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 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 inter-

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Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

action 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 schemes 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,

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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, Krajcic, 2000).

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 s/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. S/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 com-

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munication 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 et al., 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 et al., 2006). However, such moderation is still to be quantified in terms of the frequency of the Tutor's intervention. Without going into de-

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

tails 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, Vovides, 2007). The self-regulated student is able to plan and produce thoughts, feelings, and actions which s/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, 2003).

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.,

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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, Land, Turgeon, 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

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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.

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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 offered by the Faculty of Psychology, 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.

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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 (Albanese et al., 2007; Castelli et al., 2006; Castelli, in press; Vanin, 2006; Vanin et al., 2007a; Vanin et al., 2007b) 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:

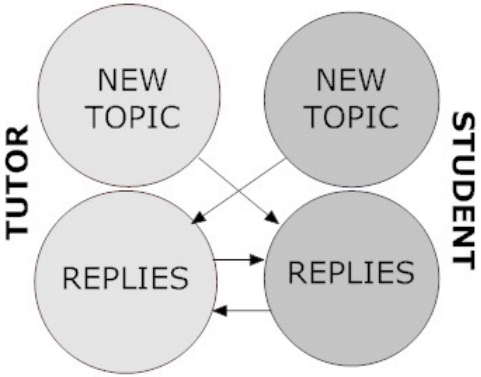

Figure 1. Scheme of analysis.

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 a knowledge-building groups which use online forums.

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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. S/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'???*"), elicit-

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

ing 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.

		Metacognitive reflection		*Tutoring style*	
Students	*No*	*SI*	*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 key words 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, Hakkarainen, Lakkala, 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.

Now analysed are the contribution of each Tutor to the online interaction and the relation between frequencies of intervention by the Tutor and the activity.

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

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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

***** p<.05

****** 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 s/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 (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 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.

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 (PER_NT) further impedes responses by the students.

The tutor should therefore intervene in moderation, leaving ample space to the students, and s/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).

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

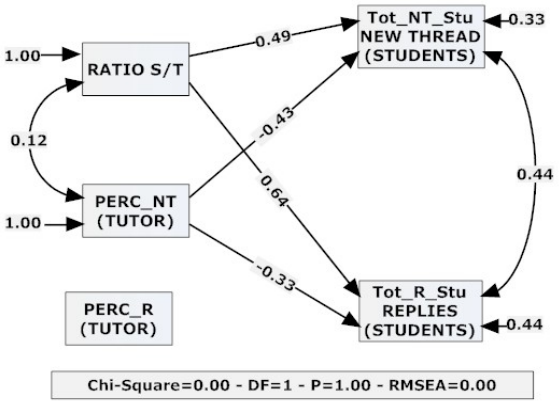

Figure 2 Mod. 1 S/T ratio, percentage of new threads started by the tutor and student participation.

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 (M_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 (Dis-

persion_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.

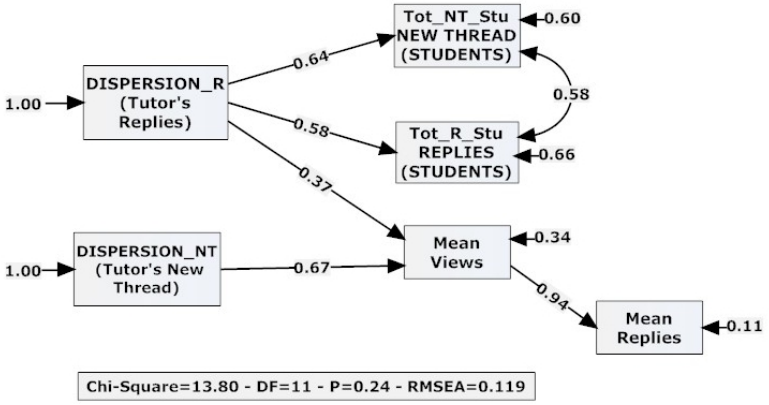

Figure 3 Model 2 – Temporal dispersion of tutor's interventions, his/her popularity (average of visits and replies) and likelihood of receiving replies.

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.

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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.

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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 s/he knows and 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/failure 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 and failure 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

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 study goals) as dependent variables, showed a statistically significant difference [$F(1.66)=6.14$, $p<.05$] in the mastery goal (Table 6).

	Mean	*Standard Deviation*
Low	18.15	2.41

Mastery approach	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*
Self -evaluation (pre test)	supportive	3.77	0.42
	destabilizing	3.91	0.43
	Total	3.84	0.43
Self -evaluation (post test)	supportive	3.85	0.42
	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 relections 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[2] (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.

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 development 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

2 See page... (link con la scheda fatta da Ligorio).

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 (186s - 6t)
Rome 2	14	3	173 (165s - 8t)
Rome 3	15	3	161 (145s - 16t)
Rome 4	14	5	560 (548s - 12t)
Rome 5	12	3	248 (236s – 12l)
Aosta 1	13	4	332 (217s – 32l -73t)
Aosta 2	13	4	201 (115s – 36l -50t)
Milan 1	13	8	221 (170s - 51t)
Milan 2	14	8	286 (250s - 36t)
Milan 3	14	8	410 (366s - 44t)
Milan 4	14	8	385 (350s - 35t)

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 'periph-

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

eral' 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 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 = Meta-cognitive 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 sign. with 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 sign. with 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 cog-

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

nitive 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,

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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).

6. 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 discus-

sions 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

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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 Champion, 1978; Cornoldi, 1995). We cite in particular the study conducted on 7038 university students by Schneider, Borkowsky, Kurtz, 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 cogni-

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

tive effort and the costs-benefits calculation intrinsic in a metacognitive change (Moé, de Beni, 2003; 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)

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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, s/he can favour an orientation to advanced epistemic agency among the students to the extent that s/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.

Varisco B.M. (ed.), *Psychological, pedagogical and sociological models for learning and assessment in virtual communities*

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