# Mathematics and e-learning: students' beliefs and waits

Giovannina Albano
DIIMA - Università degli Studi di Salerno
Centro di Eccellenza "Metodi e Sistemi per l'Apprendimento e la Conoscenza"

## Introduction

There is no doubt that ICT (Information and Communication Technologies) are now part of our daily life, investing all public and private activities we are involved in. The Italian Government strongly states their need as showed by the Financial Law for 2004, where many initiatives are cited, among them we highlight the projects:

- "PC ai giovani" (PC to young people), to foster the acquisition and the use of technological and digital tools among young people getting 16 years old during 2004, and also to cultivate their education;
- "PC alle famiglie" (PC to families), that recognises an economic contribution of 200 Euro for the purchaseof a personal computer jointly with an internet connection, during 2004, for those Italian people with a global profit in 2002 not major of 15.000 Euro;
- "PC ai docenti" (PC to teachers), that foresees the chance for teachers of public schools or universities to buy a portable personal computer to be used in education, taking advantage of a reduced price and of a payment by the division of the payment into instalments.

It is unavoidable that Education has to take into account ICT. Many initiatives have been undertaken by the MIUR (Italian Ministry of Education, University and Research) in order to spread the development of the didactic use of the technologies in the educational institutions. Deep considerations have been making in order to define new curricula in which possible modalities of using ICT in the curricula themselves are outlined and to define the main competencies that students have to acquire at the end of the high school.

The European Commission has launched the eLearning Programme whose global objective is to support and develop furthermore the effective use of ITC in the European education and training systems, as contribution to an high quality education and as essential element to adequate such systems to the requirements of the knowledge society in the context of life long education.

In the eLearning Programme a particular attention is devoted to the initial and continue education and training of the teachers, so they can use Internet and ICT during classes in a critical and responsible way from a didactic viewpoint.

The European Union underlines the strategic importance of elearning: "*E-learning has the potential to help the Union respond to the challenges of the knowledge society, to improve the quality of learning, to facilitate access to learning resources, to address special needs, and to bring about more effective and efficient learning and training at the workplace, in particular in small and medium-sized enterprises.*" (eLearning Programme).

The research problem that is at the basis of this first work concerns the following two questions: Which is the impact of e-learning on the students' learning process? How does e-learning influence in particular mathematics' learning?

In this work we present the results of a beginner investigation among students of the Engineering first year, in order to individuate their waits w.r.t. a course of mathematics supported by an e-learning platform: which is the influence of the ICT on the quality of the course, on the learning of the domain at stake, on the relationship with the mathematics.

In hard manner we have noticed the influence that students see on the relationship with the teacher, to be positively interpreted since teachers and students have been seen to be moved closer together.

## Methodology

The investigation has been performed by means of a questionnaire supply, with open answers, that the students have fulfilled alone and then have given back.
The students, before fulfilling the questionnaires, have seen a demo of the platform IWT and the available functionalities have been illustrated: on-line and off-line support materials, self-assessment tests, synchronous and asynchronous communication tools (messaging to the teacher and to other students, chat, group discussion, bulletin board). The demo has been as more aseptic as possible, that is just technical demo in order to avoid to influence the students.
The questionnaire has aimed to explore the students' expectations and beliefs w.r.t. the introduction of such kind of support for university courses both in terms of management and in terms of influence on their learning process, on the course's quality, on the relationship with the knowledge domain and with the teacher.
We have chosen to ask the name of who answers to the questionnaire in order to make a match with a corresponding questionnaire at the end of the course aimed to ask them if their expectations have been satisfied or not and investigate if and how they have changed their opinion. Such final questionnaire should be given them by the platform so who answers is obviously not anonymous, but many students have preferred to avoid to say their name or have said just the name or a false one (admitting that they were afraid to oppose the teacher and then suffer negative consequences).
We have given priority to open questions to allow the student to express their own thought and to make explicit the students' beliefs (Furinghetti, 2002) leaving the beliefs of the teacher who has a positive approach towards technologies support to learning out of the consideration.
The investigation has been performed using the method of the *self-fulfilling interview* (Brusati, 2003). The questionnaire has been distributed in the classroom: the students of Matematica I (that we will call "first group" from now on) have been asked to give it back at the next lecture, whilst the ones of Matematica II (that we will call "second group") have been asked to fulfil it promptly and give it back by an half of an hour.
We have observed that the first group gives back a number of questionnaires less than the one of the second group, but the quality of the first group is better in the sense that the second group of the students has given very brief answers not well justifying them, whilst the first group has given greater liberty to their opinions. This may depend on the fact that the first ones have fulfilled the questionnaire at home, with tranquillity, or maybe the less integration in the university system of the students just enrolled, has made them more spontaneous, avoiding all the implications due the identification of the teacher as evaluator of their profit, no didactical contract have already been defined.
We have collected 147 questionnaires. All the interviewed students have declared to have already used a computer before, but only 50% consider themselves "enough" able with technologies.
The students as average come from technical secondary schools.

## The main results

In this section we want to sketch the main results of our investigation. As we have *open* questions it has been necessary to codify the collected answers, that is we have given a look at the answers and make a list of the more frequent answers *type*.
From the waits of the students it is evident the assumption that just using the computer produces a better learning, that substitutes the assumption of the classic didactic "better teaching implies better learning". Such assumption of the students actually is the assumption of many teachers. To confirm these convictions we quote the so-called "Technological Principle", one of the six Principles of the

school mathematics of the NCTM (2000) that asserts without no empirical researches confirming it: «*Technology is essential in teaching and learning of mathematics; it influences what is taught and improves students' learning*» and the recent study "Evaluation of Computers for Teachers Phase One" of 2001 (DfES, 2002) where the following result is reported: in the last years the percentage of the teachers that *believe* that the computer improves learning has increased from 36% to 68%.
We have observed that the expectations about a course supported by a technological platform do not regard only the learning of the domain knowledge at stake (that is Mathematics), but they go behind and consider the ability of using a computer: «*To be able in the use of a computer in any domain*», «*To become able and able in using a computer*». Once more the burden of the computer's pushiness in our society has been stressed: «*…by now everything is made by computer*». Sometimes the quality of "intelligence" has been imputed to the computer itself rather than to its use: «*…I think that the future will be mainly characterised by smart tools as the computer itself*».
Moreover they expect to learn knowledge useful in their future work world. The given answers w.r.t. the usefulness of the use of the platform as support make evident the remarkable importance that the diffusion of the computer has in the daily life and the society's beliefs about such a tool, that has been seen as a MUST to "live" in our society: «*…today it is daily bread, it is on the agenda…*», «*…especially in a society as ours where by the time the PC dominates*», «*…by the time it is essential to be able to well use it, because everything is based on the computers…*», «*…tomorrow it will be the main tool of my work*», «*today the computer is much important, to be able to well use it allow us to go further*».
The role of the teacher as tutor, as guide for a right use of the computer, has been underlined and also requested. In case of absence, the computer may be an obstacle: «*Certainly useful, but also a bar if the work is not supported by the teacher in a right way, otherwise I am exposed to the risk of losing myself because of the "dispersiveness" proper of the technological tools*».
We underline that till from the first question the wait of a wider contact with the teacher has been made explicit, and it remains constant in all the questionnaire. It is interesting the considerable percentage of students that expect an improvement in the relationship with the teacher, due to the augmented chance to communicate provided by the technological tools: «*… creating a sort of direct contact teacher-student*», «*…there will be an interactive link with the teacher*», «*There will be more dialogue and approaching between students and teacher* ». We suppose that such sensation of approaching (even if not physical) should be read as "*it is beautiful to know that there is*", that is the approach consists in the fact that the teacher is always reachable (by email for instance) if they want or need. Through the platform the teacher is perceived closer, helpful, etc, and these factors have positive influence both on the motivation to study and be involved in the course «*The student is eager to learn and like the course much more*» and on the understanding.
We explicitly remark that in almost 50% of the questionnaires the students refer to the wait of wider interaction with the teacher, approaching him easier and more frequently. Such wait is so high to be expressed apart from the posed question: we can talk of the quality of the course as well as of learning, of the relationship with mathematics, in any case such wait of approaching to the teacher appears almost "intrusive"! In the case of university context maybe this is more noticed because of the high number of the students w.r.t. the high school, then the relationship between teacher and student can be more anonymous. So we can read a request of contact with the teacher, who above all at university level is felt distant and absent. Tools as those offered by the ICT approach the teacher in way that is less formal, less rigid, "warmer" in the sense that the relationship between teacher and student becomes less asymmetric: «*I believe that (the platform) helps to establish a more friendly relationship between teacher and students* ».

Exactly the high frequency of such type of responses is the reason of putting (for the second group) an explicit question on the computer's influence on the relation teacher-student. Anyway, such influence continues to appear in the answers to almost all the questions.
Note that the improvement of the quality of the relationship between teacher and student have great influence also on the improvement of the relationship between student and mathematics. In fact, the 44% of the students say that the ICT-support, by itself, cannot change their feeling about mathematics: «*I don't think so, the numbers are numbers, written or visualised on a computer* », but most of all the students think that the teacher can influence (both on the good and evil side) their relationship with mathematics: «*No, I don't think the computer is able to change the relation with mathematics, but a teacher yes* », «*A bad professor can change a good relation with mathematics (it happened to me during the last year of the secondary school, non a computer)*». This belief is true also for the quality of the course as stated with much firmness in the following phrase of a student: «*I believe that the only thing that can "un-qualify" a course is a teacher who "DOESN'T LOVE" what he/she teach and who "DOESN'T TRASMITT PASSION" to his/her students. Personally speaking, I think that an "enthusiastic teacher" allows to learn more than any other tool*».
The computer has mainly seen only as a tool able to better understand, anyway among those who believe that the use of the computer will change their relation with mathematics, some of them consider it like a tool "quasi magic", they "trust" that it can allow to overcome the difficulties they have met until now: «*… in the sense that it will improve my abilities to solve problems and theoretical exercises*», «*… because to study with a computer is more constructive and smart!* », «*… because by the computer it will be easier to face mathematics class an home works* ».
Among the negative aspects of the use of a platform, the main obstacle has been individuated in the fact that it is needed to learn first the tool (the platform, the software) to be able to learn mathematics and this is considered as an extra work. Then a course using the computer is harder, it needs an investment (sometimes seen as "loss") of time to learn the use of the tools, that has been considered subtracted to the time to be dedicated to mathematics' learning. The doubts expressed by a minimum part of students (8%) have regarded the capability of using the computer and the related needed.
Finally, we want to note that the obtained results allow to make a sort of correspondence between the teachers' beliefs and the students' waits. In fact, according to the classification of the teachers' in (Bottino, Furinghetti, 1994, 1996a), we have the following situations on the teacher-side:

- teachers who consider the computer as a tool useful to introduce mathematical subjects in a faster, simpler or more interesting way;
- teachers who aim to give the students a vision on the practical usefulness of the computers and of their impact on the social life.

From the results of the questionnaires, we have found the following situations in correspondence on the student-side:

- students who, thanks to the computer, expect to learn faster and easier and to feel mathematics more interesting;
- students who expect to learn the use of the computer because they needs it in the daily life and in our society.

## Conclusions

As conclusions, we think that many interesting starting points have been arisen from the described beginning investigations and we plan to use them as basis for further inquiries and more intensive and suitable activities in blended learning, involving both metacognitive and affective aspects. An

experimentation have been just performed in the course of Matematica II for students of Electronic Engineering in the first part of the current year. The collection and analysis of the results is in progress.

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