Ethnomathematics and the Aboriginal Leadership Year

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BACKGROUND

The Aboriginal Leadership Opportunity Year (ALOY) is a one year opportunity for selected First Nations, Inuit and Métis Aboriginal candidates from across Canada to attend the Royal Military College of Canada (RMCC) in Kingston. At RMCC the students experience academic, leadership and cultural opportunities within a military college environment. The Aboriginal students are drawn to RMCC from all provinces and Territories, from both urban and rural environments. They have been educated in the provincial education systems and also in elementary and secondary schools located on Reserves. As a result of this range of academic preparedness many of the ALOY students are challenged by the academic demands of the undergraduate level courses taken as part of the Academic portion of the RMCC program. This is a dispositional barrier to their academic success in the program (Cross 1981).

The societal importance of students' attitudes towards the choice of mathematics as a course of study and future career path is of particular concern. In many cases mathematics has become a filter in that students are filtered out or directed away from programs and careers that require mathematical understanding. Mathematics avoidance has filtered students out of formal schooling itself.

The ALOY program requires that the students study mathematics as part of the curriculum together with a language based course, a psychology course created specifically for the program and a science course. To facilitate the mathematics requirements of the ALOY program the mathematics department has created a non credit course that is a review of much of the mathematics curriculum found in many secondary schools across the country. It is not aligned with any specific provincial guidelines but is a survey course that aims to prepare the student for introductory mathematics courses at RMCC. The requirement for admission to the ALOY program is a high school graduation diploma, the GED, or equivalent; there is no requirement for a specified level of success in mathematics. Many of the ALOY students in this course have not taken mathematics since the junior secondary grades having completed only the minimum number of high school credits in mathematics required to achieve a secondary school diploma. The mathematics course, MAE/F 010, is taught for the ALOY students by a professor of the mathematics department for three hours per week during the fall term and supported for two hours per week by a dedicated Aboriginal tutor.

REVIEW OF LITERATURE

Ethnomathematics Theory: Mathematics is considered to be pedagogically and culturally neutral and to be universal in nature reaching across time and space (Burton in Funkhouser, 2000). The common elements of the secondary school curricula across Canada while focusing on Western European contributions does acknowledge knowledge from other peoples: Greece, Egypt, India, China (Closs in Funkhouser, 2000). The mathematical history of Aboriginal peoples in Canada is not usually represented in the standard mathematics curriculum of secondary schools.
There is no consensus on the meaning of the term ethnomathematics the definitions seems to have broadened with time and input and now Vithal and Skovsmose describe ethnomathematics as: "a cluster of ideas concerning the history of mathematics, the cultural roots of mathematics, the implicit mathematics in everyday setting and mathematics education" (Vithal, Skovsmose in Bush 2002, p.5).

The focus in this study was on culture and mathematics education; observing how cultural values affect teaching, learning and curriculum. We know that the mathematics classroom environment can reflect the dominant culture of the institution this project introduced aspects of Indigenous learning, and Aboriginal tutorial support into the RMCC classroom and reflects on the effects.

Introducing Indigenous learning into the classroom goes beyond the anthropological view of learning to incorporate knowledge as a 'way of living' and not merely content accumulation. There are degrees of intercultural sensitivity that are in place when a cross cultural educational experience takes place. Figure 1 shows a developmental model of intercultural sensitivity chart indicating the position of the ALOY students. The steps indicate the distance to be traveled to the point of ethno-pluralism in the classroom.

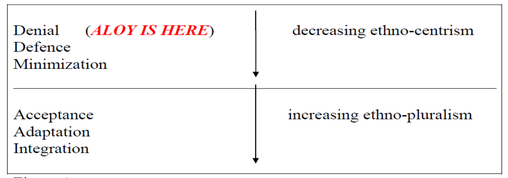

Figure 1

Using the 12 Standards of Education for Aboriginal Students, in the approach to the ALOY students we actualized Indigenous knowledge as 'a way of living' a building of community at RMCC.

12 Standards of Education for Aboriginal Students
Created by: Eber Hampton, Saskatchewan Indian Federated College

1. **Spirituality:** At the centre of spirituality is respect for the spiritual relationships that exist between all things.
2. **Service to the Community:** The individual does not form an identity in opposition to the group but recognizes the group as relatives (included in his or her own identity). The second standard is service. Education is to serve the people. Its purpose is not individual advancement or status.
3. **Respect for Diversity:** The respect for diversity embodied in the third standard requires self-knowledge and self-respect without which respect for others is impossible.
4. **Culture:** Indian cultures have ways of thought, learning, teaching and communicating that are different than but of equal validity to those of White cultures.
5. **Contemporary Tradition:** Indian education maintains continuity with tradition. Our traditions define and preserve us. It is important to understand that this continuity with tradition is neither a rejection of the artefacts of others' cultures nor an attempt to 'turn back the clock'. It is the continuity of a living culture that is important to Indian education, not the preservation of a frozen museum specimen.
6. **Personal Respect:** The individual Indian's sense of personal power and autonomy is a strength that lies behind the apparent weakness of disunity. Indian education demands relationships of personal respect.
7. **Sense of History:** Indian education has a sense of history and does not avoid the hard facts of the conquest of America.
8. **Relentlessness in Championing Students:** Indian education is relentless in its battle for Indian children. We take pride in our warriors and our teachers are warriors for the life of our children.
9. **Vitality:** Indian education recognizes and nourishes the powerful pattern of life that lies hidden within personal and tribal suffering and oppression. Suffering begets strength. We have not vanished.
10. **Conflict between Cultures:** Indian education recognizes the conflict, tensions, and struggle between itself and White education.
11. **Sense of Pride:** Indian education recognizes the importance of an Indian sense of place, land, and territory.
12. **Transformation:** The graduates of our schools must not only be able to survive in a White dominated society; they must contribute to the change of that society. Indian education recognizes that need for transformation in the relation between Indian and White as well as the individual and society.

METHOD

The project is a case study which provided the Aboriginal students of MAE/F 010 with academic support of an Aboriginal tutor who was competent in mathematics and who also had training in pedagogy. This Aboriginal tutor had the potential to provide the modeling of success that may have had a positive effect on the Aboriginal students. The tutor attended classes with the ALOY students and then provided assistance as required with questions arising from the curriculum covered in classes. The existing arrangement of providing non Aboriginal tutors continued. The rate of interaction between the Aboriginal students and the Aboriginal tutor was recorded. The success rate of the ALOY students measured by the number of students who complete and or pass the MAE/F 010 course was recorded.

To measure for any change in disposition towards mathematics the ALOY students were asked to complete a questionnaire regarding their academic history and their attitudes towards taking a mathematics class before the start of the first class and after the end of the last class. Questions regarding the use of an Aboriginal tutor in the MAE/F 010 classroom and the inclusion of cultural elements into the mathematics curriculum were included as part of a semi structured interview with the ALOY students at the end of the term one. These interviews sought out the views of the ALOY students regarding mathematics as a course of study suitable for them. The questionnaires are a reference to see if there has been a change in attitude towards mathematics.

Questionnaire Analysis:
The pre and post MAE010 course questionnaires were comprised of a series of ten (10) questions inquiring about the participants' attitudes to Mathematics as a subject of study and their own experiences in mathematics classes. The questions were posed to elicit either positive or negative answers on a Lickert-Type scale, meaning there were five (5) possible responses to each question. These responses were: Never; Sometimes; Often; Most times, Always. The response of *Often* was counted as being a negative response when the question was negatively slanted and as a positive response when the question was positively slanted. The responses were counted 1-5 for a positive scale and 5-1 for a negative scale. The scores were tallied and the average taken to produce a value for each of the ten 10) questions. The value indicated the degree of positive or negative attitude of each question. The process was repeated for the second questionnaire and the results are displayed in Table 1.

RESULTS

Table 1: Questionnaire Results

	Questionnaire 1	Questionnaire 2	Math Attitude
Question			Change?
1	3.16	3.4	Yes
2	3	2.7	Yes
3	3	3.3	Yes
4	3.5	2.2	Yes
5	2.9	2.4	Yes
6	4.2	3.1	Yes
7	4.2	2.8	Yes
8	3.1	1.9	Yes
9	4.3	4.3	No
10	3.25	3.4	Yes

While the sample is very small there is an indication that there has been a change in the attitudes of the students. The initial answers indicated a positive or neutral attitude towards mathematics as a subject the second questionnaire answers indicated a more negative view or attitude towards mathematics as a subject.
To understand what could have taken place it is necessary to refer to the answers given to the interview questions posed to the ALOY students prior to the completion of the MAE010 course. In the interviews the students spoke about their past experiences and attitudes towards mathematics. They were also asked to comment on their approach to ethnomathematics as an option in teaching mathematics.

There emerged three major themes from the case study. These were
1. a lack of preparation for the mathematics course offered by RMCC due to institutional conditions or events;
2. a lack of knowledge or interest regarding ethnomathematics;
3. a neutral open attitude to mathematics.

Preparation for Success
Several of the students spoke about not having had the opportunity to take higher level mathematics classes or not doing well in mathematics in high school. The students were mainly from small or isolated schools that did not prepare them well for future mathematics study. Others were dealing with situations in their educational history were the victims or poor administrative decisions by their school administrations or unable because of localized circumstances to have the choices other students have. This is not an unusual condition for Aboriginal students across Canada. Within the ALOY program some of the students had been placed in the MAE0010 by choice because of fear of other Mathematics classes being too hard or were misplaced there.

Not all the students were correctly placed in the remedial mathematics class. Several of them had already completed high level (grade 12) courses, but not calculus classes. These students were bored in the class, and some were disruptive, because they did not need to focus on the material they were learning. Some of the students were below the requirements of even the remedial class. Instead of starting at the level where the students were functioning and bringing them to a more acceptable level, the students were expected to function at the level of the class more in line with year one classes. These students were lost and had a hard time following and had lost confidence I their ability to do well. This reinforced the feeling that they were unable to do mathematics, as they were failing the remedial mathematics course. This resulted in a two level class in one, something that was not addressed in the MAE 010 classroom.

Table 2: Interview results by themes.

	H/S small Not all course options available	Prepared for ALOY MAE-010	Misplaced In Math courses at H/S or ALOY	Ethnomath Knowledge	Open to Ethnomath
01	Small no all courses available	No	No	No	Yes
02	No	No (bullied)	No (but missed lot)	No	Maybe
03	No	No (no (math in E/S- catch-up in H/S)	Yes (E/S curriculum not followed)	No	No
04	Small	Yes	Yes (At RMCC Dropped into MAE 010 from fear of failure)	No	Maybe
05	Small	No unmotivated	No - however ALOY placement not good for future plans	No	Not interested
06	Small	No	Yes	No	Maybe
07	No	No	Yes in ALOY math course	No	No
08	Small	No	Dropped out	No	No
09	Small	No	Yes	No	No

Ethnomathematics
The great majority of the students in the interviews spoke of having no idea of what Aboriginal mathematics could be or even argued that there was no such thing. Participant #3 stated that he thought that Natives did not care for math "Unless it's math where you don't notice it." He continued that he was not interested in studying ethnomathematics as content of the curriculum because he "Does not want to learn Aboriginal math from a white person's perspective." This is an extreme example but the general tendency was that there was no real interest in studying Aboriginal math as a subject. The general tendency could be summed up by participant #7 who said "Math is just math." While the literature on the subject would disagree with the ALOY students' attitude toward the existence of ethnomathematics this position does indicate that more work in increasing ethno-pluralism in the classroom is required.

Attitude
The general attitude in the group to mathematics started off as neutral to positive. One participant's response indicated that he was not keen of mathematics, never had been and until it could be 'downloaded like in the Matrix' probably never would be positive. Yet the others seemed to agree that although it could be confusing because of their lack of having a good background in the subject there was a need to study mathematics for future work connections or options. Yet they disconnected. The final marks of the students in the course did not reflect the level of success that their participation in the tutorial suggested. They came to the tutorials, they spoke with the tutor before and after class as well as at the tutorial times but they did not succeed in the remedial class with no official curriculum. The establishment of an ALOY math community in line with the 12 Standards of Education for Aboriginal Students by the tutor did not overcome the conditions in the ethno-centric classroom. The failure to recognize cultural clues made communications difficult. The evidence that suggest that there are common patterns in the way Aboriginal students learn or approach learning failing to recognize these resulted in "academic disorientation" with the resulting poor final marks.

OUTCOMES

This project identifies factors in the promotion of mathematics as a positive choice to Aboriginal students. This new knowledge may help to overcome barriers promoting the equality of opportunities to an already disadvantaged group in society (Orr, Roberts, Ross, 2008). The project explored how the introduction of various cultural elements may affect students' performances in, and disposition towards, mathematics. This Community Outreach Project looked to find if there was a measurable difference in the success rate and levels of satisfaction of the ALOY students within MAE/F 010 if supported by an Aboriginal tutor. Also, if cultural elements introduced into the mathematics course provided an ethnomathematical environment for study.

While the lower enrolment rates of Aboriginal youth in post secondary institutions are often attributed to broad socio-economic and historical barriers other studies reveal that Aboriginal students face more subtle barriers. These may include institutional insensitivity to Aboriginal cultures (Malatest, 2004). In a partnership of two educational institutions, Queen's University and the Royal Military College of Canada, in a Pan Canadian environment this project provided the opportunity to identify some of the challenges faced by Aboriginal learners. The successful relationships that will result from this project and the knowledge built from the shared experience may be transferrable to other curriculum subjects potentially enhancing positive learning experiences and supporting Aboriginal students.