The Gaa-maamawi-asigagindaasoyang Collective: Gathering to learn and do mathematics together!

Math for Young Children – North West Research Brief: Project Results for Year I and Year II

The Math for Young Children Project (M4YC)

Motivated by research pointing to the importance of early years mathematics, the Math for Young Children Project began in 2011 with a focus on developing professional learning communities to strengthen the teaching and learning of mathematics in Kindergarten to Grade 3 classrooms.

The project was launched in partnership with the Ontario Institute for Studies in Education (Dr. Eric Jackman Institute of Child Study and the Robertson Program for Inquiry-Based Teaching in Mathematics and Science), Trent University, and the Ontario Ministry of Education with the following goals:

- To broaden knowledge of mathematics and geometry teaching and learning
- To co-create and field test resources for use by other educators
- To conduct research to document students' learning in the area of geometry and mathematics

Report prepared by Bev Caswell, Joan Moss, Zack Hawes, Jisoo Seo, Larisa Lam, Zach Pedersen in collaboration with Sharla MacKinnon, Brent Tookenay, Jason Jones, Shelly Jones, Tracy Kabatay, Raechel Snowball, Tanya Jones, Heather Bridgeman, Jennifer Leishman, John Gibson, Wendy Orchard, Donna Chief, Angela Mainville, Heather Campbell and Al McManaman

With great appreciation for educators in the Rainy River District School Board, Seven Generations Education Institute, and the Dr. Eric Jackman Institute of Child Study Lab School

Special thanks to Jason Jones for creating Ojibwe word to describe our project.

Math for Young Children - North West (2013 – Present)

In 2013, the OISE M4YC team was invited to Northwestern Ontario to collaborate with the Rainy River District School Board and support early years mathematics teaching in schools serving First Nations students.

A diverse group of educators formed a collective with the purpose of thinking about how to teach and learn high quality mathematics in a way that is more inclusive, accessible, playful, culturally responsive and engaging. Elders and Indigenous leaders were consulted throughout the research process. M4YC – North West highlights the role of Indigenous educational leadership in improved understanding of teaching and learning mathematics. Our collaboration demonstrates the importance of respectful and reciprocal partner relationships in advancing student success.

Our Focus on Geometry and Spatial Reasoning

- Increases achievement and promotes skill and interest in the STEAM disciplines of Science, Technology, Engineering, Art & Architecture, & Mathematics
- Spatial thinking is malleable: it can be improved in people of all ages
- Provides an equitable entry point to school mathematics
- Provides strong foundation for overall mathematics learning
- Grounds mathematical understanding through body-related experiences
- Brings aesthetic appeal through use of symmetry, beautiful figures and patterns
- Provides motivation and opportunities for students to flourish in mathematics and inspires creativity
- Develops ability to read and understand mathematical models, graphs and scientific diagrams

Community-School-University Collaboration

- **Elders and Indigenous Leaders** were involved in ongoing consultation
- **First Nation Educational Counsellors** played an integral role for connecting schools and the university with communities and establishing relationships with Elders, families, and children
- **Ojibwe Language Educators** highlighted the verb-based structure of Anishnaabe language and helped to reorient the teaching of geometry to become dynamic and alive
- **Fall Harvest** event celebrating First Nation culture provided opportunity for developing awareness and understanding of Indigenous knowledges, histories and perspectives
- **Community-based Family Math Nights** included culturally relevant math activities and became model for entire school board
- **First Nation Community Daycares** created after-school math programs

Our RRDSB Research Study

In order to test the effectiveness of the Dynamic Geometry Curriculum, over the first two years of the project we conducted a research study in which we tested the students in our research classrooms (Experimental Group) at the beginning and, again, at the end of each school year, and we compared the students' growth in mathematics knowledge to the growth in another group of students who participated in a regular math program (Control Group). We also observed children in their classrooms over the course of the research project to track changes in their attitudes and engagement.

Participating communities include: Nigigoonsiminikaaning First Nation, Seine River First Nation, Naicatchewenin First Nation, Mitaanjigamiing First Nation, and Couchiching First Nation

Educators, Students and Schools

Over the course of two years, more than 500 children were involved in our research classrooms. In Year 1, we randomly selected 38 students in the Experimental Group (SK – Grade 2) to participate in math assessments. The control group included 28 randomly selected students (SK – Grade 2). In Year 2, we randomly selected 64 students in the Experimental Group (SK – Grade 3) and 42 students in the Control Group (SK to Grade 3).

In Year 1, there were 6 educators involved in the Experimental Group and 6 educators the Control Group. In Year 2, there were 17 educators in the Experimental Group and 3 educators in the Control Group.

Professional Development:

- Educators participated in 6 full days of PD including face-to-face and Skype meetings
- Educators engaged in geometry activities
- Educators introduced to research on spatial reasoning and arithmetic/numeration as well as a test of general vocabulary
- Educators designed and implemented clinical interviews with their students
- Educators designed and co-taught lessons in their classroom with the OISE team
- Educators spent 45 hours teaching new approaches to geometry as part of their regular math teaching

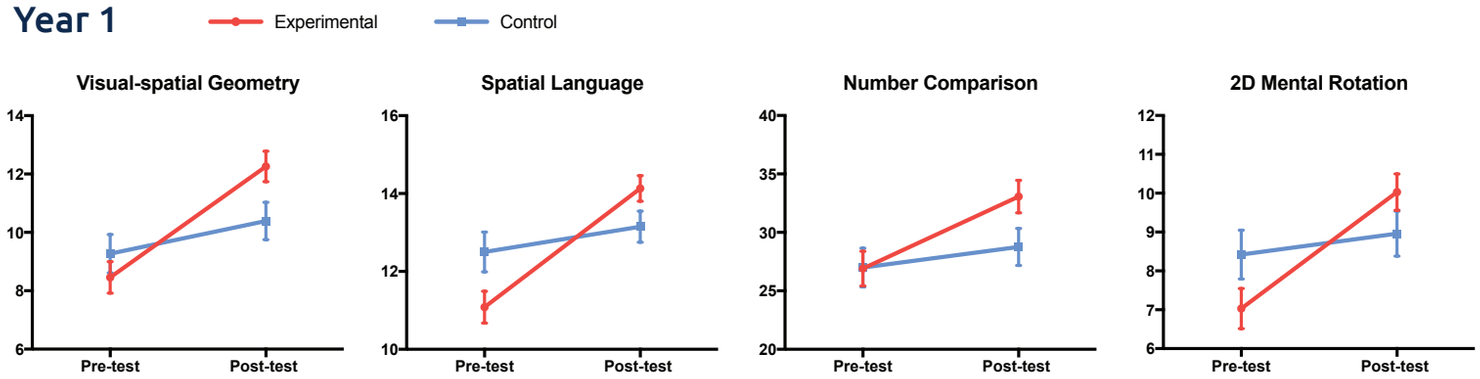
Innovative Dynamic Geometry Curriculum:

Curriculum involved two types of activities: Full 45-minute lessons and short "quick image" challenges that can be easily implemented throughout the school day. The activities are designed to develop spatial visualization skills, focussing on foundational areas of geometry: Symmetry and Congruence; Composing, Decomposing and Transforming 2D Shapes & 3D Objects; Locating, Orienting, Mapping and Coding; and Perspective Taking. Pedagogy was blend of play-based and curriculum-based approaches.

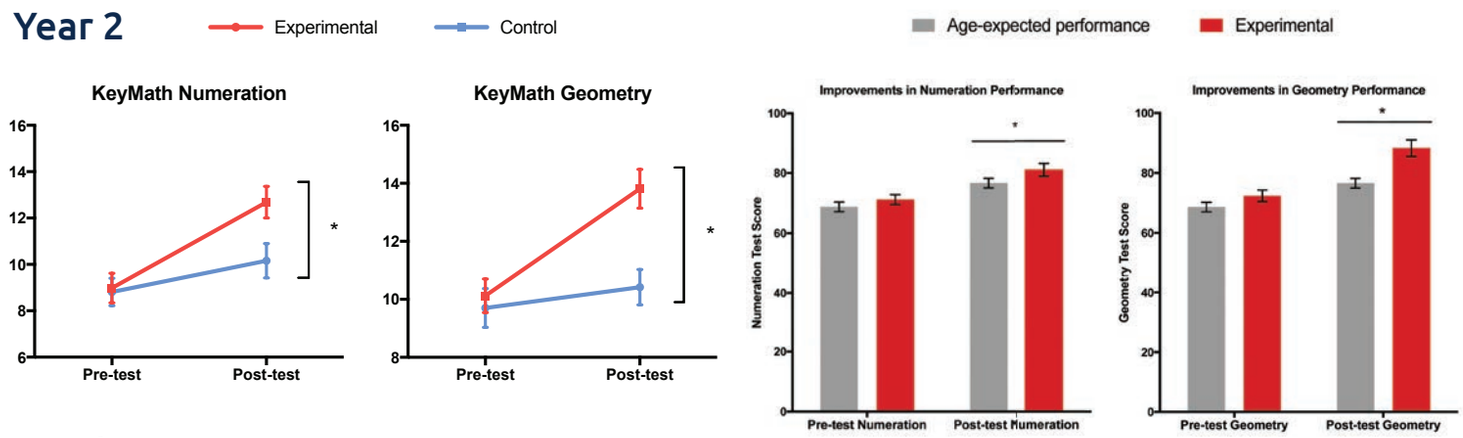
Assessments:

Students participated in a series of one-to-one assessments at the beginning and end of the school year. The measures included tests of geometry, spatial reasoning, numeration and arithmetic, as well as a test of general vocabulary knowledge. In Year 2, the comprehensive curricular-based measures KeyMath Geometry and KeyMath Numeration were added.

Year 1



Year 2



Results:

Results revealed that compared to control groups, and expected Canadian norms, children in the experimental groups demonstrated significant gains on assessments of geometry, spatial reasoning and numerical skills. The first four graphs reveal the significant gains made by students in Year 1 Experimental Group compared to the Control Group. A similar pattern of significant growth in favour of the Experimental Group on all the same measures was found in Year 2. The final four graphs reveal the significant gains made on KeyMath Measures (assessing essential school-based mathematical concepts and skills), administered in Year 2 only. The line graphs show the significant gains made by students in the Experimental Group compared to the Control Group, while the bar graphs reveal gains in comparison to the expected Canadian norms.

Major findings: quantitative and qualitative

- Widespread improvements on all geometry and spatial measures
- Much greater than expected improvements in Geometry and Numeration
- Unexpected findings of improvements in areas of mathematics not emphasized in the project, including gains in basic numeration, arithmetic, and problem solving
- Children were highly engaged with the math
- Children proved to be capable of engaging in transformational geometry, not typically addressed in early years classrooms
- Educators began to recognize spatial talent that can often go unnoticed
- Educators gained new insights and conceptualizations of geometry as dynamic and imaginative

Key Features supporting our success

Math as a Bridge

- School board had in place instructional leaders to support First Nation and Métis students in partnership with Seven Generations Education Institute
- Ongoing reciprocal learning opportunities with each of the First Nation communities
- Geometry as equitable entry point to school mathematics
- Development of student identities as doers of mathematics
- Inspiring educators as researchers and curriculum designers

Ongoing and future collaboration

- Rainy River District School Board: Continue existing partnerships in 5 schools serving First Nation students (26 classrooms)
- Seven Generations Education Institute's First Nation Student Success Program: Continue working with educators in 4 schools (9 classrooms)
- Matawa Pathways to Student Success Program: Begin working with 1 school (3 classrooms)

"The impact on our educators' capacity in math instruction has been tremendous, and the student achievement results demonstrate this impact. Aapiji gimino-giiniwaa-ate ji-gikinoo'amawangwaa abinoojiinhyag - I'm happy that you are here today as we work together to enhance education for our students. I extend my deepest appreciation to the Math For Young Children team, both the "away" team and our own RRDSB educators."

- Heather Campbell
Director of Education, Rainy River District School Board

In response to this spatial approach to math teaching, Elder Mike Kabatay remarked: "You've reawakened something that is already in our children."

- Elder Mike Kabatay, Seine River

"This [project] is reconciliation."

- Former National Chief of the Assembly of First Nations, Chief Shawn A-in-chut Atleo

We acknowledge the generous support of the N.S. Robertson Foundation.

IEN Indigenous Education Network

Couchiching First Nation

Mitaanjigamiing First Nation

Naicatchewenin First Nation

Indigenous Education Initiative

Nigigoonsiminikaaning Band

Seine River First Nation

Dr. Eric Jackman Institute of Child Study
University of Toronto

For more information, please see: www.oise.utoronto.ca/robertson