertoire. A lessening of the relationship shows more homogeneity in the terms and in the semantic ways.

The graph of Fig.5 shows an opposite trend in comparison to the graph of Fig. 3: the maximum values of Fig.3 correspond to the minimum values of Picture 5.

The interpretation seems to confirm what previously said: while the course progresses, the compactness of the virtual class increases and the sharing of meanings in the class too, the complexity of the discussion grows. That is how the length of the single sentences (more than the messages) gets bigger and a shared vocabulary emerges and due to this a smaller V/P relationship. Nonetheless considered in absolute the value vocabulary becomes richer and more complex. The two indicators then supply a useful image of the virtual class.

The graph present in Fig. 6 is interesting too. Each small box represents a forum. In abscissa there is the number of messages contained in the forums while in the ordinate the V/P relationship. The graph concerning the 96 forums enables to propose a standard for the shown parameter.

In fact one can infer three situations from the graph:

1. **forum with a number of messages between 5 and 20**:
   the V/P value depends on the quality of the forum and is in a value included between 0,4 and 0,7;

2. **forum with a number of messages between 20 and 100**:
   there is a reverse linear dependence between messages and V/P; the equation of the interpolationline is:
   V/P = 0,0018* (number messages) + 0,413.

3. **forum with more than 100 messages**:
   the V/P value is constant and oscillates around 0,2.

From what has been said values inferior to those obtained with the interpolationline (in the forums with less than 100 messages) and the values of 0,20 (for forums with a number of messages superior to 100 messages) show communities with a higher sharing of the communicative register and the direct analysis confirms a greater quality of the interaction in the forums with V/P inferior to the average value.
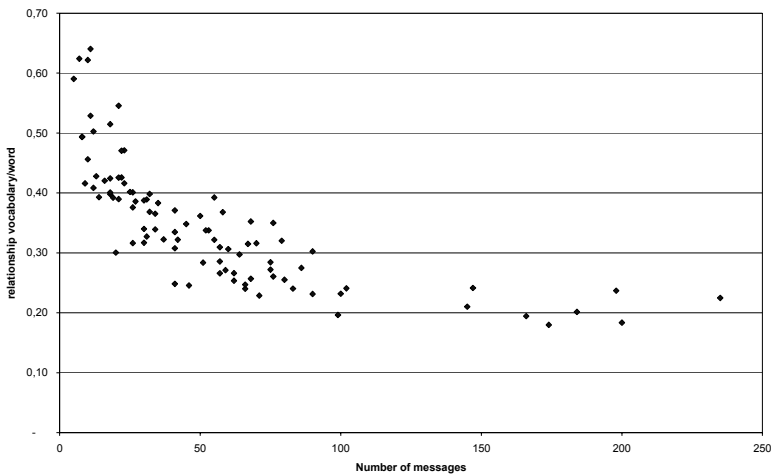
Figure 6. Relationship vocabulary/words in function of the number of messages.

9.3 Presence of ILPEC

Then the number of the present ILPEC was examined. For the ILPEC definition we refer to paragraph 4.3. The search was carried out through the IT artefact PatternSearch described in paragraph 2.

In Figure 7 there is the relationship ILPEC/sentences in function of different activities.

The presence of ILPEC, like the relationship P/F, depends on the characteristics of the forum and a high value highlights an attention for the reflection and an availability to comparison. The graph seems to confirm this interpretation: the PW forum was activated to ask for some information about the Project Work's carrying out and it was possible to foresee that it would have shown a scarce

presence of ILPEC. It is equally easy to explain a higher value of the ILPEC in the starting LAV GRUPPO forums where the discussion about the possible use of technologies in didactic was asked for and in the final LAV GRUPPO forums where the participants had to analyse and comment upon the activities carried out by other members of the group. It was also easy to foresee the minor value in the intermediate LAV GRUPPO where the participants had to organise the planning.

The values of the AT CLASSE were coherent, on average bigger, showing an increase of values from the starting AT CLASSE, the intermediate AT CLASSE and final AT CLASSE. Such a data could highlight that the availability to the comparison and the challenging of one's own opinions increases in time and the community evolves positively as it emerges from the tutors' observation.

From Figure 8 both the non-dependence of the indicator's value on the number of messages, and the possibility of identifying a threshold value for the ILPEC per sentences emerge. From the examination of the 96 forums such a value could be placed at 29%. For the application of such a threshold value one has to bear in mind the forum's goal and it can be applied with greater usefulness for forums where showing one's points of views is not required.
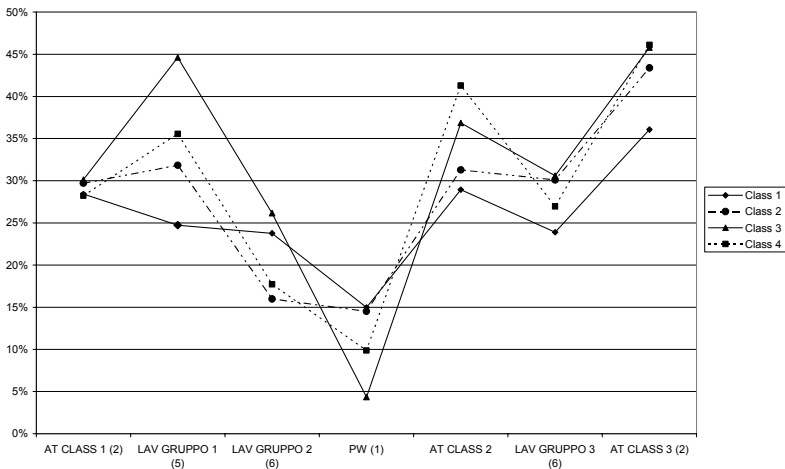
Figure 7. ILPEC per sentences and per types of forums per classes.
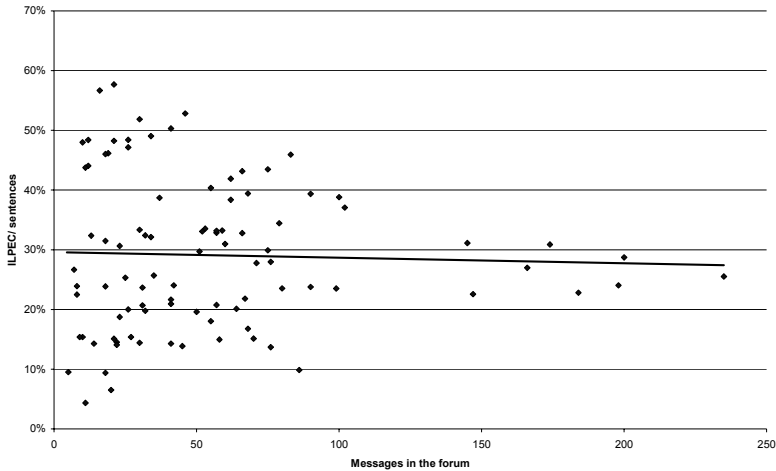
Figure 8. ILPEC in function of the messages in the forum.

9.4 Pearson Variability Coefficient (CVP) as indicator

Pearson Variability Coefficient (CPV) concerning the total data in the forums where group activities were carried out and the forums where debates involving the whole class were carried out was calculated.

The data confirm a normal distribution of the data except for the ones concerning the number of messages. From Tables 7 and 8 it comes out that the values are much below 33% and it is possible to notice a lessening of the CVP values from the first to the last activities. Such a data can be read as the result of a greater homogeneity and uniformity in the community.

	Words per sentence	Vocab./ words	ILPEC/ sentences	words/messages	Sentences/messages	Number of messages
At classe (total)	17%	**42%**	28%	30%	21%	**74%**
At classe starting	23%	**35%**	**35%**	**40%**	24%	**83%**
At classe intermediate	6%	14%	20%	12%	13%	**50%**
At classe final	14%	10%	15%	11%	10%	**37%**

Table 7. Pearson Variability Coefficient (CPV) – Forum where the whole class is involved.

	Words per sentence	Vocab./ words	ILPEC/ sentences	words/messages	Sentences/messages	messages
Lav gruppo (total)	27%	24%	**44%**	**59%**	**42%**	**91%**
Lav gruppo starting	25%	21%	**40%**	**42%**	26%	**93%**
Lav gruppo intermediate	19%	25%	**36%**	**97%**	**62%**	**73%**
Lav gruppo final	25%	20%	**36%**	31%	24%	**81%**

Table 8. Pearson Variability Coefficient (CPV) – Forum of group work small group.

9.5 Presence of either interrogative or negative sentences

The analysis was carried out on all the 96 forums of the course. The obtained data have highlighted a high dispersion and a CVP always superior to 60% and not always regularities have been detected.

9.6 Presence of nouns, verbs, adjectives and adverbs (obtained through TalTac2)

Different authors think that a greater nominalisation shows an attention to argumentation while a greater presence of verbal expressions signals

descriptive texts and a language which more similar to the oral one (Ghiglione et al., 1998).

Area	Forum title	nouns	verbs	adjectives	adverbs
	Class 1				
Starting area	Maths analysis	46%	37%	9%	8%
Intermediate area	planning	47%	36%	8%	9%
Final area	competencies	44%	38%	10%	8%
	Class 2				
Starting area	Maths analysis	49%	36%	6%	9%
Intermediate area	planning	45%	39%	8%	8%
Final area	competencies	43%	38%	12%	8%
	Class 3				
starting area	Maths analysis	44%	36%	11%	9%
Intermediate area	planning	41%	41%	8%	10%
Final area	competencies	41%	38%	11%	10%
	Class 4				
starting area	Maths analysis	49%	35%	9%	7%
Intermediate area	p planning	47%	37%	8%	8%
Final area	competencies	44%	37%	11%	9%

Table 9. Presence of nouns, verbs, adjectives and adverbs.

Table 9 shows data whose variation do not enable to detect revealing trends. The lessening of the presence of nouns to the verbs, adjectives and adverbs' benefit seems to highlight the passage to a more dialogic dialogue but, as we have already stated, the difference among the data requires the examination's extension to further forums. The increase of the adverbs percentage is surely positive and, most of all, the one of the adjectives denoting more care and expositive precision.

The analysis of tenses , the moods and verbal persons has also been carried out on 12 forums, 3 for each class. The examination was made on the daily posts to highlight the forum's evolution. The data show a greatly oscillating trend day by day. In some forums we have noticed the presence of the third person and this could be indicative of a passage from the personal case to the generalisation

as verified from the textual analysis made by the tutors. The analysis has to be deepened on a greater number of forums.

9.8 Relational indicators - the neighbourhood analysis (SNA)

Some density indicators and SNA inclusion ones have been used to monitor the relationships within the groups. The analysis was carried out through the software called Cyram Ucinet 6 for Windows[14] and concerned 12 forums, three for each class, one of the starting period, one of the central period and another one of the final period. The choice was made on the AT CLASSE type forums. The results are shown in the Table 10 SNA values.

	density				inclusiveness			
	Cl 1	Cl 2	Cl 3	Cl 4	Cl 1	Cl 2	Cl 3	Cl 4
Starting	5,44%	0,92%	2,87%	2,99%	83,00%	36,00%	76,00%	60,00%
Intermediate	11,80%	1,84%	5,54%	5,06%	96,00%	76,00%	83,00%	73,00%
Final	3,22%	0,69%	2,27%	2,07%	90,00%	76,00%	86,00%	93,00%

Table 10. SNA values.

The examination of Table 10 shows a series of information evidently quantifying both the interaction and the participation.
In particular it is highlighted how during the Master course there is a numeric increase of the exchanges, even if the number of relationships oscillates in comparison to the types of groups and the assigned tasks.

Such a data confirms what highlighted by the indicators previously analysed, in particular V/C and P/F.

The interesting data is the one concerning inclusiveness: all the examined communities show a growth of the percentage of this indicator. Many individuals, who in the Master's starting phase were peripheral or even excluded from the exchanges, have become more central in the following phases and in the final phase they have started and continued interacting in the group.

The SNA graphs concerning the same community were compared, though coming from different tools: forum (Fig. 9),

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[14] Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.

messenger (Fig. 10). The task was the one of verifying if the group behaviour within less described and "freer" was the same or similar to the one noticed in the forum. In other words, we tried to examine the exchanges, the messages and the behaviours of the participants within the forum and in the use of another tool, called "fast messenger", enabling the sending of short text messages in real time to other users who were online at that same moment.
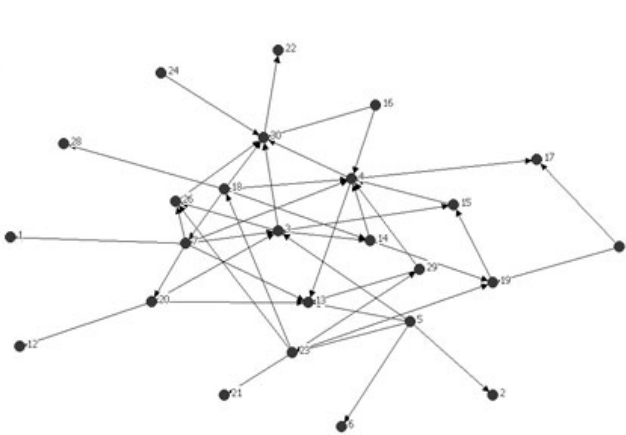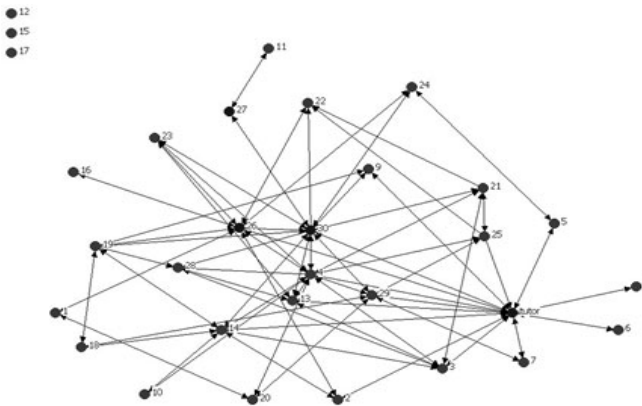

Figure 9. SNA forum.

Figure 10. SNA fast messenger.

Both the brevity of the exchanged messages and their "private" character make communication through "messages" deeply different from the one established within the forum, characterized by argumentative-like communications and aimed at the whole group, so at a wide and heterogeneous audience.

This diversity can be immediately appreciated also by the examination of the social networks coming out from the exchanged communications in the two tools.

10. Data analysis. Part C: conscious attitude

Through the tool PatternSearch the presence of some Regular Expressions (ER) denoting the presence of a reflection and subsequent consciousness acquisition in relation to one's learning path was searched for. The strings shown by the tutors according to the texts' reading were: "I am aware", "I have acquired", "I have learnt", "I think I've improved", "I've understood that", "I've acknowledged", "I've thought again", "I've revised", "I've improved", "I've succeeded", "I've experimented", "I think I've learnt". The search was carried out on the final reports. The obtained data are reported in Table 11 and give a picture that is comparable with the one of other indicators. In the conclusions the results of this analysis will be evaluated.

	class 1	class 2	class 3	class 4
total documents	30	29	28	29
words present	144	42	145	63
words/documents	4,80	1,45	5,18	2,17

Table 11. ER presences concerning reflection in the final reports.

Conclusions

Table 12 shows a synthesis of the main indicators discussed in the article applied to 3 forums, one per area, per class.

	messages	tutor/post	Words per sentences	V/P	ILPEC/sentences	density	inclusion	D crude	Threads monologues	Writings/ readings
Forum title		**class 1**								
analysis	102	5%	29	32%	37%	5,44%	83%	2,75	8	3,6%
real tasks	166	4%	29	28%	27%	11,80%	96%	2,73	12	4,1%
planning	90	5%	34	27%	39%	4,02%	93%	1,74	18	3,9%
		class 2								
analysis	30	12%	31	24%	33%	0,92%	36%	2,5	2	2,3%
real tasks	51	8%	29	19%	30%	1,84%	76%	2,22	16	3,8%
planning	62	11%	25	23%	38%	1,26%	83%	2,26	13	4,0%
		class 3								
analysis	59	6%	30	27%	33%	2,87%	76%	2,27	5	2,8%
real tasks	83	8%	30	24%	46%	5,54%	83%	2,69	1	3,6%
planning	100	2%	29	23%	39%	6,09%	93%	3,26	2	4,1%
		class 4								
analysis	47	7%	33	29%	43%	2,99%	60%	3,30	3	3,0%
real tasks	68	6%	30	26%	39%	5,06%	73%	2,75	2	4,3%
planning	62	2%	35	25%	42%	3,08%	89%	2,03	8	4,3%

Table 12. Summary.

In addition Table 12 states three data not previously illustrated, but which can be relevant for the analysis of the virtual class: the D crude (Wiley) highlighting the network structure of the forums, the percentage of the posts inserted by the tutors and the number of threads monologues.

The data considered on the whole enable a relevant global reading. Firstly it is pointed out that the data concerning **Commitment and participation** obtained by tracking the online activities give a partial vision. For example from the data of the tracking class 1 shows a behaviour that is by far more active than the other three classes. The conclusion comes from the analysis of the number of posts inserted and even more from the number of entries in the environment. As we stated at the beginning, class 1 has 11.198 entries, against 6.591 of class 2, 7.130 of class 3 and

7.797 of class 4. If we analyse the indicators **Sharing and conscious attitude** too, the evaluation changes. It is shown for example that, except the density more influenced from the online presence, the relationship P/F, V/P, the presence of ILPEC and the numbers of words expressing reflection place class 1 on the same level and sometimes at an intermediate position in comparison to the other classes.

In addition different indicators (V/P, P/F, ILPEC, D Crude, ER) are coherent among them that is to say they support the same "image" of the **Sharing** and **Conscious attitude** and this confirms the indicators' reliability. For this reason two elements come out and they can provide a useful help both to the tutors and teachers to monitor during the course and to intervene in real time in the online paths:

- ❑ the proposed indicators help to build the necessary picture to describe the interaction and the production of conscience in online activities,

- ❑ only the quantitative data, coming from the classic tracking, give a partial picture that does not completely consider the sharing and production of the meanings.

According to the research a new type of tracking will be implemented with the presence of the identified indicators, offering a picture in real time not only at the end but also during the course.

We think it is useful as well to insert the artefact called PatternSearch which enables to find Regular Expressions and enables both the tutor and teacher to search for relevant sentences. Such a tool could be used to find the presence of references in order to study materials in the forum discussions and to highlight if either the group or the individual student have carefully studied the materials supplied to search other sets of expressions, for example request for help, sharing or contraposition.

Even though the research has examined a wide number of data (a training path that lasted 8 months involving 116 participants, for a total of about 33.000 entries and a production of 96 forums, 23 scricolls, 270 blogs, more than 800 documents uploaded by the participants), the conclusions have to be confirmed and applied to

new contexts and to different targets which could give more reliability to the analysis and enable further generalisations.

The research development therefore foresees:

❑ the results' check of this research in other contexts;

❑ the development of further artefacts according to the emerged indicators;

❑ the breadth of the analysis carried out on the forums to other tools of the environment;

❑ the production of reports and data visualisation which enables one to connect information coming from different tools and from different analysis.

The development of such research requires an interdisciplinary work involving in addition to the pedagogic-didactic sector, also the linguistic-computational and the IT ones. The research fields for such a development involve the semantic web, the identification of semantic affinities among texts that are present among other things in the Latent Semantic Analysis, the aggregation of textual blocks for the production of kaleidoscopic materials with the zz-structures and the fuzzy algorithms.

Chapter 5

Mobile IVT: ergonomic and communicative characteristics of tools for Immersive Virtual Technologies used by professional communities of practice

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Abstract. This project aims to support the development of an Immersive Virtual Technology (IVT) system serving a community of practice consisting of psychotherapists who use virtual environments for therapy and treatment of anxiety disorders.

The psychosocial theoretical background includes the ethnomethodological approach, Situated Action Theory and the Intersubjectivity of the Utterance model.

Social Psychology has played an important role in the evolution of ergonomics towards a preventive rather than a corrective function: human or machine error in any case takes place within a relational context, in which attention is centred on the relationship between people, environment and instrument used.

The ecology of the process concept introduces the value of the dialogical perspective. The dialogical importance promoted at each level of the analysis phases becomes the key to a deeper and more fluid understanding of the assumptions and meaning that guide the actions of and interactions between therapists and patients.

The entire system design process is inspired by a dialogical perspective, in that it aims to effectively and non-rigidly integrate the design stages, analysis in context of use, ergonomic evaluation, creation of the virtual reality (VR) system and final work on the clinical protocol in use.

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1. Introduction

This project stems from a twofold interest: on one hand the study of new communication and interaction environments originating from the massive use of information and communication technologies (ICT), and on the other the analysis of virtual environments (VEs), ever more able to emulate the multicode and multichannel nature of human communication and ever more portable, allowing real personal use by the players involved.

The project aimed to support the development of a Immersive Virtual Technology (IVT) system serving a community of practice consisting of psychotherapists who use virtual environments for therapy and treatment of anxiety disorders.

This required the fine tuning of clinical protocols for 3D virtual reality environments (the town square, the lift, the supermarket, the underground station), developed in the framework of the Vepsy-Update project (see below for details), developing mobile interfaces enabling ergonomic, wireless use of 3D virtual environments and tools for the fruition of virtual environments supporting communication within the therapists' community of practice.

To plan and develop the envisaged systems, attention was focused on pre-conditions (the requisites to enable mobile interfaces to manage therapist-patient interaction and communication), usability tests (evaluation and improvement of system usability in the real context of use) and culture of use (monitoring of real practice of use of the developed tools).

This project originated from two previous research projects:

- VEPSY Updated "Telemedicine and Portable Environments in Clinical Psychology (European Project – IST 2000 – 25323).

- NeuroTIV "Immersive Virtual Telepresence Managed Care for the Assessment and Rehabilitation in Neuropsychology and Clinical Psychology" (Italian National Research Project 2004-2007, funded by the Italian Ministry of University and Research –FIRB MIUR 2001).

In the VEPSY Updated Project, our main goal as a research unit (Licent − Laboratory of Communicative Interaction Studies and New Technologies, Catholic University of Milan), was to obtain an evaluation of the usability of Virtual Reality (VR) processes as used by 'real' users in 'real contexts of use'. For this reason, having completed a *functional analysis* of VEs, we performed a sort of '*fine tuning'* of VR scenarios.

As the VEPSY environments are designed for clinical use further steps were necessary to achieve our goals after the basic functional evaluation:

- Establishment of a minimum threshold of ergonomic acceptability to be used for every VEPSY VR module, on the basis of specific indicators identified and reported in the Guidelines prepared at the beginning of the project.

- Development of a new ergonomic and usability evaluation method taking account of the requirements of the specific types of end users.

- Psychotherapists.

- Patients affected by specific psychopathologies.

- Integration of the results on the basis of observations emerging from *Large Clinical Trials*: this involved a direct comparison and interaction with the clinical group.

The Licent research unit carried out an ergonomic evaluation of two of the four VEPSY modules in 3 phases:

- **Panic Disorder and Agoraphobia modules**: in *Phase 1*, *heuristic guidelines* were prepared in order to obtain an effective evaluation tool. Usability tests (observations) were then carried out with generic users.

- **Eating Disorder modules**: in *Phase 2*, *basic functional requirements were verified*, from the results obtained in *Phase 1*. Usability tests (observations) were subsequently carried out with a different sample for comparison with *Phase 1*, considering psychologists and non-psychologists.

- **Eating Disorder modules**: in **Phase 3**, *semi-structured interviews* were carried out with psychotherapists involved in the clinical trials of the modules considered.

To fulfil our goal we had to shift our attention from VEs themselves to the relationships between users and VEs, focusing on how these relationships take shape in their actual context of use. To approach the most ecological context of use, we used the LPP (Legitimate Peripheral Participation) model: "This model considers the knowledge acquisition in progression terms – from the periphery to the centre – in the participation activities of the *communities of practice"* (Zucchermaglio, 2002).

The study was therefore broken down into three phases, each characterised by:

- specific aims;

- specific objects (e.g. two VE types for different psychological disorders);

- samples reflecting non-specific, specific and professional ethnomethods;

- generic, finalised and lived experience analysis contexts.

Specific tools

Traditional usability evaluation methods such as functional analysis aided by expert heuristic evaluation supported by ad hoc guidelines and user-based test*s* were supplemented with two specific ethnomethodological tools: *micro-narration* and *interviews*, used in phase 2 and phase 3 respectively. Within the framework of the paradigmatic change under consideration, a relevant role is played by the narrative concept of knowledge and culture.

Narration can be considered both an adequate tool for recovering shared practices through recollection and a useful tool for creating a group culture, i.e. suggesting a repertory of meanings establishing what it is important to observe in connection with consolidated habits. In the different phases of the analysis, micro-narration and interviews were presented to subjects in order to recover information on the co-interaction with the artefact and the co-construction of meanings in a specific professional community.

Micro-narration: users were supplied with specific information helping them to interact "*as if*" they were in the real context. For example: basic information on the specific VR protocol and the therapeutic setting was given to the psychologists tested. They were informed that "the purpose of the environments is not the creation of a perfect reproduction of the real world: patients and therapists are aware that the tool's effectiveness for the patient does not depend on the perfect accuracy of certain specific elements but rather on the perceived feeling of presence, which could be very different from that of a person without these disorders". Non-psychologist users were asked not to consider VEs as video games and the potential applications of the environments were explained to them.

Semi-structured interviews: in-depth interviews with the clinical group (psychotherapists involved in the clinical trials) were carried out in order to move towards an ecological context of use. The investigation focused on 4 main areas with reference to ergonomic aspects:

- Context of VE use for psychotherapy sessions.

- Expectations of the therapeutic protocol.

- Usability (local interaction with the artefact, interpretation of the situation and context definition).

- Towards a culture of use (possible future application of the VEPSY modules; critical aspects for training activities etc.).

NeuroTIV Project: reasons for a clinical-ergonomic analysis

From the ergonomic point of view, the VEPSY Updated project allowed us to conceive the experience of artefact use as immersed in a social and goal-driven context and to stress the component of ambiguity inherent to everyday situations. At the same time, the need for a more context-situated analysis emerged strongly, to better understand possible discrepancies between standard clinical protocol application and the real use of the VR scenarios by therapists and patients during therapy sessions. For example, some of the IT systems' drawbacks and errors proved to be a 'plus' within the context of the therapeutic framework, such as the graphic

appeal, which did not seem to have any influence on the effectiveness of VR therapy (Galimberti et al. 2004).

VR scenarios serve to speed up access to the personal experience of patients affected by specific psychological disorders, and the representation of the stimuli needed to activate this process does not need to meet requirements connected with the realism of the experience, intended as the physical characteristics of VEs: in this sense, emphasis shifts from quality of image to freedom of movement, from the graphic perfection of the system to the actions of actors in the environment (Gabbard & Hix, 1997). Correct interaction between the therapist and the patient makes it possible to anticipate and avoid orientation and navigation problems. The use of devices is simplified and the system is accessible.

It can be asserted that the criteria adopted to analyse VEPSY modules allowed us to achieve the following:

- Recognize the mediated character of every experience of presence.

- Conceive the experience of artefact use as immersed in a social and goal-driven context.

- Stress the ambiguity component inherent to everyday situations.

- Demonstrate how cultural dimensions affect the effective use of VEs.

However, both for ethical reasons and with reference to specific goals and roles assigned to the partners in the VEPSY Updated project, the ergonomic research unit did not participate in clinical trials, and the need for a detailed exploration of the therapist–patient interaction was therefore felt very strongly. In our opinion, this is the key to a new, more effective approach to the ergonomic analysis in real context.

Design and clinical practice were kept separate to a certain extent and therefore in the NeuroTIV project great efforts were made to overcome this limit by keeping the design phases and fine-tuning of the environments closely connected to the clinical applications and requirements.

Firstly, the ergonomic evaluation was included in the design process from the very beginning of the project from a preventive ergonomic perspective and secondly, the attempt to meet clinical and technological requirements are now two aspects of the same design process that cannot be considered separately.

One fundamental aspect of the NeuroTIV research is the opportunity to use outpatients as subjects for user tests rather than for video-recorded interaction analysis alone.

The advisability of improving the realism of VR environments, to give a concrete example, will therefore be suitably verified with the panel of therapists, who are, in turn, expert "users" and reference targets. In the interest of a more effective use of virtual reality in a therapeutic context, the planning of in-depth training on the use and technological operation of VR artefacts would also appear essential. Each individual element and input emerging from a qualitative analysis of this kind will therefore be verified and tested with the ultimate aim of making it possible to improve both the environments and the clinical protocols currently used (Vincelli, 2000).

	VEPSY	NeuroTIV
Objectives	Evaluation	Planning and evaluation
Analysis	Ergonomic	Clinical-ergonomic
Subjects	Users without anxiety disorders Generic therapists (Therapists not necessarily having conducted therapies within the context of the project)	Patients (videoed material) Ex-patients (no more than two weeks after end of therapy) Therapists involved in project
Planning process features	Research unit only responsible for evaluation of use of prototypes and consignment of results to external planning unit	Research unit responsible for clinical-ergonomic evaluation and planning (internal cycle)

Table 1. Main differences between VEPSY and NeuroTIV projects.

2. Theoretical approach

2.1 Psychosocial perspective

The theoretical background involves a ethnomethodological approach, to shed light on how people solve complex tasks in specific social situations, producing shared meanings and achieving their goals during the interactions, in order to make their actions understandable and successful (Galimberti et al., 2004).

As stated by Zucc’hermaglio (2002), "Ethnography is one of the most suitable methods for entering communities by interpreting the meanings that are relevant for members in building up and interpreting the social world, looking for them in the discursive interactions and in public inter-subjectively accessible behaviour.

The validity of ethnographic research does not lie in the objectivity of the description, but rather in the level of authenticity, plausibility and reliability provided by the descriptions also to the subjects observed (...). For the understanding of social situations, we must stress the importance of the *categories of meaning* performatively used by people involved in those specific situations".

According to *Situated Action Theory* – SAT - (Suchman, 1997), each action stems from the encounter and adaptation of a subject with given purposes and an environment that offers opportunities and restrictions. The subjects of the action are autonomous social players, driven by the desire to communicate themselves to others and to share certain content with them. The communication context is a social setting, characterised by a culture that acts as an active context to the process of the construction of online identities.

According to the *Intersubjectivity of Utterance (IU)* model (Galimberti, 2007; Galimberti, Cilento, 2007), the image the player gives of his/herself in online interaction is the result of a combined action that is sensitive to the environment in which it takes place. This image of the self is fluid and can be modified throughout the interaction; it is built through the encounter of the subject, context, other users and the product. On an empirical level, the ongoing dialogue between the identity and self-image proposed in the interaction results in the emergence of Subjectivity, that part of the

Self "excited" in the exchanges and "introduced" into cyberspace (Galimberti, 2007). Subjectivity therefore constitutes the impetus that transforms the enunciative behaviour assumed by the subject during online interaction in line with the strategic intentions guiding him/her. Subjectivity represents the concretisation of one or more aspects of identity as employed during the interaction, the perceptible part (verbal and non-verbal behaviour) of the subject participating in the interaction of use of ICT instruments and in the relationship with colleagues and service users, in this case home visit patients.

The fact that these operations take place in an occupational context requires the establishment and organisation of the subjects into professional Communities of Practice in which each one contributes to the building of shared knowledge and practices. Communities of practice are "groups of people who share a concern or a passion for something they do and they learn how to do it better as they interact regularly" (Wenger, 2000). The exchange and sharing of knowledge is therefore not only made possible but also boosted by online environments, which make it possible to discuss practice with colleagues even at a distance, jointly developing new ideas and concepts, reifying work objects (languages, instruments or methods), discussing meanings and giving life to forms of new knowledge (Talamo, Ligorio, Zucchermaglio, 2004). The community shares instruments, methods, techniques, styles, theories, approaches, perspectives and languages (Wenger et al., 2002): it is a process of collective exchange that leads to the enrichment of both the individual and community knowledge.

2.2 Ergonomic analysis and the role of 'Presence'

VR is now considered a therapeutic tool offering tangible improvements to the efficacy of conventional treatment of specific psychological disorders. Its cost-benefit impact means that fewer resources are required to obtain the same or even better results than those traditionally possible (Riva, 2005). Computer-generated virtual environment-based psychotherapy, also known as VRET (Virtual Reality Exposure Therapy) enables the patient to interact with a feared stimulus in a virtual environment containing anxiogenic elements. It goes without saying that the adoption of new immersion techniques must offer advantages in order to replace or provide

backup to the tried and tested therapeutic techniques used to treat anxiety-related disorders and phobia. Several authors (Vincelli et al., 2003; Riva, 2005; Krijn et al., 2004; Krijn, 2005) have dealt with cognitive-experiential therapy (CET), as this new methodology is known, which aims to de-condition fear reactions, modify the representation of reality and distorted convictions regarding panic symptoms and reduce anxiety-related symptoms. The innovative aspect of this therapy is the integration of cognitive behavioural techniques with the experiences offered by VR: the wealth of studies that have been conducted on the subject allows us to identify the disorders, especially phobia-type disorders, for which VR-based cognitive therapy is most effective (Krijn, 2006).

To date, despite intense, widespread research on both usability and VR, there is no evidence that improvements in the former can be applied to VR evaluation. To our knowledge, new VR technology has not yet been adequately connected with the important characteristic of usability. All too often, the methods – with their well-known limitations - used to evaluate VR were actually designed to evaluate the usability of interactive computer applications. For this reason, we believe it necessary to develop VR-specific usability evaluation methods and criteria. Sutcliffe (2004) observed that few evaluation methods have been proposed for assessing the usability of VEs, although field studies by VR designers have demonstrated the need for human-computer interaction (HCI) knowledge and methods. The point has been discussed by several authors: Gabbard and Hix (1997), for instance, attempted to highlight VR usability problems, while Bowman and Hodges (1999), among others, pointed out that VR system designers cannot rely on the methods developed for standard graphical user interfaces (GUIs) alone, as VR interaction is totally different. Kalawsky (1999) adapted checklist evaluation methods, based on Nielsen's heuristics (1994), to VR. Generally speaking, most studies reviewed by Sutcliffe and Gault (2004) have followed observation and expert interpretation of user errors or experimental studies reporting performance data and problems in a range of VR technologies. Nevertheless, we believe that Gabbard's (1999) statement that researchers interested in VR usability are left to perform ad-hoc assessment or in-house evaluations with little or no

scientific basis for their approach is no longer suited to the current situation. Recent developments in the ergonomics field have provided us with practically all the tools necessary to develop a method for guiding VE usability evaluation.

The construct of Presence is defined in a number of ways, such as "being there", "immersivity", "realism" and so on (Lee, 2004). Whatever the definition chosen by authors dealing with the subject, it goes without saying that the dimension of presence plays a decisive role in characterising the psychological experience of virtual reality and its applicative value in the various fields.

The technological components of presence are studied by (Issenberg et al., 2001; Pakstas & Komiya, 2002; Whitten & Cook, 2004): this aspect is closely connected to the accessible technical solutions, their adaptability to the context in which they are used and their availability in terms of resources. Different interpretations can be identified, forming a continuum ranging from the need to use complex technologies ensuring broad sensorial and control cover (Wilde et al., 2001) at one end and reference to more purely content-related elements at the other.

Other viewpoints examine physical presence (Lo & So, 2001; Mikropoulos & Strouboulis, 2004; Terveen & Hill, 1998; Woolgar, 2002) and social presence (Youngblut, 2005).

The role of presence in moderating a successful outcome of VR treatment, which is so often assumed by different authors (Schuemie et al., 2000; Wiederhold & Wiederhold, 2000), has not yet been convincingly proven. Whereas some studies found a linear relationship between presence and the anxiety experienced (Schuemie et al., 2000), others did not reach the same conclusion (Krijn, 2006, Regenbrecht et al., 1998).

We are of the opinion that some of the disadvantages identified by Loomis and Blascovich (1999) in the use of Immersive Virtual Environment technology as a research tool are still valid, despite technological progress in recent years, and we believe that they are applicable both to VR ergonomic studies in a broader sense and, more specifically, to research on the concept of presence.

The authors stress the problem of loss in ecological validity due to different factors that can be summarised as follows: the imperfection and high complexity of VR hardware and software

may increase the likelihood that artefacts contaminate the research findings; imperfections in the rendering model, limitations of the visual display, slow graphics update rate and lags between head tracking and visual display are further critical aspects; the difficulty of setting up a good-quality VR laboratory, which, at least in the short term, will call for individuals with considerable programming and interfacing skills; and finally, the occurrence of after-effects greatly depending on the characteristics of the participants and specific features of the VR implementation, a problem that involves the need for improved participant selection.

As highlighted by Cantamesse & Menti (2002), ergonomics has a vast field of application - from the design of everyday items to user-computer and user-computer-user interaction. Psychology and especially Social Psychology have played an important role in the evolution of ergonomics towards prevention rather than correction. The adoption of the concept of preventive ergonomics also led to the introduction of the principle whereby human or machine error in any case takes place within a relational context, in which attention is centred on the relationship between people, environment and instrument used. From this point on, 'IT artefacts' are considered "as experience transformers": the task becomes part of a broader scenario. The achievement of an ecology, which we can define "ecology of state", in the ergonomics research field becomes a priority.

Having established that the ecology level reached in the first study was the highest possible in that specific situation, for the second it was decided to 'force' the limits encountered previously by applying an analysis model that privileges the ability to come closer to the situation of use, partly through a theoretical context flexible enough to allow the application of more specific analytical tools and procedures.

From an ecology of state perspective we attempted to shift the focus to the concept of ecology of process. We believe this to be a key step towards truly grasping the specific nature of the context while having a satisfactory research base on which to 'graft' and interpret the data produced.

Ecology of state in turn includes ecology of context, which has been exhaustively defined and conceptualised by different research

streams such as Situated Action Theory, Activity Theory, Distributed Cognition and Scenario-based design (Spagnolli et al., 2004), and an ecology of situation, in which the term "interaction" refers to both the set of interactions as a whole and their specific nature. In this sense, we can say with certainty that the ecology of state was respected in the first study.

The ecology of process concept represents a further step towards an improved ecological framework, by introducing the value of the dialogical perspective. The dialogical importance promoted at each level of the analysis phases becomes the key to a deeper and more fluid understanding of the assumptions and meaning that guide, first and foremost, the actions of and interactions between therapists and patients. On a higher analysis level, the dialogical perspective allows a new, more flexible way of producing and interpreting data originating separately from therapists, patients and expert researchers/evaluators. Lastly, by considering a third level we can conclude that the entire system design process is inspired by a dialogical perspective, in that it aims to effectively and non-rigidly integrate the stages of design, analysis in context of use, ergonomic evaluation, creation of the VR system and final work on the clinical protocol in use.

The focus of attention shifts from therapist to patient from time to time, but does so within a context of ongoing comparison and data integration, results of the analysis and, lastly, results of the product, i.e. the proposed modifications to the environments that may lead to a substantial change in the therapeutic experience.

To give a concrete example, one aspect that the researchers faced in the first project was the cultural background of the therapists involved in the research. A simple 'functional requirements collection' (a basic step in all ergonomic studies) proved to be unsatisfactory for several reasons.

Firstly, the therapist's theoretical background and 'therapy style' can strongly influence his/her evaluation of VR environments in both a positive and negative way. For example, there is a significant difference between the consideration of the VR environment as a simple stimulus to help patients remember their personal experience without intending to fully exploit the characteristics of the immersion experience, and the intention to guide patient navigation

by proposing a sort of narrative path and discovering possible difficulties alongside their patients. This aspect cannot be resolved by referring to the clinical protocol, as it naturally leaves the therapists free to use their own personal relational style. However, in this case, there is a high risk of designing VREs tailored to suit the 'vision' of a specific therapist.

Secondly, therapists often have to deal with the considerable problems posed by the technical faults of pilot versions of VR environments. This can seriously affect therapy, so strategies to keep the patient's attention focused on the general aims of the therapy by using different techniques to increase the sense of presence in the feared situation are of course applied by therapists when necessary.

Thirdly, the level of confidence in the potential of technology and the different opinions that therapists, patients, researchers and IT designers have on technology and VR can play an important role in every phase of the project and great attention must be paid to this issue.

These are just some examples of problems that an ecology of process perspective can help to overcome through the continuous integration of patients' and therapists' experiences (both considered as expert users) and their reciprocal representations. The flexible approach enabled by a continuous, controlled shift of attention from therapists to patients, from the outcomes of mediated to non-mediated data and from an individual representation of the level of interaction to a situated perspective could help us to build a more functional model.

3. Developing mobile interfaces for the fruition of 3D Virtual Environments

3.1 Communication and ergonomics

In this paper we attempted to trace a possible course of action for the difficulties still encountered in ergonomic research in the VR field, especially with respect to clinical psychotherapeutic applications, due to the lack of accepted standards for evaluation tools. The specific type of object and, above all, the specific nature of the users (therapists and patients) pose considerable problems regarding the

ecological validity of the research. Following an evolutional path, we aimed to highlight certain key theoretical and methodological points, including the need for an approach that is increasingly close to the actual context of use within an ecology of process perspective, faced with an ecology of context that would appear to be no longer sufficient to support and opportunely motivate subsequent design choices.

From an operative research standpoint, it is unfortunately true that no standard VR systems have yet been developed for the various disorders and even officially acknowledged standard clinical protocols are few and far between (Riva, 2005). In order to take a step forward in this direction, it would appear essential to involve therapists in studies. As we have seen, the possibility of analysing the methods of use and the interactions created by clinicians with different theoretical backgrounds, expectations and representations is extremely important.

Another aspect that emerged is the change in perspective towards the subjects involved: patients and therapists are now considered as equally expert users – each in his/her own field of competence. The opportunity to conduct user-based tests not only on users with disorders but also on outpatients, and having planned various points at which researchers can come into direct contact with patients (for example by assisting the therapist in the technical arrangement of the setting at the beginning and end of the session, or by being on hand at all times to gather patients' comments or observations), considerably extended the boundaries of interaction within the work team. A good researcher, especially when dealing with qualitative analysis, must take full advantage of these moments of active participation.

In this study, the functions regarding ergonomic research and the technical creation of VR environments, which were previously separate, were definitively integrated into the work group. The design and VR environment implementation unit consists of expert programmers and electronic engineers coordinated by a psychologist with expertise in new technologies and computer design. In turn, the researchers assumed a more constructive role towards therapists: rather than gathering requisites and evaluating functions from a primarily technical standpoint, researchers and therapists

suggested and tested together what might even be substantial changes (avatar 3D, addition of the expressive emotive channel, introduction of narrative paths inside the environments) significantly influencing the clinical protocol.

Lastly, we believe it important to include a consideration on the specific role of the ergonomic researcher: this expertise is all too frequently relegated to a merely 'technical and technological' context, or restricted to design cycle phases, which is likely to considerably reduce the efficacy and quality of the entire project. This provides the stimulus to seek a role which becomes increasingly context-specific and fosters exchange and dialogue: in the case in question, having decided to better define the clinical and ergonomic value of the study, we attempted to highlight the impossibility of separating the competences of expert users (especially clinicians) from those of ergonomic researchers and IT experts and programmers, with a constructive, albeit not obstacle-free, commitment to the creation of a design culture 'expanded' to all levels of activity.

Therapy sessions

The first step in our study focused on an analysis of therapist-patient interactions inside virtual environments. We analysed the content of complete transcripts of the navigation of 8 outpatients (for a total of 53 sessions); we also analysed the three initial sessions of 9 patients (8 + 1 drop out) to understand any differences between the patient who dropped out of the therapy and the others. This analysis was conducted using the quali-quantitative analysis software Atlas.Ti 4.0, which required the definition of 14 macro-categories (for a total of 56 codes), obtained from literature and the texts themselves, based on the inter-subjective evaluation of 5 independent judges. These categories relate to the environments used, the players interacting, the judges and descriptions, references to technical and therapeutic aspects, actions possible within the VE, comparison with the real environment and past experiences, navigation instructions, states of mind and the locus of control.

The data produced can be summed up as follows.

a)   From an ergonomic perspective

In the Panic Disorder and Agoraphobia VR protocol, the choice of

the environment used during the therapy depends on the anxiety feelings induced in the patient in the first session, during which the therapist gets the patient to complete an overview of the 4 environments.

The choice therefore depends on two factors: the patient's disorder (clinical level) and stimulation provoked by the environment (ergonomic level). We are currently unable to verify the weight of these two variables. The outpatients analysis shows that the environments most often used during therapies are the underground station and the lift.

We have observed that, depending on the choice made, the relationship between experience in the VE and real experience changes: the closer the environment is connected with the disorder the stronger the patient's recall of the real environment, whereas if the patient establishes a link between the VE and a prototypical reality there is less involvement. Therefore we can hypothesize that the patient attributes a meaning to the environment.

Judgment Area
The attention of outpatients is mostly attracted by the VE's architecture (38%), which prompts the highest number of spontaneous judgments; sounds (27%) are the second element on which attention is focused spontaneously, while graphic elements become important if opinion is solicited (13%).

From the analysis it is evident that the hardware components (Iglasses and joystick) are still not sufficiently transparent (53%) to allow an immersion that stimulates a high level of presence. Spontaneous judgments are negative while solicited opinions are positive: this shows the importance of conducting user tests for the ergonomic evaluation with an indirect means of investigation in order to bypass the effect of social desirability.

Eventually, the more interaction and time spent in the navigation, the greater the increase in the patient's ability to interact with the environment. This demonstrates the need to conduct ergonomic evaluations with experienced users.

VR environment interaction area
In general, patients consider all the environments to be coherent with the reality in comparison with the possibilities of action. This element is more important than coherence/correspondence to the

visual/ graphic level. The VE must allow one to act "as if in the real environment" rather than "seem to be" the environment that it simulates.

The elements that stimulate the patient to interact are: 1) avatars (2D and 3D images), which provoke a great construction and attribution of meanings (60%); 2) experiences (17%); 3) actions (12%); 4) objects (11%). The environments arouse negative physical feelings and states of mind, in coherence with the clinical necessities and with the specific patient's disorder.

Role of the Therapist
We have observed that the therapist uses similarly precise actions and movements as the patient in the VE, the high-definition (HD) interface is sufficiently usable (the therapist can focus on getting the patient to act in the VE) and he/she uses few instructions and fixing actions .

The therapist must consider that in a therapeutic session with VE, the use of the new technologies has an impact on patient self-efficacy. During the interaction, the patient completes some positive/negative internal/external attributions on what happens. We have verified that negative attributions are more frequent (73%).

b) From a clinical perspective

In this study, we proposed a new approach named ECT (Experiential Cognitive Therapy), which integrates VR experiences with traditional CBT. The simultaneous structuring of a large amount of controlled stimuli and monitoring of the user's possible responses considerably increases the likelihood of therapeutic effectiveness, in comparison with traditional procedures.

In the method proposed, we decided to integrate the experience of the virtual environments with the techniques included in the CBT approach because they showed high levels of efficacy.

The results of this controlled study showed that ECT – like CBT – significantly reduced the number of post-treatment panic attacks, level of depression and both state and trait anxiety. Yet ECT obtained these results using 33% fewer sessions than CBT (8 vs. 12). This suggests that ECT may offer an advantage over CBT in relation to the "cost of administration," justifying the added use of VR equipment in the treatment of panic disorders.

c) Drop out patient analysis

The sample selected for the analysis included a patient who dropped out after the third therapy session. The analysis reveals that the patient did not invest more in the CBT than in the VR therapy in itself. To understand the reasons for this drop-out and find any predictive signals which might have been picked up by the therapist, we compared the first three sessions of the drop out (DO) against those of 8 patients completing the therapy with the same therapist.

The most significant differences can be summarised in the following three areas.

From a clinical perspective:

- The judgments, whether positive or negative, expressed by the DO patient regarded the semantic "game" area more than the therapy's effectiveness.

- Furthermore, while judgments of the therapy expressed by the other patients were mainly negative, the DO patient twice expressed a certain pleasure and enthusiasm in the use of the VR environment. However, she seemed to consider it just a game (she said it was amusing and stimulated her curiosity), showing a lack of critical reflection.

From a presence perspective:

- Solicited descriptions of the VE were more common than spontaneous ones: the DO patient seemed less involved in the environments and interacted more superficially

- There were more comments which underlined a failure to connect the real and the virtual (both at the script and visual level): the discrepancy between the real and virtual environment found by the patient did not seem to stimulate a suitable sense of presence in the environment, reducing her investment in the virtual therapy.

- Further evidence of her failure to develop a suitable sense of presence is that when she talked about psychophysical states, she referred not to the virtual therapy (here and now),

but anticipated what could happen in reality (there and then), demonstrating that she was not immersed in the VE.

From an ergonomic perspective:

- The patient was more sensitive than the others to the discomfort caused by the use of the VR glasses ("it made my head spin after I finished").

In conclusion, we believe that the DO patient "devaluated" the therapy itself, as shown by the following words: "I've already done all that (…) kind of reasoning, I can't stop my symptoms because in any case, I think that if I had a strong panic attack, it would make my head spin, I'm sure I'd think I would probably lose control…"

d) User-based tests

System features
A high-performance system is currently used for both therapy sessions and user-based testing. The physiological evolution of the IT market suggests that by the end of the project the required components will be readily available at reasonable costs.

Test structure and method
At the end of a treatment cycle, the DO subject was invited to take part in a videoed user test of the environment's technical function, structured as follows:

- Phase 1 (25 mins.): the subject was asked to provide basic information to a patient (impersonated by a researcher) who was about to start VR therapy.

- Phase 2 (25 mins.): Assisted navigation and in-depth interview.

Through user tests with outpatients who had undergone therapy with three different therapists involved in the project it was decided to explore topics and aspects grouped into four areas, partly obtained from the analysis of the above interaction:

- Area 1: ergonomics and usability of the environments in a conventional sense.

- Area 2: Interaction in the VR environment

❑ Area 3: Narration

❑ Area 4: Information on VR-based therapy

In all four areas it was decided to highlight certain specific functions, whose efficacy is being studied, and the possible application modes on the basis of results reported in the latest literature and previous tests. Specifically: 2D avatar vs. 3D avatar; use of the emotive facial expression channel of avatars; their motion and verbal interaction; sound realism.

Results

We will focus specifically on elements connected to interaction with VR environments and on VR therapy-related information.

Area VR environment interaction
User testing shows that the environments are not considered as very realistic, but are nevertheless able to simulate troublesome situations, which the subject is able to accept because he/she is aware that the experience is a simulation. At several different stages, the subjects highlight the environments' capacity to arouse negative situations and recollections. "*they're environments that you go into and gradually make you* **re-live**..." "...*you're scared of feeling what you feel in real life*".

The environments are considered as unrealistic, but this is not a problem as: "*You are perfectly aware that it is just a simulation of reality*".

For the patients, it is essential that the VE renders the idea of the environment it is intended to reproduce, but they do not expect it to be very realistic.

On several occasions reference is made to other people, both in real and virtual contexts, explaining that the very presence of clues/stimuli in the virtual environment recalls elements of reality that constitute the decisive factors for the individual's own disorder. *"the first few times that I saw groups of people (in the VE) I walked around them rather than passing through them"*. Furthermore, opinions on the quality of the environments appear to be closely correlated with the user's familiarity with the application and its applicability to his/her disorder. It is not required, therefore, that the environment reproduces reality, but that it is "salient" for the

patient's specific disorder (e.g.. if the patient is scared of tunnels, use of the underground station VE won't work, however realistic!). It seems necessary to develop more virtual environments/context, which may be even simpler but must be probable and connected with the specific disorders.

The recurrent aspect is the lack of interactivity, especially with the people (avatars) which are too static (especially in the town square); the subjects imagined situations in which it was possible to ask passers-by for information or order a coffee in a bar (*"The environment is pretty much okay but the graphics of the people need to be more animated, it would make it more realistic to be able to interact or ask for information, like a tourist"*).

The importance of interactivity would even appear to justify a loss in graphic realism: "*the 3D avatars are more useful, even though they have blurred faces*"

One very positive aspect in relating to the situation is noise, which subjects deemed should be realistic yet "simple" ("*The interactivity isn't bad for what it's worth: noises are important as they help create a sensation of being in that environment; the sounds are good"*). It also seems important to include messages aimed at the patient, especially phrases that are experienced in a critical way by patients (e.g. "would you like a seat?", "Do you feel okay?").

It seems therefore that the presence is connected with the ability to "cut off" from the setting of the therapy, especially through HD: the outpatients suggest the use of the head tracker instead of the Iglasses and earphones rather than the PC's speakers.

These elements would heighten the sensation of being present in the environment and would improve therapy in the narrow sense. The messages could also be introduced in correspondence with existing figures, which already constitute a stimulus.

Area Narration
The entry point would appear correct for all environments.
When commenting on the environments, subjects often refer to the reactions of the avatars to support their comments.
 "*The impact of the underground works too. At the supermarket, on the other hand, the approach is a bit more gradual because you are outside*". It would appear that the idea of starting from a pre-

sequence favours gradual immersion for those patients who might find a sudden confrontation with the anxiogenic situation too shocking. However, during the tests one subject stated that he considers a pre-sequence as beating around the bush rather than tackling the problem directly; another subject said that an immediate approach to the feared situation would be useful. It's therefore important that the therapist can choose whether or not to use a pre-sequence. The therapist uses the environments as an exploratory route to "discover", alongside the patient, which stimuli are connected with his/her condition.

The "global coherence" of the environment and the possible actions inside the VE is very important. It seems that the sense of presence and immersion in the environment increases when all the actions are congruent to the reality, even if the environment is simple from the point of view of graphic realism (e.g. the ability to use a trolley in the supermarket, take some objects from the shelves and queue at the tills to pay would increase the "credibility" of the simulation), improving the effectiveness of the therapy.

Area Information on VR therapy

The dominant role of the therapist is continuously highlighted in a multitude of aspects:

- the therapist guides the **process,** chooses which environments to explore and for how long "he will make you walk around"... "he decides everything, which environment to start from, etc.... the doctor will use everything";

- the therapist guides **navigation:** he is perceived as being the one to say where to go, what to do, what to explore ("he makes you get on and off"...; "you don't talk to the people but you speak to the doctor, who asks what you are feeling...")

- the therapist is the one that **resolves** technical problems: "then there's the doctor who sorts things out if the system locks up", although he is not seen as being a real technology expert.

- the therapist is also the one who indirectly **teaches** the subject to navigate: "I learned by watching him".

- the VR therapy experience is lived in a positive way; the features assumed by the environments can be summed up as follows:

- in the importance attributed to face to face therapy with the therapist, considering the part of the session in which fears and symptom activation are "dismantled": "in real life the face-to-face approach really helps. VR helps to bring out the fears and sensations that you have in real life and that maybe don't come out simply by thinking about the environment that causes the problem"

- in considering the environments as a stimulus to the re-evocation of the problem situation: "You won't have an attack and this will help you in real life because you remember certain sensations: once you have faced up to them inside a program, you can try them in real life".

- in evaluating the direct experience as more effective: "I'm like Doubting Thomas, if I don't experience things, I don't believe them."

The efficacy of this form of therapy seems in any case to be linked to the severity of the disorders: "I didn't have a very severe form, so it was useful; the lift is the only remaining problem", **the environment in any case is considered in a very positive way**.

One fundamental aspect of the analysis was the opportunity to use outpatients as subjects for the user tests and not only for interaction analysis. This was an important step within a theoretical situation relating to Situated Action Theory, which made it possible to adopt and analyse the perspective of real users, in this case patients who had completed therapy and therefore represented a valid reference for the evaluation of usability from the user's point of view. The basic term of reference is no longer therefore patient vs. patient but rather outpatient user vs. patient, which enables us to come as close as possible to the real context of use.

The analyses presented above were conducted considering both:

- ❑   the VR environments and their technical and functional requisites, in a narrow sense;

- ❑   the efficacy of the clinical protocol and the treatment as a whole.

The advisability of improving the realism of VR environments will therefore be suitably verified with the panel of therapists, who are in turn expert "users" and reference targets. For more effective use of virtual reality in a therapeutic context, the planning of in-depth training on the use and technological operation of VR artefacts would also appear essential.

The achievement of a basic standard deemed adequate by a number of therapists, albeit within the context of a specific disorder, is no mean feat and now pushes us to consider the possibility of creating a system that leaves vast scope for customisation by the therapist (van der Mast C. et al., 2005).

3.2 Technical questions

On the basis of the analysis of patient-therapist-artefact interactions, some modifications from the initial versions of the virtual environments were made in order to achieve a more effective interaction from a therapeutic point of view. These modifications have two implications: increased opportunity for interaction and increase in perceived correspondence between the real and virtual worlds.

For the first aspect, the main changes can be summarised as follows:

- All four environments are available in two versions: one with both 3D and 2D figures, the other with 3D figures only. The main difference between the two avatar types is functional: the 2D avatars have a high level of graphic detail but do not move, in contrast with the 3D avatars. They therefore have different functions with respect to the degree and type of immersivity.

- Control of number of avatars in the environment: in all four modules, the therapist can choose the density of human figures (low number-high number).

With respect to the correspondence between the real and virtual worlds, realistic sounds were introduced, whose quality and intensity are changed as the user approaches the source, and light and shadow effects from small and large sources are applied in relation to different environments in line with their specific features. General improvements have also been made to the graphic details, partly to make them more pleasing.

4. Professional community of practice toolbox

Having completed the development of the virtual environments, we started the final phase dedicated to training a community of users of these environments, modelled according to a community of practice structure. This last part of the project was broken down into two phases dedicated to:

a) the fine-tuning of an interface enabling *mobile* use of the environments;

b) the construction of the Community of practice of the users of the virtual environments developed.

Phase b) is still in progress and we intend to deal with its development and results in an imminent paper.

It is important to note that phase a) offered us the opportunity to set up a truly integrated work group, composed of:

- an environment planning and implementation unit, consisting of programming and IT experts coordinated by a psychologist with expertise in new technologies and responsible for IT design;

- a team of psychosocial researchers with expertise in ergonomic analysis and therapists;

- clinical psychologists acting as psychotherapists;

- patients and outpatients.

We consider this event to be one of the most remarkable results of the project.

a) Fine tuning of the interface enabling mobile use of the environments

Technology usability was validated by fine-tuning an interface enabling *mobile* use of the environments. As the ultimate purpose of the project was to provide use of the virtual environments developed in TIV mode on mobile terminals, we fine-tuned an interface suited to this purpose.

From a hardware standpoint, the process required the adoption of a mobile system based on Windows XP technology to guarantee the

correct installation of the 3D engine and the development of a resident application able to provide certain fundamental functions. Specifically, the following functions were included to facilitate communication between users (therapists and patients): access to TIV; receipt and exchange of therapist-patient messages; vocal therapist-patient connection; execution of actions requested by the therapist;

recording of the actions performed by therapist and patient on database.

Particular attention was dedicated to the development, in web technology, of an administration interface accessible by the therapist able to allow him/her to: manage the exchange of messages with the patient, evaluate the actions recorded by patients; prescribe the actions to be performed by the patients; perform research and summary analysis.

As it was not possible to use standard PDA terminals to satisfy the above requirements, following a first set of analysis and simulations it was decided to use an Origami type mobile terminal. This choice provided a tool with similar size and weight to a PDA device but a larger screen, a microphone for communication, a Windows XP operating system equivalent to the normal version for PCs (that therefore enabled the use of the 3D environments already developed) and above all capable of multiple connectivity through the LAN, WiFi and GPRS network.

Figure 1. Samsung Q1 ULTRA Mobile PC – ORIGAMI.

The web application was developed using Asp.Net technology. A semi-automatic mechanism able to manage the function without interfering with the effective use of the environments or communication between therapist and patient, to guarantee correct synchronisation between the two applications, without requiring a permanent connection.

The start screen of the web application consists of a simple panel that allows rapid access to the functions available, as shown in the figure below.

Figure 2. Page interface.

b) *Training and formation of the CoP phase*

As mentioned above, phase b is still in progress. For this reason, here we will limit ourselves to presenting and discussing the guidelines we are following to promote the practice of use of virtual environments in mobile mode by the therapists and the patients. In short, we are launching a project based on Action Theory, Dialogic Interaction Theory and Communities of Practice to provide a theoretical framework enabling us to set up and accompany a *community of use* of virtual environments comprising both therapists and patients.

The main goal of this project is to study the establishment and organisation of the therapy Communities of Practices – composed, as already mentioned, of therapists and patients – with particular attention to the contributions that each member makes to the construction of knowledge and shared practices relating to the use of the virtual environments in mobile mode. Communities of Practice are defined as "groups of people who share an interest or passion for something they do and who learn to do it in the best possible way by interacting on a regular basis" (Wenger, 2000). The provision and sharing of the knowledge that we are talking about can therefore be valorised by the fact that the object of this knowledge will be the practices of use of the virtual environments in mobile mode through the use of hardware and software artefacts described previously, used to negotiate, even at a distance, one's practice, and to work together to develop new ideas and concepts, thereby creating new forms of knowledge (Talamo, Ligorio, Zucchermaglio, 2004). This is possible because the community shares tools, methods, techniques, styles, theories, approaches, perspectives and languages (Wenger et al., 2002), to become a process of collective exchange leading to an enrichment of individual and community experience.

The project envisages the use of a series of data production and analysis practices useful for understanding what is happening and what will happen in the case being examined.

Specifically, there will be:

1. an evaluation of the virtual environments in mobile mode, according to a perspective that brings together cognitive ergonomics and ergonomics of interaction;

2. an evaluation of mode of use of the interface designed to allow the use of virtual environments in mobile mode, working on the interaction modes that characterise the user pairs (therapist – patient) and the groups they belong to (patient – patient and therapist – therapist);

3. the definition, according to the results obtained with regard to objectives 1) and 2), of guidelines for training therapists and patients and outpatients on how to use the environments in mobile mode;

4. the fine-tuning of a specific approach (meaning one that is sensitive to the context and intentions of the players involved) for the evaluation of the social use of this kind of artefacts dedicated to supporting the results obtained at the end of cognitive and behavioural therapy.

c) Conclusions

This is undoubtedly an expansion of the specific role of the researcher with expertise in ergonomics, not only when the object in question is a 3D virtual environment: this role, often found in a "technical/technological" context only and limited to a few phases of the planning cycle, was here extended to the entire project, including training in the use of *mobile* environments.

This result opens new prospects for the production and validation of virtual environments with respect both to analysis of their usability and the training of new users.

Conclusions

This paper aimed to give readers an idea of the steps followed in defining an analytical model of the usability of virtual environments.

We focused on two psychosocial aspects: on the one hand a user-centred approach to refining virtual environments, and on the other the training of a community using these environments, modelled on the structure of a community of practice.

With respect to the first aspect, we wanted to put an ergonomic research process to the test in a virtual environment for clinical psychotherapeutic applications, with the aim of plugging the gap created by the lack of recognised methodological and assessment standards in this sector. Through a path winding through the two research projects described in the opening paragraphs, we have demonstrated the theoretical and methodological cornerstones of our approach, with particular emphasis on the need for ever greater adherence to the actual context of use from the viewpoint of ecology of process. Given the lack of standard virtual reality systems for the various disorders and the relatively few officially recognised clinical protocols (Riva, 2005), we considered it essential to involve all those

interested in or with knowledge of the clinical aspect in evaluating the ergonomic dimension. We thus included not only the therapists but also the patients themselves, both considered as "expert users of virtual reality environments used in psychotherapy". The involvement of independent therapists proved not just useful but absolutely essential in analysing how clinicians with different theoretical backgrounds, expectations and ideas actually used and interacted with the system.

The conduct of user-based tests on outpatients as well as psychologically healthy users and the opportunities for researchers to have direct contact with patients (e.g. helping the therapist in the technical preparation of the setting at the beginning and end of the session, or by being available at any time to note down the patients' comments and observations) boosted the production of significant data for our goals.

From this perspective, we tried to integrate the ergonomic study with the technical development of the environments, to overcome a division caused by the uncritical adoption of models historically consolidated in the development of technological artefacts in two processes: the first, "idealistic engineering" ("design and produce") and the second "empirical refinement" ("make it, sell it and see how it goes…").

The second aspect, community training, took place in two phases. Technology usability was validated by **fine-tuning** an interface enabling *mobile* use of the environments, while the practice of use of virtual environments involved the launch of a project based on Action Theory, Dialogic Interaction Theory and Communities of Practice to provide a theoretical framework enabling us to set up and accompany a *community of use* of virtual environments comprising both therapists and patients.

This gave life to an integrated work group of:

❑ an environment planning and implementation unit, consisting of programming and IT experts coordinated by a psychologist expert in new technologies and responsible for IT design;

❑ a team of psychosocial researchers with expertise in ergonomic analysis and therapists;

❑   clinical psychologists acting as psychotherapists;

❑   patients and outpatients.

This is an undoubted expansion of the specific role of the researcher expert in the ergonomic aspect, not only when the object under scrutiny is a 3D virtual environment: this role, often found in a "technical/technological" context only and limited to a few phases of the planning cycle, was here extended to the entire project, including training in the use of *mobile* environments. This result opens new prospects for the production and validation of virtual environments with respect both to analysis of their usability and the training of new users.

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