



# Adapting Guided Discovery Notes for Larger Classes

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## Project Description:

Ken Bogart's guided group discovery notes and method were designed for small elective courses in combinatorics. The goal of this project is to adapt the notes for larger classes in discrete mathematics which are required for math majors. For each of the three years of the project, the current adaptation will be used in OSU's Fall term discrete mathematics course and the next version of the notes will be based on the suggestions of the instructor and project evaluator. In addition to the adapted notes, we will disseminate an instructor package containing both a summary of the elements of Ken's method and anecdotal advice collected from instructors during the three years of the project.

## What is Guided Group Discovery?

Ken's notes form a unified collection of problem sequences in introductory enumerative combinatorics which are designed to guide students to understand and apply fundamental combinatorial processes. Some of the problems are intentionally open-ended, and many problems in the notes could take hours of concentrated thought. Even though students often begin the problems without any idea of the solution, the context and/or leading examples that precede them have prepared a structure for reasoning. During class, the students work on problems in small groups and this is occasionally supplemented with whole-class discussion.

## An Overview of the Adaptation

After attending a Bogart-Collins workshop in August 2003, I was enthusiastic about trying Ken's notes in OSU's course, while at the same time I was anxious about how it would be received in such a different environment. As the quarter evolved, I was impressed by the amount of personal responsibility shown by many of the students and by the enthusiasm which many of the problems generated. Some of this can be attributed to the material, but most of the energy comes from the Bogart method and notes. An ongoing challenge in this project is to maintain these elements of discovery and community while expanding the interstitial discussion, which is needed in a class with six or seven groups and one instructor.

John Lee, the course instructor last term, shares my enthusiasm for the course and its continued adaptation. He frequently teaches our advanced calculus sequence, and is especially impressed by the accessibility of these topics and problem sequences for students with differing amounts of mathematical training.

Our course is now taught with the adapted notes in two 100-minute blocks, with group work peppered by whole-class activities. Students are expected to work together in class and to write up solutions independently. Since John and I agree that quick and frequent feedback is essential, we both provide a 2-day turnaround on graded work which is collected once a week. Ken's method allows for unlimited re-submission of problems, but we restricted both their number and the re-submittal window. Problems are graded on a 0-5-7-9-10 scale.

Ken's advisory board and evaluator advocated for the inclusion of more summarizing material. Summarizing handouts for possible instructor distribution are now packaged with our 2005 adaptation.

## A Comparison of Class Characteristics

The original notes are an introduction to combinatorics, while OSU's course has a broader syllabus of discrete mathematics. OSU's course enrollment is much larger—usually 24 to 28 students (forming six or seven groups) as contrasted with a maximum enrollment of 12 in the original project. Since OSU's course is not elective, the students are not self-selecting and require more motivational material. As our course is a requirement for math majors, its instructors are committed to improving proof-skills whereas Ken said he was more interested in developing and assessing creativity rather than formalism.

## The Fall 2004 Adaptation

- To address the heterogeneity of students and class size, more exposition was included for guidance.
- Elementary material on functions and induction was moved from the appendices and supplemented.
- To address the different syllabi, some advanced counting was moved to supplementary sections. and sections using the Bijection Principle were expanded.
- Whole-class discussion was used at the 85-minute mark when students seemed tired or frustrated.
- Special course-grade protocol was used to entice an advanced group who worked more problems.
- Mary's weekly assignments usually included a range of problems, from which she would grade 4 or 5.

## The Fall 2005 Adaptation

- Induction was moved earlier and new problem sequences on inductive *processes* were added.
- Problem sequences now emphasize equivalence relations over the Quotient Principle.
- The first chapter ends with a problem sequence to help the students summarize what they have learned.
- Whole-class discussion was regularly used at the 60-minute mark. Next year John is likely to incorporate more student presentations.
- Each week John specified the problems that would be graded.
- Each graded problem received two assessments: for the mathematics and for the exposition.