Learning and Teaching Mathematics in The Global Village

Math Education in the Digital Age

MATHEMATICS EDUCATION IN THE DIGITAL ERA
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Preface

Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned.

Marshall McLuhan (1911–1980)

The term *Global Village* became widespread in the late 1960s after it was introduced by the Canadian communications theorist, Marshall McLuhan (1911–1980), in several of his books (1962, 1964). The term perfectly described an emerging era when mass electronic communication technologies started making it possible for people around the world to be in contact with each other routinely, producing a form of "global consciousness." For McLuhan, it was the second great paradigm shift in human civilization. The first one came about after the invention of alphabets (phonetic writing) in the ancient world, which initiated a radical break from oral cultures and tribalism. With the advent of mechanical print technology in the late 1400s, making the written word available broadly and cheaply, human consciousness became more "literate" and thus more "individualistic," shaped by the structure of print and the fact that people read by themselves. He called the world that evolved from such technology the "Age of Print." Print consciousness was behind social revolutions of a world-shattering nature, from Protestantism and the Enlightenment to political movements favoring nationhood. Before his death in 1981, McLuhan saw, however, the end of this Age and a return to a tribal-like form of consciousness, brought about by electronic media that united people from across the globe as if they were in a village. This was called, logically, the "Electronic Age." With the arrival of the Internet and digitization technologies, this age evolved into the current "Digital Age."

The Digital Age impels all of us to become more involved with one another, no matter what language we speak or what culture we come from. This has engendered new perceptions of what education is or should be, including and especially mathematics. Through new media such as Facebook and Twitter, math pedagogy is being envisioned more and more as taking place in a globally-connected classroom, which McLuhan called a "classroom without walls." The isolated classroom with a

single teacher instructing and interacting with a small group of students in one specific region of the world belonged to the Age of Print; it is more and more an anachronism in the Digital Age. My purpose in this book is twofold: (1) to argue that the shift from the traditional "walled-in classroom" to the "classroom without walls" has started to gain momentum and can no longer be ignored; and (2) to explore what this entails concretely for the learning and teaching of math today.

I became aware of the power of the modern media to extend the traditional classroom after teaching an experimental "math for math phobics" course at the School of Continuing Studies of the University of Toronto a few years back. One of the students came to my office a short while after the course had finished and informed me that a YouTube video presentation on the notion of infinity, based on my book, *The Liar Paradox and the Towers of Hanoi* (2004), scripted and performed by two young boys (www.youtube.com/watch?v=xyFdwpM4Vb0), finally helped him grasp that concept. I remember having several reactions to this unexpected information. First, I was absolutely delighted and flattered that my book inspired two pre-adolescent boys to take the time and effort to do a video presentation on one of the chapters of the book—a presentation that I found to be both entertaining and enlightening (I truly learned from it myself). Second, my "teacher's ego" took a bit of a hit when the ex-student implied to me that the video was superior to my pedagogy and even my book. Obviously, for that student, the video was much more effective than my classroom instruction. Third, and most importantly, I came to realize the power of modern media to deliver effective math education. Simply put, the YouTube video put the finishing touches on the teaching of a math concept that was introduced and practiced in a classroom context. It was an example of how a "wall-less classroom" can function.

The traditional way of teaching with textbooks and the usual apparatus of tests may be out of synch with the times, even though it may still have utility in various ways. I can imagine an analogous situation in medieval villages where the main medium of education was the spoken word. Going to school meant gaining knowledge primarily by listening to the teacher. With the advent of cheaply produced books after the print technology revolution, gaining knowledge meant reading print materials together with the teacher's guidance. With the arrival of the Internet, the situation has changed (or is changing) once again. Knowledge-attainment now is guided not only by listening and reading, but also by navigating cyberspace and by interacting with others in that space.

McLuhan believed that the medium used to deliver content can alter the way the content is understood. Today, this "McLuhanism" has revealed itself to be a veritable law of social evolution. The YouTube video episode could never have even been imagined as having any educational implications in a previous era, even if it would have been technologically possible to have created it. The episode made it clear to me that media and content are intertwined. McLuhan was also aware of the powerful role that popular culture played in the world of mass communications because it engaged people of all backgrounds. This in no way implies that pop culture is trivial or shallow. I myself learned more about the classical myths and the novels of great literature as a youth by reading comic books than I did by reading

the actual texts in school with teacher annotations (many of which petrified me). The comic books were called *Classic Comics.* They were first published in 1941 by the Elliot Publishing Company. The first three issues were *The Three Musketeers*, *Ivanhoe*, and *The Count of Montecristo*—all three of which I read avidly in the mid-1950s as a boy growing up in Toronto. The creator of the comics, Albert Lewis Kanter, believed, in fact, that the comic book medium would introduce young and reluctant readers to great literature.

I have been a "traditional" professor all my life, and to a large extent, continue to be so. I still believe that the Socratic method of engaging with students in a dialogical way has never been eclipsed, in any age, Print or Digital. But it cannot be denied that technology today is re-shaping the world, including the academy. It has also taken the academy into the world. Math is now a common theme in popular forms of entertainment (in movies, in television programs, and so on) and this incorporation into the popular imagination, as I will argue, can be turned to the advantage of classroom pedagogy. The extension of the math classroom into the world of pop culture is another example of how a wall-less classroom can unfold.

Skill in mathematics is becoming more and more a practical necessity, not an abstract subject sheltered from the world. As journalist Thomas Friedman (2007: 300) has aptly put it, the "world is moving into a new age of numbers" in which "partnerships between mathematicians and computer scientists are bulling into whole new domains of business and imposing efficiencies in math." Television programs like the crime drama *Numb3rs*, and movies such as *A Hill on the Dark Side of the Moon, Good Will Hunting, Pi, Conceiving Ada,* and *Proof* are built around or involve mathematics. Despite its popularity in these media, mathematics is still seen as an "abstract discipline" meant for those who are inclined to learn it as an intellectual exercise. The Thinkport.org website, for instance, carried the following headline a few years back (Friedman 2007: 32): "How many times do we adults say to one another, I'm just not good at math?" Given that the ability to count and understand basic numerical concepts (adding, taking away) is acquired effortlessly in childhood, why does this negative perception exist? Is it a consequence of how math continues to be taught as a "walled-in" subject?

Certainly the quality of the modern-day teaching materials used or the commitment of teachers is not in question. Never before in the history of math education have we had so many expertly-written textbooks and materials available for use as we have today; and never before has the interest in teaching mathematics effectively been so fervent, as witnessed by the plethora of books, periodicals, websites, professional associations devoted to its pedagogy. Nevertheless, many people still hold schools responsible for the ineptitude at math that some (perhaps many) students show. Even celebrities have jumped onto this critiquing bandwagon. In her bestselling book titled *Math Doesn't Suck* (2007), television star, Danica McKellar (*The Wonder Years* and *The West Wing*) suggests outright that fear of math starts in school.

In a relevant book, Tim Chartier (2014: ix) argues how some ideas, like Google's PageRank algorithm and the construction of mazes with TSP Art, are changing how people are starting to view math. Chartier and others like him present

some very interesting facts about the interconnection between math and everyday life. But some educators see the incorporation of the everyday world into the core of math pedagogy as mere "edutainment," rather than as certifiably effective education. My view is actually that the traditional classroom is still useful, with the presence of a real teacher and with real students in direct Socratic dialog with each other. But we can no longer isolate this dialog from the outside world.

Nothing changes, yet everything changes. We still need to do mechanical exercises, which are boring for everyone concerned (students and teachers alike), as well as group-work. In an interesting 2012 book, Wendy Ward Hoffer presents a model of how to do group-work in a novel way—through a math workshop format akin to a writer's workshop, arguing that learners will gain a deep understanding of math only when they are engaged in this kind of learning format (see also Peterson 2013). I love these "get-together" models of education. But I feel they work best for those teachers who are good at them. As a student myself, I always wanted a good teacher to teach "me," apart from my peers, because they were not as understanding as the teacher was or should have been. The group-work model has only worked sporadically and unevenly across classrooms. But in the Global Village, where a broader community of learners can be accessed outside the classroom, perhaps group-work can work in a globalized community.

The reader might find that my ideas are common-sensical or perhaps simple reformulations of extant notions in math education. I suggest that this is so only in a coincidental way. I love math, and I want everyone else to love it as well. The classroom in the Global Village is morphing gradually into a paradigmatically different one from the past. So, my discussion revolves around cognizance of this fact, how it came into being, and what it implies. There is no turning back the clock, to employ a cliché that McLuhan himself used often in his classes at the University of Toronto.

Contents

List of Figures