PROGRAM GOAL

Our 2004 program review proposal identified three comprehensive goals related to the “Research and Technology Student Learning Standard.” These goals were drawn from our 2001 departmental self-study:

1. Students will be familiar with technology and software relevant to mathematics and computer science.
2. Students will be proficient in the use of electronic resources in research and critical evaluation of data.
3. Students will develop sound ethical perspectives on technology.

The first two goals had several layers of sub-goals, dealing with particular software applications and with hardware.

In response to the recommendations of the Program Review Committee, the department revised this proposal during the fall of 2005. Specifically, the Committee recommended that we

1. narrow the focus of our assessment for the current year to fewer, more specific goals;
2. identify the specific ways we would assess the extent to which these goals are being met.

We chose to focus on the first of the goals from the 2004 proposal, articulating that goal more specifically as:

Students will be familiar with appropriate uses of technology and software relevant to the disciplines of mathematics and computer science. In particular,

- a) students in some classes will gain experience using graphing and computational tools;
- b) students in some classes will gain experience using spreadsheet software;
- c) students in some classes will learn to use technical word processing software;
- d) students in some classes will learn to use integrated development environments when writing computer programs.

After further discussion (9/6/05, 9/20/05, 10/4/05) among all members of the department (except the one on sabbatical) and on the advice of the Program Review Committee, we determined that goal (c) students in some classes will learn to use technical word processing software was a measurable goal on which we could agree, and for which we could gather and analyze evidence before this January report was due (one faculty member was already collecting such evidence).

In summary, here is the goal we are focusing on in this report:

Students in the following classes will learn to use technical word processing software: MA-019, MA-108, MA-110, MA-140. In particular:

- 80% of students completing MA-019 will produce a paper using technical word processing software.
- 100% of students in MA-108, MA-110, and MA-140 will produce a paper using technical word processing software.
- 20% of students in MA-108, MA-110, and MA-140 will use technical word processing software for an assignment without being required to do so.
This goal is one aspect of our disciplinary expectations for our students. It is also one element of Westmont’s “Research and Technology Standard” (Student Learning Standard #6).

DATA

Data in the form of papers written by students using technical word processing software have been collected in the following courses:
- MA 108, Spring 2005—Mathematical Analysis
- MA 19, Fall 2005—Multivariable Calculus

(Note: the other courses have not been taught since we established this goal as part of our program review. Currently, MA-110 and MA-140 are being taught and data will be collected from those courses for analysis and inclusion in our next progress report.)

The department met to hear a report on this data from Professor Howell, the instructor of the courses and to discuss the results (1/19/06).

INTERPRETATION

The following comments were brought by Professor Howell to the departmental discussion on 1/19/06.

COMMENTS BY PROFESSOR HOWELL

GENERAL
In both courses, every student produced at least three papers using technical word processing software. At least one student in each course used the software on an assignment for which it was not required.

Westmont has purchased 15 copies of Scientific Notebook for student use. To use this software, students must go to the “computer lab” located in the basement of our library. I found that less than half of the students in a given class availed themselves of this opportunity, citing “inconvenient access” as the primary reason. The software package is available for a one month free trial download. Students tended to use that option, and made agreements among themselves to download at specified times so they could use each other’s computers throughout the semester.

MA 108—MATHEMATICAL ANALYSIS
Students initially avoided the use of technical word processing software, and only completed assignments with such software when required. They stated that too much time was needed beyond the time taken to complete an assignment in the first place. As the semester progressed, however, more and more students chose to produce their work with technical word processing software. The cause for this change is not immediately obvious. It may be the result of increased familiarity with the software as the semester progressed, or it may be due to a growing appreciation of the quality of work produced with the use of such software. It might simply be due to the fact that extra credit was given for work produced with the software. It also appears that the quality of writing improved greatly, though, again, the cause of this improvement cannot be isolated.
Four writing assignments in this course were required to be done with technical word processing software. Students reacted similarly to those in MA 108 with respect to complaints of time. The writing progress was not as dramatic as that in MA 108, probably due to the fact that the latter course is specifically designated as a “writing intensive course” within the mathematics major. In other words, more attention was given to mathematical writing in that course. Nevertheless, every student at least satisfactorily learned to use technical word processing software, though some became more proficient than others.

**DISCUSSION BY DEPARTMENT MEMBERS**

Department members discussed the challenges presented by requiring students to use software only available in the computer laboratory. We agreed that students would be more likely to have positive attitudes about learning to use technical word processing software if they were able to work on their own computers. Furthermore, we recognized that this skill will be more useful to them in the future if they have access to the software.

Some of our discussion focused on the difficulties of separating the evaluation of student learning relative to this goal from our goals concerning their broader writing skills. We agreed with Professor Howell that since students are developing their skills in using the technical word processing software at the same time that their mathematical writing skills are improving, it may not be possible to isolate improvement in one area from that in the other.

We discussed the process of collecting and storing data for future analysis. We do not have copies of all the papers produced by all the students; nor do we have exact figures concerning the number of students who chose to use the software when it was not required.

**USING THE RESULTS**

In general, we are pleased with the student outcomes reflected in the data discussed here. All students in the courses considered met our benchmark (exceeded it, even) of producing a paper using technical word processing software. Each course had at least one student who used the software when it was not required. Equally encouraging, the graduating student who received the department’s “Outstanding Graduate Award” and who planned to pursue graduate studies in mathematics requested his own copy of the software as his award gift.

As a result of our recognition that students would benefit from having more direct access to technical word processing software, one faculty member is introducing the students in MA-110 to a free software package that students can download from a website. This software is more difficult to use than the Scientific Notebook used in previous courses. We are interested in determining if the students will find that the benefits of accessibility outweigh the challenges of learning to use more complex software.

Professor Howell plans to continue requiring students to use Scientific Notebook. But in response to their questions about whether the time required to write up assignments is excessive, he is going to reduce the number of assignments for which the software is required.

In response to our recognition that students’ general mathematical writing skills develop together with their ability to use technical word processing software, we plan to have more discussion as a department about our goals in this area. In particular, we want to discuss the possibility of combining this goal (currently conceived of as simply a technical skill) with our goals for students’ more general writing skills.
We also plan to have further discussions about best practices regarding collecting and storing data. We recognize the need to have more accurate records about students’ voluntary use of the software. Professor Howell is going to work with the department’s administrative assistant to create a system for putting students’ work on our department website so that it will be accessible to department members as well as to prospective students and outside reviewers. We are particularly concerned with creating a system that will be easy for faculty to use.

For now, the data used for this report is contained in Appendix A. This data exists in raw form.

**Next Steps**

At this point, we are satisfied that, overall, we have an adequate means for determining whether our students are meeting the goal of learning to use technical word processing software. As a result of our discussions we realize that we have work to do relative to determining the best software for them to use. We also realize that the pursuit of this goal cannot be separated entirely from pursuit of our goals regarding students’ general writing skills.

Our discussions throughout this review cycle have shown us that we feel some tension between the need to identify measurable goals and the desire to articulate what we truly want for our students in the area of technology. Some of our goals for our students in the area of technology are difficult to measure (e.g., we want students to choose the appropriate technological tool at the appropriate time), but we are committed to finding ways to incorporate those goals into our review process.

In the area of technology, we have settled on this goal (regarding technical word processing software) with some reluctance. We do believe this skill is an important one for our students to gain. However, it is certainly not the most important outcome we wish for them in the area of research and technology. Nor is it a goal embraced by both disciplines in our department (mathematics and computer science), nor even by every mathematics professor.

As we work through the process of program review, one lesson we are learning is that while we share a common vision of what we want for our students, as individuals we have particular goals we would like to assess that are not shared by everyone in the department. We are also learning that a department housing two disciplines has particular challenges that we would like to continue thinking about.

We would like to encourage the Program Review Committee to provide departments with further guidance on how to incorporate individual and disciplinary differences into the review of our program. We would also welcome assistance from the Committee in addressing the tension between the need to identify measurable goals and the desire to articulate what we truly want for our students.