

# Hands-on Electronics Education

A Micron/Digilent Case Study

## Executive Summary

In 2000, Digilent's founders stood at the intersection of need and inspiration. They recognized that many of tomorrow's electrical engineers were learning their trade only in theory and simulations without any real and practical tools. They also saw how advanced toolsets like HDL frameworks, synthesizers, and simulators, as well as low-cost field programmable devices like FPGAs and CPLDs were changing the way working engineers designed boards and systems. Students needed both theory and practical, hands-on experience if they were going to be prepared for a fast-moving engineering career. So Digilent partnered with leading semiconductor companies, like Micron, to place powerful circuit implementation hardware and CAD software in students' hands for less than the cost of some textbooks.

## The Challenge

Digilent co-founder, Clint Cole is a professor in Washington State University's electrical engineering department and an experienced electrical engineer who helped found Heartstream, a medical electronics company. Professor Cole saw a disparity between students' academic experience and real-world design and development engineering. That gap meant that graduates were arriving at employers' doors ill-equipped to dive in and start designing. Cole wanted to offer students an apprentice learning model, where they could use real implementation hardware and put theory into practice. But PCBs and semiconductors could cost hundreds, if not thousands, of dollars. Most universities could not afford to provide existing demo boards to every student, at least not when those boards cost \$1,500 or more each. And engineering students—many of whom rely on grants and loans for tuition—were generally not going to be willing to shell out the price of a used car in exchange for a PCB. The cost was just too high.

Facing these challenges, Digilent set out to create a tool that could bridge the gap between engineering reality and classroom theory, and they set out to build that bridge for less than the cost of a single engineering textbook.

## Digilent Inspires Engineering Education and Finds a Partnership Solution

"Both universities and corporations share a desire for students and engineers who can easily integrate into high-technology professions after graduation. Collaborative efforts are the key to developing the necessary skill sets," wrote Craig J. Keif in a 2004 article titled, *Board of Education*. Keif, who was a graduate student at the time, was discussing a Digilent prototype and the positive effect it was having on University of New Mexico engineering students. Keif concluded by saying, the Digilent "prototype platform is a tremendous example of how academia and industry can work together to accomplish a common goal. Experiences learned in these types of endeavors pay great benefits by allowing students to learn from both real-world practice and theoretical classroom experiences."

Digilent's solution was simple. They partnered with leading semiconductor companies to develop inexpensive and yet powerful digital system design boards featuring a Xilinx FPGA and up to 128Mb of Micron CellularRAM™ memory. The partnership was not just a matter of some semiconductor companies supplying Digilent with low-cost components. It was instead a blending of both value and quality. It was a marriage of interests, both altruistic and practical. It was a cooperative that benefited students, suppliers, and future employers equally.



## Micron Quality and Value

Professor Cole and the rest of the Digilent team did not just want to pick the least expensive components for their educational boards. Rather they wanted the best possible combination of technology and cost effectiveness. Given his engineering experience, Cole had no doubt that he would find the right components for Digilent's planned educational boards, but he also wanted to engage his Washington State University engineering students. He sent them out to the internet, catalogs, and data sheets to help identify suppliers. These engineering students were to match a high-level behavioral description to an available technology. They had to reconcile concepts and schematics with off-the-shelf components. It was an exercise that would expose the students to the tools they would use as design and development engineers. It forced the students to analyze technical documentation, compare disparate specifications, and evaluate complicated cost models. But in the end, the exercise was largely a failure, reinforcing Cole's theory about hands on education.

"The students were horrible at picking components," Cole said, who explained that he had not actually expected the students to select the parts. "They just didn't have enough experience." The exercise was more about learning how to select components for a design than actually picking the parts that would go into Digilent's educational boards. But there was one exception. There was one success. For the most part, students had a hard time differentiating between similar components, but when a part stood out, even a novice could recognize its value. That was the case with Micron's CellularRAM memory.

"We liked Micron [products] due to their simple use model and mix of features, their low cost, and mostly, their exceptional value for the money," Cole explained.

"We were trying to pick the parts that met our teaching and marketing goals the best, and Micron did it."

Today, some 700 colleges and universities or about 40,000 engineering students world-wide use Digilent educational boards.

## Digilent's Demo Boards Help Fund Its Educational Boards

Not wanting to rely on discounted parts or benevolent suppliers, Digilent is a profit-making, board-development company, building advanced boards for the likes of Xilinx. "About 70-percent of our business is OEM work," Cole explained. "We build about 100,000 boards a year." It was with one of these boards that Digilent began working with Micron memory and the relationship has bloomed since. "We chose [our components] for good reasons. We like them because of their technology and because Micron is one of the best partners to work with."

## Learn More about Digilent

Digilent's most recent board is the robust Nexys-2 programmable logic design platform. It features the aforementioned Xilinx Spartan 3E FPGA and 128Mb of Micron CellularRAM memory, includes a USB2 port for board power, device configuration, and data transfer, works with ISE/Webpack and EDK, and uses a high-efficiency switching power supply for good battery power applications.

The Nexys-2 sells for just \$99.00. By comparison, Pier Luigi Dragotti's textbook, Distributed Source Coding, from Elsevier publishing will set you back \$129.95 and M. Sami Fadali's tome, Digital Control Engineering, runs \$99.95. Visit [www.digilentinc.com](http://www.digilentinc.com) to order a Nexys-2 board today.

[micron.com](http://micron.com)

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