Revitalizing Labs: Lessons from 2.5 Years of Iterative Development and Assessment of Digital Logic Labs

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A case study of change: evolution of the first two circuitry labs

Fall 2008

What we inherited

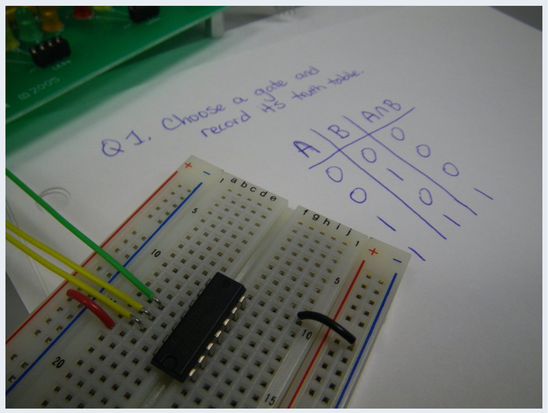


Figure: The original introduction to circuitry: students to pick a logic gate, plug it up to switches and LEDs, and verify its truth table.

In this term, the introduction sequence was:

1. Test a gate (pictured above)
2. Build a priority chain

Spring 2009

Let there be discovery...

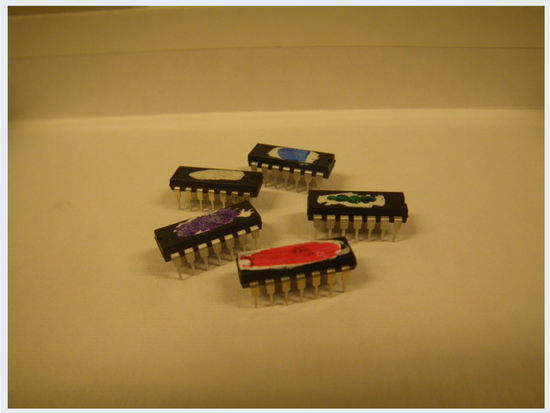


Figure: Which chip here is the AND gate? The student's task is to figure it out! Students are given "mystery gates" to identify, replacing the activity to the left.

In this term, the introduction sequence was:

1. **Mystery chip exercise** (pictured above)
2. Build a priority chain

Summer 2010

...social motivation...

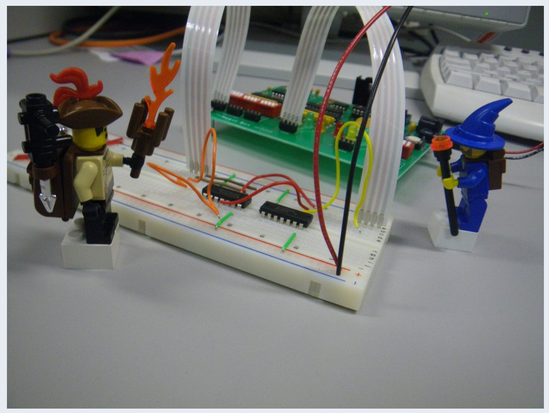


Figure: A new debugging activity: students make a circuit with bugs in it. Students swap breadboards, and try to figure out what the bugs are.

In this term, the introduction sequence was:

1. Mystery chip exercise
2. **Group debugging** (pictured above)
3. Build a priority chain

Fall 2010

...and time for creativity.

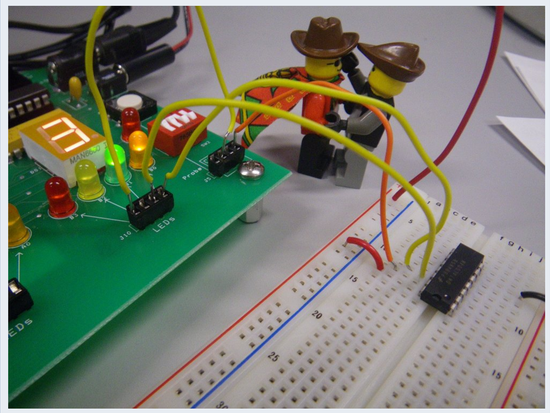


Figure: Using a clock wave generator and an 74LS04 chip, a waltz pattern is generated with the LEDs – students design creative ways for their lights to flash.

In this term, the introduction sequence was:

1. **Flashing lights exploration** (pictured above)
2. Mystery chip exercise
3. Group debugging

After six terms of incremental change

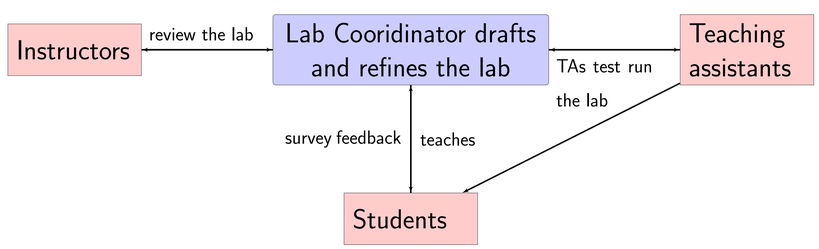
The labs are now:

- Doable in the allotted time – reducing stress on students and TAs in lab;
- Engaging, featuring more visual, immediate feedback from the equipment;
- Contextualized, with opportunities for creativity and discussion;
- Complete with clear and consistent grading.

New lab activities include:

- The addition of activities on scalability, multiplexing and limitations of theoretical models.
- An effective introduction to sequential circuitry.
- Open-ended "project labs" on cryptography, coding theory, and PRNG.

The process: drafting a lab



Survey results: overall findings

- Increased TA satisfaction
- Increased student satisfaction
- Increased student-reported learning

Acknowledgments

E.P. was supported by the CS Science Education Initiative. The changes we made would not have been possible without the input from all the instructors, TAs, and students of the course in the past three years – thank you all.

Factors for lasting change

Jones [2] lists five conditions that promote and sustain changes in the curriculum [1], all of which are satisfied in our work:

- ✓ mutual trust amongst stake-holders;
- ✓ committed and consistent leadership;
- ✓ proceeding with a non-threatening, incremental pace of change;
- ✓ professional development for academic staff; and
- ✓ the use of purposeful incentives for curriculum developers.

References

[1] Gruba, Moffat, Sondergaard, Zobel. ACE 2004, p 117.
[2] Jones. 2002. ASHE-ERIC Higher Education Report.