

2007 ASEE Conference

**EXPERIMENTAL HYBRID COURSES THAT  
COMBINE ONLINE CONTENT DELIVERY  
WITH FACE-TO-FACE COLLABORATIVE  
PROBLEM SOLVING**

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**Outline**

- Why a "hybrid" course format was chosen
- The targeted courses
- Experimental course format
- Advantages and challenges
- Performance and survey results
- Summary and future work
- Tips for potential adopters

**Why A "Hybrid" Format Was Chosen**

- To address two basic instructional problems:
  - the general ineffectiveness of the "large lecture" format in conveying course content
    - inherent "group paced" nature
    - sporadic attendance
  - the general ineffectiveness of "handed in" homework in helping students learn the course material
    - widespread "cheating" (students copying one another's work)
    - difficulty with providing timely feedback
    - observations from attempts to use on-line discussion groups to promote homework collaboration

**The Targeted Courses - 1**

- ECE 270 – sophomore-level introductory course on digital system design
- Typical AY enrollment 300-400 students
- Six learning outcomes, each assessed with individual hourly exams generally consisting of:
  - standardized multiple-choice questions that gauge understanding of content
  - application ("work out") questions that gauge more advanced (synthesis) skills

**The Targeted Courses - 2**

- ECE 362 – junior-level course on embedded microcontroller system design
- Typical AY enrollment 150-200 students
- Three learning outcomes, each assessed with a comprehensive in-lab "practical" exam consisting of:
  - standardized multiple-choice questions that gauge understanding of content
  - analysis/design questions that gauge basic skills
  - application programming questions that gauge more advanced (synthesis) skills

**Experimental Course Format (DPS)**

- Lecture content delivered via streaming video
- Contact hours used for collaborative problem solving in small-group settings (multiple sections)
- Conducted in lab so that a variety of hands-on exercises could be completed
- Instructor walk-through of solution (via Net Meeting) once sufficient time given to work each problem
- Students' "homework" score based on attendance and participation in DPS sessions
- Traditional lecture division run in parallel with experimental division (students were given choice of course format)

### Advantages and Challenges - 1

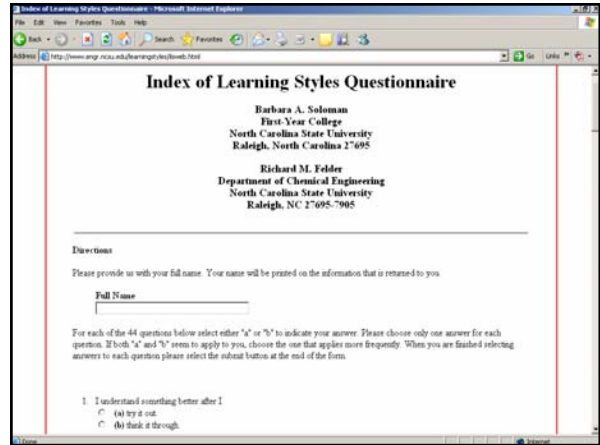
- Advantages
  - direct, immediate feedback on problem solving methodology (“bi-directional”)
  - ability of students to employ “cognitive rehearsal” (talking through how to solve a problem with their partner)
  - significantly less day-to-day overhead (handling homework and giving lecture)
  - students have more control over their education (can attend “virtual lecture” when best for them)

### Advantages and Challenges - 2

- Challenges
  - ensuring students “keep up” with virtual lecture
    - on-line quizzes and/or resource utilization tracking tools are often easy for students to circumvent
    - in-class quizzes to track progress take time away from problem solving (“useful work”) and incur additional overhead
  - ensuring students use the collaborative problem solving sessions “wisely”
    - coming to class with their annotated notes
    - not just “sitting there” and attempting to learn by osmosis

### Junior-Level Trials

- Three trials completed to date (F-05, S-06, F-06)
- Instructors
  - same for each format, both Fall trials
  - different for each format, Spring trial
- Differences among trials
  - scheduling of each student’s DPS session prior to their lab division meeting time (S-06)
  - incorporation of active learning (“in-class homework”) exercises in the traditional lecture division (F-06)
  - use of Index of Learning Styles (ILS) tool to help students choose course format (F-06)



### How ILS Survey Results Utilized

- On-line 44-item questionnaire that assesses preferences on four dimensions
  - Active / Reflective
  - Sensing / Intuitive
  - Visual / Verbal
  - Sequential / Global
- The traditional lecture division was recommended for students with some combination of reflective, verbal, and/or sequential preferences
- The directed problem solving division was recommended for students with some combination of active, visual, and/or global preferences

### Junior-Level Performance Results

Average Overall Exam Scores and Pre-/Post-GPA (4.0 Scale)						
	Trial 1 – Fall 2005		Trial 2 – Spring 2006		Trial 3 – Fall 2006	
	Traditional Format	Experimental Format	Traditional Format	Experimental Format	Traditional Format	Experimental Format
N	33	55	24	44	54	43
Pre-GPA	3.01	2.82	2.55	2.85	2.75	2.67
Outcome 1 Exam	64.8%	69.8%	63.3%	68.1%	75.7%	71.7%
Outcome 2 Exam	48.9%	51.6%	49.9%	53.2%	61.1%	63.7%
Outcome 3 Exam	47.2%	49.3%	55.6%	53.8%	59.5%	57.4%
Post-GPA	2.10	2.50	1.98	2.30	2.35	2.39

### Junior-Level Survey Results

Question	Trial	SA	A	N	D	SD
<i>The on-line lecture and directed problem solving session combination helped me learn the material better.</i>	F-05	13	23	7	2	1
	S-06	10	17	1	0	1
	F-06	8	17	2	4	0
<i>I would choose the on-line lecture and directed problem solving session combination in another ECE course.</i>	F-05	15	16	8	5	2
	S-06	10	13	3	2	1
	F-06	8	16	1	5	1
<i>I enjoyed learning course material in the directed problem solving format.</i>	F-05	11	28	7	0	0
	S-06	8	15	5	0	1
	F-06	5	16	4	3	1
<i>The directed problem solving sessions enhanced my learning experience.</i>	F-05	11	29	4	2	0
	S-06	10	14	4	1	0
	F-06	7	17	4	2	1
<i>I enjoyed interacting with my peers during the directed problem solving sessions.</i>	F-05	10	24	10	2	0
	S-06	12	12	4	1	0
	F-06	8	15	6	2	0

### Sophomore-Level Trials

- Two trials completed to date (F-06 and S-07)
- Different instructors for each format, both trials
  - F-06 trial:
    - Traditional Lecture: Prof. X
    - Directed Problem Solving: Prof. Y
  - S-07 trial:
    - Traditional Lecture: Prof. Y
    - Directed Problem Solving: Prof. Z
- Similar to junior-level trials, except typically conduct two DPS sessions each week (instead of one)

### Sophomore-Level Performance Results

	Average Exam Scores and Post-GPA (4.0 Scale)			
	Trial 1 – Fall 2006		Trial 2 – Spring 2007	
	Traditional Format	Experimental Format	Traditional Format	Experimental Format
N	94	31	185	29
Outcome 1 Exam	57.1%	70.4%	58.8%	62.8%
Outcome 2 Exam	53.4%	61.6%	51.8%	46.9%
Outcome 3 Exam	64.8%	70.8%	59.3%	61.8%
Outcome 4 Exam	62.3%	64.5%	62.2%	62.5%
Outcome 5 Exam	62.4%	63.8%	56.1%	52.1%
Outcome 6 Exam	53.1%	55.6%	47.8%	48.0%
Overall Average	62.2%	67.5%	56.0%	55.7%
Post-GPA	1.98	2.36	2.17	2.28

### Sophomore-Level Survey Results

Question	Trial	SA	A	N	D	SD
<i>The on-line lecture and directed problem solving session combination helped me learn the material better.</i>	F-06	12	12	0	1	0
	S-07	5	12	1	2	1
<i>I would choose the on-line lecture and directed problem solving session combination in another ECE course.</i>	F-06	15	9	1	0	0
	S-07	9	5	1	5	1
<i>I enjoyed learning course material in the directed problem solving format.</i>	F-06	10	13	0	1	0
	S-07	6	8	4	3	0
<i>The directed problem solving sessions enhanced my learning experience.</i>	F-06	10	14	0	0	1
	S-07	2	10	4	3	1
<i>I enjoyed interacting with my peers during the directed problem solving sessions.</i>	F-06	12	8	3	2	0
	S-07	4	10	4	2	0

### Summary and Future Work - 1

- Preliminary results, based on both exam performance and survey data, confirm the effectiveness of the DPS format relative to the traditional lecture format
- The results also confirm the effectiveness of incorporating collaborative problem solving exercises into traditional classroom presentations
- *Effectively done, there is potentially no significant difference in overall exam performance between a traditional lecture that incorporates regular in-class collaborative problem solving exercises, and a virtual (on-line) lecture format that features a recitation-style collaborative problem solving format*

### Summary and Future Work - 2

- Future studies might therefore focus on:
  - a comparison of the relative efficiencies of the two approaches (e.g. in terms of resource utilization)
  - an analysis of which approach is "best liked" by students (e.g. more frequent, less personal large-class meetings vs. less frequent, more personal small-class meetings)
- An open question concerns which approach is "better" or "worse" for a given student based on their individual learning style
- Need to perform more detailed analysis of how ILS survey influenced students' course format choices

### Tips for Potential Adopters

- On-line lecture content doesn't need to be "super fancy" to be reasonably effective
- Recommend use of tool like Media Site (Sonic Foundry) for producing and delivering the requisite "rich media" on-line content
- Employ some mechanism up front to help ensure students "keep current" with on-line content
- Give students a choice of course format if possible – this will give them perhaps their first opportunity to think about (and hopefully discover) how they best learn

### More Information

Detailed information about the courses discussed in this presentation can be found at

<http://cobweb.ecn.purdue.edu/~dtml>