External Review

Mathematics Program
College of Arts and Sciences
Dakota State University

November 8, 2005

Reviewed by
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Part 1 Executive Summary of Findings

The mathematics program at Dakota State University is functioning well. Faculty are highly qualified, complement each others specialties and work well together. Students in the program are satisfied, and had very high praise for the faculty.

The program has a high quality assessment plan and an excellent placement system into entry level courses. These alleviate many pressures that faculty could be experiencing. The instructors in charge of the entry level courses are highly competent and the support structure recently put in place for these courses should begin to show results.

Enrollment growth is a concern for most mathematics departments. The faculty are working with area high schools to develop relationships that will translate into additional students. The department has developed a second major with computer sciences. A similar major could be considered with either the sciences or business.

Curriculum for the mathematics program is difficult for an outsider to assess, due to the specific nature of the program. However, there are items that should be considered by the department. The first would be to determine if a rotation of upper level courses is possible. This is of great help to students – they know what to expect and are able to get the pre-requisite knowledge needed for a course. Second, I would suggest the department examine their curricula for both the math for information systems major and the education major to determine if they are aligned with current recommendations from professional societies, and if they should be. The recommendations I am familiar with are specific to mathematics and mathematics education majors. Only the mathematics faculty at Dakota State, who are most familiar with their specific program, would be able to determine if these recommendations are appropriate to their specialized programs.

Part II Schedule of On-Site Visit

Tuesday, November 8, 2005

8:00 – 8:30	Dr. Wittmayer, Academic Vice President
8:30 – 9:30	Dr. Kari Forbes-Boyte, Dean of College of Arts and Sciences Dale Droge, Math and Science Coordinator
9:30 – 10:30	Carrie Ahern, Assessment Specialist
10:30 – 11:00	Risë Smith, Karl Mundt Library
11:00 – 11:30	Craig Miller, Network Manager
12:00 – 1:00	Lunch with Math Faculty
1:00 – 1:20	Andrew Shiers
1:20 – 1:40	Glenn Berman – was unavailable to interview
1:40 – 2:10	Kim Jones, Terry Ryan
2:10 – 2:30	Jeffrey Palmer
2:30 – 2:50	Rich Avery
3:00 – 3:30	Student Interviews – Kendra Weisser, Sheila Schneider, Jeff Swett
4:00 – 5:00	Exit Interview Dr. Wittmayer, Academic Vice President Dr. Kari Forbes-Boyte, Dean of College of Arts and Sciences

Part 3 Academic Program Evaluation

Analysis of trends in the discipline

There are two major texts influencing mathematics departments today. Although both are geared specifically to mathematics departments, and not mathematics for information systems, I believe they are still very relevant to the program at Dakota State University.

The first text it the *CUPM Curriculum Guide 2004, A Report by the Committee on the Undergraduate Program in Mathematics,* which is put out by the Mathematical Association of America (MAA). In this report, the MAA puts forth six fundamental recommendations for mathematics programs and courses in mathematical sciences (see Appendix). The main points of these recommendations are that

1. Departments should know their students and should strengthen the goals and curriculum of courses to meet their students.
2. Incorporate activities in courses that will help all students progress in developing critical reasoning, problem-solving and mathematical habits of mind.
3. Every course should strive, through examples and activities, to show connections to other fields of study.
4. Encourage and support faculty to collaborate with faculty from other disciplines
5. At every level, courses should incorporate activities that help all students progress in learning to use technology as a tool for solving problems and a learning tool.
6. Encourage, support and reward faculty efforts to improve the efficacy of teaching and strengthening curricula.

The second text, *The Mathematical Education of Teachers*, put together by the Conference Board of the Mathematical Sciences as a part of the MAA and the American Mathematical Society. There are many excellent recommendations in this text for the development of mathematics teachers at the elementary, middle and secondary teachers. Among these recommendations for secondary teachers are:

1. A course in number theory or abstract algebra to understand why number systems operate as they do.
2. A course in geometry – including 20^{th} century developments
3. A reflective look at functions (beyond calculus)
4. Realistic problem solving experiences with statistics
5. Key topics in discrete mathematics
6. A 6-credit capstone to relate their college mathematics to secondary mathematics
7. A computer science requirement to include the design and analysis of algorithms and the use of programming to solve problems.

Again, both texts give excellent reasons for their recommendations and ideas on how to implement the recommendations. I would highly suggest the mathematics departments review these documents, if they have not already. Both documents can be downloaded or purchased from the website for the Mathematical Association of America, www.maa.org.

Analysis of academic programs and curriculum

At first glance, the number of mathematics courses needed for a major or endorsement seems small with 9 needed for a major and 10 for an endorsement, and the number of supporting courses seems quite large. Keeping in mind that it is a Mathematics for Information Systems major, I did some research to see what similar programs offered. The closest type of program I was able to find were those that offered a combined major in mathematics and computer science. I looked at 6 programs at colleges in the United States, Canada and Great Britain. The number of mathematics courses required for majors at these colleges ranged from 8 to 15, with an average of 11 courses. Two-thirds of these programs also required Calculus III, which DSU does not. From this, I would conclude that the number of mathematics courses is adequate, but on the low end of comparable programs.

Analysis of the programs shows some concerns with regard to the recommendations of our professional societies for the training of mathematicians and secondary mathematics teachers.

1. It is recommended that mathematics students be exposed to some depth of mathematical thinking by taking a sequence of courses above calculus – for example Abstract Algebra I and II. No such sequence is apparent in the catalog. This sequencing might currently be handled by the topics courses that are taught, but it does not appear that students must take a sequence.
2. There is no capstone sequence for the secondary education majors as recommended that relates their studies back to the mathematics presented in high school. This is a new recommendation, so it is not surprising that such a capstone is not in place yet.
3. From my discussions with Dr. Avery, there is also a concern with the amount of geometry that secondary education majors are receiving. There is a geometry course on the books, but it is not often offered. Instead, secondary students receive their geometry training in MAT 342 Mathematical Concepts for Teachers II, which is geared for elementary level teachers. Additional material has been added to this course to ensure secondary teachers receive the information they need, but unfortunately this material goes well beyond what the elementary teacher needs.

With respect to the service courses the department provides (Basic Algebra through College Algebra), I have very high praise for the efforts being made. The way students are placed into appropriate courses and held to the expectation that they learn the material in one course before moving on is commendable. The use of MyMatLab appears to work well for students in the courses who care to learn the material. There is a good support structure in place and excellent, caring instructors guiding the students. I have brought many good ideas regarding these courses back to my institution and we are hoping to begin implementing them next year.

Analysis of program enrollment and student placement
According to a report by the National Science Board on the Science and Engineering Indicators 2004 (http://www.nsf.gov/statistics/seind04/), 'enrollment in advanced undergraduate courses rose only slightly from the 1995 low, but because completion of the calculus series is a prerequisite for such courses, enrollment in advanced courses is expected to increase after 2000.' Dakota State appears to be seeing this growth, with a growth in their Mathematics for Information Systems Majors from 16 in 2000 to 37 in 2004 and an increase of Mathematics Education majors from 11 in 2000 to 18 in 2004. A part of this growth may be attributed to the number of computer science majors who are now double majoring in math.

Placement of majors after graduation is phenomenal, at nearly 100%. Students are securing employment with quality companies.

Analysis of faculty credentials
It is clear that the strength of the mathematics program is its highly qualified, dedicated, caring faculty. This statement was echoed by everyone I spoke with, from students to staff to administration.

Faculty are very active in all areas: teaching, scholarship and service. It appears the faculty's strengths complement each other very well – making for a well rounded program with a minimal number of instructors.

Analysis of academic and financial support
As the faculty state in their self-study, academic and financial support are adequate. From my visit, I believe this is an accurate assessment.

Analysis of facilities and equipment
Facilities and equipment are currently serving the need of the faculty.

Analysis of major-field assessment
The assessment activities used by the mathematics program are thorough and complete. They include both quantitative and qualitative data. Due to the number of majors, quantitative data will need to be collected for a number of years before appropriate assessment can occur. In the interim, the information gathered from the qualitative data should be examined.

Analysis of strategic planning
The University and College of Arts and Sciences strategic plan are in alignment with the mission of the University. Through my conversations with the mathematics faculty, they are addressing several of the strategic goals. The program and support structure for the entry-level mathematics courses will help with overall retention, as these courses have been shown to be one of the main reasons students do not return. With respect to recruitment, Dr. Avery is doing a variety of activities in the K-12 schools that will increase visibility of Dakota State University. The mathematics faculty are making strides in terms of using technology in imaginative ways in their courses and making use of the wireless computers. Finally, the faculty, led by Dr. Avery, are writing a number of grants to increase funding for their programs.

Overall evaluation of strengths and limitations of the academic program being reviewed

Strengths

1. High quality, caring faculty
2. Faculty that have identified what else needs to be done and are working to accomplish it
3. Ability of graduates to get quality opportunities
4. Excellent placement program for entry courses
5. Quality assessment plans
6. Technology – both in terms of what they have and how they use it
7. Double major agreement with computer science

Limitations

1. Ability to offer a wide variety of upper level courses in a timely manner
2. Are education students getting the geometry they need?
3. Lack of a sequence of upper level courses for majors
4. Lack of capstone course for education students
5. Because of inability to offer a wide variety of upper level courses in a timely manner, students have to take courses when they are not fully prepared – they have not had the appropriate pre-requisites
6. Departmental leadership – who is responsible and compensated for getting things done?

Part 4 Recommendation for Change

1. Strongly consider developing a rotation for upper-level mathematics courses.
2. Examine the mathematics that secondary students take, determine if it fits with recommendations from professional societies and the goals of the college and find a way to make the necessary changes.
3. Examine the mathematics that majors take, determine if it fits with recommendations from professional societies and the goals of the college and find a way to make the necessary changes.
4. Consider discussing with business and the sciences a way for students to double major in mathematics that is similar to the current structure with computer science.
5. If the structure of the college permits, consider appointing a chair of the mathematics department. The department is working well at this point, but the appointment of a recognized leader of the department would give the department an opportunity to focus its ideas, plan for the future, and continue to build upon what it has accomplished.

APPENDIX

CUPM Curriculum Guide 2004 Recommendations

Recommendation 1: Mathematical sciences departments should

- Understand the strengths, weaknesses, career plans, fields of study, and aspirations of the students enrolled in mathematics courses;
- Determine the extent to which the goals of courses and programs offered are aligned with the needs of students as well as the extent to which these goals are achieved;
- Continually strengthen courses and programs to better align with student needs, and assess the effectiveness of such efforts.

Recommendation 2: Every course should incorporate activities that will help all students progress in developing analytical, critical reasoning, problem-solving, and communication skills and acquiring mathematical habits of mind. More specifically, these activities should be designed to advance and measure students' progress in learning to

- State problems carefully, modify problems when necessary to make them tractable, articulate assumptions, appreciate the value of precise definition, reason logically to conclusions, and interpret results intelligently;
- Approach problem solving with a willingness to try multiple approaches, persist in the face of difficulties, assess the correctness of solutions, explore examples, pose questions, and devise and test conjectures;
- Read mathematics with understanding and communicate mathematical ideas with clarity and coherence through writing and speaking.

Recommendation 3: Every course should strive to

- Present key ideas and concepts from a variety of perspectives;
- Employ a broad range of examples and applications to motivate and illustrate the material;
- Promote awareness of connections to other subjects (both in and out of the mathematical sciences) and strengthen each student's ability to apply the course material to these subjects;
- Introduce contemporary topics from the mathematical sciences and their applications, and enhance student perceptions of the vitality and importance of mathematics in the modern world.

Recommendation 4: Mathematical sciences departments should encourage and support faculty collaboration with colleagues from other departments to modify and develop mathematics courses, create joint or cooperative majors, devise undergraduate research projects, and possibly team-teach courses or units within courses.

Recommendation 5: At every level of the curriculum, some courses should incorporate activities that will help all students progress in learning to use technology

- Appropriately and effectively as a tool for solving problems;
- As an aid to understanding mathematical ideas.

Recommendation 6: Mathematical sciences departments and institutional administrators should encourage, support and reward faculty efforts to improve the efficacy of teaching and strengthen curricula.