

Exploring Innovative Community-based STEM Education Strategies for Indigenous Children and Youth: Can Summer Science Camps Provide an Opportunity for Two-eyed Seeing?

C Purdy¹, S Grant¹

1. Department of Applied Human Nutrition, Mount Saint Vincent University, Halifax, Nova Scotia



ABSTRACT

Evidence suggests that an academic achievement gap exists between Indigenous and non-Indigenous learners in Canada; specifically, in *Science, Technology, Engineering and Mathematics (STEM)* (1,2). Moreover, there are data to suggest that Indigenous people are underrepresented in various STEM-based professions (e.g. Dietetics). The Two-Eyed Seeing (TES) Model, developed by Albert Marshall and colleagues, offers a framework upon which to layer education strategies marrying western science and Indigenous Knowledge (or IK) and to facilitate communication and respectful knowledge/skill exchange (3). *My name is Chelsey Purdy. I identify as a Mi'kmaq woman, trained in Western Science, and as a Dietetic Intern, studying within the Department of Applied Human Nutrition, Mount Saint Vincent University. During my directed study, I critically reviewed peer-reviewed literature on the application of the TES model in Indigenous and non-Indigenous student learning. I became particularly interested in examining the "effectiveness" of interactive education approaches on knowledge/ skill transfer and student achievement in STEM. Informed by my lessons learned from and reflections on MIKM 2701: Learning from Knowledge Keepers of Mi'kma'ki, this directed study provided insight into the current peer-reviewed evidence available on TES application in interactive STEM education initiatives (e.g. science camps), what the literature defines as effective, and what evaluation strategies have been applied (4,5,6,7,8). At the present time, conclusive evidence does not exist to support whether or not science camps are effective in promoting STEM education in Indigenous Communities, but there are few examples of comprehensive evaluation published/available in the peer-reviewed literature (4). Moreover, it is important to recognize that there is likely unpublished data available on this topic. This review has inspired questions that have motivated me to pursue an honours thesis (with my current Supervisor) that may include the development and implementation of a community-based TES science camp evaluation framework. Dr. Grant and I are sharing this work (at this conference) in hopes of receiving feedback from our colleagues, partners and the larger community.*

ACADEMIC ACHIEVEMENT

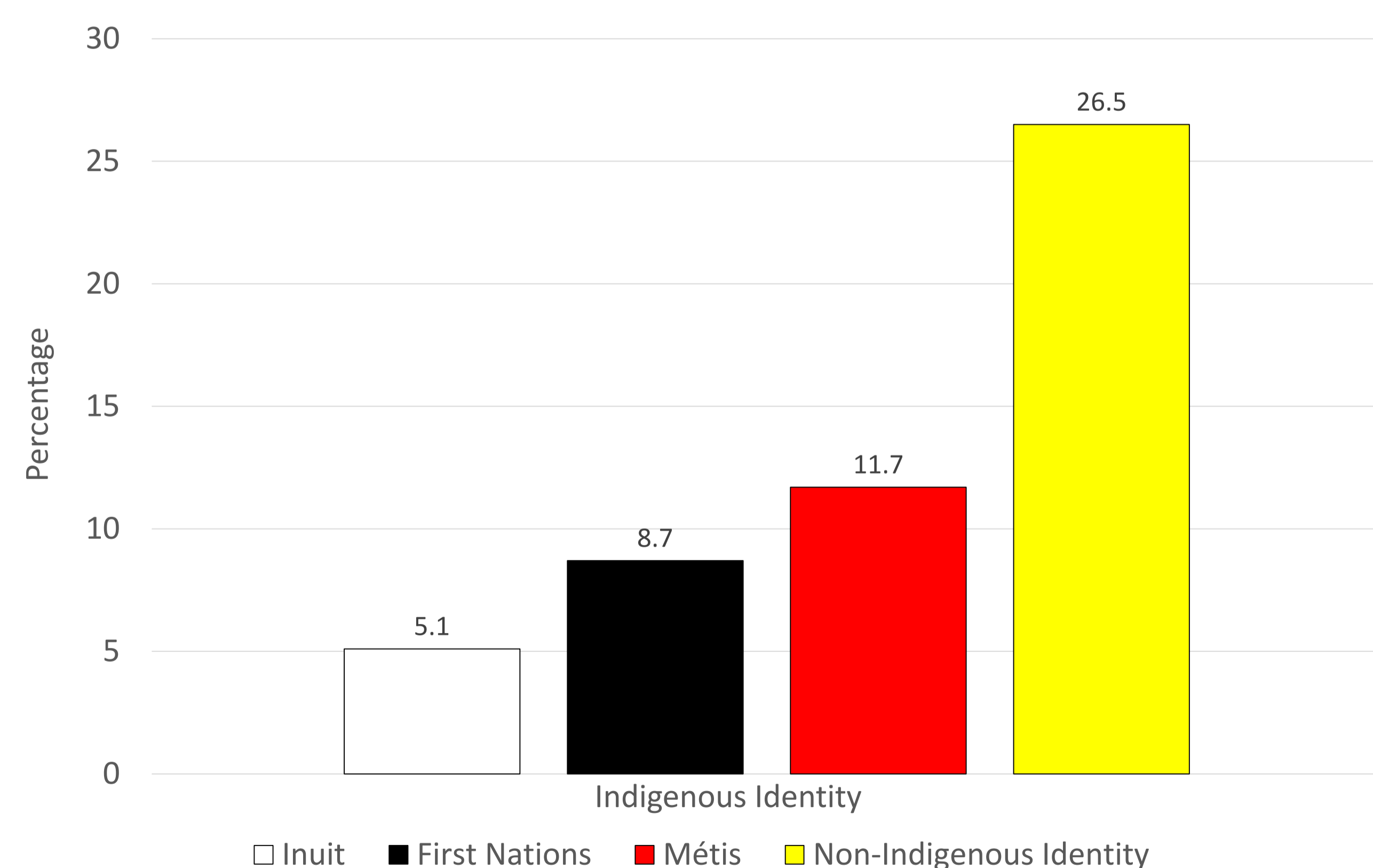


Figure 1. University Certificate, Diploma or Degree at a Bachelors Level or Above, for the population 25 to 65 in Canada 2011 (Adapted From Statistics Canada (1)). **Demonstrates that there are sizable gaps in STEM attainment between different cultural identities.*

Performance domains (e.g. math, literacy) of children and youth in grades 3 to 9 conform to the following ranking (by cultural identity), based on average scores of provincial assessments in 2009 (2).

African Nova Scotian < Mi'kmaq < Acadian < European Descendent

TWO-EYED SEEING (TES)

"Two-Eyed Seeing is hard to convey to academics, as it does not fit into any particular subject area or discipline. Rather, it is about life: what you do, what kind of responsibilities you have, how you should live while on Earth ... i.e., a guiding principle that covers all aspects of our lives: social, economic, environmental, etc. The advantage of Two-Eyed Seeing is that you are always fine tuning your mind into different places at once, you are always looking for another perspective and better way of doing things."
– Albert Marshall

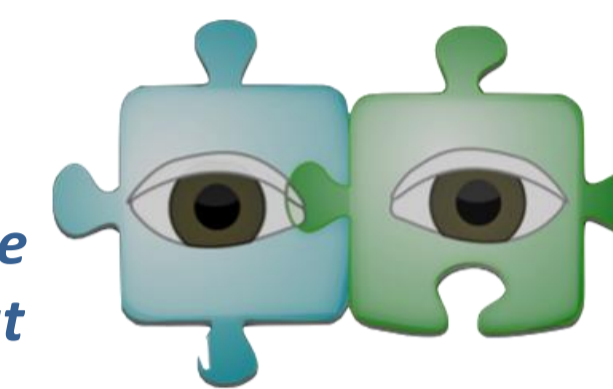


Table 1. Comparison of Western Science, Indigenous Knowledge and TES

Western Science	Indigenous Knowledge (IK)	TES
Canadian Society	Indigenous Communities	Relationship Building
Dominant	Sub-ordinate	Legitimacy of all knowledge systems
Researchers	Knowledge Keepers and Elders	Researcher-Community Engagement
Didactic Learning	Experiential Learning	Multi-voiced Classrooms
Reductionism	Holism	Integrated Research

MIKM 2701: Learning from Knowledge Keepers of Mi'kma'ki



For this directed study, an open access Indigenous course, *Learning from Knowledge Keepers of Mi'kma'ki*, was referenced to gain insight, knowledge and wisdom from Mi'kmaq Knowledge Keepers and elders. Permission to use the course was granted from the class facilitator Stephen Augustine, Dean of Unama'ki College and Aboriginal Learning and Hereditary Chief on the Mi'kmaq Grand Council.

"During this directed study, I realized that I was using what I have been taught, (Western Science) in the academy, to validate the Indigenous Knowledge that was passed to me. Dr. Grant and my other mentors have been exploring this with me and I am enjoying seeing from both eyes." – Chelsey Purdy

TES and Effective Learning

Learning Styles

Is there a difference between Indigenous and non-Indigenous students?

- It is likely that no difference exists between Aboriginal and non-Aboriginal students in terms of teaching method effectiveness (6).
- Academic success may be less associated with the selection of a specific learning style and more with a judicious dosage of several learning styles (6).

Prior Knowledge

Can connecting new information to old ideas enhance learning?

- Effective learning often occurs when multiple connections can be made between new and old ideas (7).
- It is easier to accept, understand and remember new ideas and information when it fits into a person's present framework of knowledge and beliefs (7).

Characteristics of an Effective Learning Environment

- Constructing personal meaning
- Choice
- Challenge
- Control
- Collaboration
- Consequences that promote self efficacy (8)



SUMMER CAMPS

- There are a diversity of Science Camps being developed and implemented across the country that draw from the two-eyed seeing framework. Sustainable community-based models include: Let's Talk Science! Sandy Lake First Nation (2009-Present) (4,5,9).
- There are a diversity of evaluation methods being used to evaluate effectiveness (and "success") of said Science Camps. The majority appear to use questionnaires, but other methods/ approached may be warranted (4,5,9).

NSERC-funded Promo-Science TES Pilot Project

NSERC = Natural Sciences and Engineering Research Council of Canada



- A community-based STEM science camp funded by NSERC has been developed in partnership with Pictou Landing and Sipekne'katik First Nation.
- Development team members included myself (Chelsey Purdy, Acadia First Nation), Florence Blackett (Millbrook First Nation), Iain Caldwell, and Ashley Copage (Sipekne'katik First Nation) as the team leader.

Summer 2018 Camp Overview:

- Day 1: Scientist Training at MSVU
- Day 2: Bringing Science Home (each community will have a community camp day)
- Day 3: Science Fair (to occur in one of the two communities)

CONCLUSIONS AND NEXT STEPS

- There are a number of science camps being developed and implemented that draw from the two-eyed seeing framework; some have been sustainable.
- There is limited peer-reviewed, publically available data on evaluation of said science camps. The majority (all reviewed) are using questionnaires/ surveys for evaluation.
- This work supports development of two-eyed seeing, community-based evaluation strategies.
- As a member of the NSERC-funded Promo-Science TES Pilot Project, I will complete an honours thesis to explore and develop community-based evaluation strategies with our partnering communities.

ACKNOWLEDGMENTS/ Wela'lin

The authors of this poster would like to thank Stephen Augustine and Cape Breton University for allowing the use of MIKM 2701: Learning from Knowledge Keepers of Mi'kma'ki for guidance throughout this directed study. Also, thank you to Cheryl Bartlett, Art Stevens, Tuma Young, Gary Manoakeesic, Anthony Hanley, Julie Ennis and the Sandy Lake Health and Diabetes Project Team for their mentorship.

REFERENCES

1. Statistics Canada. Education [Internet]. Aboriginal Statistics at a Glance: 2nd Edition. 2015 [cited 2018Apr23]. Available from: <http://www.statcan.gc.ca/pub/89-645-x/2015001/education-eng.htm>
2. Thiessen V. Identity, Equity and Performance: Mathematics and Reading Literacy in Nova Scotia Public Schools. 2009.
3. Hatcher A, Bartlet C, Marshall A, Marshall M. Two-Eyed Seeing in the Classroom Environment: Concepts, Approaches, and Challenges. Canadian Journal of Science, Mathematics and Technology Education. 2009;141-53
4. Kakegumick KE, Hayward MN, Harris SB, Saksvig B, Gittelsohn J, Manokeesic G, et al. Sandy Lake Health and Diabetes Project: A Community-Based Intervention Targeting Type 2 Diabetes and Its Risk Factors in a First Nations Community. Frontiers in Endocrinology. 2013Nov;4:1-9.
5. LTS. Sandy Lake Partnership [Internet]. Lets Talk Science University of Toronto St George. [cited 2018Apr13]. Available from: <https://lts.escalator.utoronto.ca/home/sandy-lake/>
6. Borque J, Bouchamma Y, Larose F. Aboriginal Students' Achievement in Science Education: The Effect of Teaching Methods. The Alberta Journal of Educational Research. 2010;56:57-71.
7. Effective Learning and Teaching [Internet]. America Association for the Advancement of Science ; 1990 [cited 2018Feb]. Available from: <http://www.project2061.org/publications/sfaa/online/Chap13.htm>
8. Paris SG, Yambor KM, Packard BW-L. Hands-On Biology: A Museum-School-University Partnership for Enhancing Students Interest and Learning in Science. The Elementary School Journal. 1998;98(3):267-88
9. SuperNOVA at Dalhousie University, Halifax, NS - Outreach [Internet]. Halifax, NS - Outreach. [cited 2018Apr13]. Available from: <http://www.supernova.dal.ca/outreach/>