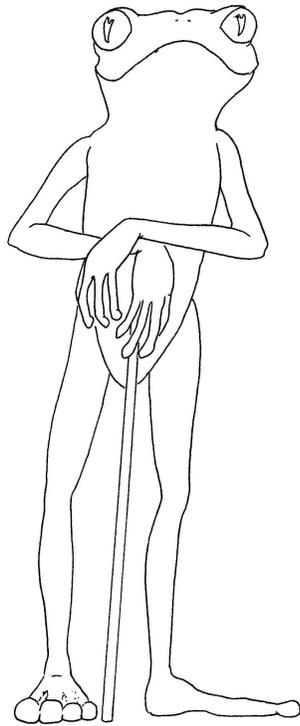


The Efficacy of the  
Mathematical Academic Centre for Excellence



MACE

A Technical Report Delivered to  
the Director of the Centre for Teaching Learning and Technology  
University of Northern British Columbia  
by

Jennifer Hyndman, Mathematics  
Peter MacMillan, Education  
Vivian Fayowski, Learning Skills Centre Advisor (Math/Stats)  
Kamal Lutfi, Disability Management

July 2008

## 1 Introduction

In Fall 2007 the Teaching and Learning building opened and with it the Mathematical Academic Centre of Excellence (MACE). The centre appeared to be popular with students and the space was heavily used with over 1664 documented daily visits during Fall 2007 and 1481 visits during Winter 2008. The visits were recorded through a sign-in process that was voluntary and not rigorously enforced so these numbers are low. The first three authors applied for and received a Centre for Teaching, Learning and Technology Faculty Associate award to do an analysis of usage and efficacy of MACE. This report summarizes the results of the study.

## 2 MACE

Room 10-2088 is the physical space that supports MACE. The room is accessible 24 hours a day and 7 days a week. During the academic semesters tutors are on duty in the room for approximately 20 hours per week. The tutors are senior undergraduates, graduate students, the LSC Math/Stats Advisor, and faculty from Mathematics, Physics, and Computer Science.

Students using the room work on material in mathematics courses and courses with high levels of mathematical content including physics, chemistry, computer science and commerce. The students study on their own, get one-to-one help from the tutor, meet other students from their courses, create study groups, and work in study groups while in MACE. There is a high level of cross discipline interaction, for example, a faculty member from Physics might be helping a Computer Science student with a Mathematics problem.

## 3 The Project

The purpose of this project was to establish the degree of utilization of MACE and the effects of this centre as it relates to student satisfaction, success, and student retention. Therefore, the instruments were designed to collect information about student satisfaction with mathematics support services at UNBC, and in particular the Mathematical Academic Centre for Excellence. Data was collected through a survey (appended at end) administered to 190 students in first year Mathematics, Physics, and Computer Science courses and through focus groups.

All three of the major researchers (Fayowski, Hyndman, and MacMillan) were present and participated in the questioning during both focus groups. Following standard focus group methods, a set of questions had been developed prior to the group meetings but the nature of follow-up questions and interviewee responses allowed the researchers considerable latitude for discussion. One researcher primarily kept notes and audio-tape recorded the focus group sessions. The research assistant (Lutfi), who also completed the survey analysis, was given both handwritten notes and the audio-tapes for transcription purposes. After this was completed and all researchers were given draft copies of the transcription, the four researchers classified the statements according to themes that were agreed-upon by following a consensus model. Once this was complete, one researcher produced a written draft of the focus group portion of the report document while another researcher drafted the survey response portion.

The material is presented here in three sections: the Likert-scale items from the survey, the free response questions from the survey, and the focus group themes.

## 4 Likert-scale Items

The survey contained Likert-scale items and has three sections: descriptive information, use of services/support systems, and satisfaction with services/support systems. The students were selected due to their presence in a high mathematics content class that was chosen due to its typicality among other such courses. The generated data was analyzed using the Statistical Package for Social Sciences (SPSS), version 16.0.

### 4.1 Descriptive information

The survey was completed by a total of 190 participants. Of those responding to the question on gender (186), 55.9% were female, and 44.1% were male. The respondents' ages ranged from 19 to 49 years; however, the majority of the participants (91.7%) were between 19 to 25 years. According to the information gathered, 19.4% of the respondents intended or declared to be in Mathematics, Physics or Chemistry; 20.4% in Commerce; 54.8% in other programs (including Environmental Engineering, Biochemistry, Biology, Computer Sciences, Geography, etc); 5.4% declared Mathematics and a second program as their majors. With regard to year of study, over half

(59.7%) of the respondents reported they were in their first year of study; almost one-quarter (23.1%) reported they were in their second year; and the remaining (17.2%) were in third and fourth year of study.

Asked about their proficiency in language, 92.5% of the respondents declared proficiency in English. In addition, 86.1% reported English as the commonly spoken language at their home; 82.9% reported themselves as English speakers born in Canada. It's worth noting that the high reported percentage of proficiency in English (92.5%) could be a result of the respondents considering themselves professional/fluent in English simply because they were attending school.

The respondents were asked to estimate their average letter grade in their current mathematics and/or high mathematics content course. The average letter grade reported was a B. Only 21.8% reported expectations of an A or A+ grade in their respective courses. Respondents were also asked to estimate their median letter grade in their other courses with high mathematics content. Participants estimated their average letter grade for additional course work slightly higher — in the B/B+ range. A higher percentage, 26.9%, reported expectations of an A or A+ grade. This trend suggests that students felt they were doing better in their chosen area of study in course work with high mathematics content than in the required mathematics courses. The respondents were also asked to use the UNBC letter grade scale to describe their average secondary school grade. The reported median letter grade was between B+ and A-, slightly higher than their anticipated letter grades in their currently enrolled courses in university. This is consistent with the spread in marks that occurs with the transition from high school to university.

## 4.2 Use of services

Services available for UNBC students were categorized as: Mathematical Academic Centre for Excellence (MACE), one-to-one tutoring at the Learning Skills Centre (LSC), Supplemental Instruction (SI), meeting with professor outside of class, private tutoring, and peer study groups. Respondents were asked to determine their use of the above mentioned services on a six-point rating scale ranging from *not at all* user to *daily* user. Table 1 contains a summary highlighting the usage information obtained in the survey.

## The Efficacy of MACE

Domain	MACE	LSC	SI	Prof	Private Tutor	Peer Group
Daily	3.8	1.1	4.4	0.5	0.0	8.2
Several times a week, weekly, several times a month	46.2	11.4	36.3	28.5	8.7	39.4
Not at all, or once a month or less	50.0	87.5	59.4	71.1	91.3	52.5

Table 1: Frequency of Usage (%)  
(Rounding may result in column totals that are not 100%.)

Some highlights on usage include:

- a) **MACE:** Half of the respondents, **50%**, reported using MACE several times a month, weekly, several times a week, or daily.
- b) **LSC:** Only **12.5%** report accessing LSC one-to-one tutoring several times a month, weekly, several times a week, or daily.
- c) **SI:** **40.7%** of respondents report attending SI several times a month, weekly, several times a week, or daily. Note that SI is offered in specific courses only and was not available to students in all the classes surveyed.
- d) **Professor:** **29%** report meeting with the professor outside of class several times a month, weekly, several times a week, or daily.
- e) **Private tutoring:** **8.7%** report using a private tutor several times a month, weekly, several times a week, or daily.
- f) **Peer group:** **47.6%** report working with a peer group several times a month, weekly, several times a week, or daily.

The trends on usage indicate that students favour MACE, with peer group and SI usage also notable. A commonality in these three services is the peer group factor. The results suggest that working with a peer group is the preferred choice among the survey respondents with daily peer group usage occurring twice as frequently as MACE and SI usage (8.2% vs. 3.8% vs. 4.4% respectively) and approximately eight times more often than one-to-one tutoring or seeing the professor. This is in line with much of the current research (Tinto, 1993; Levitz, Noel and Richter, 1999). By their nature,

both MACE and SI provide settings conducive to developing peer study group relationships and this is to be encouraged as it will lessen feelings of isolation and contribute to academic success. Private tutoring was limited in usage, however, this is not unexpected as monetary and accessibility issues will factor into usage. All the other services are free and regularly available. The categories, seeing the professor and LSC, are indicative that a student has self-identified that s/he requires assistance beyond the peer group and has sought out this type of one-to-one help. In summary, results of the presented information clearly demonstrate the effectiveness of MACE service among all other available services.

### 4.3 Satisfaction with services

Respondents were asked to identify the rate of their satisfaction with the foregoing mentioned services on a five-point rating scale ranging from *not at all satisfied* to *extremely satisfied* given that they were users, even minimally. There was an excellent response match for non-users of a service to the corresponding satisfaction level. For example, 27.7% indicated they were non-users of MACE — this matched closely to the 28.9% who did not respond to the question on MACE satisfaction levels. Similar matches were observed on all six support options. Table 2 contains a summary highlighting the findings on satisfaction levels.

Domain	MACE	LSC	SI	Prof	Private Tutor	Peer Group
Very satisfied or extremely satisfied	74.1	49.3	59.0	47.1	38.7	60.2
Satisfied	20.7	39.1	35.9	48.0	54.5	35.8
Not at all satisfied or not very satisfied	5.1	11.5	5.2	4.9	6.8	4.1

Table 2: Satisfaction Levels (%)  
(Rounding may result in column totals that are not 100%.)

Some highlights on satisfaction levels include:

- a) **MACE: 94.8%** of MACE users are satisfied, very satisfied, or extremely satisfied with MACE with a resounding **34.1%** reporting they are extremely satisfied with MACE.

- b) **LSC: 88.4%** of LSC one-to-one tutoring users are satisfied, very satisfied, or extremely satisfied with this service and **17.4%** report they are extremely satisfied with one-to-one tutoring.
- c) **SI: 94.9%** of SI participants are satisfied, very satisfied, or extremely satisfied with SI and **24.8%** report being extremely satisfied with SI. Note that SI is offered in specific courses only and was not available to students in all the classes surveyed.
- d) **Professor: 95.1%** of students receiving assistance outside of class from their professors are satisfied, very satisfied, or extremely satisfied with this form of assistance. However, only **13.0 %** report they are extremely satisfied.
- e) **Private tutoring: 93.2%** of respondents who access private tutoring are satisfied, very satisfied, or extremely satisfied with this type of service. Only **11.4%** report being extremely satisfied.
- f) **Peer group: 96.0%** of students who work with peers are satisfied, very satisfied, or extremely satisfied working with a peer group with **22.8%** reporting they are extremely satisfied.

The trends on satisfaction indicate that overall, students are at least satisfied (a low of 88.4% to a high of 96.0%) with all service options available for mathematical support. This is to be expected as these services are voluntary and the respondents had chosen to use the service. Thus the extreme level of satisfaction is the most informative category for our analysis. As with usage, students are extremely satisfied with MACE most often, with SI providing the next highest proportion of users as extremely satisfied. The extreme satisfaction level for MACE is fully three times that of private tutoring. Once again, the peer factor appears to be the commonality correlated with highest levels of satisfaction. MACE and SI both provide the support of a student assistant, either a tutor or an SI leader. This may account for the slightly higher percentage of extreme satisfaction observed in MACE and SI in comparison to the peer group alone.

## 5 Free Response Questions

On the survey there were two questions requiring a short response from the students. These items are related to reasons for leaving UNBC and reasons for staying at UNBC and are thus related to retention issues.

## 5.1 Question 25: Reasons to Leave

In the 39 (20.5%) responses to the survey question *If the chances of returning to UNBC are relatively low, please suggest the reasons that would cause you NOT to return.* four primary themes arose: program of study, weather and climate, finances, and student status.

The predominant theme was program of study. Although several students simply indicated that “UNBC lacks the program” they were interested in, other students specifically listed such areas as engineering, geology, marine science, and human genetics.

The cold weather, snow, and air quality were listed as reasons for leaving. Issues around finances arose in a variety of ways including concerns about lack of affordable off-campus housing, student fees, and UNBC scholarships running out.

The positive reasons for leaving UNBC were graduation and limits on length of time for exchange students.

## 6 Question 26: Reasons to Stay

In the 131 (68%) responses to the survey question *If you are expecting to return to UNBC, please suggest the reasons that encourage you to stay here.* five primary themes arose: program of study, finances and family, social environment, services, and other miscellaneous items.

The words “I like my program” occurred several times and describe the sentiments of many of the comments. Students also indicated that they like UNBC. Specific degrees mentioned include Environmental Engineering, Biochemistry, Biology, Business, Chemistry, and Environmental Science. Uniqueness of a degree or courses in a degree appear to keep students at UNBC.

Living at home is a predominant response for this question and it is tied to decrease in costs and to lack of readiness to leave home. Scholarships and low/paid tuition were also mentioned by about 10 students.

The social environment at UNBC was praised with frequent references to the “friendly atmosphere” and the “small class sizes”. The physical campus was described as gorgeous. The approachability of faculty and the supportive staff lead to a sense of community for the students.

The services mentioned by the students were the Mathematical Academic Centre for Excellence (MACE), the Learning Skills Centre (LSC), and Sup-

plemental Instruction (SI). Phrases used to describe these services, particularly MACE, were all positive and included “amazing services” and “great resources”.

The miscellaneous items included one reference to a job and one statement from a lost student who wrote “no idea what I am doing”. There was only one reference to research opportunity at UNBC. Given the number of research opportunities available to students this is surprisingly low. In contrast to many, there was one student who listed the weather as a reason to stay at UNBC.

## 7 Focus Group Themes

Following the collection of survey responses from selected populations of students, two different focus groups were formed. One group consisted of 6 (4 male, 2 female) undergraduate MACE users while the second group of 4 (3 male undergraduates, 1 male graduate student) were MACE tutors.

### 7.1 Focus Group with users of MACE

The authors held one focus group with four male and two female users of MACE. The themes that arose at the focus group include physical place, people, learning community, ongoing issues, and recruitment and retention.

A student summarized her view of MACE with “MACE is my home”. The library was described as noisy with “people chatting about parties and other stuff”. Students chose MACE to study ahead of the library, the cafeteria, and the hallway.

To the question *Why did you choose to use the MACE facility?* the responses were primarily about people. These people were generic “others”, tutors, and peers. In response to a question about MACE changing behaviour in class, the students indicated they make friends in MACE and were “more at ease with classmates”. MACE provided a social structure that is otherwise missing at UNBC.

Without knowing the terminology, the students described MACE as a learning community. MACE is seen to provide a community of people with a common interest of learning mathematics (and related subjects) in a peer-to-peer manner. The physical environment and focus on an academic subject encouraged interest by the students. Despite having access to graduate students, senior undergraduates, and faculty in MACE, the students continu-

ously referred to working with their peers. It is “better to interact and spend time with peers” and the follow-up comment “more understanding at your level” clearly summarize the students’ preference with peer-to-peer learning.

A number of issues that will need to be monitored in an ongoing manner arose. These included how to teach students how to get help and ask questions in MACE. Students suggested posters in MACE and more advertizing in orientation and classes. Training of tutors arose as an issue as “some students don’t know what they are talking about”. The huge diversity of courses serviced by tutors in MACE is likely to lead to this as a continuing problem unless we monitor it closely.

The last theme can be described as recruitment and retention. “Everyone thinks I was nuts and PG is not even on the map” describes how a student’s friends thought about her coming to UNBC. However, she continued with “it turned out to be really awesome” with “small classes and small groups of people”. This student had not previously considered herself to be very good at mathematics but had done well in her mathematics class at UNBC and said “I find myself helping” others in MACE. The students agreed that one major reason that students leave UNBC is poor grades.

## 7.2 Focus Group with MACE tutors

The authors held one focus group with three undergraduates and one graduate student who are paid tutors in MACE. The themes that arose at the focus group were primarily learning community and training.

The tutors indicated that students “develop social networks” through working together and through forming study groups. The availability of the space for “more than four hours per week” (limited drop-in support had previously been available at LSC) provided continuity and “better opportunities for learning”. Students came to work in MACE rather than coming for help so MACE is not viewed as a place for remedial help but rather as a place to improve a B grade to an A grade.

MACE was also viewed as a place that students could freely talk about mathematics and tell jokes about mathematics knowing that it would be socially acceptable.<sup>1</sup> This is indicative that MACE is providing an environment where students are learning to *behave* like mathematicians and scientists.

---

<sup>1</sup>An example (not discussed during the focus group) is that the Math/Physics Student Society created a T-shirt for their golf fundraiser. The T-shirt has the frog associated with MACE lounging on a large  $\pi$  (as if it is a table) with the caption “Math, you know you want it.”

The tutors themselves used MACE as a location to study when they were not working. The MACE tie, which is green with a gold frog holding a brown talking stick, clearly indicated when they were on duty so they had no problems with being able to do their own work even though they sometimes were asked questions when not on duty.

The training that the students received through the Learning Skills Centre one-to-one training program and Supplemental Instruction training gave the tutors the skills they need for working in the more complex environment of MACE. However this level of training appears to be required for a tutor to be successful. MACE was described as the “hardest for me to tutor” by someone who had experience in a full range of other types of assistance through the LSC.

Working in MACE provided additional skills for the tutors as they had to “learn how to express thoughts clearly” and “learn more ways to explain the same things”. They were unanimous in their desire to work in MACE again.

## 8 Recommendations

The high usage of MACE, the high levels of student satisfaction (which leads to retention), the positive impact on the student experience, and the growth of a positive mathematical subculture within UNBC lead the authors to strongly recommend the continued support of MACE, both financially and otherwise.

## References

Levitz, R. S., Noel, L., Richter, B.J. (1999). Strategic Moves for Retention Success. In Promising Practices in Recruitment, Remediation, and Retention, G. H. Gaither (Ed) *New Directions for Higher Education*, No. 108, (pp. 31-50).

Tinto, Vincent (1993). *Leaving college: rethinking the causes and cures of student attrition* (2nd ed.). Chicago; London: University of Chicago Press.

## Mathematical Academic Centre for Excellence (MACE) Survey

Again, the purpose of this survey is to collect information about student satisfaction with Mathematics support services at UNBC, and in particular the Mathematical Academic Centre for Excellence (MACE). Please take a few minutes to reflect on your UNBC experience and then give us your response. This research project has been funded by UNBC and has received approval from the University Research Ethics Board.

Do you understand that you have been asked to be in a research study?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have you read the previous page of attached information?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>IF YOU VOLUNTEER OR ARE ASKED TO PARTICIPATE IN EITHER A FOCUS GROUP OR AN INTERVIEW</b> , do you understand that the focus group sessions or interviews may be recorded?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you understand the benefits and risks (if any) involved in participating in this study?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have you had an opportunity to ask questions and discuss this study?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you understand that you are free to refuse to participate or to withdraw from the study at any time? <i>You do not have to give a reason and it will not affect course marks or any services that you might be receiving at UNBC.</i>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Has the issue of confidentiality been explained to you?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you understand who will have access to the information you provide?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

If you wish to continue, please turn to the next page.

First, please tell us about yourself. Circle the term(s) that best fits; write in an answer when appropriate.

1.	Gender	Female	Male			
2.	Year of Birth					Fill in: _____
3.	Program (intended or declared)	MATH	PHYS	CHEM	COMM	Other _____
4.	Year of study	First	Second	Third	Fourth	Graduate level

5. I am most proficient in this language

a) English	b) another European language
c) an Aboriginal (N. American) language	d) an Arabic language
e) an African (non-Arabic) language	f) an Asian language (Mandarin, Cantonese, etc.)
g) a South-Asian language (Hindi, Punjabi etc	h) Other: name _____

6. At home my parent(s) or others in the home most commonly speak

a) English	b) another European language
c) an Aboriginal (N. American) language	d) an Arabic language
e) an African (non-Arabic) language	f) an Asian language, e.g. Mandarin, Japanese.
g) a South-Asian language, e.g. Hindi, Punjabi	h) Other: name _____

7. My background is best described as

a) a fluent English or English only speaker born in Canada	b) born in a European country
c) of Aboriginal / Metis / Inuit descent	d) of Arabic descent
e) African (non-Arabic) descent	f) Asian descent, e.g. Chinese, Korean,
g) South-Asian e.g. Indian, Filipino	h) Other: name _____

Describe how often you use the follow services/support systems by circling the best description.

8. The Mathematical Academic Centre for Excellence (MACE)

Not at all	once a month or less	several times a month	weekly	Several times a week	daily
------------	----------------------	-----------------------	--------	----------------------	-------

9. Other Mathematical supports – one-to-one tutoring at the Learning Skills Centre

Not at all	once a month or less	several times a month	weekly	Several times a week	daily
------------	----------------------	-----------------------	--------	----------------------	-------

10. Other Mathematical supports – Supplemental Instruction

Not at all	2. once a month or less	3. several times a month	4 weekly	Several times a week	daily
------------	-------------------------	--------------------------	----------	----------------------	-------

11. Meeting with a professor outside of class

1 Not at all	once a month or less	several times a month	weekly	Several times a week	daily
--------------	----------------------	-----------------------	--------	----------------------	-------

12. Private tutoring/ assistance with course work

Not at all	once a month or less	several times a month	weekly	Several times a week	daily
------------	----------------------	-----------------------	--------	----------------------	-------

13. Informal peer study groups

Not at all	once a month or less	several times a month	weekly	Several times a week	daily
------------	----------------------	-----------------------	--------	----------------------	-------

Describe **HOW SATISFIED** you are the follow services/support systems by circling the best description.

14. The Mathematical Academic Centre for Excellence (MACE)

<u>Not Applicable</u> Do not use	Not at all Satisfied	Not Very Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
---	-------------------------	-----------------------	-----------	-------------------	------------------------

15. Other Mathematical supports e.g. one-to-one tutoring at the Learning Skills Centre

<u>Not Applicable</u> Do not use	Not at all Satisfied	Not Very Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
---	-------------------------	-----------------------	-----------	-------------------	------------------------

16. Other Mathematical supports e.g. Supplemental Instruction

<u>Not Applicable</u> Do not use	Not at all Satisfied	Not Very Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
---	-------------------------	-----------------------	-----------	-------------------	------------------------

17. Meeting with a professor outside of class

<u>Not Applicable</u> Do not use	Not at all Satisfied	Not Very Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
---	-------------------------	-----------------------	-----------	-------------------	------------------------

18. Private tutoring/ assistance with course work

<u>Not Applicable</u> Do not use	Not at all Satisfied	Not Very Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
---	-------------------------	-----------------------	-----------	-------------------	------------------------

19. Informal peer study groups

<u>Not Applicable</u> Do not use	Not at all Satisfied	Not Very Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
---	-------------------------	-----------------------	-----------	-------------------	------------------------

20. UNBC as a university in general

	Not at all Satisfied	Not Very Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
--	-------------------------	-----------------------	-----------	-------------------	------------------------

21. In the Mathematics course(s) in which I am currently enrolled, I would estimate my median (average) letter grade to be

<D	D	D+	C-	C	C+
B-	B	B+	A-	A	A+

22. In other course(s) with high Mathematics content in which I am currently enrolled, I would estimate my median letter grade to be

<D	D	D+	C-	C	C+
B-	B	B+	A-	A	A+

23. My secondary school Grade Point Average if described using the UNBC letter grade scale would correspond to the following letter grade.

<D	D	D+	C-	C	C+
B-	B	B+	A-	A	A+

24. The likelihood that I will return to UNBC next year to continue my studies is (circle the closest estimate).

0%	20%	40%	60%	80%	100%
----	-----	-----	-----	-----	------

25. If the chances of returning to UNBC are relatively low, please suggest the reasons that would cause you NOT to return.

---



---



---

26. If you are expecting to return to UNBC, please suggest the reasons that encourage you to stay here.

---



---



---

If you are willing to participate in a focus group on the topic of Mathematics support please NEATLY print your UNBC email address in the following space

---

Should you wish a personal copy of the final report, please NEATLY print your UNBC email address in the following space \_\_\_\_\_

THANK YOU FOR YOUR COOPERATION AND PARTICIPATION!