

Applying Process Tracing to the Development of the Indigenous Math Courses and Secondary Math Education Program at Turtle Mountain College

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Background and Motivation

Undergraduate math courses focused solely on Indigenous math are relatively new within tribal colleges/universities. Turtle Mountain College has developed a three-course sequence on Indigenous Math in conjunction with developing their bachelor's program in Secondary Math Education. The development process of the Indigenous Math courses led to the Indigenous Math Framework. The framework has four components situated within the medicine wheel. The four components are (1) Nature/Place/Land, (2) Community, (3) Heritage/Traditional Games, Arts, Engineering, etc., and (4) Language. The framework is not the only way to view Indigenous math but rather just a way that is used at Turtle Mountain College (Luecke 2023, 2025). The courses and framework build upon scholars who articulate the error and danger of Western perspectives of math being mythologized as pure, universal, culturally neutral, and culturally superior (Aikenhead, 2017; Bishop, 1990; Ernest, 2021; Kawagley, 1997; Medina et al., 2024; Stevens, 2021; Xu & Ball, 2024). Further, these courses stand on previous K-12 math education research demonstrating that math and local language/culture integration strengthens students' cultural identity and improves math exam scores (Lipka et al., 2007; Kisker et al., 2012).

Purpose of the Study

The development of the Indigenous math courses and the Secondary Math Education program focused on content and pedagogy (Luecke, 2023, 2025). This research will go beyond the end-product of what was developed and study the why and how of the development process. The expectation is that a greater understanding of how the Indigenous Math courses and the Secondary Math Education program were developed will afford opportunities to strengthen the courses and program as well as offer insights into supporting any math faculty interested in integrating more Indigenous ways of knowing and being into an undergraduate math class. The research question is "What strategies for developing math (and math education) programs with a greater emphasis on Indigenous STEM can be derived from a retrospective analysis on the development of the Indigenous Math courses?"

Methods

The research methods are situated within an Indigenous research paradigm with its emphasis on relationality, relational accountability, and storywork (Archibald, 2008; Kovach, 2009; Wilson, 2008; Windchief & San Pedro, 2019). Aligning with the research question, a process tracing method (Atcha, 2022; Beach, 2017; Montano et al, 2025) will be applied to the initial development of the Indigenous Math courses and Secondary Math Education bachelor's program to determine strategies in navigating tensions/decisions in development. A process tracing methodology affords a systematic, reflective analysis to see causal relationships on how the courses/program developed. Identifying moments of decision, struggle, and overcoming demonstrate one way to increase Indigenous Math content in all math courses/programs.

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