

Edward Doolittle (First Nations University)



*Residential Schools*

Residential Schools were Canadian government-sponsored schools for Indigenous children, generally run by religious orders. The schools were designed to assimilate Indigenous children into Christian religion and the dominant Canadian culture. About 150,000 Indigenous children in Canada attended residential schools from the time the system was developed beginning in 1879 until the last school was closed in 1996.

Students in the residential school system, now known as Residential School Survivors, experienced an extraordinary level of mistreatment and abuse perpetrated by those in charge of the schools. The resulting legal action led to the [Indian Residential Schools Settlement Agreement \(IRSSA\)](#) in 2007, the largest class-action settlement in Canadian history, with \$1.9 billion in damages paid to all former students (the Common Experience Payment) and an additional \$3.1 billion paid for damages suffered beyond the norm. As part of the settlement, the IRSSA also established the Truth and Reconciliation Commission (TRC) to document and preserve the experiences of the survivors.

One of the most astonishing statistics uncovered by the TRC is that of the death rate of Indigenous students who attended residential school. Out of about 150,000 attendees, at least 6,000 died of various causes directly related to their attendance in residential school, a death rate of about 1 in 25 students. In comparison, the death rate of Canadian soldiers serving in World War II was lower, at about 1 in 26.

Many of the students' deaths were attributed to tuberculosis. While tuberculosis likely affected most of humanity before the discovery of antibiotics, the disease became deadly in the presence of malnutrition and poor living environments, conditions which were endemic in the under-funded residential schools system. In addition to malnutrition, violent physical and sexual abuse of children in the system was rampant. I personally know residential school survivors who have told me harrowing stories of malnutrition, physical abuse, and sexual abuse. Thousands more stories like theirs have been documented by the [TRC](#).

One might characterize the failures of residential schooling as malfunctions of a system that was badly conceived, badly funded, and badly executed. But we must remember that the primary goal of residential school was "to kill the Indian in the child," a policy of cultural genocide. While the residential school system generally failed in its duty to protect Indigenous children, it generally succeeded in its aim to disrupt the transmission of Indigenous cultures and languages from one generation to the next. Canadians have a moral duty to undo those effects of residential schools, and reestablish healthy, thriving Indigenous cultures and communities.

*Truth and Reconciliation*

To that end, the TRC issued a set of 94 Calls to Action directed at Canadian governments and Canadians in general. The complete set of [Calls to Action](#) may be found on the TRC web site. For example, Call to Action 62 reads, in part:

*We call upon the federal, provincial, and territorial governments, in consultation and collaboration with Survivors, Aboriginal peoples, and educators, to: ... ii. Provide the necessary funding to post-secondary institutions to educate teachers on how to integrate Indigenous knowledge and teaching methods into classrooms.*

Many of the Calls to Action are related to education. As Justice (now Senator) Murray Sinclair, chair of the TRC, has said, "Education has gotten us into this mess, and education will get us out."

*Government Response*

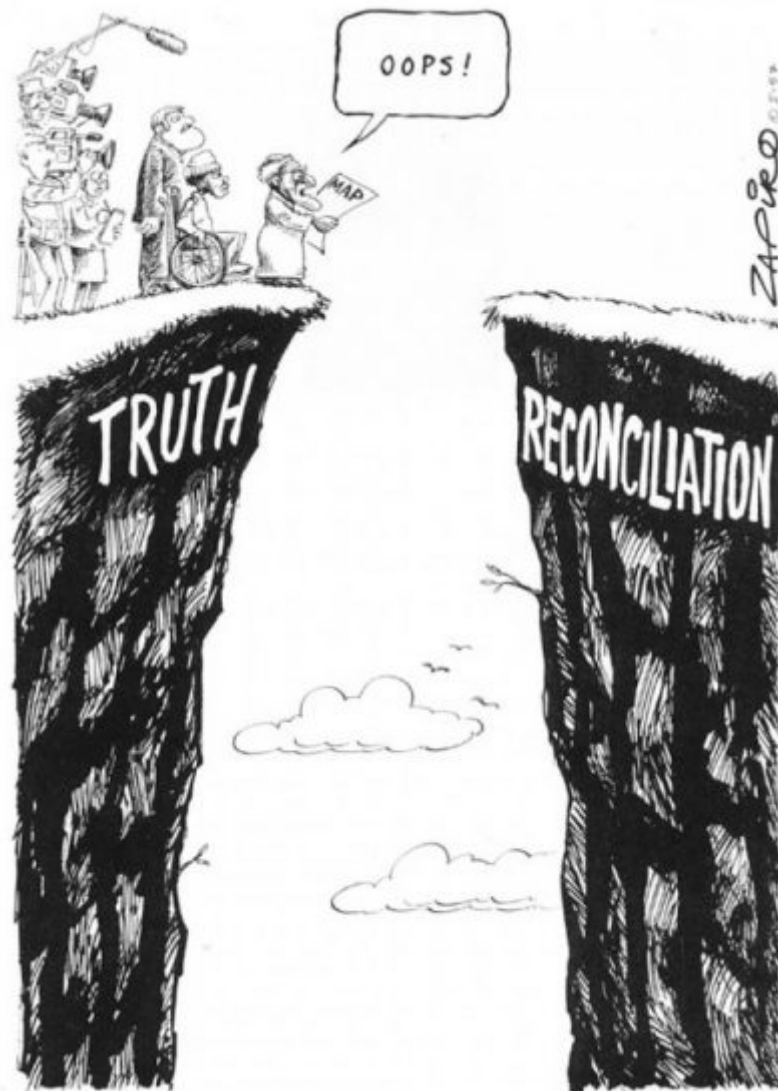
On December 15, 2015, the Canadian federal government committed to implementing the Calls to Action, which call for changes not only to the situation of Indigenous people in this country, but also to the relationship between Indigenous and non-Indigenous people.

As an example, in response to Call to Action 43, the Government of Canada has announced its full support of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). UNDRIP has the potential to cause far-reaching changes to Canadian legal and governmental frameworks, particularly those related to resource management, and ultimately changes to Canadian society. We all have a responsibility to learn about those changes so that we can prepare ourselves, our students, and our institutions.

### *Universities' Responses*

Canadian universities and other professional organizations have begun the long process of responding to the Calls to Action. Due to the comprehensive and far-reaching nature of the Calls to Action, universities' responses have been slow and tentative, and vary tremendously from one institution to another. However, there are some common themes emerging.

For example, Indigenization at various levels (the classroom; student services; the institution as a whole) is a common emerging theme of universities' responses to the Calls to Action. Indigenization is not yet well defined, but it includes the notion of incorporating Indigenous ideas, concepts, and practices into curricula, teaching methods, research, administration, and community service. Indigenization could conceivably impact every aspect of a university's operation, including its mathematics teaching and research.



Zapiro-1997

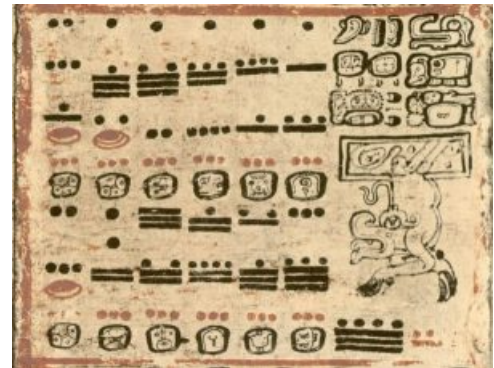
### *Reconciliation and Mathematics*

As mathematicians, we are being asked by our institutions to Indigenize our practice as part of their overall effort. Yet we are among the least well-prepared for this request. Mathematics, with its dedication to truth (or at least validity), is sometimes valued for being beyond culture and politics. That is certainly one reason why I was first attracted to mathematics in my youth. Whether mathematics really can be so removed from the issues of the day is debatable, but there is no question that the associated attitude is common among mathematicians, and as a result, we may be poorly prepared when called upon to contribute to cultural, moral, and political endeavors.

Yet, I believe there is a compelling reason for mathematicians to contribute to the reconciliation effort, beyond the imperatives of our institutions and the moral imperative for all Canadians mentioned above. Consider what was taught in residential schools. My impression is that many students learned only four subjects in those schools: manual labour skills, generally farming for the boys and housekeeping for the girls, to establish the place of the Indigenous students in the economic order, and to help maintain the underfunded schools; religious studies, to colonize the students and break their connection to traditional cultures and spiritual beliefs; English or French, again to colonize the students and break their connection to traditional languages; and mathematics. "Mathematics is how they really got us," said one residential school survivor to me. The issue has not been studied at all, to my knowledge, but it seems likely to me that in residential school the power of mathematics was misused, as were the other residential school subjects, as a tool for colonization and repression. The study of that issue is within the domain of mathematics education, but all mathematicians and math educators should be aware of the potential of mathematics to do harm as well as good.

What can mathematicians do to contribute to the reconciliation effort? I would like to offer a modest collection of practical ideas, touching on the typical duties of mathematicians working in post-secondary institutions mentioned above, particularly curriculum, teaching methods, research, and community service. My suggestions are derived from my own personal experience and the local contexts in which I have worked. In my career, I have taught over one thousand Indigenous students in a variety of locations (reserves in Ontario and Saskatchewan; remote reserves ("fly-in communities") in northern Ontario; universities and colleges in Ontario and Saskatchewan) and for a variety of programs (generally math courses required as components of a non-science diploma or degree, but also math methods courses for K-12 preservice teachers, and even Indigenous Studies courses). Yet there is enormous variation among the hundreds of Indigenous communities and hundreds of thousands of Indigenous people across the country, of which my experience is but a narrow cross-section. I encourage anyone interested in these issues to seek out opportunities to gain their own different experiences with Indigenous cultures and to develop their own creative responses to the issues that face us. I continue to be astonished at the creativity and valuable contributions of colleagues who have taken up the challenge of Indigenousizing their practice.

I have had moderate success Indigenousizing curriculum in some courses, especially Introductory Finite Mathematics, which includes topics like arithmetic in other bases (like Mayan arithmetic and Chumash arithmetic) which has an interesting connection to the Unicode base 16 representation of Indigenous writing systems; modular arithmetic, which can be applied to time-keeping and calendars; and elementary number theory, which can be studied using bead work. Some examples I use are admittedly superficial; for example, choosing important dates in Indigenous history when showing students how to calculate the day of the week given the date, or using Indigenous data when studying the distribution of blood types with Venn diagrams; but I feel that anything is better than nothing, as long as a superficial example is not a reason to stop improving. In statistics, I use Indigenous games as examples in the study of probability, and there are many opportunities to use Indigenous data from Statistics Canada. I have not yet had much success Indigenousizing the calculus curriculum, but I believe there is an opportunity to draw examples from situations of interest to Indigenous people.



Arithmetic in Mayan Base

In general, I find that applied mathematics is more interesting to Indigenous students than pure mathematics. I have had Indigenous students go from bored and disengaged to riveted when I introduce applications that resonate with them. I feel that we could do better to teach more applied mathematics throughout the curriculum, from elementary school through university. Our system now seems to be designed like an arrow pointing to multivariable calculus, even though only a miniscule proportion of students ever take that course; I feel that we would do better with Indigenous students, and perhaps with all students, if we thought of the math curriculum more as a study of interesting, practical problems, for which we can draw in tools as needed.

Coupled with modifications to curriculum, we need also to consider modifications to teaching methods, pedagogy and andragogy, to reach our Indigenous students more effectively. Indigenous students have all been affected by residential school, whether directly or indirectly through the experiences of their relatives and members of their communities. As a result, in my experience, Indigenous students mistrust formal education systems. As educators we must work to overcome that mistrust and by being absolutely trustworthy. Furthermore, despite all the attention that residential schooling has received, one of the major problems at the root of the system still persists: the underfunding of the federal school system responsible for teaching Indigenous students on reserve. [By some estimates](#), reserve schools are funded at a rate 30% less than provincial schools. Many reserve schools are also remote, making it difficult to stock and staff the schools. I have sat in classes in reserve schools without functioning science labs, in which teachers who have little math or science background just read from the textbook. The solution to those problems would be to improve funding for reserve schools, and I think we should all call on the federal government to do so, to eventually deal with the shortages that reserve schools experience. However, in the meantime, we need to be understanding about our university students' difficulties resulting from poor prior education. I encourage my students to use aids like calculators and help sheets in tests, for example. One of my students even brought in a multiplication table, which I encouraged her to use.

As university professors, I also feel we have much to learn about teaching methods from our colleagues in elementary math education, which will benefit all students, particularly Indigenous students. For example, I have successfully used "rich tasks" in which the class breaks into small groups of four students to solve a set of interesting and carefully designed problems in my finite mathematics classes. Universities can help by reducing class sizes, particularly for classes designed for Indigenous students, or at least providing more opportunities like tutorials for skilled teaching staff to interact with smaller groups of students.

There are many research opportunities for mathematicians in Indigenous contexts, particularly in applied mathematics addressing the many difficulties and challenges faced by Indigenous people in Canada. That type of research could also be viewed as community service. One of my current

research projects is to study the structure of word puzzles and games and to apply the results to assist in the construction of puzzles and games in Indigenous languages. In my project there is some mathematics (graph theory), some statistics, some computing (theory of effective and efficient computing; programming; perhaps machine learning), and some study of Indigenous languages. The mathematics is not particularly difficult or leading-edge, but there is potentially enormous value to Indigenous communities who are struggling to find ways to reverse the language loss which resulted from the residential school system. Water quality in Indigenous communities is another issue which may benefit from attention by researchers.

Beyond the current needs of Indigenous communities, there are research opportunities in cultural practices like games, arts, crafts, and other material culture. Those who are interested in pursuing research in those areas should be aware that ethics requirements are stronger for research in Indigenous communities, and should review the section on research in Indigenous communities the [Tri-Council Policy Statement TCPS2](#), and should also be aware of the [OCAP](#) (ownership, control, access, and possession) principles for Indigenous research data. It is important to have a true partnership with Indigenous researchers when doing Indigenous community-based research. Furthermore, researchers should realize that Indigenous cultures continue to use oral tradition, so researchers must consult elders and traditional teachers to obtain information which might be contained in books in other contexts.

We can overcome the shameful legacy of our past and build a better nation together. I hope that mathematicians and math educators can see the valuable role that they can play in doing so. I look forward to sharing success stories with you all in the future. Skennen (peace).