

Plenary Panel 3: Pandemic times: challenges, responsibilities and roles for mathematics and mathematics education communities

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David Wagner's opening comments

Dear colleagues. Dear friends.

First, let us recognize the tremendous disruptions, pains and fears we, our loved ones, and others have suffered in this pandemic. The physical suffering, the isolation, and the compelling demands to care for others in new ways have been real and deep.

Second, let us remember that the coronavirus is probably not the most significant destructive force of our era.

What has been?

- The social fabric of our world,
- the power structures we humans have erected and maintained,
- and our deep manipulation of our physical environments—

these together probably set the stage for the virus to be born, and certainly set the stage for the virus to multiply as it has and for the political and social chaos that ensued.

In fact, the pandemic is not the virus alone. It is the virus, entangled with the socio-political vectors and the environmental landscapes, all acting together.

Thus, to answer the question about the responsibilities of mathematics educators in this pandemic, I step back to generalize and consider our responsibilities in crisis.

We knew crisis was upon us before the pandemic.

- The 2017 Mathematics Education and Society Conference theme was “Mathematics Education and Life at Times of Crisis.”
- In 2013, crisis theorists Topper and Lagadec pointed to the human environmental footprint and the increasingly interconnected world and said: “major events are not new, but they have got denser.”
 - Crises are “no longer a mere chain of interactions, but ‘piles’ of activities, ‘biologically’ entangled and intertwined.”
- This kind of context already motivated Rittel and Webber in 1973 to coin such problems as “wicked” problems:
 - They already recognized that “the classic paradigm of science and engineering – the paradigm that has underlain modern professionalism – is not applicable to the problems of open societal systems.”

This is our context – we live in a risk society that spans the globe (Beck).

We live in a volatile world.

Mandelbrot applied fractal geometry to volatile financial markets.

Using this approach in the current crisis we see that we have to look through the massive changes and upheaval in the pandemic to examine what lies beneath – the structures that have not changed.

I consider the 161 articles we received in our call for papers for the special issue on the pandemic in *ESM*, and the thoughtful reviews of these papers.

And there I see mathematics educators in action, responding to crisis.

With my co-editors, Esther Chan and Cristina Sabena,

I saw that the pandemic has challenged usual patterns of research in our field.

Many scholars were pressed with other demands and unable to focus on their research plans or on their reviewing commitments.

Others found themselves with more time than before.

Not surprisingly, the disparities appear to align with and magnify existing disparities such as gender disparities.

Thus, this is an example of something that stays the same while we feel like everything is changing.

In the manuscripts we received, we saw scholars looking for accessible data that would help the field understand the pandemic.

This was not easy.

The pandemic makes it hard to start new studies involving participants.

And we know that studies of social structures really need researchers to listen to the people most impacted by the structures.

Over time, I expect that we will see more research that uses data that is harder to access, with deep engagement with the people most impacted by the crises.

Some researchers in the soon-to-appear special issue see the pandemic as a prompt for questioning school curriculum:

- What mathematics is needed by citizens to make sense of the crisis?
- Researchers looked to public dialogue for analysis.
 - We see governments, citizens and special interest groups disseminating graphs and statistics to explain pandemic events and inform action.
 - For example, some of the research groups asked what mathematics is needed to make sense of these statistics.
 - It is a good question.
 - But we see that it doesn't exactly answer the question of what curriculum is needed.
 - This is because the forms of statistics representation chosen by governments and others is guided by what they think citizens will understand.
 - There is circularity when people ask what mathematics to teach based on what mathematics is being used.
 - We need our field to identify new priorities for school mathematics.

Some mathematics teachers have seen the pandemic as a prompt to re-examine their teaching.

Surely, students would not accept a focus on the usual skills and knowledge.

One should expect that this supposedly powerful mathematics would be used in class to address the most obvious disruption of our era.

I would expect a call from students and from society, echoing the decades of injunction from Ubiratan D'Ambrosio,

- to examine the complicity of mathematics in the structures that allowed the virus to thrive
- in addition to the possibilities for using mathematics for justice in these times.

However, speaking from my own experience, I see people distracted from asking the deep questions, distracted by our social systems and the immediate needs of disrupted networks.

Students and teachers are focused on the compelling, immediate, local needs.

Some educators are asking the bigger questions and trying to take the crisis seriously with their mathematics teaching.

We received articles that tell of ways to address disease spread in mathematics classes.

There is an account of a discussion group that examined a historical mathematical conversation about vaccinations.

There are examinations of school teacher accounts of how they adjusted their teaching.

Teachers' experiences often described the challenges of using technologies new to them and their students.

Many of the manuscripts we received studied distance teaching via digital and other technologies.

Of course, our field has been studying distance and technology in mathematics teaching for decades, but now more scholars are interested in these things.

Marcelo Borba reminds us that technologies of distance learning need to be seen as entangled with their contexts.

One thing that is immediately clear in pandemic teaching is the inequities:

- unequal access to internet
- unequal access to computers and tablets
- unequal home infrastructure for uninterrupted time
- unequal competing demands for time

Even while teachers and school systems work very hard at combatting them, these inequities persist.

Again, this is another example of something that is invariant in this time of massive change.

For example, we have research that shows how rural families in Turkey have greater challenges.

And the needs of Indigenous students, students of colour and students who have recently migrated are ignored.

The affects of poverty are magnified.

So I ask again, what are our responsibilities as mathematics educators?

To answer this question, we need to answer other questions.

What should every citizen know?

Surely the answer is different than it was thirty years ago, considering the massive changes in interconnectivity in our world.

To particularize this question, we need to identify the human and social problems of our time.

- What mathematics is necessary to understand interconnectivity?
- What mathematics is needed to understand climate?
- What mathematics is needed to understand biodiversity?
- What mathematics is needed to understand wealth distribution?

Which problems are the most pressing?

- Should school mathematics be oriented around understanding our world or acting on it?
 - And if it is for action, who do we expect to use mathematics to act on the world?
- Should mathematics focus on learning algorithms when they can be performed instantaneously on handheld devices that are ubiquitous?
- Or should mathematics learning focus on communication?
- Or, on the other side of the coin, on identifying misinformation?

- Should mathematics classrooms host reflection on the positive and negative uses of mathematics in our world?
 - Or should we pretend that mathematics is outside of or above morality?
- Should mathematics classrooms host discussion about appropriate and responsible use of mathematics?

With all these questions, the underlying question is this:

On what bases do we judge mathematics education?

We as individuals, and we as a collective?

I think the first priority is to see ourselves as caring humans. Before the pandemic I was reading a lot about hope.

Novelist Jonathan Franzen wrote an article in which he thought of hope as a resource. He thought about investment advice, in which advisors always say “diversify your portfolio” –

- invest your hope in short-term and long-term opportunities.

As a mathematics educator in a time of crisis, big or small crisis, a diversified portfolio approach would have me looking at local, immediate challenges

and also stepping back to ask big questions.

- I would devote time to love the people in my family and community.
- In my teaching roles, I would help my students achieve their immediate needs, even if I think those needs are crazy – crazy demands from a crazy society.
- In my research, I may study the local, immediate needs but I may also look at the big questions: and examine the structure beneath the crisis.
 - What is invariant?
 - And where that structure is unjust, how can it be changed?
- And I would reflect on how these different levels of action speak to each other.

Thank you. I look forward to our dialogue.