David F. Robitaille Professorship in Mathematics and Science Education

Vision Statement: Cynthia Nicol

My vision for re-appointment to the Robitaille Professorship in Mathematics and Science Education focuses on: 1) sustaining and expanding the Robitaille International STEM Network (dfr.stemnetwork.educ.ubc.ca); 2) fostering continued support for innovative Science, Technology, Engineering and Mathematics (STEM) research and community engagement; and 3) continuing focused support for M in STEM education for Indigenous and all learners.

I advocate for STEM education beyond calls for workforce readiness in a changing global economy. STEM education provides access to economic opportunities *and* opens opportunities for understanding (reading), interpreting (analyzing), and changing (writing) the world. STEM education can engage and inspire learners and communities in seeking actions to problem solve complex world issues such as: addressing climate change and forced displacement, reconciling our relationships with each other and our environment, and responding to deepened inequalities of the global pandemic.

STEM education has potential for decolonizing educational practices—to interrupt colonial structures and logics to re-imagine our relationships with each other, including human and non-human or more-than-human worlds. My research interests explore such re-imagining, and are specifically focused on the 'M in STEM,' the mathematics of STEM, so that youth, educators, Elders, families and communities can participate in creating and sustaining innovative, resilient and culturally rich communities

If re-appointed I will pursue high impact initiatives in STEM education including establishing and sustaining research excellence; building community relationships and engagement; and mentoring of graduate students, teacher candidates, and teacher educators (see Appendix A for a list of proposed initiatives and possible impact indicators for the 2021-2024 Professorship).

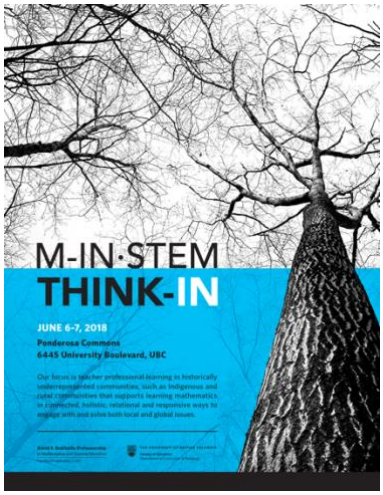
STEM Education Research Excellence

With this Professorship I will draw upon my scholarship and leadership in mathematics education, teacher education, Indigenous education, and participatory action-based research methodologies to continue growing the David Robitaille International STEM Network. The Network supports research mobilization and community engagement for both rural and urban communities, including all age levels from early childhood to adults, across diverse settings, and for both Indigenous and non-Indigenous learners. The Network website highlights information about the Professorship and its members, lists supported research projects and community engagement activities, features outstanding STEM educators, offers STEM digital resources, and lists recipients of the Network's STEM teacher innovation grants.

Through the Professorship I will continue leading the David Robitaille Endowment Fund with 10 EDCP colleagues as co-researchers. Initiated in 2018 through my first term of the

Professorship, our project *Exploring STEM Education through Community Engagement*, investigates STEM education in maker spaces, community settings, and teacher education contexts. Our first research context, the 2019 Family Math and Science Day, involved six graduate students and two faculty members resulting in a STEM 2021 conference poster presentation and academic paper. Our research mobilized through the Network will be provide examples of innovative STEM education pedagogies in varied contexts. It could also be beneficial to outreach organizations who seek evidence-based research for their program decision-making.

To promote research connections at national and international levels I will build on the stimulating *M in STEM Think-In* hosted by the Professorship in 2018. The *Think-In* gathered 22 leading mathematics education researchers from across Canada, the UK and Australia, along with eight EDCP graduate students. Together we explored and focused on the role of mathematics in STEM education, particularly related to issues that matter for rural and Indigenous communities. We presented our work at a 2019 AERA Symposium as a team of 20 academics and graduate students from 13 institutions across Canada. The Symposium, well-received with standing room only, led to a 2020 Special Issue of the *Canadian Journal of Science, Mathematics and Technology Education*.



I will build on this model and its research outcomes to host a second *M in STEM Think-In* in 2022. Canada is a leader in mathematics education and Indigenous education research and can benefit from a structure to support sharing of research projects and results. I envision the Professorship hosting a *Think-In* to explore and strategize forming a national collaborative that can mobilize knowledge across and between Canadian research sites and local communities. This national collaborative could showcase and make accessible research projects, research tools, resources and teaching materials across universities, diverse communities and geographies related to STEM education and Indigenous education. Research mobilization in this area is crucial as more research explores how teachers across Canada respond to the Truth and Reconciliation Commission's 94 Calls to Action in the area of STEM education and implications for students, families and educators.

Through the Professorship I will continue to explore culturally responsive STEM education through three projects.

Project 1: *Indigenous Storywork and Mathematics Education*. Dr. Jo-ann Archibald Q'um Q'um Xiiem and I are working with teachers on Haida Gwaii and in North Vancouver, this year through Dogwood 25 funding, to explore pedagogical opportunities in connecting mathematics, community and culture. Working with school district principals of Indigenous education and teachers of Indigenous students we are together drawing upon Indigenous Storywork and our PAIRS model (place, action, inquiry, relationships and storywork) to examine possibilities for implementing these ideas in classrooms and what it means for students.

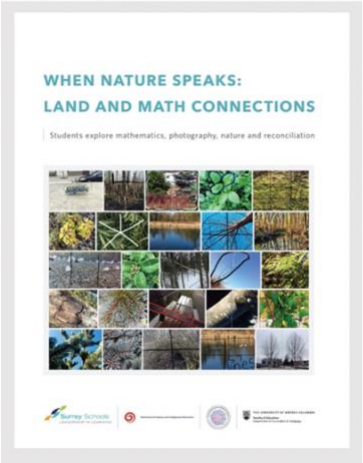
Project 2) *Mapping Place*. In this project I will work with Haida Gwaii District teachers and community Elders alongside the Haida Marine Traditional Knowledge Study to explore possibilities and challenges for teachers to include Indigenous knowledges and pedagogies in mathematics and science within elementary and secondary classrooms. This project will include the use of mapping technologies and data visualizations to study place from multiple perspectives.

Project 3) *Re-imagining STEM with/as Place*. Stemming from collaboration with colleagues initiated during the 2018 *M in STEM Think-In*, this project explores opportunities for (re)centering place/land education in STEM. This proposed research will form the basis for a SSHRC Insight Grant proposal challenging STEM frameworks that privilege human-centeredness.

Building Relationships and Community Engagement for STEM Education

I am dedicated to supporting and enhancing professional and community relationships for STEM education through the Professorship by 1) supporting STEM teacher innovation grants; 2) extending the Indigenous math education network; and 3) STEM outreach activities.

Robitaille STEM Innovation Grants. Teachers across the province are calling for support and opportunities to share experiences and approaches of decolonizing their practices and facilitating math learning improvements for Indigenous learners. Through the Professorship I will continue to support the Robitaille STEM Innovation Grants. These grants support teams of teachers exploring M in STEM and Indigenous education projects. To date seven projects from teams of teachers and schools across the province were selected to receive research support (see project examples dfr.stemnetwork.educ.ubc.ca). Although some projects are on hold due to pandemic restrictions, others have continued and will be shared at the *2021 Virtual Indigenous Mathematics Education Symposium*. I plan to support an additional 5-7 school teams of teachers throughout the province each year through these STEM Innovation Grants.



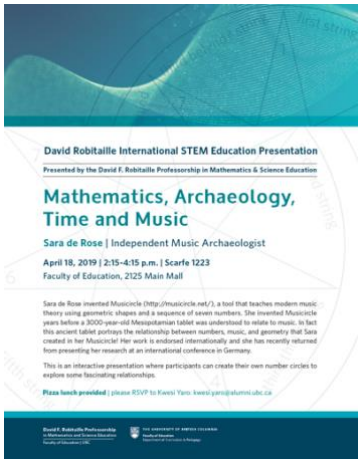
Indigenous Math Education Network. Through the Professorship I will continue working with Dr. Jo-ann Archibald Q'um Q'um Xiiem to support and extend the *Indigenous Mathematics Education Network* (indigenous.mathnetwork.educ.ubc.ca) and its annual Symposium focused on improving mathematics education for Indigenous learners. We plan to grow the *Indigenous Math Education Network* to be a vibrant hub offering resources for teachers including: professional development sessions (in person and virtual); professional resources including downloadable podcasts, videos, and lessons created and offered by teachers in collaboration with communities; networking and mentoring opportunities that bring teachers together to inquire into their practices; and formal research into promising practices that improve mathematics education experiences for Indigenous learners/families/communities. Through the Professorship we will seek additional funding at community and Ministry levels for the Indigenous Math Education Network to grow and provide the supports teachers, communities, and families are calling for.

STEM Education Outreach. If re-appointed I will continue to provide capacity to support existing outreach activities (e.g., Family Math and Science Day, Intergenerational Learning on the Land, and Mathematics Activities at the UBC Orchard Garden) and explore ways to enhance and improve partnerships (e.g., with BC's Brightest Minds physics contest and the UBC Faculty of Science Physics Olympics).

Committed to reaching rural and Indigenous communities with M in STEM activities I will continue successful Network initiatives such as: *Math at the Mall* (Math-Off Challenge); *M in STEM Community Pop-Ups* offering Math at the community library, at the park or the beach, or in front of local shops); *Our Families Count Math Night* for Indigenous families; and the annual *Family Math and Science Day*. A new initiative stemming from the success of the 2021 *Virtual Family Math Fair* and requested by parents across Canada will be a virtual *Monthly Family Math Fair* (MFMF) activity session. The virtual MFMF will bring families together through math on Saturday mornings once a month with graduate or teacher education students as hosts.

Mentoring and Student Learning in STEM Education

The Professorship will continue its strong mentoring of graduate students, teacher candidates and teacher educators. I will continue to mentor students through the successful *Science & Math Education Teaching Research and Inquiry* (SyMETRI) group and the *Mathematics Teacher Educators Collaborative* (MTEC) meetings that bring EDCP mathematics, science, and technology graduate students, sessional instructors, and faculty together in a supportive environment to share research projects and ideas (See Appendix B).


David Robitaille International STEM Education Presentation

Presented by the David F. Robitaille Professorship in Mathematics & Science Education

Mathematics, Archaeology, Time and Music

Sara de Rose | Independent Music Archaeologist

April 18, 2019 | 2:15–4:15 p.m. | Scarfe 1223
Faculty of Education, 2125 Main Mall

Sara de Rose invented Musicircle (http://musicircle.net/), a tool that teaches modern music theory using geometric shapes and a sequence of seven numbers. She invented Musicircle years before a 3000-year-old Mesopotamian tablet was understood to relate to music. In fact this ancient tablet portrays the relationship between numbers, music, and geometry that Sara created in her Musicircle! Her work is endorsed internationally and she has recently returned from presenting her research at an international conference in Germany.

This is an interactive presentation where participants can create their own number circles to explore some fascinating relationships.

Pizza lunch provided ; please RSVP to Kwesi Yaro: kwesi.yaro@alumni.ubc.ca

In addition, I will continue to explore strategies for reaching and mentoring graduate students through new events such as the *Dialogue for Doctoral Students* (DfD) meetings, initiated during my 2018-2021 Professorship. Future initiatives include offering graduate students Robitaille STEM Network research grants that support students collaborating on STEM research for presentation and publication to academic and community audiences.

With the Professorship I will explore the feasibility of developing a STEM education themed elementary teacher education cohort. Teacher education initiatives like these can provide reciprocal learning opportunities where evidence from research informs practice and wisdom from practice informs research.

In summary, with the 2021-2024 Professorship I will continue to grow and build on the successes of the David Robitaille STEM Education Network through fostering research excellence, building community relations and engagement, and nurturing mentoring. The Network will continue to be a centre for researchers interested in innovative STEM education research and for educators keen to explore new ways of conceptualizing, teaching and learning STEM in classrooms. Through the Professorship I will continue to support various outreach activities, collaboration with members from multiple disciplines, across a range of geographic areas (rural and urban), and with diverse expertise and experiences (families, community, school and universities). The Professorship will explore new initiatives, extensions and networks, and support activities that inspire innovation and change in STEM education, research and professional development.

Appendix B provides a list of accomplishments and impact indicators for my 2017-2021 Professorship term.

Appendix A: Timeline, Proposed Initiatives and Impact
3-Year Proposed Activities for the David Robitaille Professorship
(2021-2024)

Proposed Initiatives and Activities	Yr 1	Yr 2	Yr 3	Impact Indicators
Maintain the STEM Education Network website with new and innovative content including educational resources, feature educators, and podcasts with researchers, educators, community and industry.	✓	✓	✓	Web analytics (number of website visitors, global location, period of engagement with the site and pages accessed within the site); increase in the number of resources uploaded; (un)solicited comments and feedback from users.
Grow the STEM Education Network by providing opportunities/support for faculty connections and collaborations through the Robitaille Endowment research.	✓	✓	✓	Number of research presentations, reports, and publications; reports available on the Network website; publication of research monograph.
Develop and establish international collaborations.		✓	✓	Increased number of partnerships and/or deepened, previously established, collaborations.
Explore feasibility and interest in developing a national collaborative to mobilize STEM education and Indigenous education research.		✓	✓	Attendance at a hosted national Think-In; feasibility report written; possible actions pursued including exploration of national partnership funding opportunities.
Professorship research projects: 1) Experiences of teachers using Indigenous Storywork in mathematics classrooms; 2) Collaborative research with SD 50 Haida Gwaii on STEM education with Haida Marine Traditional Knowledge and GIS mapping technologies; 3) Exploring STEM with/as place and developing a SSHRC IG.	✓	✓	✓	Projects 1 and 2: Study completion results presented at district and provincial levels providing example of urban and rural M in STEM education research supported through the Network; results featured on Network website; 4 articles (2 academic and 2 professional) submitted for publication. Project 3: development and submission of SSHRC IG.
Provide organizational support for extending the Indigenous Math Network and seek further funding	✓	✓	✓	Development of the Indigenous Math Network website with increased educational resources, podcasts, videos, digital stories; increased number of urban and rural schools engaged in STEM education inquires;

from Ministry and other organizations to maintain the Network.				increased number of STEM education projects shared on the Indigenous Math Network website; funding proposals submitted to Ministry and other organizations; survey to determine how teachers and districts are using the Network and its impact on their practice.
Provide Robitaille STEM Network Innovation Grants to support and recognize teachers pursuing STEM and Indigenous education inquiry projects and to support sharing their innovations.	✓	✓	✓	Number of applications submitted; number of projects completed; geographic diversity of projects; number of projects shared on the Indigenous Math Network website. Survey and interviews with recipients to determine impact on practice.
Provide organizational support for ongoing outreach activities and encourage participation of graduate students and teacher education students.	✓	✓	✓	Attendance at activities; reported degree of success by event organizer; number of graduate students and teacher education students participating; increased number of graduate research projects connected to STEM outreach activities; increased connections with faculties across campuses and organizations. Public community events of STEM education.
Provide graduate student research grants that support collaboration on innovate STEM education research for presentation and publication to academic and community audiences.		✓	✓	Collaborative STEM research grant Terms of Reference developed; number of applications submitted; number of research projects completed; number of projects presented at academic conferences; number of resulting publications.
Provide organizational support for mentoring and collaboration with graduate students, sessional faculty and faculty through SyMETRI, MTEC, and DfD activities.	✓	✓	✓	Number of attendees (faculty, students and sessionals) at SyMETRI, MTEC, and DfD meetings; number of SyMETRI, MTEC, and DfD meetings; SyMETRI web blog analytics; number of graduate student assistants and research projects.
Complete a feasibility report on developing STEM themed elementary teacher education cohort, and STEM elementary education certificate. If feasible begin work on developing these cohorts.		✓	✓	Degree of completion of feasibility report; if feasible, proposal for STEM elementary cohort written and approval sought by the Department, Teacher Education Office, and Faculty.

Appendix B: Accomplishments

4-Year Summary of Activities, Timeline of Accomplishments, and Impact

(2017-2020 funded; 2020-2021 unfunded) [1]

Initiatives and Activities	Yr 1[2]	Yr 2	Yr 3[3]	Yr 4[4]	Impact Indicators
Grow and establish the STEM education Network.	✓	✓	✓	✓	- 11 UBC Faculty of Education are members of the DFR International STEM Network.
Provide opportunities for faculty connections and collaborations through retreats (Yr 1), seminars (Yr 2-3) and Network website.	✓	✓	✓	(✓)	- Hosted 3 collaborative meetings held between 2017-2019 with DFR STEM Network members to explore collaborative projects. - We submitted and were successful in receiving funding for a collaborative project: *Exploring STEM Education through Community Engagement: Case studies across maker spaces, communities, and teacher professional learning*. (✓) Our research is ongoing.
Provide organizational support for ongoing outreach activities and encourage participation of graduate students and teacher education students.	✓	✓	✓	✓	- Supported 13 STEM focused community events (5 in Yr1; 6 in Yr2; and 1 in Yr3; and 1 Yr4). Events ranged in size from 650 people attending the Family Math and Science Day to 25 people attending Our Families Count Gathering at the Vancouver Aboriginal Friendship Centre. - Hosted the first UBC Virtual Family Math Fair with 300 families and 500 participants registered from across Canada and the US. Presentations by 40 graduate and teacher education student volunteers, and teacher educators. - 11 graduate students supported in both outreach organization and research.
Develop Network website (Yr 1) and maintain with new content (Yr 2-3)	✓	✓	✓	✓	- Website development began in Yr1 and continues.

[1] 2017-2020 I held the Professorship with funding; 2020-2021 I hold the Professorship as unfunded
[2] Each year of the Professorship runs from September 1 to August 31
[3] Events in Year 3 restricted due to COVID-19.
[4] Year 4 of the Professorship is unfunded, and events limited due to COVID-19 restrictions.

					- Web analytics will be added to determine the number of website visitors, where in the world, when and for how long they stay at the site and where they travel within the site.
Provide organizational support for mentoring and collaboration with graduate students, sessional faculty and faculty through SyMETRI (Science and Math Education Technology/Teaching Research and Inquiry) and MTEC (Math Teacher Educator Collective).	✓	✓	✓	✓	- Organized and supported 15 SyMETRI meetings including 12 invited presentations by graduate students, visiting professors, or cross-campus faculty. - Organized and supported an additional 6 SyMETRI meetings to work on a collaborative project titled *Math Inside and Outside* in response to the global pandemic (to be added to the DFR STEM Network website) - Lead MTEC meetings in Yr2, Yr3 and Yr4 with instructors. Developed Canvas shell for resource sharing. Provided technology support for MTEC instructors. - Created the Dialogue for Docs (DfD) with 3 meetings (total attendance 37 doctoral students and faculty).
Explore collaboration with *Networks of Inquiry and Innovation* and *Growing Innovations* to support STEM education and share innovations.	✓		✓	✓	- Collaboration confirmed with both provincial organizations through offering STEM and Indigenous Education Innovation Grants - Supported(ing) 7 projects through the Network Innovation Grants; some support limited due to pandemic restrictions. One project completed Sept 2020 see: https://dfr.stemnetwork.educ.ubc.ca/teacher-grants/
Professorship research: Collaborative research with SD 50 Haida Gwaii on STEM education with Haida Marine Traditional Knowledge and GIS mapping technologies.	✓	✓	✓		- Collaborative research with Haida Gwaii postponed due to COVID-19. - Hosted successful M in STEM Think-in with 30 leading STEM Canadian and International scholars to focus on STEM for rural and Indigenous communities. - AERA Symposium stemming from the M in STEM Think-In (standing room only) - Special Issue of *Canadian Journal of Science Mathematics Technology Education* – published June 2020.

Complete a feasibility report on developing STEM education grad cohort, STEM themed elementary teacher education cohort, and STEM elementary education certificate. If feasible begin work on developing these cohorts.		✓	✓	✓	- Math Education M.Ed cohort offered 2020 with 27 students. - Ongoing collaboration with Science Education cohort to development cross-cohort STEM focused courses.
Provide organizational support and recognition for rural teachers pursuing STEM education inquiry projects and sharing their innovations.		✓	✓	✓	- Supported(ing) 7 projects through the Network Innovation Grants https://dfr.stemnetwork.educ.ubc.ca/teacher-grants/ - Organized 6 Math Pop-Up sessions in rural BC communities - Presented at the BC math education conference (BCAMT) on Math Pop-Ups and community engagement. - Developing a teacher resource based on presentations at the Indigenous Math Symposium.
Provide organizational support for the International Conference on STEM in Education hosted at UBC in 2020; encourage mathematics education research participation.			✓	✓	- 6 grad students were part of a team collecting data during the Family Math and Science Day. Poster paper accepted to be presented at the STEM 2021 conference.