E-TUTORING AND MATHEMATICS: HOW THEY WORK IN BLENDED LEARNING COURSES.

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1. Introduction

School and university are, in general, the places where society can create for its students the possibilities to express to the fullest their own learning abilities. These possibilities arise when both learning and teaching exist in constant interaction when the student is assigned a pro-active role. E-learning technology represents a fundamental resource in such an approach, by allowing for a level of flexibility that permits lecturers to follow a creative teaching pattern of active teaching even in subjects where the theoretical aspects are prevalent, such as mathematics.

In every educational institution the teaching of mathematics has had to face growing and more specific problems, especially in relation to modern students' attitude towards this discipline coupled with a general decline in students' mathematical abilities. Teachers and lectures are finding that mathematics is held in low regard by many students who fail to apply themselves and as a consequence have more difficulty in mastering the subject. As Peter Gates states in his Issues in Mathematics "I see mathematics envisaged by pupils, parents and teachers as little more than a collection of techniques to be captured rather than an approach to be understood." (Gates, 2002). Within a university setting lecturers are finding that students come to them with lower competences in mathematics and therefore have to spend some time making up ground. This is especially true of students within the Faculty of Economics, where many students treat the subject as merely a starting point to better understand the disciplines of economics and statistics, where the more theoretical aspects of mathematics are considered to be an overarching structure that to many students is difficult to understand and assimilate. Lecturers find themselves having to discuss topics from the point of view of their actual application, rather than their conceptual worth which then leads to a weakening of learning potential that in turn means students have a superficial understanding of mathematical concepts. This is connected to the importance of a university education that guides students towards research as a fundamental skill to be gained by students in the process of life-long learning. These and other considerations have lead us to undertake new teaching practices in which classroom lectures are intertwined with valuable experiences online.

From observations made on the students both in the classroom and online, it would appear that as regards the discipline of mathematics, students' cognitive styles remain completely personal and lend themselves with difficulty to collaborative group activities. For example certain problems set by lecturers in the online environment encourage students to engage in a virtual dialogue with the lecturer without the students dialoguing amongst themselves in order to obtain a solution. In mathematics blended learning courses, students are set tasks wherein they had to correct certain mathematical problems. The lecturer noted how each student duly produced answers online that often necessitated the same corrections on the part of the lecturer without first collaborating with their peers in order to come to a collective answer. It seemed therefore important to promote more collaborative attitudes and autonomy amongst students of mathematics with an eye to future research in the subject by the students.

It is within this context that the questions surrounding the definition of the role of lecturer and tutor arise (tutors may be experts in the field or senior students.) It is crucial to define each role and the relationships and collaborative work undertaken by these figures as regards the collaborative arena that is e-learning in order to achieve the results

required from the students on behalf of active participation. As Crosta and McConnell point out (2005) Italian online courses often have the distinction of separating the tutor and lecturer role between the tutor who is the "online" expert and the lecturer as "content" expert.In section 2 we outline some pedagogical reflections of the relationship between lecturer and tutor: in section 3 the paper presents an experiment that has taken place within a mathematics course delivered in blended learning mode at the University of Bergamo and involving senior students; section 4 outlines a project and modus operandi of a tutorship project and lastly section 5 offers some conclusions.

2. A note on tutoring and autonomous learning

As well as being a specific educational technique, tutoring can be appreciated for its role in creating relationships of varying kinds and therefore seen in a more complex light of "tutoring process". As with any type of relationship different levels co-exist: the *inter*-personal that is reworked by degrees (in a co-progression between the participants) and the *intra*-personal sense (that is, of personal development.) The "tutoring process" as a whole brings into focus questions on dependence and autonomy. As Ehlers (2004) points out "a learning process is not something that is delivered to a learner by an e-learning provider but rather constitutes a process of co-production between the learner and the learning-environment." Or rather, how can a lecturer not fall into a tutoring relationship that creates barriers to true student autonomy? How can one work with a student to instil genuine lifelong learning skills through a didactic presence in accordance with the student's personal style of study rather than resorting to study techniques aimed at short term performance goals?

This idea of guiding the student to lifelong learning skills occurs when the student "learns" to participate actively during the tutoring process and can therefore assume for themselves tutoring skills. The tutor emerges as an important bridging factor between cultural, disciplinary and contextual experience. Such a figure should be able to create ties and interactions between the many steps in the educational life of the student. The tutorial also has the role of promoting life-long learning by removing obstacles that stand in the way of effective participation on behalf of the student in courses, by identifying and developing the complex needs that are manifest in the educational, social and professional culture of the student. However the tutor should know how to create and maintain a relationship with the student that does not fall into a dependence on the part of the student but rather safeguards and helps promote his or her growing autonomy. Dependence occurs when there exists a strong asymmetry between tutor and student, that often can emerge in the differences in ability and knowledge typical in higher education contexts. In such cases the student loses faith in his/her own knowledge, in his/her decision making abilities and begins to focus on a role that highlights performance rather than looking at concepts and innovation that would help the student project him/herself better in a professional context. The tutor must be able to active a dialogue that is not totally defined by the role/goals envisaged by the task in hand. They must be able to create an empathetic environment where all members can exchange ideas typical to each participant in a tutoring relationship. It should be stated that autonomy does not mean the absence of any relationship, but is, rather, the ability to engage actively in these very relationships. Within a tutorial process the student can develop the skill of "resilience", that is, the ability to bear, tolerate (to a certain degree) and rework hardships (included those on a psychological level) that are inherent in an educational life. The ability is in some way activated, acknowledged and considered by the student him/herself thanks to the tutoring they have received during their university life. In general, tutorials lead by lecturers, remain discipline specific and essential in the discovery and understanding of crucial subject points and those on which to work during the tutorials themselves. It is on this basis that the "tutorial relationship" which lies at the heart of the "Humanities" and their interdisciplinary background is created. Therefore it is necessary for lecturers to develop skills in educational, relational and organisational group roles as well as the methodologies of monitoring and evaluating formative processes (be they internal, external or autonomous.)

Such skills are tied to the teaching role that is transformed into a softer role whereby the lecturer takes on the role of tutor in the sense above. Considerations that emerged from teaching experience lead us to define a tutorial function of a different level that is less discipline based but rather focuses on more specific collaborative relationships. By observing the dynamics in the relationships between students on a specific university course it became evident that the relationships created with more experienced students who served as mediators between course contents and skills proved highly efficient. Such interventions work both on a linguistic level and on a motivational method. Above

all in certain disciplines, such as mathematics (as stated earlier), the advancement of knowledge has to be promoted through situations where "natural" defences and student diffidence need to be broken down. Whatever a lecture does in this context can often prove ineffectual, as they place at the centre of their relationships a certain linguistic rigor and assume a certain motivation on the part of the students. It is therefore crucial to introduce new figures as tutors who, on a linguistic level, can encourage the interaction between personal language and language tied to the discipline and on a motivational level can support attitudes that lead to greater curiosity and openness on the part of the students. As Breuer points out (based on his own and other studies) "successful e-learning always requires the existence of a teacher or tutor who coaches the students…communication does not adjust itself between the learners simply by bare request" (Breuer 2004)

3. E-learning in Mathematics courses.

Starting from 2004-2005 the Advanced Mathematical Methods course in the Economics faculty was delivered in blended learning mode. The course took place with modules each one over 4 weeks and the activities contained therein echo the classroom structure of the course by developing topics and deepening knowledge through practical activities, tests and exercises. The lecturer noted how interaction in the e-learning part of the course was solely lecturer-student, with students constantly referring to the lecturer's superior skill and knowledge of the subject completely bypassing other students (even when for example the same question had been posted in a discussion room and indeed been answered already by the lecturer). Students divided into two broad camps: average-low ability students, who preferred to undergo practical activities, exercises and tests and showed little interest in participating in forums or more collaborative problems and average-high students who participated actively in more complicated problems and showed some willingness to interact with fellow students, or rather would respond to any adjustments made by other students to problems set by the lecturer. The lecturer was interested in drawing out the average-low level students in order to give them the confidence to participate more and therefore learn to interact more spontaneously with their peers in an e-learning context.

The following year (2005-2006) a tutor system was instigated whereby certain students from previous courses who had demonstrated both skill in the discipline and active interest in the e-learning part of the course were engaged as tutors. The idea being that someone who was closer to the students themselves would be able to assess their needs, abilities, be able to oversee their online participation and bring out those who needed it. As the student-tutor had already participated in the course previously as students it was felt that they would have certain pre-requisites, namely:
- they have enough subject knowledge to answer questions posted up in discussion rooms;
- having had personal experience of life as a students on the course they would be able to understand, capture and resolve any difficulties that students on the course were having.

As McPhearson and Nunes point out e-tutors should have skills that "provide advice on different levels of access to learning materials according to the need of individual participants" (McPhearson and Nunes, 2004). The idea of using senior students is that they are closer to the students' needs on some levels than the lecturer. Tutor training was established so that the first phase took place before the start of the course where the student tutors would go over the material to be used with the lecturer and together would offer advice, suggestions etc in order to improve the scope and aim of the materials to be used. This kind of collaborative work means that the tutors themselves feel more ownership of the course and have more invested in making it succeed, vital, according to Kennedy and Duffy (2004) to the success of any distance course. This phase was very successful with tutors engaging actively with the lecturer in providing new direction for the materials to be used. The second phase then took place in the first 2 weeks of the course where the tutors would overview forums and discussion rooms without actively participating in order to gain an understanding of the problematics and difficulties students of the course were having. The third and final phase took place in the last two weeks of the course where the tutors would be free to intervene directly in the e-learning environment when they thought it necessary by answering questions, posting up appropriate exercises and generally guiding students as they saw necessary. These second and third phases did not prove as successful as the first phase, in that students in the course made little connection with the tutors and therefore the tutors had little

visibility within the course. The fact that the tutors kept wholly to the online environment meant that the students on the course did not fully recognise them or their roles within the course and therefore continued to refer to the lecturer as their sole source.

For the course in the academic year 2006-2007 the tutor role evolved somewhat to become a "holistic tutor", that is, tutors now engage with students within the classroom as well as the online setting. The use of the word holistic denotes a role that encompasses all aspects of both the course and the students' path through it, The holistic tutor not only operates on a didactic level but also maintains a watchful eye on the students' welfare. This role serves especially to promote life-long learning skills in conjunction with subject matter. The aim of using a holistic tutor is to create a figure that the student can refer to for whatever issue he/she may want to discuss. As Crosta (2006) notes in her description of a blended learning course, "I became more and more aware of how the moral, psychological and affective support was crucial for the participants' learning experience, more than the need for explanations of the content." This is possibly even more relevant in a subject such a mathematics, where students who are in difficulty can find it extremely unnerving to ask for help from a lecturer. In keeping with our philosophy of tutoring as expounded previously in this paper, the holistic tutor is the one who can draw students into a reciprocal tutoring relationship where the boundaries of mentor/pupil are levelled to create a more equal relationship of giving and asking. One of the benefits of blended learning that tutors are able to interact face to face with students and it was felt that perhaps by taking advantage of this fact in order for the students to come to know the tutors would mean that they responded to them more. The idea behind the holistic tutor is a senior student who becomes a reference point for the current student other than the lecturer, where different dynamics take place in the relationship. The tutors role is much more informal and allows as student who may not be too confident in his or her ability to make contact with a far more approachable figure. It was also hoped that tutors could encourage a certain collaboration amongst students.

4. The Tutorship project

The project described in this paper has demonstrated the potentials and weaknesses of the diverse forms of traditional tutoring and has demonstrated the need for greater integration between activities in the classroom and online by tutors. The principle aim is to develop the relationship between student and both in the classroom and online. Rather than have a tutor that is a discipline expert or acts as a facilitator online, the tutorship project has assigned different activities to various tutors to undertake in the classroom (exercises, seminars etc) depending on each person's strengths. Tutors were chosen from students who performed particularly well in different activities in the previous years course. In parallel to classroom activities, each tutor will create a personal discussion room in the e-learning part of the course. Each forum is wholly managed by the tutor who uses it to maintain contact with the students and to stimulate participation. In this way students are more eager to participate as they know the person they are dealing with and what type of questions they can put in each forum. Tutors are in a sort of "competition" with the aim of having the "most successful" discussion room, thus tutors are stimulated to take on responsibility for their forums and become more autonomous themselves. The lecturer takes on a more supervisory role of a subject expert intervening when he or she becomes aware of difficulties that need his/her particular attention. The course then becomes the "property" of each stakeholder (lecturer, tutor and student) where they can achieve personal professionalism in a truly collaborative environment. In particular the project regards a Mathematics course that lasts 12 weeks. As on the course mentioned in Section 3, tutors will be involved in the creation of course material with the lecturer and organisation of the forums. In this phase the tutors can gain a good understanding of the pedagogic approach of the lecturer and become much more involved into the course project.

Each tutor has a different context and various tasks in order to support the different needs of the students and their particular approaches to study. In 2 hours weekly face to face time with the students the tutors can have personal contact with them in order to facilitate on-line collaboration and to have a good feeling of the going head of the course. Each tutor has a personal forum and is in close contact with the teacher of the course in order to resolve problems and to ask for a direct intervention of the teacher if needed. In weekly meetings with the lecturer the tutors discuss problems and organize the activities of the next week. It is important that each tutor has very clear

environment and a high level of autonomy in proposing and performing activities. Three tutors involved have been assigned the following roles:

Tutor	Context	Tasks
Traditional tutor as discipline expert	Each week this tutor takes a lesson face to face in which he proposes the solution to exercises and suggests some others which will be published on the e-learning course. In this way there is a connection between the activities in the classroom and the on-line communication.	Creates practical activities in the classroom and posts up problems for students to discuss on the website
Tutor facilitator	Frequently most students in mathematics courses had problems in using e-learning in an efficient way to create texts, publish materials, post messages. The tutor facilitator aids the students in this aspect.	Supports students in the production and publication of materials
Holistic tutor	This tutor participates in some of the lessons and is available for discussions with the students taking some appointment, if needed, for individual work.	Supervises students in their individual study paths by making suggestions and encouraging the use of all the available tools

At the end of the course tutors help the students to prepare for the exams helping the lecturer to evaluate the personal path of each student. It is not the single on-line activity that is evaluated but the entirety of the work of each student and autonomy and original approach is taken into account. The role of the lecturer is to deliver the lessons and to oversee the on-line process giving suggestions to the tutors and proposing new activities; the aim is to make the lecturer a supervisor of the on-line course but very much involved in it.

5. The tutorship project in action

The Mathematics course where the project took place has the following characteristics:

1. Students enrolled on it are all in the second year of degree courses within the Economics faculty

2. The course is divided into three modules:
    a. Integrals
    b. Functions of several variables
    c. Optimization
3. Some students took all three modules while some only part one and some only part two.

The course therefore demonstrates many differences in student experience and length of time students frequented. In previous years this meant that it was difficult for students to engage in any e-learning activities especially with regards to discussions between students and lecturer. It was noted that in a four week period (the length of one module) students only used the e-learning environment in the last two weeks, and only then to ask somewhat banal questions (correction of exercises) rather than engaging with any of the problems posted specifically on the web site.

The project took place as described in the following table:

Module	Weeks	Topic	N° hours f2f	N° of students	Tutor facilitator (Chiara)	Traditional tutor (Francesca)	Holistic tutor (Riccardo)
A	4	Integrals	24	49	yes	yes	yes
B	4	Functions of several variables	24	52	yes	yes	yes
C	4	Optimization	24	26	no	no	yes

As one can see the project covered the whole course but the tutoring activity took place effectively in the first two modules, in the third tutoring acted mainly as a support to students to help them prepare students lead seminars to be given at the end of the course.

The results of this experiment proved interesting. The use of tutors in the e–learning part of the course meant that students engaged with it much more quickly and not only in standard activities, but also by participating in discussions and the resolution of problems posted by the lecturer. The most difficult problems where posted in the forum of the Holistic Tutor (Sala di Riccardo) that subsequently became the liveliest room with frequent exchanges between students and students/ tutor without ay lecturer intervention. Student interventions in tutor forums and in standard activities were analysed by frequency and it was noted that although the number of student s who actively took part was relatively small, participation was constant and intense. At the end of the course students completed course questionnaires where it emerged that although many students did not actively participate, most kept up with discussions (classic "lurker" behaviour). All the students rated the tutor presence both in face to face and in e-learning with high approval as the tutors showed themselves to be very available and closer to the students' way of thinking. Finally we observed that results at the end of the course were better than previous years and that above all students seemed truly interested in the subject matter. It is however also worth noting that while in the first two modules students undertook that online activities for the most part on their own, in the third module students began to form collaborative groups, with sometimes a resulting loss of quality in the work. This point will be studied further as the project continues with a focus on the limits of collaborative work as regards the learning of mathematics.

6. Conclusion

We have discovered in the course of examining a mathematics module over 3 academic years that the use of tutors in a blended learning environment, both in the classroom and online can be highly beneficial for students. Through the experience we have undergone we have decided to change the role of tutor from a disciplined based "teacher" to one which is more focused on the students' interests, and so have created different tutoring roles. Evidently, these roles are in many ways "tailor-made" that is, they match skills senior students demonstrated when enrolled on the course as students. In this way we hope to bridge the divide between lecturer and student, between mentor and learner and allow students to develop for themselves skills that go beyond the subject matter in order to develop possibilities that signify that the students themselves will be able to fully partake in the tutoring relationship in an equal manner. In a subject such as mathematics, such a relationship is keenly sought if the students are to develop a fuller understanding of the discipline. Furthermore as university students it is imperative that they gain expertise which goes beyond disciplines and enhances their lifelong learning skills. As Holley notes higher education institutions should the produce graduates who are theoretically and practically prepared for working in an information age (Holley 2002)

7. References

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