Measuring the Impact of Adaptive Learning Modules in Digital Logic Courses

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Overview

The purpose of this project is to develop and test a set of adaptive learning course materials to address background deficiencies in computer engineering. The interventions proposed will target a sequence of introductory digital logic courses that are found in every ABET accredited computer engineering program.

Motivation

Can an adaptive, e-learning environment that provides personalized instruction improve student understanding of computer engineering?

Student Interest – Students lose interest when course material is either too hard or too easy.

Background Deficiencies - Students often lack the necessary prerequisite knowledge in introductory engineering courses due to their varied backgrounds and different high school curricula.

Large Entry-Level Courses – The sheer number of students in introductory courses prevents teachers from providing personalized instruction.

Remote Delivery – Online instruction often lacks the instructor interaction that can be provided in a live offering.

Project Plan

1) Digital Logic Curriculum

Delivery – Two new textbooks + >100 instructional videos.

Assessment – 600+ multiple choice & VHDL design problems.

Laboratory Experience – Fully portable lab kit provides hands-on experience with both classical and modern (HDL) design.

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2) Baseline Understanding

Based on Analog Discovery 2, Terasic DE0-CV FPGA Board, & 74HC Family Parts

3) Adaptive Learning Modules

• Learning outcomes 4.4 (Logic Minimization) and 5.5 (VHDL Concurrent Signal Assignments) were selected for intervention due to high-level of student confusion observed by instructors.

• Modules pilot tested in fall-16, spring-17, and summer-17 on students from three universities. Performance on subsequent homework was measured and focus groups were conducted.

Conclusion

• A significant improvement in the associated homework score was observed for students with GPAs between 2.5-3.0. This confirms adaptive learning can help with background deficiencies.

• Majority of results were damped by ceiling effect, so it isn’t clear if modules are impacting mastery.

• Focus groups revealed students wanted modules to be optional, multi-mode (both text & video), and are not necessary for every section.

• A module for section 7.4 is necessary.