

## Foreword

There is a global perception that mathematics is surrounded by a special aura that places this discipline in a rather unbalanced position. On the one hand, mathematics is all around us, permeating everything, and has been created to simplify our world by building models to better explain and understand our reality. On the other hand, mathematics appears rather complex due to a broad range of variables; for example, its intricate notation. Nevertheless, and also quite inexplicably, mathematics enjoys a massive consensus around the world: theorems, formulas, principles, methods, and so forth are identical from one continent to the other. As if to further enhance its splendour, mathematics is known as the “queen and servant of the sciences” because it supplies the needs of other sciences (physics, economics, geology, engineering, etc.).

However, teaching mathematics is not mathematics itself, it is a completely different issue. Curricula, teachers, and institutions must deal with the perceptions and emotions provoked by this divine discipline. Hundreds of papers have been written on the subject of the anxiety caused by mathematics learning, not to mention feelings of frustration and a lack of self-confidence experienced along the path towards accomplishment. Linked to this, a common belief can be identified in the educational arena: students have the sense that one is either good or bad at mathematics. Those who are gifted at mathematics are believed to be blessed with divine inspiration thus making their locus of control more external. These feelings are virtually exclusive to learning mathematics. Of course, successfully learning mathematics is also related to enthusiasm and empowering, both of which are required for achieving the prized goal of autonomy. It is not easy to find the middle ground when talking about perceptions and behaviour and that makes the teaching work in a mathematics classroom all the more difficult. It is also a challenge for teachers to gracefully cross the bridge separating mathematics (as a discipline) from teaching mathematics (making it meaningful), tackling Chevallard’s evocative “didactical transposition”.

In this context, teaching and learning mathematics has an ally in online education. Like all partnerships it can be for better or for worse; in the end, it mostly depends on one’s willpower and ability.

In equal shares, online education has the ability to either improve or worsen mathematical teaching. It is taken for granted that when designing an online course the ultimate aim is to improve teaching and learning and not simply to reach the greatest possible number of students with the least amount of effort by breaking through barriers of space and time. However, in both the design and implementation phases there are important decisions to be made that have no routine answers, much less any solutions that can be copied directly from face-to-face education. On the contrary, teaching delivered using a technological medium is supposed to be extremely considerate due to the fact that technology mediation is able to take us from one extreme to the other without us really being aware of the journey. Teachers are able to bring together a group of elements that enhance significant learning all in the same course. In this modality of

learning it is easy to succumb to the temptation of teaching large numbers of students while expending the minimum amount effort. Nonetheless, quality online education without a reasonable and continuous investment is as yet unknown.

In consequence, different online decisions can standardise teaching and make it poorer, but in their favour they are easy to implement in online classes. Some examples of these decisions include: choosing increased automation; making teaching homogeneous; a preference for quantity as opposed to personalisation; opting for formalisation that reduces flexibility; or an inclination towards poor feedback and study based on repetition and low skills levels.

Putting aside this negative aspect, online teaching has been called to do much more and to truly provide an amplifier for teachers that goes beyond borders and offers an authentic study framework to help students better understand and live in today's world.

Among its more positive aspects, the online alternative has the potential to catapult the educational community towards providing more transparent ideas and processes that present facts and events neatly from the inside. Moreover, thanks to its ability to bring the real world into online classrooms by simulating or capturing everyday situations, students are encouraged to develop high-level skills, such as argumentation and reflection relating to the processes they have experienced at first hand.

This approach does not ignore the scalable values technology provides education in terms of measurability, counting, and more, but we all need to go a step further. More than simply building a stereotype of online mathematical education by making the most basic choices, we aspire to use online education as a *mindtool* as a whole (extending on Jonassen's terminology) thus giving teachers and students the right to expand their competences when working with technology to carry out tasks that they would not be able to do alone. Online mathematics education defined as a *mindtool* in this manner helps to better capture, visualise, and manipulate hidden processes, reasoning, and facts that otherwise exist only in teachers' minds and are barely intuited by students. The opportunity we have in online mathematical education nowadays is precious, and our decisions are open to innovation.

*Elena Barbera*

*Universitat Oberta de Catalunya, Spain*

*December 16, 2010*

**Elena Barbera** is a Doctor in Psychology from the University of Barcelona (1995). She is currently Director of Research for the eLearn Center at the Universitat Oberta de Catalunya in Barcelona (Spain). She is also an Adjunct Professor for the international doctorate in Nova Southeastern University in Florida (USA). Her research activity is specialised in the area of educational psychology, a field in which she has more than a hundred publications, conferences, and educational courses, relating in particular to knowledge-construction processes and educational interaction in e-learning environments, evaluating educational quality and assessing learning, distance learning using ICT, and teaching and learning strategies. As head of the EDUS (Distance School and University Education) research group, she participates in various national and international projects related to online teaching and learning and student assessment. She is an external and independent evaluator of research projects promoted by local, national, and European Union (e-learning and lifelong programme) bodies, and she collaborates with international organisations in developing knowledge by organising congresses and international awards as a member of their scientific committees.