

## DISCRETE MATHEMATICS TEACHING MODULES

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Discrete Mathematics is a topic taught to preservice mathematics teachers at East Carolina University in two undergraduate courses, one course directed at future middle school teachers (grades 6-8) and the other for secondary teachers (grades 9-12). These courses prepare prospective middle school and secondary teachers to teach discrete mathematics courses and topics in their respective curriculum. Discrete topics covered in the courses vary slightly but include graph theory, logic, counting techniques, social choice, matrices, set theory, sequences, mathematical induction, and recursion. The course curriculum incorporates the North Carolina Teacher Education Standards and the NCTM Principles and Standards encouraging cooperative learning, technology integration, making connections and real life applications. The sophomore and junior level students use a variety of representations to model and solve real-world and classical problems. They are required to use the processes of problem solving, reasoning and proof, communication, connections, and representation as the foundation for the teaching and learning of the discrete mathematics. They are asked to demonstrate their knowledge of major discrete concepts and theories through a diverse set of assessments. The students experience a variety of instructional strategies and tools useful for exploring discrete topics throughout the course.

### **The Text**

One of the most difficult aspects of preparing students to teach discrete math is that the list of discrete topics is not uniformly agreed upon by all mathematicians. Thus the topics taught in a discrete class vary widely throughout the nation. And this ambiguous nature carries over into the selection of a text for the course. No one text seems to cover all the topics or most of the topics in depth enough to warrant advising teachers to purchase just one text. This instructor varies the required course text depending on the level (middle school, secondary) of the course and then supplements heavily from a variety of sources.

### **Preparing the Stage**

Since there are so many topics to cover in the discrete course in a limited amount of time only a select few topics are actually taught by the instructor. Usually the course begins with the topic of coloring, and then progresses into graph theory, coding, fair division and social choice. A few days on counting and matrix applications usually end the directed teaching portion of the course. These initial discrete topics are covered in class and are chosen by the instructor specifically because the majority of the undergraduates are unfamiliar with most of these mathematical topics. The students are taught the unfamiliar topics using a variety of modeling and instructional strategies they can later employ as

future teachers. Through homework assignments and in-class activities they are encouraged to use their problem solving techniques to create motivating discovery lessons for these specific discrete topics. Once they are familiar with the complexity of creating an engaging and mathematically relevant discrete lesson they are given the requirements for their final exam unit. This exam unit is a culminating activity in the course. It allows the students to apply their best techniques in collaboration with their peers to create a dynamic discrete teaching module as their final exam.

### **The Procedure**

The students choose a topic from a select set of discrete topics not previously covered in the class. The available discrete topics are presented to the students with short descriptions of the topics by the instructor approximately one month before the end of the semester. The students are asked to select their top three choices and submit them in writing to the instructor. The students receive their exam unit topics and group assignments within two days of their choice. The assignments combine students into groups of 4 and 5 based on their top selections and the discretion of the instructor. The students receive the full final exam assignment in writing and begin working cooperatively to create the discrete unit. During this month of exam unit preparation the students are allowed 2 class days in the computer lab for group work on the project. The unit is due the last week of class.

### **Discrete Exam Unit Requirements for the Secondary course MATE 2800**

1. Each student will choose a discrete topic from the following list of topics which together will form a unit:
  - a. Weighted Voting Systems
  - b. Sealed Bids and Estate Division
  - c. The Mathematics of Apportionment
  - d. Trees and Networks
  - e. Mathematics of Scheduling
  - f. Recursion
  - g. Symmetry/Fractals
  - h. Arithmetic sequences and series
  - i. Matrices-Leontief and Leslie models
  - j. Cryptography
  - k. Logic-truth tables, syllogisms
  - l. Mathematical Induction
  - m. Set Theory
2. The topics will be divided so that a group of 4/5 students will work together in a fair and equitable manner to create a unit plan.
3. Each group will create lessons, a project, and an assessment instrument that will constitute approximately a week's worth of instruction on a discrete topic. This complete set of lessons will be designated as a unit.
  - a. The unit will include the lesson plans, worksheets, assignments, a project, and a form of assessment.
  - b. At least one lesson must use manipulatives and/or be written as a discovery lesson.

- c. The unit must be typed (scan any extra materials) and e-mailable.
  - d. A bibliography must accompany the unit.
  - e. Ideas for lessons already available on the web or in texts must be credited, but should be adapted appropriately to meet our criteria.
  - f. The lessons notes should be in a PowerPoint presentation and the worksheets, and other descriptive materials must accompany the unit in e-mailable form.
  - g. Credit in the footer all materials with the group names listed.
  - h. The lessons should be teacher friendly, mathematically correct, and complete.
  - i. Assignments, worksheets, and examples must include work with solutions, not just the answers.
  - j. The PowerPoint and accompanying materials will be delivered on a CD and due last day of class on \_\_\_\_\_.
4. The unit plan with accompanying materials should be delivered on a CD the last day of class. \_\_\_\_\_. The CD should have a topic name for the main folder, Label sub folders for the 3 lessons, the project and the assessment.
5. By the last day of class each students will complete
- a) an individual evaluation describing her/his part in their unit project and
  - b) an evaluation of each of their group members.
6. Exam (25% of grade)
- On the exam day each group will make a presentation to the class of their unit in a 15-20 minute session.

### **The Individual Exam Grade**

Each student must have completed a lesson, project, and/or assessment within the unit plan and also must have performed a specific group job. The module is graded on the rubric based on the module requirements. There will be a general group grade for the unit which can be amended to reflect individual work on the unit in the group for each student. This amended grade will constitute a personal final exam grade for each student and may be different for everyone in the group, if responsibilities and completion of tasks are uneven.

### **Student Self and Peer Evaluations**

Each student is required to submit an individual evaluation of their group member's efforts and results. The students are told to be honest in their evaluations and praise where it is earned and constructively criticize where it is deserved. Each student must also fill out a self evaluation form describing their work on the project. The students are encouraged to give very detailed descriptions of their contributions to the project. The students email their self evaluation and contribution sheet and evaluations on each of their group members to the course instructor after the unit is turned in during the last week of class. These evaluations are viewed in tandem with the rubric while grading the modules. They are used by the instructor to help determine the individual final exam grade for each student. Both forms are shown below.

## The Individual Discrete Project Participation Evaluation for Group Members

Student name \_\_\_\_\_

Fill out one form for each member of your group. Circle the scale number that best describes your response to the question.

Project Topic \_\_\_\_\_

Group Member Name \_\_\_\_\_

1. Performed his/her assigned tasks for the project  
1 No                      2 Half way                      3 Yes
2. The quality of work this person did on their part of the project was  
Below Average                      Average                      Above Average                      Excellent
3. Was punctual with his/her part of the project so that the rest of the group did not suffer  
1 Not at all                      2 Was late                      3 On time or early
4. Was cooperative and I found working on this project with this individual to be  
Below my expectations                      Met my expectations                      Above my expectations
5. Overall, my evaluation of the effort this person exerted on this project as a group member is  
1 Poor                      2 Acceptable                      3 Above average                      4 Extremely impressed

Additional Comments.....

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### Discrete Math Exam Unit Project Contribution

Name \_\_\_\_\_

Topic \_\_\_\_\_

Other Group members \_\_\_\_\_

1. Your contribution to the group, such as the PowerPoint project, organization, etc....
2. Your contribution to the project content assignment, worksheets, homework, etc....
3. Comments....

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### The Exam Unit CD

Each group delivers on the due date to the instructor both a hard copy of the module and a CD containing the complete electronic version of the module. The units are copied and presented on the exam day as one CD to each student. The CDs normally contain at least 5 modules of complete discrete units ready to go. On the exam day the student groups make a presentation of their unit to their peers.

### Course Satisfaction and Outreach

Because the students leave the course with this wealth of complete and creative discrete mathematics lesson plans they feel this course is a true asset in their teacher preparation. The student evaluations for the course are very positive. The students always comment about the motivating teaching strategies and the problem solving atmosphere in the classroom. The highlight of the class to them is creating their own unique module and then receiving the complete set of class modules for their future teaching career. As student interns many of our students have used these lessons while teaching in the field.

In fact the success of this course and the usable discrete units these students have created has spread in our teaching community. Each semester teachers in the field send requests for copies of these discrete units. The pre-service teachers have gladly shared their unit CDs with a number of experienced teachers. The teachers who are using the modules in their discrete math classes are amazed with the quality and creativity of the modules. The teachers are quick to praise the thoroughness of the student work. This exam assignment has resulted in not only a usable product for our future mathematics teachers, but also a desirable offering from the university to our discrete mathematics teachers in the field.

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