

## Will 2020 be remembered as the year in which education was changed?

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### *The parable of the man and the dog* (adapted from *Other Old Stories*)

*Once upon a time there was a man who studied at a university how to teach dogs to bark. After completing his degree he could not get employment, so he continued with his studies and completed a PhD in his field, and was appointed at his university to train students to teach dogs how to bark. Not many students studied with him.*

*Then a terrible virus, affecting dogs and causing them to lose their ability to bark, hit the world and caused a worldwide pandemic. Not everybody was equally unhappy—after all, barking dogs can be rather noisy. Rumours, that this virus could be man-made, were heard. The virus spread exponentially and soon few dogs remained that could bark. And the world was quite quiet.*

*Suddenly his discipline was very popular and all over the world new experts started writing important articles and books and blogs on how dogs should be taught how to bark. International companies launched big money-making projects and many teachers and scholars boarded the band-wagon.*

*Unfortunately not all attempts were successful—teaching a dog how to bark does not always imply that the dog will learn how to bark.*

*But some were. And the man had a small smile. And more students.*

*And, although somewhat differently, they could live happily ever after.*

In March 2020, the World Health Organization declared COVID-19 a global pandemic. In response to COVID-19, many countries have applied strict social distancing measures and a lockdown policy. The pandemic has had a serious impact on schools, students and teachers. Students and teachers have not been allowed to visit schools and universities physically and most institutions have transformed to an online teaching and learning approach.

After being faced with the reality of COVID-19, following measures introduced by governments all over the world, and the various arrangements made by schools and universities in compliance with these measures, students and teachers have had to make drastic changes to the traditional teaching and learning approach, working and learning from home. The world of teaching and learning has changed dramatically and we find ourselves relying on technology to conduct lectures and other teaching

and learning activities. Our students are in remote locations away from campus, and we connect with them using technology. Despite all of these changes, life goes on, and we have to live with this reality, which is now referred to as “a new normal” (Sehoole 2020).

At many institutions, online offerings included the uploading of learning materials onto learning management systems, procurement of laptops for students who did not have access to computers, and the securing of free data for accessing the course material to ensure that online learning did not become prohibitive to students and staff in terms of costs. Many teachers and students had to transition to this new mode of delivery.

Digital communication, including lessons, assessment tasks, engagement with students and virtual committee meetings have become “a new normal”. As a consequence of COVID-19, digital literacy and attributes that were previously difficult to address, are being fostered in students to help them successfully navigate the 21st century (Sehoole 2020). This situation makes online and blended learning even more relevant than before.

The educational problems and solutions have been (tongue-in-cheek) referred to as *Panic-gogy*—for panic + pedagogy (Kamanetz 2020). *Panic-gogy* means understanding students' practical resources and problems, including availability of devices and the internet, family responsibilities, students sent home who need to find a new place to live, and financial constraints. But it also means addressing the question of how teachers are going to move into this environment with their teaching approaches (Engelbrecht et al. 2020).

There is uncertainty about this move to online teaching. In some instances the move to using technology could have political consequences. Rushed efforts to ‘teach online’ can give blended and online learning a bad name, evoking student protests rather than being experienced as pedagogical innovation (Czerniewicz 2020). On the other hand, in many countries, online teaching can give access to education to a broader group of students, who have not had it so far.

### **Mathematics education**

The question is what the consequences of this pandemic will be for mathematics education.

In the short term, many international mathematics education activities and conferences, such as ICME-14 and PME 44, had to be cancelled because of COVID-19.

In the longer term, technological advances may enable significant changes in education regarding delivery and accessibility. Educators see technology as a way to improve communication, learning, and the mastery of instructional material. The new generation of educational technologies is creating environments where students can direct the creation of their own knowledge (West and Bleiberg 2013). On the other hand, the current situation exposes very clearly the social gap that exists in the world.

There is concern that the hurried adoption of new technology will lead to falling back to a pedagogy of transmission of knowledge (Bakker and Wagner 2020). There are also concerns about assessment, about the absence of the obvious social benefits of face-to-face environments and about the disappearance of work-home boundaries—in essence we are social people and we need company.

But there are also different ways that education may develop because of the crisis in mathematics education. Prominent are the rapid developments in the field of blended and online learning models. Educators invent new approaches and educational games to address the needs of students. Some publishers have made their educational software and curricula available as open source online material (Bakker and Wagner 2020). Another luxury is that some people suddenly have the time to reflect and to spend quality time on their research, which often leads to creativity.

There is some consensus that teaching should be student-centred. In fact, Engelbrecht et al. (2020) argue for using internet features to foster a student-centred knowledge-pull approach in which the student not only decides on what resources s/he needs to master the curriculum, but even has an input on what content should be included in the curriculum.

This view is not shared by everybody. Olivier (2020) writes that  
 ...self-guided online learning is doomed to fail. Learners simply have no incentive to keep at their studies without peer pressure, a teacher at hand or a structured learning environment.

He justly raises the problem of under-resourced schools and teachers who have little experience in using an online approach, and he argues that a blended model should be used where digital remote learning and teaching is backed up by dependable infrastructure and skilled, motivated teachers.

So perhaps it is somewhat premature to want to move over too rapidly to a student-pull approach to the extent mentioned above, and we should try to find some balance.

For many years, authors (Borba and Villarreal 2005), have argued that different media lead to different mathematics. With the pandemic, different media came into play almost in a mandatory way.

Since learners now mostly study at home, the role of parents in the education process becomes more important. In many instances the parents are not really equipped to assist their children in their education. Research needs to address the issue of how mathematics educators engage in these situations.

The crisis also gives an opportunity for change. Teachers and scholars who did not have the opportunity or time to get in touch with digital technology are forced to go online. Amongst a number of other suggestions for research, Engelbrecht et al. (2020) highlight the need for research on how young children handle this new situation in relation to mathematics learning; on how student teachers will be able to engage in their mathematics teaching practice in these new circumstances, a discussion that Borba (2020) started in a manuscript that has been submitted for publication. There is little research on online education associated with levels below high school.

Another relevant question is what the implications of this new situation are for mathematics teacher education. How should our current training of teachers be adapted to make provision for these new challenges?

West and Bleiberg (2013) referred to the traditional setup of a school. Classrooms are stacked on top of each other like ‘egg crates’ with same-age students in each room. Teachers each occupy their own cell and interact with each other only occasionally. Despite some change over recent years, the egg crate culture remains the dominant norm in many schools and inhibits creativity and collaboration. New flexible educational approaches using current technologies could expand the notion of a classroom to an environment where students could direct much of their own learning. In such a world teachers will not become obsolete—they will play an essential role in supporting student learning. Teachers would be freed up from hours of one direction communication and grading of assessments to more creative activities, such as creating courses or doing research.

### **Social issues**

COVID-19 has brought to the foreground the realities of the inequalities that exist in many countries. Not only has this been made more obvious within institutions, but also between institutions, as different universities and schools have different capacities and levels of preparedness to resume their academic and schooling activities. Students with access to digital devices and internet may not be the majority in many countries. COVID-19 may prove to be a turning point for these countries to confront the inequalities, with a view to putting in place redress mechanisms that will change the state of poverty and inequalities worldwide (Schoole 2020).

Borba (2020) points out that these social inequalities amplify the importance of *Critical Mathematics Education*, which responds to the problem of social inequality in (mathematics) education, and claims that education is not neutral: it can promote equality or inequality. With COVID-19 the social divide can become even wider, with the rich becoming richer and the poor poorer; disadvantaged students can become even more disadvantaged, and this may take place all over the world.

### **Mathematics**

As the pandemic has spread across the world with devastating consequences, mathematics has been gaining face and is currently in the spotlight. News media, such as papers and websites all over the world, use graphs and charts as never before. Everybody is talking about exponential growth as the number of cases doubles and about how one infected individual can lead to unexpectedly large numbers of COVID-19 patients. We can illustrate to students how exponential growth models are being used in hospitals to calculate how many ventilators, or how many hospital beds, they will need (Gonser 2020). ‘Flattening the curve’ is no longer a concept that only mathematicians understand.

In the second world war, mathematicians, such as Alan Turing, helped in breaking codes that served to shorten the war—and now mathematical advice is used to determine lockdown periods and to budget for medical needs. Mathematics is used in

many areas of this crisis; engineers use mathematics to design new breathing equipment and doctors to calculate medicine doses. (Mathematics Teacher Training Scholarship 2020). Research on risk and disaster mathematics is also growing in importance.

Gonser (2020) quotes Amelia Nierenberg of The New York Times, as follows:

When future historians look to write the story of life during Coronavirus, these first-person accounts may prove useful. History isn't usually told by the bigwigs of the era, even if they are some of its main characters. Instead, it is often reconstructed from snapshots of ordinary lives.

COVID-19 mathematics enables curriculum developers and textbook authors to include relevant practical examples in curricula and textbooks; Bakker and Wagner (2020) even predict increased interest in mathematics and statistics after the pandemic.

In future, we will be able to talk about the role that mathematics played in the current crisis, using this example to illustrate how important mathematical modelling is for government decisions.

### **To conclude**

COVID-19 has forced institutions into using technology without the luxury of time to consider existing research or best practice—they are running crisis management to survive. There is a worldwide concern about the 'disastrous effect' of closed schools on students, and suggestions such as holding back all students by a grade, since students lost months of learning, have been made. It is certainly true that these school closings are devastating for many students and their families, especially for disadvantaged students. But to speak of a 'lost generation' is somewhat exaggerated. Education is more than merely filling up students with educational content, month by month, and should not be measured by the time it takes (Ewing 2020).

The radical transformation to online and blended teaching and learning caused by the COVID-19 pandemic is not the way we would have liked to conduct this transition. Teachers' brief has changed overnight. They had to jump in at the deep end—sometimes with little advance notice and often with little support. As schools were closing some teachers frantically had to gather materials to use online. We have to realise that for many teachers, this was an entirely new experience. Teachers encountered new problems and can feel isolated and uncomfortable in this environment. They had to spend days and weeks constructing new materials in new formats for online instruction. They formed support groups, shared materials and created new innovative approaches in some cases. They spent huge amounts of time answering questions, working with students individually or in groups, and communicating with concerned parents. The experts keep on telling teachers that online instruction is more than merely imitating classroom instruction: but they know it first-hand; they experience it every day (Ewing 2020).

We have mentioned the social concerns that are arising during the pandemic. We like to consider mathematics education as being connected to democracy, to equal opportunity. The changes in education that we currently experience through the pandemic, may be increasing the social gap, due to the non-availability of internet

access and unpreparedness of school systems to address such a dramatic change in such a short time.

Coronavirus is like a blackout that has caught half the world off guard in the elevator of inequality and the myth of a globalization that is supposed to benefit us all. (Aguire, 2020)

During this pandemic we fully and gratefully acknowledge and celebrate medical staff, nurses, doctors and other front line workers who have put their lives at stake, working hard, and who have accomplished much. Spare a thought, however, for the thousands of teachers who, in these impossible circumstances, are doing their level best to take care of the next generation—our children—for they are education's front line workers.

We hope that the current low status of teachers in communities in many parts of the world may improve now that parents engage more in their children's education, and the role of teachers during COVID-19 is appreciated in a wider community.

The worldwide lockdown has given us a glimpse of what the future may look like. More people may be working or studying from home, using online meeting or educational platforms, replacing existing processes with digital equivalents using remote workspaces, online interactions and digital service delivery.

So yes, it seems as if this pandemic, that has been instrumental in turning students' bedrooms into classrooms, certainly is affecting education in many ways. Researchers who have been in the field for a long time—like the man in the parable—should advise and collaborate with the new scholars. They should filter through all the new ideas and help select those approaches that are not only teaching students but also enabling them to learn, so that we can all live happily ever after.

The question is: Will 2020 be remembered as the year in which education changed?

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