Teaching and Professional Activity
Department of Mathematics, St. Olaf College
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To assure a distinctive faculty committed to undergraduate teaching, the Department of Mathematics affirms the general objective of faculty expectations as expressed in the Faculty Manual: "While the College gives primary emphasis to effective undergraduate instruction, it holds that high quality teaching is inseparable from scholarly and creative effort." In the following statement we describe how the Department of Mathematics interprets this objective for our own discipline. In doing so, we follow the categories of Effective Teaching and Professional Activities described in the Faculty Manual.

Environment for Learning

Work in the mathematical sciences is an essential part of a liberal arts education. Most students at St. Olaf study mathematics, as most study literature, music, science, and foreign languages. Mathematics is one of many important modes of thought, one that is essential for comprehending nature and society. Mathematical science at St. Olaf is not an elite discipline for the few, but a lively and accessible subject appropriate for all.

To say that mathematics is not an elite discipline is not to say that it is an easy discipline. No one ever masters more than a fraction of it. While respect for our students requires that we make mathematics available to all, respect for mathematics compels us to challenge students both with high standards and powerful applications.

During the past half century, mathematics has evolved into a collection of related but diverse mathematical sciences, including statistics, computer science, applied mathematics, actuarial science, biomathematics, epidemiology, mathematical economics, and others. Applications of mathematics have spread far beyond physics and engineering, into information science, economics, biology, social science, robotics, and computer graphics, and even to parts of the fine arts and the humanities. St. Olaf students study mathematics for many different purposes; when they graduate, they enter careers or graduate programs in all the mathematical sciences, but also in fields ranging from classics to molecular biology. We encourage and applaud such diverse sequels to a St. Olaf mathematics major.

This explosion in the mathematical sciences is mirrored in our curriculum: more than half of current St. Olaf courses were not taught to undergraduates a few decades ago. It has also been reflected in student interest in mathematics: mathematics is now one of the larger majors at St. Olaf, and is studied at advanced levels by many students whose primary professional interest is in some other field.

Diversity in objectives contributes to a distinctive environment for learning, which is defined as much by students as by faculty. Much of what the faculty does is motivated (and occasionally constrained) by the interests of students. The nature, the quality, and the size of our program all depend on the genuine enthusiasm for mathematics and

accessibility to students that department members display. Students study mathematics at St. Olaf because they know that they will be taught by people who care about them as well as about introducing them to the power and beauty of mathematics.

The number and diversity of students who study mathematics at St. Olaf – well above average for a college of our size – presents both opportunity and challenge. Part of the challenge resides in the variation in abilities found at all levels, from beginning calculus to senior seminars. We believe that the opportunity to introduce mathematics to a larger audience, including many average students, far outweighs the obstacles encountered. As much as possible, we seek to personalize the mathematics program to the interest of particular students through tutoring, colloquia, newsletter, contract major, problem solving group, picnics, and even a mathematics department music recital. A large number of majors provides the opportunity to offer a wide range of courses, allowing our best students to gain exposure to graduate-level courses in their senior year. We seek to provide an environment in which each student can develop mathematical power and confidence.

The breadth of today's mathematical sciences suits well the objectives of a mathematics program in a liberal arts institution. We believe that everyone can benefit from the study of mathematics: our task as faculty is as much to plant seeds of encouragement as to reap a harvest of accomplishment. Mathematics at St. Olaf opens doors: it liberates students from the impediments of mental imprecision; it enlightens students with the understanding of structure; and it empowers students with tools for solving problems.

Effective Teaching

Teaching is the bridge between our students and our discipline. The goal of the mathematics faculty at St. Olaf is to teach students, not just to teach mathematics. Our teaching must respect both students and mathematics: as we insist on high standards, we must also actively help students meet these standards.

Mastery of the Subject

To teach mathematics, one must know how to think mathematically. Typically this is achieved by intensive specialized study leading to original research. Undergraduate experiences in research-like activities are one of the most effective means of stimulating interest in mathematics. To provide these opportunities, faculty must always sustain and deepen their understanding of selected areas of mathematics.

Because of the breadth of the mathematical sciences, one must also know enough about several advanced areas to help students begin to recognize the internal unity of mathematics. Members of the Department of Mathematics are expected and encouraged to teach a wide variety of courses. Since mastery of this breadth of mathematics is rarely provided by one's graduate education, and since the nature of the curriculum continually evolves, members of the faculty must continue to grow laterally (as well as vertically) in order to maintain their own mastery of mathematics.

Intellectual Stimulation of Students

Teaching mathematics requires enthusiasm for mathematics. So does learning mathematics. While one does not have to anticipate a career in mathematics in order to learn mathematics, students need to engage the discipline actively if its power is to manifest itself in their minds. Since students differ widely in their backgrounds and interests, an effective teacher must use a variety of strategies to reach students and stimulate the effort required to learn mathematics. Applications to other fields, relevance to other parts of mathematics, delight in the precision of a logical argument, appreciation for the intrinsic beauty of abstract structures – all are legitimate and important avenues to stimulate intellectual development of students. Appreciation of different perspectives and motivations benefits both students and faculty by broadening one's understanding of the scope of mathematics.

Teaching takes place in the office and the corridor as well as in the classroom. It occurs during advising and lecturing, in supervising undergraduate research, in group work and lab projects, through papers and examinations, in asking and answering questions. Both directly and indirectly, especially through examples, good teaching should encourage students

- To question, to read, to think, to speak, and to write about mathematics;
- To engage mathematics actively rather than to receive it passively;
- To experience the satisfaction of mathematical insight;
- To become mathematically independent;
- To collaborate with others both in solving problems and in assuring quality work;
- To innovate, to experiment, and to take appropriate risks.

Contributions to Liberal Education

An intrinsic part of human culture, mathematics plays an important role in the general education goals of the College. This relationship is manifest not just in a few specific service courses, but throughout the curriculum – because the link between mathematics and other fields is forged not in curricular units but in the minds of students. Effective teaching of mathematics in a liberal arts college requires not only that appropriate contact be made on matters of substance between mathematics and other fields of human inquiry, but also that each mathematics class contribute to the overall goals of liberal education to produce thoughtful, articulate, capable, and sensitive persons.

Professional Activity

The primary purpose of requiring significant professional activity of faculty in a liberal arts institution is to ensure that they remain intellectually alive and active in their fields. This need is especially great in mathematics because of the rapid growth of the mathematical sciences, the continuing integration among formerly disparate mathematical areas, and the increasing integration of mathematics with other disciplines. To accommodate these trends in our discipline without corresponding growth in department size requires that our faculty, as a group, develop "laterally" as well as "vertically" within the mathematical sciences.

Recognizing the breadth and diversity of the mathematical sciences, the Department of Mathematics views professional activity broadly, stressing creative and imaginative professional work in many forms: research, exposition, problem-solving, curricular and pedagogical reform, software development, incorporation of technology, editing, reviewing, research supervision, and the like. Supervising undergraduate research, in particular, combines both teaching and professional activity, since one needs to know a field well in order to direct research in it.

Individual members will – and should – differ in the degree to which they embrace various forms of professional activity. What matters most is that, individually and as a Department, we play active roles in the life and development of our discipline. Of all our faculty we expect professional activity, whatever its form, of high quality, as judged by one's peers.

In the following paragraphs we interpret the professional activity categories mentioned in the Faculty Manual. Because we understand the subject broadly, we offer many and disparate examples. We do not, of course, expect every Department member to play every possible role described.

Public Professional Activity

We include in this category all published works (texts, research papers, reviews, classroom resource materials, expository articles), presentations at meetings and at other institutions, leadership in professional organizations, arranging professional workshops, and professional consulting. The important common element in this category is the professional scrutiny afforded by public presentation and, especially, by the various forms of peer review. For this reason, we attach greater "weight" in this category to peer-reviewed articles. Such scrutiny is vital both to the individual and to the institution in ensuring quality, accountability, and visibility to our professional work.

Traditional research in the mathematical sciences – creation of new and significant mathematical ideas, usually leading to research journal publication – depends on important but deep results scattered among hundreds of journals. The mere discipline of systematic hard work, an essential ingredient in library and laboratory research, is no guarantee of research results in mathematics. Good mathematical ideas that result from

years of work may take only a few pages to express; indeed, elegance and brevity are seen as positive values in mathematics. For these reasons we rely also on measures other than formal publication, such as the professional assessment of disciplinary peers, here at St. Olaf and elsewhere.

We encourage and salute traditional, journal-directed mathematical research whenever an individual does it. The creation of new mathematics expresses as nothing else can the fundamental processes of mathematics, and an active research program in the department helps stimulate new ideas and new modes of thought. But it is not something we demand as a *sine qua non*, for either promotion or tenure. We *do* expect from every member a high quality of professional activity – as defined broadly above.

Relating Scholarship to Teaching

Directly or indirectly, all professional activity relates to teaching. Teachers who are active imbue their courses with a spirit of current thought. Only rarely in undergraduate mathematics will the details of a professor's research translate directly into material suitable for classroom instruction. But the process of doing mathematics, even if not always its content, inspires effective teaching and models scholarly work.

Supervision of undergraduate research offers an excellent example of bridging scholarship to teaching. Such research, although seldom publishable in professional journals, goes well beyond the content even of advanced courses in the mathematics major. Choosing research topics appropriately and guiding student work effectively requires both breadth and depth of knowledge in the research supervisor.

Mathematical scholarship supports teaching in several ways: in development of new courses, in integration of computing and applications into traditional mathematics, in development of research experiences for undergraduates, in supervision of independent study in areas that reach into unfamiliar territory, in development of innovative curriculum materials for new courses, or in development of computer software and documentation. In cases such as these professional work is focused on local issues and, for this reason, may not lead to significant public exposure. It is, nevertheless, important both for the Department and for the individual.

The Department's generalist approach to course assignment often encourages individuals to teach in a wide variety of areas. This policy, too, effectively relates teaching to scholarship – the other side of the coin. When an analyst begins to teach combinatorics, or an algebraist computer science, significant professional work is accomplished in lateral growth. Since both the department and the individual benefit from this work, we view it as evidence *both* of effective teaching and of professional activity.

Stimulating Intellectual Development of Colleagues

A key difference between mathematics as practiced at St. Olaf and its manifestation in most universities is that we make great efforts to operate as a team rather than as a

collection of individual specialists. Each individual's professional activity stimulates others in the department, so the collective effect is in some sense greater than the sum of its parts. Students benefit both from the results of such collaboration as well as by observing – often participating in – the process: it helps them to learn as part of a team in their mathematical undertakings.

In some cases this internal stimulation takes the form of visible public activities: departmental seminars, colloquium presentations, joint study projects with St. Olaf and Carleton colleagues, departmental computer workshops. In other cases it takes place in a one-on-one basis, with individuals talking with each other about mathematics, teaching, and curriculum development. Increasingly, as mathematics and computer science infuse into other fields, interdisciplinary contacts lead to stimulating uses of mathematical methods in other fields. Such activities become visible in new department initiatives as well as in broadened interests and expertise of members of the department.

Leadership in these areas is vitally important to the department, and must be recognized as a significant aspect of professional activity. Since cooperative projects benefit their leaders only indirectly, it is easy for such efforts to vanish under the press of more urgent teaching and professional activity. Nevertheless, they are one of the things that make mathematics distinctive, and must be recognized as an important part of professional activities.