# Experimental Cross-Hybrid Course Formats


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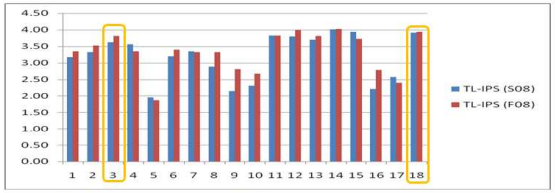
- Hybrid = "inverted" format in which traditional in-class and out-of-class activities exchanged, also called Directed Problem Solving (DPS)
  - lecture content delivered via streaming video
  - contact hours used for collaborative problem solving in small-group settings
- Instructor walk-through of solution once sufficient time given to work each problem ("directed problem solving")
- Students' "homework" score based on attendance and participation in DPS sessions
- Traditional lecture division run in parallel with experimental division
- Students given a choice of course format

## Traditional Lecture Survey Results



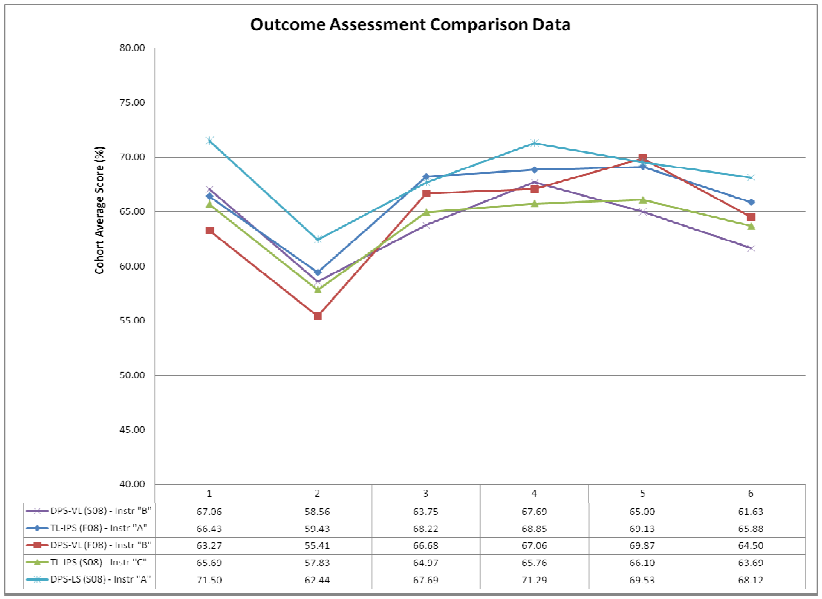

1. I chose the traditional lecture option by default (i.e., arbitrarily).
2. I chose the traditional lecture option based on my *Index of Learning Styles* survey results.
3. I was glad that I had a choice between two different course delivery options.
4. I used the on-line lectures *in addition to* attending the "live" class lectures.
5. I used the on-line lectures *instead of* attending the "live" class lectures
6. The *Lecture Workbook* class note format helped me learn the course material.
7. I made effective use of both formats of the *Lecture Workbook* (skeleton and annotated).
8. I feel that I learn course material better in a traditional live lecture format than in a "virtual" (on-line) lecture format.
9. I would *not* consider taking *any* ECE course in a directed problem solving format.
10. Use of the "clickers" enhanced my in-class learning experience.
11. I took advantage of most of the on-line learning resources available for this course.
12. The in-class homework and attendance quizzes helped me learn the course material.
13. The practice homework sets and solutions helped me learn the course material.
14. The practice exams and solutions helped me learn the course material.
15. The modular, on-line ("virtual") lectures helped me learn the course material.
16. This course should *only* be offered in a traditional lecture format.
17. This course should only be offered in a directed problem solving format.
18. This course should continue to be offered in both a traditional lecture and a directed problem solving format.

**Challenges associated with hybrid format:**

- 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
- development (and maintenance) of a standardized testing methodology to ensure reliable comparisons among experimental trials/cohorts

**Cross-hybrid variants explored:**

- Directed Problem Solving with Virtual Lecture (DPS-VL)
- Directed Problem Solving with Lecture Summary (DPS-LS)
- Traditional Lecture with Integrated Problem Solving (TL-IPS)
- Traditional Lecture with Take-Home Work (TL-THW)




| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DPS-VL (S08) - Instr "B" | 67.06 | 58.56 | 63.75 | 67.60 | 65.00 | 61.63 |
| TL-IPS (F08) - Instr "A" | 66.43 | 59.43 | 68.22 | 68.85 | 69.13 | 65.88 |
| DPS-VL (F08) - Instr "B" | 63.27 | 55.41 | 66.68 | 67.06 | 69.87 | 64.50 |
| TL-IPS (S08) - Instr "C" | 65.69 | 57.83 | 64.97 | 65.76 | 66.19 | 63.69 |
| DPS-LS (S08) - Instr "A" | 71.50 | 62.44 | 67.69 | 71.29 | 69.53 | 68.12 |

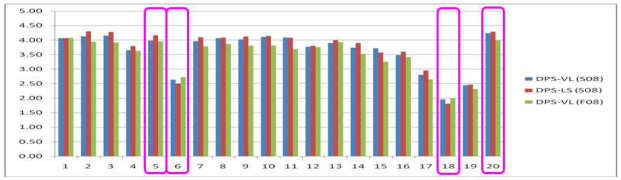
**Course outcomes:**

1. an ability to analyze static and dynamic behavior of digital circuits
2. an ability to represent Boolean functions in standard forms, to map and minimize them, and to implement them as combinational logic circuits
3. an ability to use a hardware description language to specify combinational logic circuits, including various "building blocks" such as decoders, multiplexers, encoders, and tri-state buffers
4. an ability to design and implement arithmetic logic circuits
5. an ability to analyze, design, and implement sequential circuits and use a hardware description language to specify them, including various "building blocks" such as counters and shift registers
6. an ability to design and implement a simple computer

**Advantages of hybrid format:**

- 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)
- students have more control over their education (can attend "virtual lecture" when best for them)
- significantly less day-to-day overhead (handling homework and giving lecture, meeting only twice/week)

## DPS Survey Results




1. I chose the directed problem solving option based on my *Index of Learning Styles* survey results.
2. The on-line lecture and directed problem solving session combination helped me learn the material better.
3. The on-line lecture and directed problem solving session combination helped me prepare for exams.
4. The on-line lecture and directed problem solving session combination helped me prepare for the laboratory experiments.
5. I would choose the on-line lecture and directed problem solving session combination in another ECE course (if available).
6. I would prefer *only a live (traditional) lecture* over the on-line lecture and directed problem solving session combination for this course.
7. I enjoyed learning course material in the directed problem solving format.
8. Having a choice of course delivery options enhanced my ability to learn.
9. The directed problem solving sessions enhanced my learning experience.
10. I enjoyed interacting with my peers during the directed problem solving sessions.
11. I feel that most of the other students enjoyed learning in the directed problem solving format.
12. The on-line lecture enhanced my learning experience.
13. The on-line lecture prepared me for the directed problem solving sessions.
14. I viewed the on-line lecture before participating in the directed problem solving sessions.
15. The *Lecture Workbook* class note format helped me learn the course material.
16. I made effective use of both formats of the *Lecture Workbook* (skeleton and annotated).
17. Use of the "clickers" enhanced my in-class learning experience.
18. This course should *only* be offered in a traditional lecture format.
19. This course should only be offered in a directed problem solving format.
20. This course should continue to be offered in both a traditional lecture and a directed problem solving format.

**Summary and Future Work:**

- 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
- Future studies will 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)
  - development of "cross-hybrids" that might be even more effective

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