TWO-STAGE EXAMS TURNING EXAMS INTO A LEARNING EXPERIENCE

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Active Learning and Collaborative Exams

- Many studies have shown that cooperative group work promotes learning:
  - P. Heller, et. al. classic study in physics (1992), etc.
- Nevertheless, exams remain individual assessment tools
- In 2001 a U of Massachusetts group showed that interactive exercises and collaborative exams significantly increased information recall in an Oceanography course (Yuretich, R., et. al.)
- In summer 2009 we tried a similar study in two CS courses
  - a first year course on formal models of computation (similar to traditional Discrete Math courses)
  - a second year course on software development techniques (intro to Software Engineering)

Collaborative Activities in the two Courses

- Short interactive exercises during main concept discussion

- Group exercises on main concepts
  - students form groups of 2-3
  - work on solving a problem for 10-15 mir
  - submit solution to instructor
  - instructor and students discuss solution
- Two stage midterm exam
  - stage 1: student take an individual exam for 80 (or 50) min
    - hand in their papers
  - stage 2: students take the same exam in groups
    - form groups of 3-5 students, their choice
    - have 50 (or 30) min to complete the exam

The Group Exam

- Every student participated in a group
  - even students who had never participated in group exercises
- Most groups had active discussions
  - more working scribbles on group exams than on individual exams
  - group members were comfortable working with each other
  - no multiple choice questions; questions needed considerable work

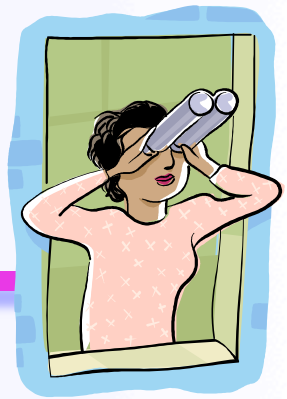
The Group Exam (cont')

- Three problematic groups:
  - a group entirely comprised of 3 extremely high-achieving students
    - no discussion; divided the exam and filled in the answers
  - a group of 3 low-achieving and 1 high-achieving students
    - high-achieving student wrote the whole exam
  - a group of 1 high-achieving (female) and 3 average-achieving students (male)
    - high-achieving student got frustrated as she was unable to convince the others
    - Heller & Hollabaugh made similar observations

Student Feedback

- The majority (75.5%) of the students found the two-staged exam helpful:
  - "…was fun, amazing and very helpful … It also turns the stress of the exam into something positive …"
  - "I learned a lot from others. I was also able to help others …"
  - "… they (partners) made me realize certain issues I didn't see before. Also I learned from them certain techniques …."
  - "…we got immediate feedback and thus we immediately were able to learn our mistakes …"
- Groups dominated by high or low achievers don't always work well
  - "… I felt that I couldn't put 100% of my input because some of my group members were really persistent on their solutions …"
  - "… partners wasted a lot of time… "

Our Observations/Analysis



- Performance in in-class group exercises improved after the midterm
- Performance in 3 isomorphic questions in final exam improved in one class, but dropped in the other:
- Models of Computation:
  - average drop of 6% over the 3 isomorphic questions
- Software Development:
  - average gain between 5% and 31% in the 3 isomorphic questions
  - question on S/W testing: 72.5% did better, 15.5% did worse
- Group exercises and two-staged midterm improved student success in the Software Development course
  - summer 09 had the highest average and lowest fail rate among the last 10 offers of the course (reported in ICERI 2009 paper)

Lessons Learnt – Future Plans

- Two-staged exams can be a valuable learning experience
  - immediate feedback on the exams is very important in learning
- Group exams are more effective when students have participated in in-class group activities before the exam
  - are more ready to work with each other
- Group structure and composition is important
  - imbalance of member abilities in a group may reduce knowledge transfer
  - gender imbalance and lack of communication skills may have similar results
  - need to rethink of how to form groups
    - let students work with different groups before the exam
    - have the instructor assigning the groups
- Groups should be formed prior to exam
  - some students wasted time do decide which group to join

Lessons Learnt – Future Plans (cont'd)

- To foster discussions and knowledge transfer, group exam should have new isomorphic questions and appropriate duration
- Question type and difficulty can affect the learning experience
  - challenging questions with non-trivial answers work better for high-achieving students
  - highly challenging questions may discourage low-achieving students
  - need to further investigate question types that are more suitable for two-stage exams
- We plan to continue offering two-stage exams in a number of our courses and investigate the issues mentioned above