# Forth and Computer-Assisted Instruction (CAI) I. From Mainframe to Micro: From Coursewriter to Forth.

by

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## Abstract

Since 1976, the Department of Landscape Architecture at The Ohio State University has used Computer-Assisted Instruction (CAI) in several of its technical course offerings. This informal 35mm slide presentation traces the evolution of the programs from alpha-numeric IBM 370 versions written in IBM's Coursewriter III, through Magnavox Orion-60 plasma panel/35mm rear-slide projector versions written in Phoenix, to IBM PC/Enhanced Graphics versions written in Forth.

In 1976, as a young assistant professor teaching technical courses in the Department of Landscape Architecture at The Ohio State University, the author faced problems. Most of the problems dealt with numbers and the major problem was the sheer number of problems. For example, problems in polar and cartesian coordinates, property traverse closure and adjustment, and horizontal and vertical curve alignment. Another problem was the number of students who asked for more problems and old tests to work to be certain they fully understood how to work the problems before a test.

In 1976, the Director of the School of Architecture was using a Computer-Assisted Instruction (CAI) program in City Planning History courses and suggested that his program might be suitable for technical courses in our department. It was not suitable, but the Office of Computer-Assisted Instruction was willing to undertake creation of another CAI program which would be.

By 1979, drill and practice modules covering coordinate systems, land surveying, road alignment and storm drainage were in use. Although students said they liked the CAI modules and scored well on CAI tests, they did not score well on hard-copy graphic versions of the same material. A lack of graphics capability in the mainframe CAI programs appeared to be a major reason for poor learning "transfer."

In 1980, experiments were made with the Magnavox Orion-60 plasma panel terminal. The plasma panel allowed rear projection of 35mm slides through the display, graphics/text overwriting, and touch-screen response. After about a year of exciting developments, Magnavox stopped production of the Orion, and the software vendor stopped developing support. We went back to alpha-numeric displays.

At the time, Ohio State was a beta site for the CAI language and with each release, modules that had previously worked failed as the newer system overwrote buffers and counters used by the older programs. Maintenance became a migraine as various individuals re-programmed modules for efficiency (or to step around "enhancements"), then left the university. By mid 1982, the Office of Computer-Assisted Instruction had become the Office of "Computer-Based Education" and had begun development of a PC-based authoring system. Graphics was not a first priority requirement of the PC authoring system. They chose UCSD Pascal. We chose Forth.

With the incentive of a twenty-IBM/PC microcomputer lab to be installed in the School of Architecture in Autumn, 1984, I rewrote over 80% of the mainframe CAI programs in Forth. The drill and practice programs included 640x200 pel graphic illustrations for each problem type and utilized 32-bit floating point math. In late 1984, beta-test copies were used in the microcomputer laboratory, and the finalized programs have been used by students each year since. In 1985, the programs and an eighty page user guide were published [BRE85]. Since 1985, we have been working with the Enhanced Graphics Adapter (EGA) for 640x350 pel, 16 color displays.

In 1986, a tutorial on superelevation, the banking of highway curves, was used in research for a Ph. D. dissertation dealing with formative evaluation of instructional materials. That study is the subject of a poster session later in this conference.

Hardin's Law: You can never do just one thing.

Working with the EGA is, as many of you know, not so simple as working with the older CGA. Spinoffs of trying to get the tutorial working were "Kameleon," a quick reference to XORing colors onto background colors, and "Photools," some tools for photographing displays which brought you the slides you see today. In an attempt to create detailed images, a primitive "point editor" was developed as an alternative to buying a digitizer [BRE86].

Ultimately, working with the EGA led to working with EGAPAINT™ from RIX Softworks, Inc. A paint program is fun, but is often not very useful by itself. I learned how to

import images created with EGAPAINT™ into Forth where they could be captured and manipulated as bit-maps. My first efforts produced "Dragrace" and "Dogfight," mindless little animations using detailed images.

Obviously, there is little "academic scholarship" evident in the last few examples, but much was learned. The incorporation of images created with a paint program into CAI material greatly reduces the time and effort required to count pixels and build the image from lines, arcs, and dots. Had I known how to do this when writing the superelevation tutorial, animations could have been much more detailed yet much simpler to program. Currently, work is being done on a storm water control simulation in which many of the things learned in trivial pursuits are being used for producing serious instructional material.

The point of this historical overview of the trials and tribulations leading to adoption of Forth as the preferred authoring system for creating Computer-Assisted Instruction and Learning materials is that Forth makes it easy. Traditional CAI authoring systems limit one to the level of the system's capabilities. Forth lets you rise (or fall) to the level of your own imagination.

Notes:

EGAPAINT is a trademark of RIX Softworks, Inc.

"Kameleon," "Photools," "Dragrace," and "Dogfight" are available in source code on the Laboratory Microsystems, Inc. Bulletin Board. (213) 306-3530 24-hours/day.

References:

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