Ill-Structured Capstone Projects in an Electronics and Instrumentation Advanced Lab

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1. Introduction

- The *Physical Measurements and Instrumentation* (PMI) course covers analog & digital electronics and LabVIEW programming
- In the second half of PMI, students work on ill-structured capstone projects, where they apply their newly learned knowledge to automate experiments that were learned in previous advanced labs
- The PMI capstones provide a context in which to study how students solve ill-structured problems

2. The PMI Course

Analog & Digital Electronics
+
LabVIEW Programming

→ ***Capstone Projects***

1st Half — 2nd Half

3. Examples of PMI Capstone Projects

- Measuring the Speed of Light
- Saturated Absorption Spectroscopy
- SQUID (Superconducting Quantum Interference Device)
- X-Ray Diffraction
- Chaotic Circuits

4. Ill-Structured Nature of the Capstone Projects

Characteristics of ill-structured problems[1,2]	***Capstone Projects in PMI***
⇨ One or more problem elements are unknown	Unclear which electronic components, measurement & analysis technique should be used
⇨ Require integration of content domains	Require integration of knowledge from electronics, instrumentation, programming and physics
⇨ Solutions not predictable or convergent	Several different solutions are possible depending on the electronic equipment and analysis technique used
⇨ Typically encountered in professional settings	For example, in research labs, we do experimental measurements, planning, debugging, etc.

5. Students' Learning Outcomes

The capstone projects offer students excellent opportunities:

- To learn or re-learn physics concepts
- To write LabVIEW programs and build circuits on the NI ELVIS II prototyping board
- To see usefulness of electronics in physics experiments

6. Ongoing Work

Study to find out how students solve ill-structured problems

References

1. Jonassen, D. H. (2007). Learning to solve complex scientific problems. In Jonassen, D. H. (Editor), chapter 1.
2. Jonassen, D. H. (1997). Instructional design model for well-structured and ill-structured problem-solving learning outcomes. Educational Technology Research and Development 45(1), 65–95.