

# **Discutere di Matematica: confronto tra il caso online e in presenza**

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My doctoral thesis concerns research in mathematics education, with particular reference to the use of the social networks. In this respect, I am interested in online discussion in mathematics and the comparison between the online case and the face-to-face one.

My starting point was the curiosity to investigate if it is possible to discuss online about mathematics. The hypothesis of research primarily concerns the temporal dimension of asynchronous online discussion with respect to synchronous face-to-face discussion. On one hand this asynchrony allows the student to acquire a better understanding of the learning path through the dialogue (for example, they can ask others to be helped in understanding a concept that find difficult or address a particular problem). On the other side, having the possibility of intervening in a time that can be considered infinite, both the student and the teacher can come back at any time on issues already seen and resume them from a different point of view, or having another maturity or according to a personalised time for single student. The asynchrony also allows to think before answering and, therefore, allows to give more thoughtful responses. These comparison and back-and-forth mechanisms work on the metacognitive level of learning, which is essential to support the growth of an independent student.

Equally important are the effects on the non-cognitive / emotional level of learning, such as the motivation and confidence levels. A student who is struggling with new ideas will be reassured to discover that other peers are facing similar difficulties. In addition, the possibility of an interface as the computer and be able to think before answering can reassure timid students.

The term discussion was introduced formally in education by Pirie and Schwarzenberger (1988) as "speech focused on a mathematical topic in which there are original contributions of students and interaction". In their approach, as well as in Richards' one (Bartolini Bussi et al. 1995) and in the French scientific tradition (Doise and Mugny, 1981), no importance is placed on the role of the teacher. Later, Bartolini Bussi and colleagues (1995) distanced from such ideas and took inspiration from Vygotsky that, speaking of internalization, refers to interactions between teachers and students who play different roles to be valued in the teaching –learning process. Bartolini Bussi, Boni, Ferri (1995) identified a typical scenario of mathematical discussion where there are multiple entries, each of them having an internal component (thought) and external one (speech) that makes communication possible. Various types of discussion can be defined: problem-solving discussion, conceptualization discussion and meta-discussion.

In my research I was interested in the use of the social network Facebook and the e-learning platform Moodle for online discussions. The first involved the fifth year High School students as well as incoming university students, so considering the delicate transition from secondary school to university. Conceptualization discussions (e.g. on the concept of limit) as well as problem solving discussions took places: in the first ones, the meaning of the concept at stake was negotiated with students, in the latter ones the students have been involved in discussing various solutions proposed by them. In the thesis, some carried out activities are presented.

Chapters I and II were devoted to frame the research problem in the literature and highlighted some possible differences between the face-to-face and online discussion. I have considered the theoretical framework distinguishing between dialogic learning and mathematical discussion. The first refers to a learning that takes place through the egalitarian dialogue in which different people provide arguments based on the validity of the claims and not on the power of the same (Kincheloe et al., 2007). The second is characterized by the presence of multiple entries each having a different role that must be respected (Bartolini Bussi et al, 1995).

After an introduction and analysis of the tools with respect to education used for discussion, namely Facebook and Moodle (Chapter III), I have described in details the experimentation of the online discussions on Facebook (Chapter IV) and on Moodle platform (Chapter V) with students from a High School. In Chapter VI, I analyzed a further experimentation on Facebook with incoming University students, aimed to recover some basic mathematics knowledge needed as pre-requisites to Engineering courses.

For each experimentation, the analysis of the discussions' transcripts with respect to the initial research hypothesis is presented.

In Chapter VII, we have analysed the students' answers to questionnaires submitted at the end of the experimentations, in order to investigate their opinions on the carry out activities.

The thesis concludes with the final comparison of the cases studied observations and indications of possible future research opportunities.

Summarizing the outcomes of the thesis' work, we can say that first of all the use Facebook was perceived differently by the students at school and at university. The former ones, in fact, did not participated consistently and continuously because they considered the discussion far from the ability needed for the forthcoming examinations. I tried to figure out if there might be a relationship between student participation and their view of mathematics. So I get back to read their narratives about their relationship with mathematics (they made during our first meeting). I found that students who did not participate in the discussion considered mathematics as a subject made only of exercises, as opposed to those who took part who believe that mathematics is also more. For

instance, we report some excerpts from the narratives. Students engaged in the activity wrote: “mathematics can be regarded as the philosophy because it too is not based on logic calculation but of thought”, “math is a discipline that I have been always interested in even when I have been not able to understand it and to solve a particular problem. This is probably because I have been always aware that, when I was able to solve it, I could tell myself to be able to reason”. Students who did not intervene in the discussions seem to share their conflicting relationship with the mathematics, sometimes identified with the teacher, such as: “Long time ago I and math agreed a lot and my performance was the best. All was complicated when a teacher has traumatized me not explaining where I made mistakes ... The trauma has been continuing up to date where I cannot say what is my relationship with mathematics”. In other cases the beliefs concerning self-efficacy come into play, such as: “I and mathematics are two opposite things. Despite repeated attempts in trying to assimilate something for personal satisfaction, I realize that unfortunately I have no aptitude for this matter”. The discussion lasted about a month, and then stops abruptly. This is why I did an interview where the students stated that they did not take part in the discussion no longer because of final examination occurred in June. Nevertheless they get a look at many questions without answering. It would seem that the activity did not work because students do not perceive Facebook as a place where to study seriously.

Instead, the analysis of activity on Facebook with University incoming students revealed that it worked very well. Students made use of the online tool intervening frequently and arguing, in many cases, the answers chosen among the multiple items, responding to the moderator's explanation requests motivating the answers. The fact that the questions were always available gave everyone the freedom to be able to choose the time to take advantage of support, and this has been certainly one of the benefits of the asynchrony of the discussion. The moderator was just a facilitator who helped to give the role of an expert to one of the team's member, becoming a resource for peers. The intervention was personalized and, often, an interesting discussion arose concerning the possibility of using different semiotic systems.

The analysis of the transcripts of the second experiment with high school students on Moodle platform revealed a blended use of technologies when students begun posting pictures of exercises written on exercise notebooks or LIM, and it also revealed the progress of discussion due to the comparison among peers and with the teacher.

From the analysis of the final questionnaire, it was possible to infer that this difference is due primarily to the students' desire to compare with peers and especially with the teacher (who at the university is perceived as distant). Moreover they consider such a comparison as an effective support, essential to enhance their learning to let them able to certainly overcome any gaps.

Concerning the experimentation using the Moodle platform, the questionnaires reported a positive perception of many students, due to the online availability of the teacher out of the office hours. However, the participation was not so active because of lack of motivation intrinsic to the student.

The used tools have allowed to show how much students like the continuous teacher's support at any time of the day in order to clarify their doubts without the need of waiting the classroom time, that can occur few days later.

The research also highlight the critical issues identified in the explanations proposed in the textbooks, can slow learning of the discipline while being able to constantly compare helps to overcome them immediately.

The findings encourage us to continue our investigations with the intention to analyse more specifically the reasons for the limited success of the debate at the high school and then go to plan more wisely activities. Based on the findings certainly more continuous observation of classroom activities allow on one hand to test and refine the analysis tools, and on the other hand to clarify the relationships between the face-to-face and online discussion.

I also plan to carry on the experience at university courses to understand the evolution of the use of on-line discussions on social networks as a methodological practice over a long period, in order to exploit and maximize the benefits and to reduce difficulties and draw-backs.