# Emma Castelnuovo and her commitment to a school without boundaries

Nicoletta Lanciano
Univ. di Roma «La Sapienza» and MCE (Movimento di Cooperazione Educativa)

e-mail: nicoletta.lanciano@uniroma1.it

**Abstract.** Emma Castelnuovo has travelled extensively. Her commitment to a school for all, promoting social justice through teaching maths, and the development of each student, brought her to countries that had been dictatorships and to countries that had been colonies. In the years 1978 to 1982 she travelled four times to Niger, and her work was important for the whole country.
Recently, we students organized residential courses called L'Officina Matematica di Emma Castelnuovo to highlight the practical orientation through which we continue to spread her methods and keep them updated in a changing society.
From her teaching for a democratic school, and putting emphasis on attention to "borderline cases" of space and time, I developed the International Project "Globolocal" on a democratic and didactic use of the globe.

## 1. Education as a journey

Emma has travelled extensively in Europe and Central and South America. She has also travelled to Africa, which I will talk about in more detail below. Her books have been translated into several languages, and her methods for teaching maths influenced school education and teacher training in several countries. Her commitment to a school for all, a school that promotes social justice and the development of each student through teaching maths, brought her into countries that had been dictatorships and into countries that had undergone colonialism where local culture was not recognized and valued by the school and by society.

The journey has a lot to do with education, with teaching, and with learning. How is it possible to enter something new into one's own body of knowledge, and therefore learn and build new knowledge and welcome something unknown? The journey plays an important role in a learning process. Even in our language we use the same metaphors for knowledge and for the journey: Emma admired Archimedes and often says she has sympathy for the man from Syracuse, Sicily, in the South of Italy, but who went several times in his life to Alexandria, Egypt, to argue at the Museum and at the Great Library with the people who lived there. So he travelled the Mediterranean, which was not so easy at the time. This is the challenge of the trip: to be able to accommodate people, ideas, and new and different things, to go to a country where there are people we think it worthwhile to meet to discuss directly with them, believing that it is important to go to places that are, simply, elsewhere. It's like teaching and learning: meeting new cultural elements and encountering new areas of knowledge.
In order to travel, as to learn and teach, you need curiosity and openness, and if you must enter into an unknown and perhaps uncertain area, you must pass through the territories that are a priori unknown, and must speak other languages to communicate with people who usually speak a different language than our own, which is metaphorically very important in education. You should know and remember that in the beginning our students do not know our disciplinary languages, so we must help them gradually to enter the territory of a discipline when speaking in a foreign language, as I'm doing now. You might not find the words or might fail to be precise; we have moments of difficulty and we make mistakes. We must look for the words but you're in trouble if you want to say something but do not know how to do so completely. When we speak a foreign language we experience personally the same difficulties that students have when they begin to enter the unknown territory of a discipline: it takes time, and understanding is not a friend of speed. This

is also why I believe that not speaking a second language is a serious educational poverty, and this is often the case for Anglophones.

2. School and University - 1960

I begin with a first boundary crossed in 1960 by Emma together with Lucio Lombardo Radice, a professor at the University of Rome "La Sapienza". Together they invented the stages of collaboration between schools and the university (*tirocinio*), basically training university students who wished to become teachers in maths or who wanted to study the didactics of maths, and who went to classes for a period of a few months. I personally had the opportunity to stay three years in Emma's classes in middle school, the first year to discuss my thesis. Then, with a CNR Scholarship, I spent two years among Emma's students in her classes, and during her travels I had the opportunity to substitute for her. It was an opportunity for me to revisit mathematics encountered at university, where the geometry was completely separated from algebra, and analysis from physics. So, I had the opportunity to restore the relationship among those subjects, to re-establish a dialogue among them, a dialogue with a soul and a meaning, because I had the time and the opportunity to marvel at concepts and numbers.

Now it is natural to think that in the training of future teachers and education researchers there must be a period of training in the classroom, of spending some time observing a teacher and students in the class of an expert teacher. This is an opportunity to spend some time to see how it really goes when students ask questions, have a difficult time, and try to think/analyze in the ordinary school. Students at the University "La Sapienza" then began to experiment the school also through the eyes, through experience, and through the desire to communicate the art of teaching in Emma's classes and the classes of others (Lina Mancini Proia, Liliana Ragusa Gilli, Ugo Pampallona ...) in Rome, which allowed them to see the school from the perspective of the adults, from educational responsibility, from the relationship with parents, and not only from the perspective of a teacher of a certain discipline.

But then it was the sixties, the beginning of all this.

3. A Public School for all -1979

Another important thing for Italy, but through CIEAEM and also through international ties to other countries, was the possibility that Emma had to add her own course in mathematics, especially geometry, to the official programmes for Italian middle/ schools (eleven to fourteen years old). Lucio Lombardo Radice, mentioned above, told her in 1979 on the last day of work at the Commission for Programs, in which the two were engaged, "*Emma, you realize our success? These are our ideas, it is our way of thinking.*" It was the new programmes from middle school in 1979, a school for all, even for disabled children who were now allowed to sit in the same class as the other students. The main intention declared in the programmes was that everyone was able to understand, so we had to offer a maths syllabus for everyone, which was related to the concrete and not the abstraction of Euclid's Elements, which necessarily cut off the less able.

4. The General Public -2007

More recently, in 2007, Emma, at the age of ninety-four, held the General Lecture at the Auditorium of Rome during the first Festival of Maths, and the *string* she always kept with her was taken out of her pocket and shown outside classes to the general public: holding the string in her hands, tied in such a way as to form the fixed perimeter of a set of rectangles in which change the base and the height, the question posed was whether the surface actually changes or not. The solution comes from the observation of borderline cases, which is one of the highlights of Emma's mathematics education.

The boards and materials of the exhibitions, which we took with us during our travels in Italy and elsewhere in Europe, found a place in the halls where hundreds of people of all ages passed by.

5. The Idea of the Exhibitions: Paul Libois

She got the idea of the exhibitions from Paul Libois, the Belgian mathematician who had been a pupil of his father and his uncle. Emma said the letters he wrote to friends in Rome were "so full of content and so . . . cryptic." Paul's messages were not easy. "The reality is observed, weighed," says Libois, "through all our senses until the concrete is a crumbled grain of abstraction." Libois's message was very interesting, and it was he who asked general questions about education with a view of the changing society. These writings can be found in a book published in Brussels when Libois retired in 1981.

"For all this we can draw a warning for tomorrow's education," writes Emma. "Should we develop at the same time, study and work and get closer, in this way to move toward the formation of the whole man of Comenius and Pestalozzi?" On the other hand, as Comenius wrote at the time of Galileo in 1600, "Knowledge must begin with the senses." And so, why do we still too often begin with words?

Paul Libois had invented maths exhibitions for his college students to give older students an opportunity to speak to younger ones, as communication between pairs sometimes improves the exchange of messages.

In October 1979, when Emma and Lina Mancini Proia retired, Paul and other friends such as Jean Sauvy and A.S. Krigowska spoke at the International Congress at the Accademia dei Lincei.

Paul worked with the Decroly School in Brussels, and Decroly asked him the following regarding school: How can we get young people to build the future by requiring them to sit still? How can we have a school through which students get to know the world yet remain in class? Do we want students to learn to speak, to learn the language of the disciplines, while asking them all the time to keep silent? It is a contradiction!

And it is the same contradiction that Célestin Freinet had highlighted in France, as had other teachers and educators at that time.

6. L'Officina Matematica -2002/2012

It is with MCE which shares Freinet's pedagogy and which is part of the International Federation of the Methods of Modern Education – FIMEM - that, in 2002, that Emma took part in the residential courses for teacher training: we, her students, organized a group of courses called L'Officina di Matematica Emma Castelnuovo." We call these courses "Officina," but you could just as well say "workshop" or "place of the craft" to emphasize the practical nature related to the study and construction of materials that teachers can then use in the classroom in parallel with the laboratory of thought.

In order to bring into the classroom ideas, dynamic methods, and Emma's materials (which we deem to be quite extraordinarily up to date even today), and to update them in a school and in a society that is changing all the time, we offer materials and new experiences that go in the direction of the multiculturalism that is present in our cities, in our society, in our classrooms.

We also want to work with something that many think to be a waste of time: the hands. Even students at university and teachers as well do not know how to do things using their hands, and we think this is a serious loss in our society! For example, making regular solids only with the gesture of folding paper into a cylinder and then, with the fingers, closing it for a tetrahedral: it is to observe the hands that work with the brain. After we have watched it, we can study it, and ask questions: What is this? How is this done? Is this normal? But once we have seen the gesture we cannot forget the object! And it makes for much more democratic teaching in a school for all.

In a democratic school, even for the weakest it is also very useful to work with your hands, with your body: it gives many more opportunities than working only with words (written, read, heard), which increases the differences. It must be said: to have a school for all we must change the school. One does not have in the classrooms, as there were at the time, only nobles or Jesuits, the sons of the rich with books at home, the urban children without tribulations, those children born in the country who have eaten today, who do not want war. For all the poor in the world it is important to

continue and to not abandon the basic, and therefore essential, attitudes of humanity. In addition, the language used in school is often very different from a student's own mother tongue: the use of language can increase the differences between students in a class while the goal is to help and develop all intelligences. As pedagogy and psychology teach us, we comprehend and reason in different ways: there are more figurative minds, while others are more verbal or more formal, and in order to unite everyone, arguments must be presented in several different ways.
The right of all children of the earth to receive an education is developed in the article "Ieri e Oggi," published by Emma in *Cooperazione Educativa* No. 3 (2000): 9-14, in which she made an analysis about students and masters in the history of the Western school from ancient Egypt and Mesopotamia to the present day in Europe, but also in Niger or in Mexico.

During the three days of the course, which takes place at the laboratory Casa *Laboratorio di* Cenci in Umbria in central Italy, teachers are often introduced to the same things that are presented in the classroom, the same subjects and the same teaching materials. The laboratories are organized to help "see" the algebraic relations, the laws of physics, the relationship between a manner of growing up and changing, and calculus derivatives between elastic fabric and affine transformations which allows for the transition from the ellipse to the circle or vice versa through a small gesture, to see the transformations produced by an electric lamp or by the sun. We reflected on the relationship between similarity and trigonometry: once we have learned trigonometry we forget that before we can know how to fully resolve problems through similarity, it is important to know how to recognize that the similarity is so powerful!
It is important to build together all didactic materials: if you have never done it before you might think that it's too difficult!
In the residential courses, we use a long time period and an open space. The duration of three days is important, as illustrated in a famous saying of Emma's: "Give the children the time to waste their time," which is to say, give them the time to stay with things, to observe them, think about them in their own time, in silence. When you hold the string in your hands you can discover lots of things, you can reach extreme cases of the surface while the perimeter of rectangles that can be formed is always the same . You can see it but you need to have the string. Open space: now it is the neurosciences that tell us that it is very different to talk or think in the open air or in a closed classrooms, and I can personally say that this is very different, in my experience, to solve a problem, to reason, to make assumptions, with the sunlight or at night under the stars, and it is not the same to do so in classrooms as in the open air, where you can look at the sky. We lost these different possibilities in the organization of the Western school: until a few decades ago, schools were not always like this. Before, we had the peripatetic schools, with craftsmen or in libraries, or in Africa under the trees: therefore it is only here that we have built "boxes," and maybe a school like this is not the most useful for all knowledge. For years I have been seriously wondering about this. Outdoor body movement does not mean using only you hands: hand movement is too small to develop thinking, to develop thoughts on space, the three-dimensional space, the large space of the planet, the universe. So you have to move, you need to move around, with a rhythm for example, to really see the problems of angles that take a new meaning when they are great, when the sides go to infinity.

To manage the multiculturalism of our classes it is worth it to introduce aspects of maths through problems which are meaningful to everybody, even to immigrants, so you must select examples with relationships such as in the following: what is the influence on our income, in each different country, on the price of buying a television set?
In the plenary sessions, Emma taught us the idea of crossing the boundaries of time to introduce the "masters" and to travel back in time to the history of science: Archimedes, of whom I have already spoken, and his physical intuition; Thales and Galileo; and to the history of the school and pedagogy: Pestalozzi and Clairaut, Enriquez and Decroly, to name but a few.

**7. Emma in Niger - 1977-1982**

A significant portion of Emma's travels her trips to Niger from 1977 to 1982.
She was invited there four times by Annie Berté, who wrote afterwards: "I asked Emma to come to Niger to do something different from the programs of the French colonization."
They had met at the CIEAEM in Louvain-la-Neuve, near Brussels.
During her first trip in 1977, invited by the Irem of Niamey, Emma realized that what she presented was too far and too different from what they were doing, and that teachers of French training could not understand what she said. So, she invited them to come and see how she ran her classes, with her students, and to discuss it afterwards. From then on her travels brought profound changes in a country with very abstract programs.
When she returned to Niger, sent by UNESCO in 1978 and in 1980, she accepted but with the condition of having a class with students who work for two weeks straight through. And every year she organized a final exhibition on the work of these two weeks. From one year to another there were new students in the class, but the older students were able to bring their new classmates up to date because they remembered very well the topics covered in the previous year. This is because remembering is easy when you have thoroughly understood and enjoyed a particular subject of study. On the other hand, we all tend to forget things which we find disagreeable and which we don't like, and instead remember pleasant things: and this also happens at school!
Emma has pictures of Nigerien students who show their work: it really was something very great: Nigerien children showing their work to the university professors, to teachers in their school, and to city authorities.
In her travels, as in her classes, Emma paid special attention to reality, that is to nature, art, crafts.
In this country, one of the poorest in the world, with its primitive language (meaning for example that there is are no verb tenses, no past or future, no word for the concept of infinity, no word "odd" for numbers) one must invent a turn of phrase, a new saying, a concrete example which can help one understand fully the concept to then explain it in a creative fashion. French is a foreign language both to Emma and to her "Nigerien students, which put them on the same plane.
Maths can facilitate the correct use of language, we can use few words, but in a very precise way."
Emma Officina p. 149
After the fourth trip, Emma wrote a harsh letter about what she thought of the situation of students, of teachers, and of maths education as she had experienced it in the country; her work was a political action.

> I found in the schools of these two cities, swept by a sandstorm that determines health conditions which in general are not very good, the same enthusiasm that I found working for three weeks at CEG III of Niamey during my two UNESCO missions in 1979 and 1980. The intelligence of these Nigerien students is such that we can rest assured that we are training men full of initiative for the future of the country. But teachers often complained about not being able to develop a "dynamic" maths, due to the lack of preparation as well as the frequent inspections on the part of educational inspectors and advisers/counsellors who insist on theoretical teaching/lecturing, something which breaks up the class. … In this regard, the Inspector of Agadez, a professor of mathematics, did not attend any of our activities although we had invited him warmly.

This letter was sent to the Italian CNR, to the President of the Republic of Niger.

In 2003, when Emma was ninety years old, we gave her a gift: we sent to the CEG III of Niamey a plate with the following text:

*CEG III - Niamey - Niger*
*Emma Castelnuovo came to work in this school with students and teachers for a living mathematics without borders in 1978 and in 1980*
*Emma's friends for her 90 years*
*Rome 12-12-2003*

And we have given books to this school, because as Malala Yousafzaj - the sixteen year old girl from Pakistan who recently (in 2013) spoke at the UN in New York – says: "*illiteracy is the door to poverty and submission*". This problem is still a reality in several countries in the world: families do not pay to send girls to school, but rather it is the boys who go to school for various reasons. So to help women to get an education, Nigeriens have asked us for a gift of maths books.
They welcomed the plate and the books with a large party, and they composed a song that says, amongst other things: "... The trees you planted grew / They gave delicious and majestic fruit / Niger is enjoying the fruits of your efforts. / Thank you very much, Ms. Emma, thank you. / We still remember your stay in Niger. / You amazed everyone with your courage, and your dedication to work. / The Nigerien people show their gratitude. / Mrs Emma you have given your knowledge to the Nigerien people. ..." (FIG.)
Partying and singing were accompanied by a dance, and the girls were well dressed; we saw it in a videotape that Mamadou very kindly sent us. At that time he wrote to me about Emma saying that "She is well known in Niger, where she has many friends." This was twenty years after her travels. So what Emma did has had a much bigger echo than her maths lessons.

8. For a Democratic World: the International Project Globo Local
In the spirit of Emma, we, her students, continue to organize educational activities and to produce training materials.
With other friends, we have founded a Project for a democratic school, for an education connected to the reality of the whole planet, and one which pays attention to the "borderline" cases of space and time: the Poles and the Equator, the days of the Equinoxes and Solstices, the times when the sun rises and sets, the middle of the day.
You know the world as a globe whether it's Greenland or Australia: what is the problem?
The fact that the Northern Hemisphere is on top and the Southern Hemisphere is on the bottom is imposed on the entire planet, but the truth is that it is an implicit form of violence.
The whole planet is under our feet no matter what country we are in.
Our proposal is to eliminate the fixed support and place the globe in a homothetic position, therefore not in a position only more democratic, but also more useful for astronomy and geometry. And by putting the entire planet under our feet, we are all at the top!
Putting the globe in a homothetic position with respect to the sun means placing it in its true position, which is different if you are in Turin or in Niamey, at the South Pole or on the equator. For this reason we launched the Project Globo Local, which invites everyone to free their own globe and place it in the correct local position, therefore in its correct position, and to make it local and democratic so that the Sun may do on the globe what it does on the entire planet, in real time. We have to put the globe in the Sun, in order to see directly on the globe, the seasons, the time zones, day and night: all these arguments of astronomy that are so hard in a two-dimensional book and so little understood all over the world.
We can make this revolution, which is only a small change for we who live in the Northern Hemisphere, but it is a big revolution for those who are at the Equator or in the other hemisphere: with a small gesture consisting of releasing the globe from its fixed support, we can make a big modeling difference.
The Project site is http://www.globolocal.net and there you can see pictures of several countries. In the pictures in the PP: Chile where the Tropic of Capricorn passes through; near Bogotá near the Equator; Antarctica; a town in the Northern Hemisphere just like Milan. (FIG)

9. Thank You, Emma
I end with a recent photo of Emma, taken in 2013 in her beautiful flowered garden terrace in Rome: Emma who taught us to think through borderline cases, which we all use in our different fields because we have learned to recognize them in different areas of reality. But we are all enriched by

this way of thinking, which we do not forget, which is going to be part of our way of thinking forever. She gave us eyes to see geometry everywhere; she opened us up to a new way of thinking, to travel in space and time and beyond the borders separating people, who are very different from one another.
Thank you, Emma!

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