Metacognition, motivation and self-efficacy in a socio-cognitive online environment. First results of a survey at the University of Pisa

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In the *knowledge society* the processes of learning and of knowledge management take place, very often, online and in social online environments, thus producing issues of complexity and sustainability, related to cognitive processes of learning, that students - even at university level - are not always able to understand and / or to deal with. As a matter of fact, although many universities are beginning to introduce them into their courses, social networks are not yet perceived as learning tools and the use that students make of them is still limited to entertainment and to communicative tasks. This study reports the case of a Management course at the University of Pisa, where the institutional VLE – based on Moodle – has been integrated with a student support group hosted on Ning. A survey has been administered to a sample of 220 Management Engineering students, in order to study the role of metacognitive, motivational and socio-cognitive variables in student

self-efficacy perception towards academic success and in their ability to make an 'effective' use of ICT for learning. The first results of the survey are reported and discussed.

1 Introduction

Many authors (Tapscott & Williams, 2007; Papacharissi, 2010; Subrahmanyam & Šmahel, 2011) observe that social media are increasingly present in higher education in order to allow Universities to (re)connect to a new kind of student. Social networking sites are used by these institutions as 'alternative spaces', in order to help students adapt to the university lifestyle through the online interaction with peers and teachers (Yu *et al.*, 2010).

As Ulbrich *et al.* (2011, p. 2) maintain:

"*Members of the net generation use the web differently, they network differently, and they learn differently. When they start at university, traditional values on how to develop knowledge collide with their values. Many of the teaching techniques that have worked for decades do not work anymore because new students learn differently too. The net generation is used to networking; its members work collaboratively, they execute several tasks simultaneously, and they use the web to acquire knowledge.*"

An important aspect of this scenario is the change that social media have brought to student use of information, supporting forms of knowledge consumption and knowledge construction that are very different to the epistemological principles of formal education and individualized instruction. Some authors use the expression "*a new culture of learning*" (Thomas & Seely-Brown, 2011) to indicate a kind of learning that is based around principles of collective exploration, play and innovation.

Nevertheless there is a gap between this 'new culture' and the actual forms of learning in higher education institutions, where there is still no access for the concepts of "*collective intelligence*" (Levy, 1996) and "connective intelligence" (de Kerckhove, 1998), of "*liquid modern world*" (Bauman, 2010). Technology-based collective or fluid intelligence alters the mechanism of production of knowledge, since "*...knowledge remains always in the process of development, and [...] information remains always unfinished, extensible, and evolving*" (Bruns, 2008, p. 6).

On the other hand, we have to observe that sometimes "digital easiness" is often overestimated. As the "digital natives" debate has demonstrated that there is a discrepancy between myth and reality of student apparently widespread use of technologies (Selwyn, 2009), there are also clear disparities between the education rhetoric and educational realities of social media use

(Selwyn, 2011). Very often exaggerated expectations have been disappointed by inadequate practices. This is why Gouseti (2010) has described the process of technology adoption in educational environment as a cycle of "*hype, hope and disappointment*".

In this sense, perhaps the most pressing challenge for the higher education institutions at present is to focus on how best to utilize social media – i.e. in appropriate ways to the different contexts. Besides considering immediate practical issues (for example, how to assess students' collaboratively authored work or how best to design blended curricula; see Gray *et al.*, 2010; Buckley *et al.*, 2010), universities need to address rather more difficult longer-term issues, as for example:

- how to support staff and students alike in making sustained and mea-ningful use of online technologies?
- how to improve students metacognitive strategies and, consequently, their self-efficacy in using online technologies?
- how to study and analyse the 'modeling' socio-cognitive processes that take place in online environments?

The article presents a survey that involved 220 Engineering students at the University of Pisa, that followed a *blended* management course. The institutional VLE – based on Moodle – has been integrated with a student support group hosted on Ning. The aim of the survey was to understand the role played by metacognitive, motivational and socio-cognitive aspects both on academic achievements and on an 'effective' use of online technologies to enhance university learning. Our hypothesis was that study strategies aren't predictive of academic success, unless they are supported by an adequate attitude to self-regulated learning and to self-monitoring.

After a brief overview of the theoretical background, we illustrate the methodology, the tools and the features of the survey sample. The results that we report here are only partial and concern specifically the metacognitive and the motivational variables, and student use of ICT for learning.

2 Online environments and metacognitive approach

Metacognitive knowledge, the highest level of knowledge, as presented in didactic taxonomies, refers to the ability and opportunity for learners to understand, control, direct and manipulate their knowledge and their learning process, i.e. their attitude to *self-regulated learning* (Azevedo *et al.*, 2009).

According to Antonietti and Cantoia (2001), a metecognitive approach to ICT can be developed at different levels: *representations* (i.e. the mental representations of ICT: what people think of its potentialities, of its features, which

expectations or fears people have etc.); *metacognitive knowledge* (mental operations to be performed, awareness on one's abilities and limits, the structure of one's way of thinking etc.); *control aspects* (what to do, when and how to act in order to set up strategies to face context challenges etc.); and further aspects connected with one's awareness, monitoring, self-correction and generalization. Using these categories to analyse social networking 'practices' could be very challenging (Yang *et al.*, 2011).

As Gaeta *et al.* (2011) contend, "knowledge technologies" have been exploited to create innovative and challenging self-regulation scenarios in e-learning systems. A learning environment that could act as metacognitive artefact, suitably scaffolding learners to improve their self-regulated abilities, is still lacking though. Learning processes, especially when linked to "conceptually rich domains" (Azevedo, 2009; Lin, 2001), require strategic environments, where learning experiences are the result of a design phase that looks at a metacognitive perspective (Tsai, 2009) as a vehicle to stimulate reflexive processes on knowledge and self-knowledge.

Many studies have demonstrated that computers are able to capture and represent metacognitive knowledge and abilities in different ways: through graphical representation of interaction, tracking changes and recording times (to monitor for example the time spent in a task, in a process of problem solving etc.), giving the opportunity to reflect on and compare group discussions (chats) or personal reflections (blog).

Technological artefacts make visible choices, mental associations, different approaches to learning and problem solving and can help students gaining awareness of their mental processes.

For a lasting impact on student learning, influencing their lifelong- and lifewide learning through different types of learning and teaching settings (formal, non-formal and informal), it is fundamental to stress the importance of both cognitive and metacognitive strategies. It is also important to promote and/or enhance learning behaviours that allow students achieve their goals in a self-directed and self-controlled way. Successful learning with advanced learning technologies is based on the premise that learners adaptively regulate their cognitive and metacognitive behaviours during learning. However, there is abundant empirical evidence that suggests that learners typically do not adaptively modify their behaviour, thus suggesting that they engage in what is called "dysregulated behaviour" (Azevedo & Feyzi-Behnagh, 2011).

3 Motivational beliefs and socio-cognitive approach

A key role in learning process is represented by motivational beliefs and affective aspects (Pintrich *et al.*, 2003). This assumption is still valid in tech-

nology enhanced learning environments.

Learning expectations in technology enhanced learning environment and with computed mediated communication tools (chat, web forum, etc.) refer to the belief that these tools can help students learn better (Garland & Noyes, 2004). Studies on e-learning and online education have demonstrated that expectations strongly influence students' satisfaction in the use of ICT tools (Bures *et al.*, 2002).

Expectations are mediated by students' perception of their self-efficacy in using online tools. According to the Social cognitive theory (Bandura, 1977; Bandura, 2011) self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments. This belief is strongly influenced by the structural model of self-motivation and self-regulation of action. Self-efficacy is a focal determinant because it affects behavior both directly and by its influence on the other determinants (Bandura, 2011).

Social cognitive theory is founded on an agentic perspective (Bandura, 2011). To be an agent is to exert intentional influence over one's functioning and the course of events by one's actions. Social cognitive theory subscribes to a casual structure grounded in triadic reciprocal causation. In this triadic co-determination, human functioning is a product of the interplay of intrapersonal influences, the behavior individuals engage in, and the environmental forces that impinge upon them.

Self-efficacy belief is also a component of motivation. Pintrich (2003) identifies three motivational components that are present across motivational theories (though the conceptualisation of each varies): beliefs about one's ability to perform a task (expectancy component), beliefs about the value of the task (value component), and affective reactions to the task (affective component).

According to Pintrich's analysis (2003), the expectancy component has been considered in two senses: beliefs about the control one has over the outcome of the task (or one's environment more generally) and beliefs about one's efficacy.

The value component of motivation in Pintrich's analysis is broken down into two central components: goal orientation and task value. People's goal orientation has typically been defined in terms of two broad orientations: an orientation towards increasing competence (*mastery orientation*) or an orientation toward increasing performance relative to others (*performance orientation*). The former leads to higher performance and learning, but results regarding the latter are mixed. Specifically, a distinction is made between being orientated towards achieving high performance (approach) in contrast to avoiding low performance (avoidance). There is some evidence to suggest that having an approach performance orientation leads to high achievement and learning, whe-

reas an avoidance performance orientation leads to low learning outcomes.

Brett and VandeWalle (1999) reported that goal orientation does not have a direct relationship with performance, but that it is mediated by the contents of the goals that individual select.

Furthermore, goal orientation is associated with cognitive, motivational and affective components. In studies on e-learning and online education, goal orientation is positively related with effort, time dedicated to the use of ICT tools proposed in the course and with final assessment and evaluation (Bures *et al.*, 2002).

4 The research

Online social network are spontaneously used mainly for entertainment and communication. Learning to use them to manage one's knowledge is a strategic asset. It is therefore important to improve student capacity to learn through critical reflection on their learning process, increasing their awareness of the complexity of the process, especially when dealing with media and multimedia environments.

Our hypothesis is that study strategies aren't predictive of academic success, unless they are supported by an adequate attitude to self-regulated learning and to self-monitoring. Our aim is to analyse the relationships among self-efficacy belief, motivation, metacognitive strategies and learning outcomes.

The sample of the research was composed by Engineering students (mainly of the first year) of the University of Pisa, that follow a *blended* Management course. The institutional VLE – based on Moodle – has been integrated with a student support group hosted on Ning (EduORG2.0), which is used as a sort of 'laboratory', an environment in which students can enhance their learning through interaction and availability of further, non-compulsory, resources (Martini & Cinque 2011). In Ning there are: (1) a blog with post concerning daily lessons or team competition; (2) a forum, with are 3 pre-fixed categories (SOS, for better understanding; course continuous improvement; (3) groups: every group has its own page with logo; (4) case histories of entrepreneurship: an article is available every week and can be downloaded with BoxNet (integrated in Ning); (5) useful links; (6) twitter in home page: for rapid prompts by the teacher; (7) Most popular videos; (8) Must-read books: books review concerning Management are posted every week; (9) RSS from Il Sole-24 Ore and Ansa news; (10) Events: seminars with visiting professors; (11) scheduling meetings with the teacher through Doodle; (12) surveys trough Polldaddy; (13) feeds from Diigo; (14) cultural links.

The level of users' participation and proactive involvement is high since they see the community as an important element to increase their wealth of

knowledge, create new relations and increase their "learning" effectiveness and visibility. In addition, a number of users proactively participate in the creation of contents, take part in discussions and create interpersonal relations of trust and mutual engagement.

4.1 The survey

The main goal of the research was to investigate on student perception of the efficacy of technology enhanced learning, with a particular focus on social networking in university learning. Nevertheless the scope of the research is wider. Due to a multidisciplinary team, it also involves investigation in other related fields: motivation, metacognition and study strategies, ICT for learning and organizational abilities.

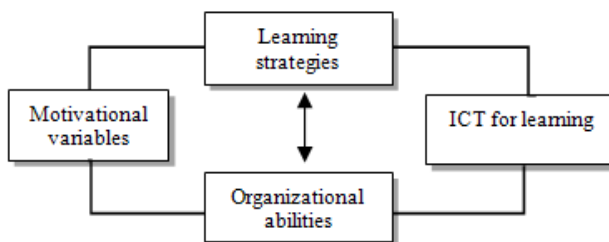The conceptual framework of the research is illustrated in figure 1.

Fig. 1 – Conceptual framework

To investigate on learning strategies and metacognitive competence we used a version of the questionnarie QAS (*Questionario sull'Approccio allo Studio*, De Beni *et al.*, 2003), that was already readuced ad adapted by Bonica (2006) for university students. The questionnaire investigates on five areas of university study strategies: (1) organization, i.e. the ability to plan and manage one's time in relation to study activities; (2) elaboration, the capacity to personally reflect on what has been studied and to look for further learning resources; (3) self-evaluation, the capacity to monitor one's learning and to evaluate one's own knowledge on a subject; (4) strategies to prepare for a test; (5) metacognitive sensitivity, which refers to meta-conceptual awareness of knowledge, i.e. to the capacity to reflect on ones' own mind functioning while studying.

For motivational variables we used a modified version of a questionnaire which was already tested and validated (Mattana, 2010) in a research on students of the University of Cagliari. The questionnaire investigates on the following items: learning expectations with ICT tools; mastery orientation; ap-

proach and avoidance dimensions of performance goal orientation; self-efficacy (in using ICT for learning and for teamwork). In the version used for our research, we included a section to investigate particularly on students' self-efficacy belief on their ability to use communication tools to collaborate on-line with their colleagues, to share information and resources with them.

To investigate on the use of ICT tools (both hardware and software) for learning we used a translation of the ELRC (E-learning Research Center) questionnaire approved by JISC (Joint Information Systems Committee), a British institution that monitor the use of digital technology in UK. The questionnaire includes 20 questions. Some of them require students to link specific activities (for example: communicating with students; communicating with family/friends; communicating with tutors/teachers; doing a learning task collaboratively; doing a learning task individually; gathering information; listening to course material; managing information; oral presentation; planning a group learning task; planning a individual learning task; reading course material; revising for an exam; self assessment exercises; viewing course material; writing an assignment) with the following tools:

- hardware (laptop, iPad or Tablet pc, digital audio, digital video, digital camera, electronic whiteboard etc.);
- online communication tools (chat rooms, emails, blogs, wikis etc.);
- online learning facilities (search engines, videoconferencing tools, virtual learning environments, online assessments etc.);
- specialized software (spreadsheets, word processor, Power point, project management tools, simulation software etc.).

The sample of the survey is composed by 220 students, if the first (130), second (70) and third (20) year of Managerial Engineering course at the University of Pisa. Students were explained the goals of the research and received the link for the access to the online survey. The survey is still open and up to now one third of the sample has already answered (85 students; *response rate* 38.6%), with homogenous distributions concerning gender (49% female respondents e 51% males) and age (70% of the sample is composed by 1st year students; 28% by 2nd year students; 2% by 3rd year students). Some of the students will be asked to participate in interviews in a further step of the research. All the students have used EduORG 2.0, the social network based on Ning that was set up as a support tool for the Management course (Martini & Cinque, 2011; Martini & Cinque, 2012).

4.2 The results

Learning strategis, organizational abilities and motivational variables

As far as the first two parts of the questionnarie are concerned, we calculated mean, standard deviation and correlation among the following variables (each one was represented by almost 10 items):

- *Learning strategies and organizational abilities*: (SO) Organization strategies; (SA) Self-assessment strategies; (SE) Elaboration strategies; (SM) Metacognitive sensitivity; (SPP) Strategies to prepare for a test;
- *Motivational variables*: (OOA) Learning goal orientation; (OOP) Approach dimension of performance goal orientation; (OOE) Avoidance dimension of performance goal orientation; (A) Self-efficacy.
- *Learning outcomes*: (V) assessment; (S) satisfaction.

After finding positive correlation between metacognitive components and motivational variables – and between them and learning outcomes (on this see also Cinque *et al.*, 2011), we analyzed the single items.

TABLE 1
Mean and standard deviation of metacognitive and motivational variables

Variables	M	DS
SO	2,72	0,41
SA	2,18	0,36
SE	3,29	0,61
SM	2,69	0,47
SPP	2,22	0,38
OOA	3,32	0,77
OOP	2,98	0,94
OOE	2,1	0,68
A	3,61	0,89
V	3,78	0,71
S	3,34	0,93

Analysing means, it is evident that both *outcomes*, assessment and satisfaction, have higher values. Among the motivational variables, the highest means are to be found in self-efficacy belief about technology enhanced collaboration (3,61), which is further confirmed by learning goal orientation (3.32) and in elaboration strategies (3,29). The lowest value concern self-evaluation and the

avoidance dimension of performance goal orientation.

All the variables are positively related, except for the avoidance dimension of performance goal orientation that is not related to: organization strategies, elaboration strategies and learning goal orientation. These first results confirm what literature had already shown on 'traditional' teaching/learning, i.e. the positive relation between metacognitive and motivational variables, on one side, and, on the other, between them and learning outcomes. As in previous studies, the splitting of performance goal orientation in two sub-dimensions (approach and goal) does not produce satisfactory results: the avoidance dimension of performance goal orientation has no adequate confidence level. This could be due to the fact that the avoidance sub-dimension is not distinguished from the approach sub-dimension of the performance orientation. The dimension of the sample doesn't allow for more specific analyses. Further studies, with wider samples, could validate our findings and the conceptual framework.

ICT and self-efficacy beliefs

One part of the questionnaire was specifically aimed at analyzing self-efficacy beliefs on the use of ICT and on-line resources (social networks) for communication and collaborative work.

TABLE 2
Self-efficacy beliefs in using ICT and online resources for collaboration

Activities	1	2	3	4	5
Communicating online with colleagues	2%	7%	33%	37%	21%
Collaborating online with colleagues	2%	7%	30%	42%	19%
Sharing information online	3%	8%	26%	41%	22%
Online team work with colleagues (blended modality)	3%	10%	31%	44%	10%
Online team work with other people (purely online modality)	3%	14%	26%	38%	19%

The majority of the respondents is in the medium-high part of the Likert scale, i.e. they *partially agree* (3), *agree* (4) or *fully agree* (5) on sentences concerning their ability to communicate, collaborate, share and work online both with colleagues (*blended modality*) and with people that they can not meet in presence (*purely online modality*). This last distinction is not so evident, so confirming that the distinction between 'physical presence' and 'online presence' has no sense for young people.

It should also be noted that a higher self-efficacy belief coefficient s not

related with the number and the variety of tools students use, an aspect investigated by a further part of the questionnaire. Following Bandura (2011), we can say that self-efficacy belief is independent from the 'effective' use, but is rather modeled by social environment, by positive feedback of the members of a group or a community.

This outcome is further enhanced by the results concern specifically the social learning environment created in Ning (EduORG 2.0). Students expressed positive and very positive feedbacks on the impact that EduORG 2.0 has on their learning, on its usability (interface and navigation), on teacher support and, generally, on the *blended* modality of the Management course.

TABLE 3
EduOrg2.0 impact and evaluation of the course

Sentences	1	2	3	4	5
EduORG2.0 was very useful to enhance learning and to improve understanding of the course contents	2%	0%	23%	48%	27%
The teacher's support was helpful to study the contents of the lessons	2%	0%	24%	48%	26%
Online activities were adequate to my learning needs.	2%	3%	31%	51%	12%
I received an adequate support to participate in online activities	2%	5%	26%	50%	17%
The blended modality (classroom and online activities) is adequate to my learning needs.	3%	5%	50%	35%	7%
The graphical interface of EduORG 2.0 make it easy to access it and to work.	3%	6%	14%	30%	47%
The navigation in EduORG 2.0 is intuitive and consistent throughout the wesite.	2%	8%	16%	36%	37%
I am satisfied with results so far obtained	2%	13%	43%	31%	10%

ICT for learning

For this part of data (based on the responses to ELRC questionnaire), after the usual analysis (means, standard deviations, correlations and frequency distributions), we thought to aggregate tools and activities, in order to produce a 'map' of technology usage for learning activities.

We created dicotomies for each category of tools. *Hardware* (laptop, iPad or Tablet pc, digital audio, digital video, digital camera, electronic whiteboard etc.) was divided into three dicotomic groups: 1.1 audio (Au) / video (Vi); 1.2 mobile (Mo) / desktop (Fi); 1.3 input (In) / output (Ou). *Online communication tools* (chat rooms, emails, blogs, wikis etc.) included two sub-groups: 2.1 synchronous (Si) / asynchronous (As); 2.2 sharing (Cn) / social network (SN).

Online learning facilities (search engines, videoconferencing tools, virtual learning environments, online assessments etc.) are represented by one group: 3.1 closed systems (Ch) / open source (Ap); *specialised software* (spreadsheets, word processor, Power point, project management tools, simulation software etc.) is divided into two sub-groups: 4.1 retrieve (Re) / map (Ma); 4.2 Microsoft Office software (Of) / different specialized software (Ss).

Analysis of the data across the different subgroups reveals a number of interesting results which give us a valuable insight into students' current practice in using technologies and their experiences.

The data show that students are using a range of different types of learning strategies, appropriating the tools to meet their own needs in relation to the kind of activity they are performing. This is why we furthermore aggregated activities in groups, in order to study which typology of tools (desktop/mobile, input/ouput etc) is prevailing in each typology of activities.

Activities were grouped in the following tasks: *assimilative task* (reading from a text book, listening to course material, revising for an exam etc.); *information handling task* (gathering information, managing information, oral presentation, self-assessment etc.); *organizational task* (planning a group activity, planning an individual learning task etc.); *communicative task* (communicating with students, communicating with family/friends, communicating with tutors/teachers); *productive/experiential task* (writing an assignment, doing a learning task collaboratively or doing a project work).

A further step was to map activities and tools on the Cartesian plane consisting of two perpendicular axes representing:

- productivity (concern for results);
- relationality (concern for people).

On the diagonal the learning axe is represented.
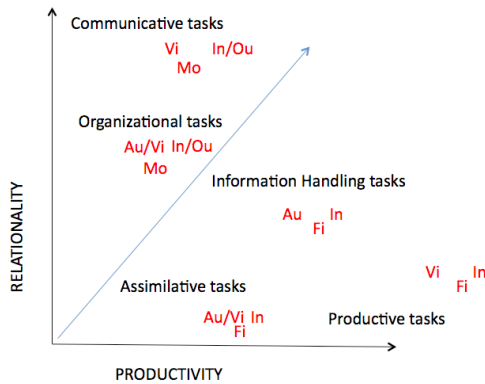Figures 2a, b and c show details about the single groups of tools.

Fig. 2a - Hardware

As far as hardware is concerned, we can say that while on the productivity side 'traditional' tools (audio, desktop, input devices) are prevailing, relationality shows a more variegate usage.
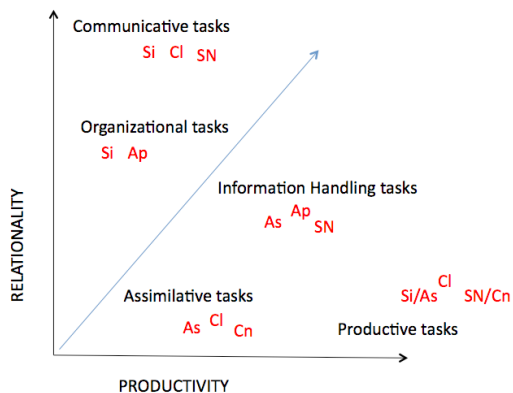

Fig. 2b - Online communication tools and online learning facilities

In this case, we put together two groups (online communication tools and online learning facilities) and we observed that among 'relational oriented' usages there is a prevalence of sychronous tools, of social networking sites and, partially, of open resources.
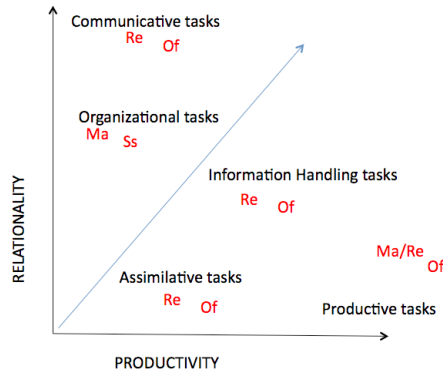
Fig. 2c - Specialised software

As far as specialized software is concerned, no differences are evident between the two areas (relationality and productivity) and in both cases 'passive' functions (retrieve) and usage of well-known software (Office) are prevailing.

Conclusions

These first results confirm literature findings on 'traditional' teaching/learning, i.e. the positive relation between metacognitive and motivational variables, on one side, and, on the other, between them and learning outcomes. Few studies have so far investigated these variables in online environments and, specifically, in social networking environments.

For the data concerning student experiences of technologies for their learning, we must highlight that we investigated usage and not 'preference' and that these experiences are influenced by many factors such as: environment, usability, accessibility, ownership and personalization, discipline demands, learning strategies, support and community, institutional infrastructure. This is why the socio-cognitive approach seems most appropriate to investigate on these data, since it takes into account also contextual parameters.

Furthermore our study confirms the importance of learning expectations and self-efficacy beliefs on student ability to make an 'effective' use of ICT for learning. It has been proved that these factors affect also student self-evaluation and their evaluation of the course.

The need for designing adequate technology enhanced learning environments has often been stressed in pedagogical literature and in teaching prac-

tices. This means, on one side, that tools should not be selected on the base of their availability and of teachers' preference, but to meet specific learning needs. On the other side, our study confirms once more that there is a gap, a 'dissonance' between the 'officially prescribed' learning technologies and the way in which students use technology outside the classroom. We need to 'rethink' about our teaching through the lens of the technologies used by our students and "while we do not hold that we should adopt all of the technologies that are in our students' pockets, the fact remains that if we begin to experiment with these tools, we will be better prepared to confront the challenges posed by the next wave of technologies" (Davidson & Waddingdton, 2010).

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