ACTIVITIES AND FINDINGS

1 An Overview

This is the annual report for the third year of my NSF grant, DUE–0410641, which has been extended until August 2008. The purpose of the grant is to adapt Ken Bogart’s successful project, “Teaching Introductory Combinatorics by Guided Group Discovery”, to a required discrete mathematics course for math majors. The report covers the time period from September 2006 through July 2007.

2 The course at Oregon State

The prototype course at Oregon State is taught once a year and is a required course for mathematics majors in their third year of study. When I originally approached our undergraduate curriculum committee with the idea of applying for the grant, they promised the course would be taught in guided-discovery format using the progressing adaptation for at least the three years of the grant. At that time, the material in our discrete mathematics course was in flux, and the curriculum committee was pleased to have a proposal for the course. In the last academic year, the department has agreed that the material in the adapted notes should be the course syllabus; in fact, this change has now been made at the university level. (These notes are the recommended text, but individual course instructors are free to decide on the text.)

I taught the course in both Fall 2003 (when the proposal was being written) and Fall 2004, and the Fall 2005 and Fall 2006 classes were taught by John Lee. The size of our class at OSU is steadily increasing, and last fall the enrollment was 29 with the class full at the original cap of 24 before spring registration ended. Our department will begin offering two sections every Fall, and we expect the enrollment to stabilize at about 20 students in each section of the course. This coming Fall, John will teach one section, with the other taught by Lea Murphy, the undergraduate head advisor. Both will use guided discovery and they expect to coordinate closely.

In addition to having the two sections, John and I have asked the department to encourage faculty members to teach the course for at least two consecutive years. We think this arrangement will serve as built-in mentoring of faculty who are new to the course. Also this promise of two years would be a sign that the course instructor has a solid commitment to helping the evolution of the course at OSU.
3 The Notes

As I’ve commented in earlier reports, adapting the notes has taken significantly more time and effort than I anticipated in the original proposal. But it has also been satisfying to evaluate student response and to work with John Lee on the continuing adaptation.

My Website has links to a copy of the first three adapted versions as well as an additional copy of the 2006 adaptation which is annotated in red to indicate the significant changes from the 2005 edition. I will post the 2007 notes when they are available, probably by the end of August.

In this annual report I won’t review many specifics of the changes from Ken’s original notes that have been made in earlier versions. These will be summarized next year in the final report. Rather, here I’ll summarize changes that have already been made for 2007, other changes I expect to make before the 2007 notes go to press, and finally the changes that will be made next year.

Last September Rosa Orellana (Dartmouth) agreed to serve as a consultant on the project, analyzing the current notes and class organization from the perspective of someone who was very involved in the original project. She knows Ken’s notes well and has taught from them several times. Her report is an attachment to this report. Because the latest adaptations have involved more significant changes and re-orderings than I had been able to discuss with Ken, I think the overview she brings is especially helpful to the project and so ultimately to the students.

This summer is the fourth adaptation of the notes. Some relatively small changes suggested by John Lee have already been completed, as well as many of Rosa’s more detailed comments (on pages 2ff of her report). Because our classes don’t begin until the end of September, more time remains to work on this adaptation.

As far as Rosa’s suggestions, I expect to be able to finish the following for this version:

- Incorporate Ken’s sequences on Bell and Stirling numbers. For this, some rewriting is necessary both in order for them to fit with our perspective of equivalence relations as well as my slightly changed version of the material on distributions. There’s also the question of adding the necessary exposition for our less-experienced students. I expect this will be identified as an optional section.

- Part of Ken’s style is asking multiple questions within one problem. In some problem sequences, I changed this into problems with several different parts in order to make the problem easier to understand. Because I wanted the students to learn to pick out the questions, I didn’t do that uniformly. Rosa makes a general comment of doing that more often, especially for the first chapters. I want to re-visit this questions, and I plan to finish that for September.
• Revisit the question of pulling definitions from the problems. John and I had agreed that Ken’s having them within problems was very much in the spirit of guided discovery. But Rosa recommends otherwise.

• Rosa recommends more end-of-chapter summaries, which we have already accommodated with separate sheets instructors can pass out if they like.

• Rosa also recommends considering adding more figures to the notes—a good idea and one that hadn’t occurred to me. Preparing such for the September version isn’t feasible, but I should be able to flag places where illustrations might be helpful. As the two instructors teach, they can comment on these and also suggest other places. Drawings can be made for the next year.

One of my innovations to the notes was crafting the problem sequence which ends the first chapter. John Lee thought his classes were especially receptive to it, and Rosa also liked it. The sequence was designed to personalize student understanding of guided discovery especially from two viewpoints: how to approach problems and the importance of regularly summarizing what they’ve learned. This is part of a future plan to design a collection of sequences, one ending each chapter, which attempts to advance the student’s general ability to think and work “like a mathematician”. This change requires more thought than can happen for this version. We have already composed single-page review sheets separate from the notes which will be provided to instructors along with the TeX file which they can modify.

3.1 Anticipated publication of the notes

All versions currently appear on my Website.

When Ken and I discussed my original proposal, we agreed that the adaptation would be linked to any publication of his notes and that if it were significantly different we might publish it separately. Rosa’s analysis encouraged me to think in terms of publication, and in June I wrote an exploratory letter to Ruth Bogart in order to gauge her and the other family members’ interest in the project. Ruth’s reply came immediately and was enthusiastic. Per her request for more specifics, I recently sent her more details on the adaptation, which was a kind of mini-final report. At this point we’re considering making both sets of notes available under public Free Documentation License. The status of this should be determined by the end of this grant, and we welcome any ideas.
4 The Instructor Handbook

An important feature of the grant proposal was an instructor handbook to accompany the adapted notes. I anticipated it would be a place to discuss the guided-discovery method as well as give detailed information about problem sequences. This has become a joint project with John Lee. Since another colleague who has not been involved in this project will be teaching a section along with John, this coming fall provides us an opportunity to test-run the current version of the handbook. We’d like the final version to be an instructor supplement which will be motivational as well as pass on practical advice that we’ve learned while teaching the course, and among other things will include anecdotal information and advice from the OSU instructors.

Separate chapter summaries which can be modified by each instructor have been written and are included in this handbook. We were motivated to do this because many of our students missed (and needed) the instructor summarizing which is a usual part of instructor-led courses, and this was consistent with the comments of many of the instructors who used Ken’s book. In fact, Ken had decided that a possible way to incorporate this without negatively affecting the guided discovery would be to provide summaries to instructors who would then distribute them to their classes as they wished.

5 Dissemination

In February I learned that the MAA Notes volume on discrete mathematics was going forward, and it would include my chapter on the implementation of guided discovery in discrete mathematics courses at OSU. I met the editor, Brian Hopkins, in 2005 at the NSF poster session at the January meetings.

In April, I gave a presentation to the annual meeting of the PNW section of the MAA. Because this kind of presentation is different for me, preparation required a lot of time, especially for a 20-minute talk. But I think it was well-received and I’ve learned a lot about what can work in this kind of venue. I expect to give one or two talks coming this academic year, and I’m grateful to have the remaining travel funds to help support this endeavor.

When Dr. Orellana and I originally discussed her serving as a consultant, I also suggested she might write a paper with me and John Lee, comparing and constrasting the various implementations of Ken’s project. We three are very interested in doing this.

John and I have started work on a shorter publication, perhaps of the sort published in FOCUS of the MAA, which will concentrate on our observations on mathematical induction, and our students’ understanding of inductive processes.
6 Concluding Thoughts

As I said earlier, work on the notes has taken more time than I had anticipated—in fact, the work on the notes alone long ago surpassed the amount of time I had originally allocated for the whole project. Dr. Orellana’s comments have resulted in still more changes. Some of the more substantial changes will be deferred to the 2008 edition of the notes. I’m pleased she agreed to help, and was relieved to read her overall assurance that the spirit of guided discovery has been maintained.

Work on the project has also resulted in more time spent in discussions with John Lee (and other colleagues to a lesser extent), discussions which are invaluable and have influenced my general teaching. The high level of these discussions was unanticipated, and we agree that some of it merits wider dissemination in the mathematical community.