

# Political, technical and pedagogical effects of the COVID-19 Pandemic in Mathematics Education: an overview of Brazil, Chile and Spain

**Adriana Breda** 

Universitat de Barcelona, Spain

✉ [adriana.breda@ub.edu](mailto:adriana.breda@ub.edu)

**Danyal Farsani** 

Universidad de Chile, Chile

✉ [danyal.farsani@gmail.com](mailto:danyal.farsani@gmail.com)

**Roger Miarka** 

Universidade Estadual Paulista, Rio Claro, Brazil

✉ [roger.miarka@unesp.br](mailto:roger.miarka@unesp.br)

## Efeitos políticos, técnicos e pedagógicos da Pandemia COVID-19 na Educação Matemática: um panorama do Brasil, Chile e Espanha

### Resumo

Este artigo discute os problemas e questões que surgem na Educação, em particular na Educação Matemática, a partir da problematização dos efeitos da pandemia COVID-19. Para isso, três pesquisadores em Educação Matemática do Brasil, Chile e Espanha se encontraram virtualmente. Com base nas discussões, o grupo forneceu o contexto para cada um dos três países em termos de como eles vêm gerenciando as ações relacionadas ao contexto da pandemia e selecionou três histórias que vivenciaram nesse contexto, que utilizaram como elementos materiais para uma discussão conjunta de forma não localizada. Por esse caminho, tem-se como resultado um panorama dos efeitos do COVID-19 na educação em diferentes países, os quais foram classificados em três dimensões: técnica, política e pedagógica. Além disso, são apresentadas questões à Educação Matemática produzidas a partir da problematização dos efeitos da pandemia.

Palavras-chave: Coronavírus; Educação à Distância; Didática da Matemática; Filosofia da Educação Matemática.

### Abstract

This article discusses the problems and questions that are raised in Education and specifically in Mathematics Education from the problematization of the effects of the pandemic of COVID-19. For this, three researchers were brought together in Mathematics Education from Brazil, Chile and Spain, who started to meet virtually. Based on these discussions, the group provided a context for each of the three countries in terms of how they have been dealing with the pandemic and selected three tales they lived related to the pandemic, that were used as material elements for a joint discussion in a non localized way. With this path, as results, it is shown an overview of COVID-19 effects in different countries related to education, that were categorized in Technical, Political and Pedagogical dimensions. Besides that, questions are presented to Mathematics Education produced from the problematization of the effects of the pandemic.

Key words: Coronavirus; Distance Learning; Didactics of Mathematics; Philosophy of Mathematics Education.

Submetido em: 29 de setembro de 2020 – Aceito em: 20 de novembro de 2020

## 1 INTRODUCTION

---

We would like to start the introduction of this paper with a truncated poem, 'Children of Adam', from one of the most influential Persian poets of the medieval period. Sa'adi was a 13<sup>th</sup> century Persian poet whose poems emphasized unity in mankind, showing an interdependence that transcended social class, barriers and labels. Many of his poems, and particularly 'Children of Adam', greatly impacted India and had significant influence throughout Central Asia. Due to the beautiful, humanistic message it conveys, the poem is inscribed at the entrance to the United Nations building in New York.

Human beings are members of a whole,  
In creation of one essence and soul.  
If one member is afflicted with pain,  
Other members uneasy will remain.  
If you have no sympathy for human pain,  
The name of human you cannot retain.

This thirteenth century poem, succinctly describes the interdependence of each individual not as a whole, but in the social world. A disaster or a calamity does not only affects an individual, but the all humanity.

For the first time since the Second World War, the whole world is facing the same problem: how to deal with the Coronavirus, also called COVID-19. Several strategies have been adopted by different countries, most involving some type of Social Isolation. The problem that begins as a health issue, quickly shows its economic, political, social, educational fields, etc.

One of the elements present in Social Isolation is the restriction of face-to-face service in public institutions, which involves schools and universities. The effects of this restriction are the most varied.

This article is located in this panorama, and aims to *discuss which problems and questions are raised in Mathematics Education from the problematization of the effects of COVID-19*. However, how to proceed, if we understand that Mathematics Education covers different domains of research and performance, it is not restricted to geopolitical boundaries, and it crosses different contexts?

This article sought to deal with this diversity by assuming it in the most radical possible way. We gathered three Mathematics Education researchers, each one from a different places and different research domains, who started to meet virtually to discuss the question *What can Mathematics Education learn with the problematization from the effects of COVID-19?*

The group included Adriana Breda, professor at the University of Barcelona (UB),

Spain, researcher in Didactics of Mathematics; Danyal Farsani, who recently finished a post PhD research on Body Language and Education at the University of Chile (UCHILE), Chile; and Roger Miarka, professor at State University of São Paulo (UNESP), Brazil, researcher in Philosophy of Mathematics Education.

Based on the virtual discussions of this group, this text was organized in five parts. The first part consists of this introduction, in which the proposal is announced. The second part provides the context for each of the three countries in terms of how they have been dealing with the pandemic. The third brings three truncated stories, also called tales, all of them describing one describing something that happened in one of these countries during the pandemic, in order to bring material elements for a joint discussion, presented in the fourth part, which the guiding question *What can Mathematics Education learn from the effects of COVID-19?* is assumed. The article ends with some final remarks.

Following this path, we hope to show an overview of the effects of COVID-19 in different countries and, with this, to discuss them in the domain of Mathematics Education in a non-localized way.

## **2 ONE DISEASE, THREE CONTEXTS**

---

### **COVID-19 in Brazil: a panorama of divergences**

The first Brazilian governmental actions linked to COVID-19 began in February, with the repatriation of Brazilians who lived in Wuhan, the Chinese city that was the epicenter of the infection. Fifteen days later, on February 26<sup>th</sup>, the country confirmed the first contamination, when Europe already had confirmed hundreds of cases and had been already facing deaths from COVID-19.

Despite information about the disease abroad being widely disseminated by the media, the population did not take it seriously until the confirmation of the first case in Brazil. Major events, such as the Brazilian Carnival, for example, did not even have their cancellation considered. Measures from foreign countries, such as flight restrictions, were considered extreme by the population and sometimes the subject of speculation that linked them more to economic and political issues than to health.

On March 5<sup>th</sup>, the first case of internal transmission in the country is exhibited. The Federal Official Gazette indicates, on the same day, the acquisition of 500 thousand masks of the N95 model and almost 19 million surgical masks, as well as goggles, hand sanitizers and gloves. In the following day, the Ministry of Health announced the expansion of measures to reinforce hospital assistance in dealing with the virus, but it only regulates isolation and quarantine criteria a week later, on March 13<sup>th</sup>, to be applied by health authorities to patients with suspected or confirmation of Coronavirus

infection. The first death from the disease is registered on March 17<sup>th</sup>.

The number of cases goes up dramatically. There are not enough tests for everyone. The ministry's recommendation is that testing will be done only in severe cases. In other cases, the epidemiological clinical criterion is taken into account.

Rio de Janeiro, one of the most affected Brazilian states, decrees an emergency situation and defines temporary measures to prevent contagion. Public events and activities are suspended, as well as visits to prison units and transportation of inmates to hold a hearing, visits to hospitalized patients diagnosed with COVID-19, and face-to-face classes in public and private schools. The 17<sup>th</sup> day of March, the Ministries of Justice and Health issued an ordinance that authorizes hospitalizations and compulsory quarantine to contain the progress of Coronavirus.

Most Brazilian states imposed Social Isolation, following the indications from the World Health Organization and the Brazilian Ministry of Health, whose minister at the time was Luiz Henrique Mandetta. Non-essential trade, schools and universities closed their doors.

São Paulo, which has the largest record of cases and the largest public school system in Brazil, as an example, carried out a gradual stoppage of classrooms in Basic Education until March 23<sup>rd</sup>, and most higher education institutions had already accomplished. The three public universities in São Paulo – USP, UNICAMP and UNESP – had already suspended their academic calendar on March 17<sup>th</sup>. The Education Ministry launches a measure that seeks to promote Distance Learning, making the number of school days in a school year more flexible. The problem is that most teachers and students were not prepared for this type of teaching. Many of them do not even had the necessary devices, such as computers with Internet access.

Just over a month has passed since then. The number of contagions and deaths by COVID-19 in Brazil follows an increasing curve. The speech of the current President of Brazil, is contrary to Social Isolation, with phrases that carry pejorative words associated with the disease (see Table 1). In the meantime, the Minister of Health, a great defender of Isolation, is exonerated by the President.

**Table 1:** Source: own authorship. See more at <https://noticias.uol.com.br/saude/ultimas-noticias/redacao/2020/05/01/todos-nos-vamos-morrer-um-dia-as-frases-de-bolsonaro-durante-a-pandemia.htm?cmpid=copiaecola>

Date, Cases & Deaths	Excerpts from the President's Speeches
15/3, 200 cases & 0 deaths	"We cannot enter a neurosis as if it were the end of the world. Other more dangerous viruses have happened in the past, and we haven't had this whole crisis. There is certainly an economic interest in all this in order to arrive at this hysteria . . ."

17/3, 291 cases & 1 death	"This virus has brought a certain hysteria. There are some governors, in my opinion, I may even be wrong, who are taking measures that will harm our economy a lot ..."
20/3, 904 cases & 11 deaths	"After the stab <sup>1</sup> , it won't be a little flu that will knock me down, okay? If the doctor or the Ministry of Health recommends a new test, I will do it. Otherwise, I will behave like any of you present here ..."
27/3, 3417 cases & 92 deaths	"If everyone is with coronavirus, this is a sign that they have been defrauding the cause of death of those people, wanting to make a political use of numbers. (...) In São Paulo I don't believe in these numbers ..."
29/3, 4256 cases & 136 deaths	"This is a reality, the virus is there. We're going to have to face him, but face him like a fucking man, not like a kid. Let's face the virus with reality. That's life. We will all die one day ..."
12/4, 22169 cases & 1223 deaths	"It seems that the issue of the virus is beginning to go away, but the issue of unemployment is coming and beating hard ..."
20/4, 40581 cases & 2575 deaths	"Look, look, look, man. Who talks about... I'm not a gravedigger, okay?"
28/4, 71886 cases & 5017 deaths	"So what? I'm sorry. What do you want me to do? I am Messiah <sup>2</sup> , but I don't do miracles..."
27/5, 394507 cases & 24600 deaths	"..."
22/09, 4560083 cases & 137359 deaths	"..."

The date is May 7<sup>th</sup> and in this panorama of divergences, the measure of Social Isolation in Brazil remains, with the support of governors and a large part of the Brazilian media.

### Coronavirus, a "rich disease" in Chile: Practical implications for the future education

The first case of COVID-19 in Chile was confirmed by the Chilean Minister of Public Health on the third of March 2020. This made Chile to be the fifth country in Latin America confirmed with Coronavirus after Brasil, Mexico, Ecuador and Argentina. At first, COVID-19 in Chile, just like "gout" in the olden days in other parts of the world, was perceived to be "rich people's disease". The first cases of COVID-19 in Chile consisted of people with financial privileges who travelled to Europe (Italy, France and Switzerland) during the winter holidays skiing. The ministry of health speculates that it was first in Europe where the Chileans were contaminated and on their return to Chile, they contaminated first their family (partner and children) and then their colleagues and co-workers. Just 10 days after the first confirmed case in Chile, on the 13<sup>th</sup> of March, a very prestigious and expensive school in Santiago (whose students consisted of rich upper class Chileans) closed its gates as they found confirmed cases of coronavirus among their teachers and students (Radio Agricultura). In Santiago, government responded by an iron-fist, which put in place a compulsory quarantine only within the rich

<sup>1</sup>Current President of Brazil refers to an alleged stab he received during presidential campaigns.

<sup>2</sup>Current President of Brazil refers to his second name, Messias, which means "messiah" in Portuguese.

comunas/areas such as “*Las Condes*” followed by a military curfew from 10pm until 6am. At first people were concerned how COVID-19 only affected the rich upper class society. Just like the olden days where upper class people in society could easily access meat in their daily dietary consumption, they often suffered from severe pain in their joints. Gout was later perceived to be the rich people’s disease as it is caused by the excessive consumption of uric acid found in meat, which was expensive at the time and only affordable by the rich upper class. As the time passed by, more and more cases of COVID-19 in Chile were confirmed across different social sectors (rich and poor), young and old, and all the way from the north to the south of Chile.

The COVID-19 pandemic is first and foremost a health crisis which consequently crystallised financial, educational and political problems across the world (of course, with the only exception of Turkmenistan under the leadership of Gurbanguly Berdimuhamedow). In Chile, just like many other countries around the world, schools, colleges and universities are faced with an important dilemma between: closing institutional settings in order to reduce contact and saving lives; or keeping those open enabling professionals to work, maintaining the economy and allowing students to gain epistemological access. Exactly five months after when the Chilean president, Sebastian Piñera, declared a state of emergency on the 18<sup>th</sup> of October due to its social protests, on the 18<sup>th</sup> of March, the president issued a state of catastrophe. This meant that the Chilean government banned any social gatherings of more than 50 people, and obliged all the education to proceed through the medium of “online”. This decision was of course, in accordance and in line with UNESCO’s recommendation to use online or distance learning programmes that schools and teachers can use to reach their students remotely and limit the disruption of education. This decision, as perceived by many the best solution, by many other Chileans was considered to be a “joke” and a lack of misunderstanding and mis-considerations by the rich and wealthy policy makers. This is due to the unequal access to internet, computers and technology. In many Chilean public schools, there are no sufficient heaters in every class, and in a couple of cases I have witnessed, there was no access to “running water”, let alone internet or laptop for students! It is clear that George Bush’s “no child left behind policy” is obviously not applicable and has no space for Chilean public education.

Just like other countries around the world, COVID-19 brought both short term and long term problems and limitations in relation to teaching, learning and evaluation. There are severe short term issues that are perceived by many families, as homeschooling is not only a disruption to parents’ productivity but also to students’ social life and social learning. Many vulnerable students will be further at a higher disadvantage due to not only the resources, but also the non-cognitive skills of their parents. Many of these parents may not have had a formal education, and therefore are unable to

provide additional help when needed. Of course, this is clearly not true for the wealthy Chileans as they can afford to have hourly paid teachers from the USA and the UK.

Other short term problems consist of assessments and measuring students' true progress due to a lot of trial and error and uncertainty on an untested and unprecedented scale. It is interesting to note that, these interruptions and obstacles in relation to assessments will not just be a short term problem, but can also have long-term consequences for the affected cohorts and are likely to increase inequality. For example, in many northern hemisphere countries such as UK, have cancelled all exams for the main public qualifications – GCSEs and A levels for the entire cohort. The [International Baccalaureate](#) which is an international pre-university course (generally for students of 16 to 18 Years old) have also cancelled its exams for 2020 cohort. In the long term, Chile, just like many other countries in the southern hemisphere, has the advantage of developing a solution for their final/end of the year exams in December 2020.

### **Coronavirus in Spain and the impact of the pandemic on Education**

The seriousness of the situation in Spain and the measure taken to try to stop the spread of the virus has affected the main system that makes the country work, such as the health system, the economic system, the political system and, not least, the educational system. With the closure of all educational centres at all levels, it has been suggested, by the Spanish Ministry of Education, non-contact telematic work. Obviously, not all centres have managed to implement this methodology, given the conditions of vulnerability and lack of digital resources in certain regions and sectors of the country. This change has generated a debate on how the student evaluation system and their respective learning would be carried out. For all the difficulties encountered, one of the alternatives found by the Spanish Minister of Education, together with the regional counsellors, was the "general approval" for all Elementary, Middle and High School, being left to the teachers the decision on the qualification of each student based on their predicted grades. This decision highlights the weaknesses of the country's educational system, which is not yet ready to take action in the face of emergency situations, without the students' learning being impaired.

The emergency situation generated by the COVID-19 crisis also generated the sudden closure of all face-to-face university lectures and led to the need to continue university teaching activity in a non face-to-face way (in all university careers and their respective levels). The measure taken did not facilitate transforming face-to-face university lectures or online teaching, due to two reasons. Firstly due to such a short period of time and, secondly due to the lack of technological organizations. On the contrary, the university community sought to identify the simplest formulas with the support of technologies that had the widest possible reach. To promote the continuity of academic work, Spanish universities provide teachers and students with some technological

resources, such as the Virtual Learning Campus and programs such as professional Skype, Adobe Connect, among others.

Although the classes continued virtually, the adaptations made led again to the debate on how to carry out the evaluation of student learning. According to the university group, non-attendance in person does not represent an impediment in the evaluation, since the current European Higher Education Area (EHEA) has the continuous evaluation modality as its main criterion. In this sense, within the autonomy of each university, alternatives and tools have been made available that include ways to carry out continuous and formative assessment, mainly maintaining the opportunity to promote the development of competences such as digital, collaborative and autonomous learning in students.

### **3 THREE COUNTRIES, THREE TALES**

---

#### **Who is afraid of distance learning?**

*May 5, 2020. Congregation Unit Meeting.* The classes at the State University of São Paulo, Brazil, have been suspended since March 17 due to COVID-19, which means that classes were not allowed, whether face-to-face or remote. The justification was that not all students would have access to the devices needed for remote teaching. However, the Social Isolation requested by the state governor was not expected to last so long. After almost two months with the calendar suspended and with no forecast of returning to face-to-face classes, the Unit approves the reopening of the calendar. It is understood that the reality of the different courses is not the same, in a way it is given autonomy for each Course Council to decide which subjects will be taught remotely. A point highlighted by the Unit Congregation: it is not a matter of distance or online learning, but of teaching with remote activities.

*May 7, 2020. Mathematics Course Council Meeting.* All teachers who teach classes in the Mathematics Course are invited to a virtual meeting on the provision of remote subjects. At the meeting, there are teachers of the domains of Pure Mathematics, Education and Mathematics Education. In special, the mathematics educators that took part in this meeting also work in the oldest and biggest Postgraduate Program on Mathematics Education of Latin America. The discussion is effusive and lasts three hours. Many arguments are presented questioning the possibility of the content of Mathematics to be taught virtually. It is required a prior study before offering disciplines remotely in order to clarify on what such teaching modality is based on, how to operate it, and how to assess students' knowledge. It is also asked if the students have access to the necessary devices. In the end, the Council assumes a position. It requires from the Congregation fundamental criteria for offering subjects remotely, which involve a minimum number of students that consider themselves able to attend it, both from a

technical and psychological perspective; an explanation of what is meant by remote education; the presentation of possible assessment methods; and technical and pedagogical support to operationalize the use of devices by teachers.

May 11<sup>th</sup>, 2020. Congregation Unit Meeting. The only course councils that express concern about teaching with remote activities are Geography and Mathematics.

### **The Chilean Tree Climber**

Ever since the third of March 2020, Chile is confronted with perhaps, one of its biggest problems in education. Students are expected to learn, teachers are expected to teach but there is no formal education. The Chilean government complied with UNESCO's recommendation with online or distance education where teachers can remotely teach through platforms such as Zoom or Canvas. As we briefly mentioned before, many ordinary working class Chileans raised their concerns. While many upper class Chileans perceived this as the best solution that government could offer during this time of crisis, many Chileans with different socioeconomic backgrounds considered this governmental decision to be a "joke", a lack of misunderstanding and misconsiderations by the rich and wealthy policy makers. There are of course problems with gaining access to a stable internet connection and materials (such as laptops/computers) which we shall turn to next.

During a road trip that one of the authors had in the first week of May, driving through the countryside of a city called Temuco (700 kilometers south of Santiago), he became aware of an event that actually touched his heart. As he was driving he became aware of a massive moving object with a light on a tree. As he drove closer, he saw a teenage boy on a tree holding his mobile phone. He stopped the car, got out of the car and walked towards the tree. He asked the teenage boy, "I see that you are on a tree, do you need help to get down?". The teenage boy replied: "No thank you. I am waiting to receive a better internet signal so that I can send my coursework". He was a medical student, studying at a public University in Chile, and he climbed a tree in the dark, risking hurting himself, in order to send his coursework. Unfortunately this is the reality for many Chileans living in rural areas or living in lower socioeconomic areas. A good and a stable internet connection costs approximately 10% of the minimum wage in Chile. As a result, it is understandable and reasonable why not every household in Chile have internet access, and therefore, not ready for this new phase transition with online learning.

### **The implementation of a face-to-face designed subject in a virtual modality**

The emergency situation generated by the COVID-19 crisis in Spain led to the need to continue teaching in all university careers virtually. One of them is the Primary Education Teacher career, which trains future teachers who will work in primary education

(students from 6 to 12 years old) in the country. This career is made up of subjects that must develop certain competencies that future teachers must acquire in order to carry out teaching at that educational level. The first subject of this career, within the field of Mathematical Education, is the so-called *Reasoning and Mathematical Activity in Primary*, in which future teachers must develop the ability to work in teams, the ability to value diversity, and the ability to exercise criticism and self-criticism. Furthermore, they must develop the ability to motivate and enhance the school progress of students in the framework of comprehensive education and promote autonomous learning, based on the objectives and content specific to each educational level. They also need to develop the ability to design and develop educational projects, activities and materials, including digital ones, and the ability to integrate information and communication technologies (ICT) in guided and autonomous teaching and learning activities. The change carried out in the development of the subject in the context of COVID-19, such as, the transfer of the implementation of a subject designed in the face-to-face modality to a virtual modality, has generated a series of questions. On the one hand, in relation to the development of the competences that future teachers must develop in the subject knowledge and on the other hand, about the different dimensions of learning (content, procedure and attitudes) of future teachers about each thematic block thought of the subject.

#### **4 A CROSS-BOUNDARY DISCUSSION AND FINAL REMARKS**

---

The historian Dr. Karnal, in an interview, confirms that it is remarkable that the world is undergoing constant changes, but there are three factors that accelerate these changes and design a new configuration of history: war, revolution and epidemics. In a historical process, women acquired the right to vote, after occupying jobs in a massive way, while men were servants in the First World War. That is, although the fight for this right was already underway, the conquest was accelerated by the historical factor of war. The historian Dr. Yuval Noah Harari, creator of the work *Sapiens: a brief history of humanity*, one week after participating in a long academic debate to decide whether classes at a university in Israel would be switched to remote mode, saw all classes assuming this modality, given the nature of coronavirus pandemic.

The COVID-19 epidemic is accelerating. This acceleration generates a variety of concerns in the field of education by educational agents (researchers, teachers, students, community) of all levels, sectors, social classes and cultures. It is a global change that education has invitingly to deal with. The three tales that we presented, each one involving authors of this paper in different countries, all of them crossed somehow by COVID-19, show us the effects of the pandemic in different dimensions of education.

Referring to our initial question "What can Mathematics Education learn from the effects of COVID-19?", we listed three dimensions for discussion - called political, technical and pedagogical -, all of them triggered by our stories.

In the Brazilian tale, the political dimension of the effects of the pandemic is explicit, insofar as there is a clear fear of assuming distance education in Higher Education, which is highlighted by the university's position in preferring the use of "teaching with remote activities". This option emphasizes that this is not a change in the teaching modality, but an adjective for a group of activities. The discussions focus on a way of offering these activities and not on a methodological bias, even though the Department where they took place counted with experts on distance learning research. The fear ends up being justified discursively in two ways: "does the student have the necessary devices and internet access to participate in these activities?" and "does the student have the emotional condition to participate in remote activities given the context produced by the pandemic?". Note that both central questions fall on the student.

We could also ask why teachers in Mathematics Education in the largest and oldest postgraduate program in Latin America no longer assumed this process there. It looks the focus of the concern is not on pedagogical struggles, but on the danger of a reorganization of the teaching offer, that could be understood as "a path of no return". In this way, the debate on distance learning involves all teachers of the Mathematics Course, and not just those ones who are supposed to have better conditions to offer pedagogical support.

Given that the focus of discussion and the concern about the effects of the pandemic falls with greater emphasis on political aspects and that, in this discussion, the questions generated from the technical point of view - to access or not to access technology or its conditions of use - related on the social, emotional or economic conditions, it means that the discussions on the pedagogical aspects related to the COVID-19 effects are not the central topic of discussion, precisely because a problem arises that precedes this: before the political question about the pedagogical work being or not at distance, one wonders whether there are technical conditions for conducting distance education, without losing its breadth of service. This concern with the technical dimension seems to be more prominent in the Chilean and Brazilian stories than in the Spanish one.

Lack of access to technology or fast and reliable internet access has created a big problem for students in Chilean and Brazilian public schools. This problem prevents students in rural areas and from disadvantaged families to gain access and connect to their online activities designed for remote activities. This is a big problem especially for students from disadvantaged families and with low socio-economic backgrounds.

With this, we highlight that the technical dimension feeds back questions concerning

the political dimension, as it can, with the quick implementation of distance education, create layers of access to education, according to socioeconomic conditions, as it is explicit in the Chilean tale, which would be reasonably plausible also for the Brazilian reality.

In Spain, although some autonomous communities have presented difficulties in the technical question (gaining access to the use of technologies for educational work), and of course, although a political debate has been generated within the field of Education, the discussion mainly concerned the sequence of the classes and how the evaluation of the students would be carried out. With this, we want to highlight that the debate, particularly in the field of Higher Education, was directed to the pedagogical ones.

In the case of the development of the subjects of the higher level careers in Spain, the main question was neither if all students would have access to technology nor if the classes would be virtual, as the continuity of the teaching and learning processes became virtual by government regulation, without a prior broad political debate with participation of teachers.

The debate generated within the pedagogical dimension caused some questions to be put into operation. For example, how to develop the competencies that teachers had previously planned for a classroom setting? Should teachers think about developing other skills? How to design criteria and forms of evaluation, since, methodologically, the configuration of the class had to be designed differently than usual? What kind of learning would the students achieve?

The novelty of all this is that the process of thinking about the pedagogical re-planning did not happen in advance, but at the same time as the process of changing the face-to-face modality to the virtual one. The first difficulty that was evident was the short time space to think and reflect about new strategies that could guarantee the pedagogical one, given that the change of modality was already happening at the same time. In other words, it would be one's own experience of developing pedagogical work in the new modality that could bring some evidence or indications of how to evaluate, assess the skills developed or the learning acquired by the students [15].

Returning to the experience in the course of Reasoning and Mathematical Activity, it was possible to observe, for example, some changes generated by the effect of COVID-19 on pedagogical work. One of them was the modification of the interaction between the future teachers when carrying out the didactic activities. Once internet connection problems, time mismatches and emotional problems on their part have become evident, the dynamics of group work and the face-to-face mode of interaction was changed. Many students have worked individually or in pairs, a dynamic that, in a certain way, influenced the development of the ability to work as a team. Other evidence that

has been observed due to the change in modality was that the students, not having access to the Mathematics laboratory available at the university. As a consequence, they were not able to work with the tangible materials, and had to follow instructions and examples of uses of materials through educational videos and making their own materials. This is a crucial aspect that stands out in the development of the design materials competition. It is also highlighted that a certain capacity for ICT integration has been developed, since future teachers had to use online teaching platforms (Virtual Campus), searching for support material on platforms such as YouTube, Educational Applets, etc. In addition, it was evident that students developed autonomous learning with much more emphasis, since they have worked with guided teaching activities through the theoretical and educational materials provided by the teacher of the subject.

The issue of interaction between teacher and students when carrying out the didactic activities pointed out in the discussion about the Spanish story also emerges somehow from the Chilean tale. In this story, an asynchronous education relationship is implicit, in which teacher and student are not connected at the same time. In these conditions, we can ask ourselves what elements of interaction are present in this way of educating.

Teaching and learning of mathematics is multimodal and frequently involves the employment of gestures [1, 2]. Gestures have been shown to reflect speakers' embodied thinking about mathematical concepts and play a role in conveying knowledge in teaching/learning interactions [3, 4, 5]. Within the framework of embodied cognition, mathematical thinking and learning are grounded in bodily experience and manifest themselves in bodily expression to help analyse meaning in mathematical discourse and in the processes of collaborative problem solving [6, 7, 8, 9, 10].

At different times a teacher needs to be a demonstrator, motivator, administrator and evaluator, just to name some of the aspects of the profession [11]. In a dyadic, triadic or a group conversation, many nonverbal aspects of communication, such as the proxemics, posture, gestural movements, facial expressions, and micro-expressions, direction of gaze and eye contact are key to the professor as they/them can glean information from their students, in order to adjust and modify the lesson pitch (to slow down or advance faster with the instruction of information). We consider it necessary to share the importance that has been given to body expression in all cultures and at different times. For example, the famous English playwright Shakespeare who, since the 16th century, made a statement on body expression:

There is language in her eye, her cheek, her lip,  
Nay, her foot speaks, her wanton spirits look out  
At every joint and motive of her body.  
Shakespeare, Troilus and Cressida, 4.5.55-7

The gist of “conversation”, even with the minimal amount of information, is clearly interpretable through gestures and micro-momentarily-movements. Human body-language is one of the richest and most obscure sources of information in interpersonal communication. As educators, we have taken this element of embodied cognition as granted. Unfortunately, due to COVID-19, there has been a radical phase transition from the traditional presencial to an online format. This very basic phase transition has affected: a) the quality of teaching (better engaged with the students), b) controllability and monitoring (e.g. walking around the classroom), and, c) the consequent effects on students with various socioeconomic groups. We will explain each of these three point below:

As educators of mathematics education, we were taught, evaluated and implemented lessons through presencial interactions. Through social interactions we have learnt to motivate, engage, and get closer to other interlocutors. A sudden change in the medium has brought with itself a lot of surprises that are mostly: time consuming, and the quality of teaching may not be as good. Another challenge is in relation to Teacher Education, particularly in the southern hemisphere countries, where courses start in March, where prospective teachers are not able to observe nor teach classes. Furthermore, Teacher educators were not prepared to translate their materials to online teaching in such a short time period.

Controllability and monitoring is another aspect that enables the teacher to take charge of the lesson. Some of these aspects are “given” and some other aspects are “earned”. For example, in the UK, the teachers are addressed with “Sir/Miss/Mrs” or “Mr/Miss/Mrs followed by the surname” whereas a teacher can call out students by their first name. In Chile teachers are called by “tio” or “tia” meaning “uncle” and “aunt” whereas a teacher can call out students by their first name. In Brazil, similarly to Chile, the treatment among teachers and students is also intimate. What else is given is the “height” and “space”. Fact that the teacher can walk frequently and create different proxemics prominent patterns or special pedagogy [12, 13]. These subtle nonverbal patterns confirm the role of the teacher as a guide, and not a “sage on a stage”. What can be earned is mutual respect and building rapport which of course develops over time. Furthermore, a teacher’s ability to “de-escalate” a situation, e.g. by changing shoulder orientation and breathing patterns which makes it impossible to transmit through online teaching.

The reflection made from the three stories indicates that the arrival of the Covid-19 generated a wide debate regarding the changes brought about in education and, in particular, in mathematics education. Some evidence, derived from this new experience, could encourage discussion on how to re-plan and implement pedagogical practices, in particular, thinking about the development of new skills and learning that must be achi-

eved by students [14]. However, this debate is only possible if it has a definition on the technical and political dimension. That is, before discussing and defining the changes related to pedagogy, it is essential that the actors in the educational field have the technical conditions (computers, internet, trained human resources) so that, through an agreement with a political dimension, it is possible to institutionalize the pedagogical change. Obviously, the three dimensions are connected, as in order to implement the technical dimension it is necessary investing in public educational policies, and in order for the pedagogical change to be institutionalized, a great consensus is necessary, in political terms, about the curricular changes that must be implemented.

In the perspective of generating which problems and questions are raised in Education and specifically in Mathematics Education from the problematization of the effects of COVID-19, we have conducted a cross-border conversation about the effects of the pandemic in the field of education. This reflection led us to the fact that there are three major dimensions affected by the arrival of the virus: politics, technique and pedagogy. The lack of preparation for online teaching, the lack of a political consensus about the modality change and the lack of technical resources, generated mainly by socio-economic conditions, leads us to ask the following questions: How to configure public policies that aim to promote the teaching of mathematics in distance education without creating different levels of access to education depending on socio-economic conditions? How to guarantee technical support to all educational agents and what should be the strategies for its maintenance and improvement? The distance learning and teaching process of mathematics seems to continue reproducing strategies created for face-to-face teaching. What other modes of distance learning could be promoted and what skills to be developed that are not established in classroom teaching? In short: What can math education learn from this?

We believe there is still prospective hope even though we only reported on the problems. As Albert Camus, a French Algerian novel writer once said in his book *La Peste* (1947), a disaster brings the best and worst in man. This is in line with an old Persian maxim: "The night hides a world, but reveals a universe". The COVID-19 has indeed presented some serious short-term challenges in education. However, we believe identifying the problems is a first step to deal with them, taking them as an opportunity to update our educational systems to a new reality that will possibly last.

### Acknowledgments

---

The financial support from FONDECYT 3170062 and PGC2018-098603- B-I00 (MCIU/AEI/FEDER, UE) is gratefully appreciated.

## REFERÊNCIAS

---

- [1] K. L., O'Halloran, *Mathematical Discourse: Language, Symbolism and Visual Images*, Continuum, London and New York, 2005.
- [2] D. Farsani, (2015), *Making Multi-Modal Mathematical Meaning in Multilingual Classrooms*, Unpublished PhD thesis, University of Birmingham, 2015.
- [3] S. Gerofsky (2010), *Mathematical learning and gesture: Character viewpoint and observer viewpoint in students' gestured graphs of functions*, *Gesture* 10 (2010) 321-343. [[CrossRef](#)]
- [4] L. Radford, F. Arzarello, L. Edwards and C. Sabena, *The multimodal material mind: Embodiment in mathematics education*, in J. Cai (Ed.), *Compendium for Research in Mathematics Education*, Reston, NCTM, 2017, pp. 700-721. [[Google Scholar](#)]
- [5] L. Radford, L. Edwards and F. Arzarello, *Introduction: beyond words*, *Educational Studies in Mathematics*, 70 (2009) 91–95. [[CrossRef](#)]
- [6] R. Núñez, *Gesture, Abstraction, and the Embodied Nature of Mathematics*, in W-M. Roth (ed.), *Mathematical Representation at the Interface of Body and Culture*, Information Age Publishing, Charlotte NC, 2009, pp. 309-328.
- [7] L. W. Barsalou, *Grounded cognition*, *Annual Review of Psychology*, 59 (2008) 617–645. [[CrossRef](#)]
- [8] R. Nemirovsky, *Three conjectures concerning the relationship between body activity and understanding mathematics*, in N. A. Pateman, B. J. Dougherty and J. T. Zilliox (Eds.), *Proceedings of the 27<sup>th</sup> conference of the International Group for the Psychology of Mathematics Education*, Vol. 4, PME, Hawaii, 2003, pp. 113-120. [[Google Scholar](#)]
- [9] L. D. Edwards, *Gestures and conceptual integration in mathematical talk*, *Educational Studies in Mathematics*, 70 (2009) 127-141. [[CrossRef](#)]
- [10] C. Yoon, M. O. Thomas and T. Dreyfus, *Grounded Blends and Mathematical Gesture Spaces: Developing Mathematical Understandings via Gestures*, *Educational Studies in Mathematics*, 78 (2011) 371-393. [[CrossRef](#)]
- [11] J. Hattie, *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*, Routledge, 2008. [[CrossRef](#)]
- [12] D. Farsani and R. Araya, *Professional Proxemics, Part I*, ECTEL Workshop Proceedings, 2017.
- [13] F. Lim, K. O'Halloran and A. Podlasov, *Spatial pedagogy: mapping meanings in the use of classroom space*, *Cambridge Journal of Education*, 42 (2012) 235–251. [[CrossRef](#)]
- [14] V. Font, A. Breda and G. Sala, *Competências profissionais na formação inicial de professores de matemática*, *Praxis Educacional*, 11 (2015) 17-34. [[Google Scholar](#)]
- [15] J. L. Lupiáñez, *Competencias del profesor de educación primaria*, *Educação & Realidade*, 39 (2014) 1089-1111. [[CrossRef](#)]

## BREVE BIOGRAFIA

---

**Adriana Breda**  <https://orcid.org/0000-0002-7764-0511>

Postdoctorado en la Universitat de Barcelona, Doctorado y Maestría en Educación en Ciencias y Matemáticas por la Pontificia Universidad Católica de Rio Grande do Sul (PUCRS), con un período de doctorado sándwich en la Universitat de Barcelona (UB), España (financiado por el programa PDSE, CAPES). Profesora e investigadora en la Universitat de Barcelona (UB, España).

**Danyal Farsani**  <https://orcid.org/0000-0002-9412-3161>

Dr Danyal Farsani received a BSc in mathematics from Coventry University (2009) and a PhD in Education in 2015 from the University of Birmingham and two post-docs from Universidad de Chile. Dr Farsani is interested in communication (verbal, vocal and visual) and frequently presents nonverbal training with specific reference to behavior management and pedagogical practices in different institutional settings. As well as his contributions to the field of education, Dr Farsani also provides training to lawyers, Congress members and the police.

**Roger Miarka**  <https://orcid.org/0000-0002-0633-8446>

PhD in mathematics education at the State University of São Paulo (UNESP), Brazil. He works at the same university in the Department of Mathematics. His research interests include the philosophy of mathematics education, ethnomathematics, and epistemology. He currently develops a research project that aims at understanding the role of ethnomathematics in society and to develop alternative methodologies for this area.