**SPECIAL INTEREST ARTICLE**

# Mathematics Education: Problems and Solutions in Supporting a Complex System

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***Abstract***

*Students are guaranteed, by legislation, a math education that focuses on the process of mastery learning, and that incorporates an Indigenous worldview. The issue is that some teachers and principals are apprehensive or do not have the skill or knowledge to support mastery learning and Indigenous worldview in math. This article is not a reprimand, rather, it is an invitation for growth for all members of the complex system. My viable solutions to the issue of incorporating mastery learning and an Indigenous worldview are about relying on legislation, and continuous support through creating responsive professional development plans.*

As a math instructional coach, providing professional development and support to students, teachers, and principals in mathematics is my job. Having educators incorporate mastery learning and an Indigenous worldview into mathematics in order to support student success is currently the most pressing issue I face. Research into this issue has helped me to understand better why incorporating mastery learning and Indigenous worldview in math is important, and is an issue to students, teachers, and principals. The research also leads me to several solutions to support students, teachers, and principals to foster changes needed. Mandating and legislating change, providing tailored professional development plans and continuous support, orchestrating opportunities to develop pedagogical leadership, and changing my thinking and approach as the coach are viable solutions. Being a math instructional coach in the kindergarten to grade 12 system requires my application of support and professional development plans across the complex system, in order to vary and be responsive to the issues and people in that system. Incorporating mastery learning and an Indigenous worldview into mathematics is the issue my current system faces, and tailoring my coaching to support each member of the system is the solution.

## Supporting Students

Teaching for mastery learning and incorporating an Indigenous worldview in math education are important practices because students are entitled to a math education that helps them to understand the world around them. In Manitoba, understanding the world and land around us means incorporating and honouring an Indigenous worldview and mastery learning (Appropriate Educational Programming Regulations, 2005; Frontier School Division, n.d.; Truth and Reconciliation Commission of Canada, 2015). When students work toward mastery learning, and when they have an education that reflects an Indigenous worldview, they are better able to move through the kindergarten to grade 12 math education system (Manitoba Education, 2014). Students also more likely to graduate, seek higher education, and have a better quality of life (Hattie et al., 2017). For students, the solution to the issue of not being taught the mastery learning process and Indigenous worldview in mathematics is twofold. One solution relates to educators knowing how to support students in a way that orchestrates mastery learning, and honors and incorporates an Indigenous worldview in mathematics. The second solution is in relying on legislation and professional obligations to ensure that change is mandated.

Incorporating an Indigenous worldview and mastery learning is especially important in mathematics in Frontier School Division. It is important because it is unlikely that mastery learning will develop without incorporating an Indigenous worldview. I reached out to multiple sources to determine the student population in Frontier School Division that self-declares as Indigenous. The generalized

answer I kept hearing was that between 80% and 85% of students in Frontier School Division self-identified as Indigenous (J. McCracken, Student Data Manager Administrative Assistant, personal communication, November 15, 2020). The only hard evidence found came from Provincial budget reports. According to the Manitoba Education Schools' Finance Branch (2020), Frontier School Division reported that they expected 59.6% of their operating fund revenue for the 2019-2020 school year to come from First Nations (p. 53). This revenue is based on the enrollment of students who report treaty status and does not include non-treaty, Metis, Inuit, and students who self-declare as Indigenous. A significant proportion of Frontier School Division's student population identifies as Indigenous, so ensuring that mastery learning and an Indigenous worldview are incorporated into math education is a significant issue.

The problem of guaranteeing students' rights to an appropriate education is really an educator issue. Students are guaranteed a math education that is appropriate to them, and that orchestrates opportunities for mastery learning and incorporates an Indigenous worldview (Appropriate Educational Programming Regulations, 2005; Frontier School Division, n.d.; Truth and Reconciliation Commission of Canada, 2015). Planning for student success in these areas requires the skill and knowledge to put these teachings into practice. Feeling uncomfortable, or lacking the skill to deliver the curriculum, is not an excuse for teachers and principals to ignore it, and legislation can be leaned on to mandate change (Manitoba Teachers' Society, 2014). To have real change take hold, though, educators need to be supported and taught the skills and knowledge required, and then receive continuous feedback and support in order to see those changes through longterm (Vennebo & Aas, 2020). Mandating and legislating change is a reactive solution, while working with teachers and principals and supporting change are proactive solutions to the issue of not having mastery learning and an Indigenous worldview taught in math classrooms to students.

## Supporting Teachers and Principals as Educators

Incorporating mastery learning and an Indigenous worldview into mathematics is an issue for teachers and principals, so the solutions must include changes in them. The problem is that educators feel they do not know how to incorporate Indigenous worldview and mastery learning into math education. They worry about carrying out the learning in an inauthentic way, or worry that they do not have the right or skill to teach for mastery and Indigenous worldview (Meyer & Aikenhead, 2021). This apprehension is normal, but it is not a valid excuse to exclude mastery learning and Indigenous worldview from math education. It is an invalid excuse because mastery learning and incorporating Indigenous perspectives in curriculum are mandated. The same twofold solution offered in the student section also applies here. Educators can be mandated to incorporate mastery learning and an Indigenous worldview into math education, or they can be supported and provided the learning to make these changes, and then given opportunity to practice and receive feedback.

Legislating and mandating change is less effective than supportive coaching. Holding an educator professionally accountable through progressive discipline often sours the coaching relationship and trust for a time (Brown, 2018). Sometimes, teachers and principals come around once they realize that incorporating mastery learning and an Indigenous worldview in math education benefits student growth. In some cases, though, the coaching relationship never repairs and that connection is closed off. Relying on legislation to force teacher and principal change, and mandating the use of mastery learning and an Indigenous worldview, is one solution to ensure that students receive an appropriate math education.

The solution that I am more interested in pursuing is to support students in mastery learning and an Indigenous worldview in math through working with teachers and principals. Instead of mandating or shaming educators to change, I would rather create a professional development plan that is responsive and provides continuous coaching support (Brown, 2018). The first step in creating the professional development plan requires the coach to acknowledge that change is slow and difficult (Guskey, 2002). It is important to preface this because it is easy to become defeated when a treatment is applied to the system and the effect is not immediately apparent. The next step is to

provide a coaching session or a professional development opportunity, then follow the session up repeatedly with those educators so that they can be guided to reflect on and receive feedback on the learning and growth of their students, and themselves (Desimone, 2009). Educator change takes place when student growth is apparent and there is opportunity for feedback (Keiler et al., 2020). The last piece of the process is to provide consistent coach follow up, support, and pressure to grow (Sowell, 2017). This professional development and coaching plan creates the opportunity for educator change to take root, and is a viable solution so that mastery learning and an Indigenous worldview in math education becomes incorporated into schools and classrooms.

To apply this solution to my own practice, I have organized grade-group sessions wherein I meet with all teachers of the same grade for half a day, four times a year. At these sessions, tailored professional development on skills and knowledge that are seen as needing support are provided. Following the professional development session, scheduled classroom visits with the individual educators occur multiple times when new skills are put into practice. In an upcoming grade-group session, I am working with the Indigenous Way of Life instructional coaches to present to teachers on what mastery learning and an Indigenous worldview look like in math education.

When educators feel supported and safe to share their struggles and vulnerabilities, educator change and student growth can flourish (Pearce, 2019). This may seem idealistic, but it can happen with a well-developed coaching and professional development plan. The solutions to the issue of having educators not teaching for mastery learning and an Indigenous worldview in mathematics can include discipline and legislation, or it can include space and support to grow and learn.

## Supporting Principals as Pedagogical Leaders

As well as learning skills and knowledge about mastery learning and an Indigenous worldview in mathematics, principals specifically also need opportunity for professional development related to their role as the pedagogical math leaders of their schools. When principals are supported and given opportunity to practice being pedagogical math leaders a complex system change is more likely to occur (Radinger, 2014). The structure of how to apply support, feedback, and professional development for teacher change can also be applied to principal change (Desimone, 2019). Supportive coaching and a professional development plan for principals is a solution to the issue of not having mastery learning and an Indigenous worldview taught in math classrooms.

Pedagogical leadership skills are not always tacit to principals. When learning to lead, there is not one prescribed manual to follow, nor are principals given a list of questions that help drill deeper into math pedagogy (Davis & Renert, 2012). Some principals, in fact, try to delegate to coaches the responsibility of being the pedagogical leader. This delegation, or avoidance, is an attempt to circumvent tough conversations and mentorship in pedagogy and practice. Again like teachers, principals do not feel like they know how to, or have the skills to, lead those tough conversations (Radinger, 2014). They do not know how to facilitate those conversations and move thinking from surface learning to deep or transfer learning (Hattie et al., 2017). Learning to be the pedagogical leaders of their schools is where principals are looking for support, and giving them exactly that is the solution to ensure that they have the skills to incorporate mastery learning and an Indigenous worldview into math education across their schools.

Principals need the opportunity to receive professional development on being pedagogical leaders, and then receive the same follow up support and pressure that teachers experience (Radinger, 2014). They also need time with other principals, so that they can practice some of these skills and situations with others in the same role, and practice having tough pedagogical conversations (Vennebo & Aas, 2020). In Frontier School Division, principals are required to attend professional development sessions with their teachers. Principals are also required to attend their own meetings wherein instructional coaches, principals, and superintendents work alongside them to build skills in pedagogical leadership. Focus will be applied in the upcoming meetings to include opportunity for scenario or real problem solving regarding the incorporation of mastery learning and an Indigenous worldview in math. When principals become the pedagogical leaders of their schools, teacher change,

student growth, and change in the complex system happens much more effectively (Pearce, 2019). When given professional development and support, principals can pedagogically lead and cause change in the issue of the lack of incorporation of mastery learning and an Indigenous worldview in mathematics.

## Math Coach Development

My last issue and solution to incorporating an Indigenous worldview and mastery learning in math education is potentially my most important or most damaging tool: myself. As the coach, I have to support teachers, principals, and students in the kindergarten to grade 12 math system. I am the decisive element in how this is going to be carried out and whether what I say humanizes or dehumanizes the people I work with (Ginott, 1972). How I create space for others to learn, and how I choose to lead, are all factors that I control (Brown, 2018). The issue presented throughout this work is my issue, and comes from the environment that I am in. Therefore, the solutions also have to include change in me (Davis & Simmt, 2006). In complexity science, all members of the system have a role to play and have power to effect change (Davis & Renert). My skills have to vary, and I have to be responsive to the learners I have in front of me. I also need to have courage and knowledge to have hard conversations, as well as the math knowledge for teaching (Vennebo & Aas, 2020). As a coach, I meet with the other divisional and provincial numeracy leads, take coursework in this area, read professionally, live as a learner, and work with my own mentors to build my skills so that I work more effectively with others. When effecting change, a person's most powerful tool is oneself, and engaging in reflection is part of the solution to my issue.

## Conclusion

It is easy to point fingers, be angry, and say that not providing an opportunity for mastery learning and an incorporating and Indigenous worldview in mathematics is the problem, and that teachers and principals should take responsibility and change. It is much harder owning that the only thing that one can truly control is oneself (Brown, 2018). I am the coach, and if I want things to change I have an obligation to help change them. My solutions to this issue come from a variety of stances, one being a hard-nosed one where I could solely rely on legislations and professional obligations to mandate teacher and principal change. The other stance is to support by creating professional development plans for teachers, principals, and students that are responsive their specific needs. Having educators incorporate mastery learning and an Indigenous worldview into mathematics to ensure that students receive appropriate math education is my issue, and providing continuous support and responsive professional development is my solution. Although legislating seems quick and rewarding, it rarely causes actual change because, even if mandated, teachers and principals still do not have the skills or tools to cause change, and their fears of doing harm or not having the authority or skills still remain (Meyer & Aikenhead, 2021). Honouring the mastery learning process and incorporating Indigenous worldview into mathematics requires all members of the complex system to commit to working and learning together for change, not mandating it.

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