Technology can improve learning through the use of: software tools, the Internet (as a resource or laboratory), learning objects (systematically designed learning resources to enhance the learning process), and learning systems (systematically designed systems that facilitate the holistic development of learners with expanded dimensions of learning experiences).

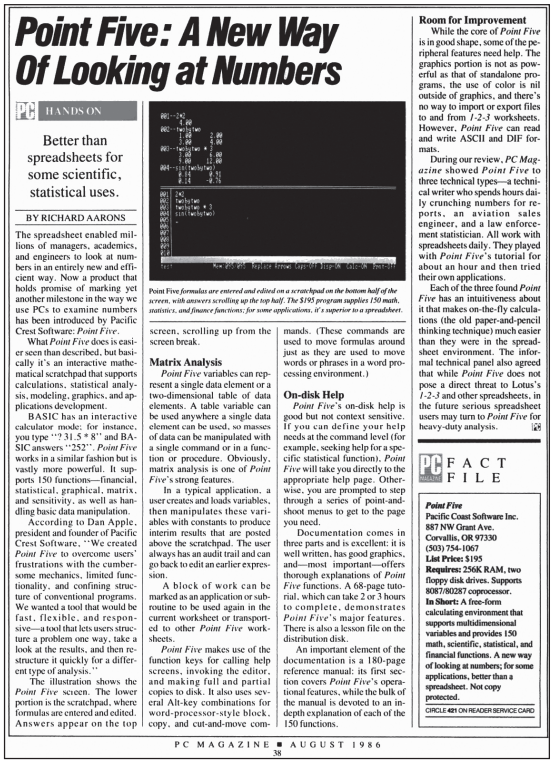
Learning Objects, Learning Systems, and Online Learning

Pacific Crest Software, Inc. (later, Pacific Crest, Inc.) began its corporate life as a technology company offering among its catalog of products the modeling and problem-solving software Point Five and PC:SOLVE.

Point Five was an "interactive mathematical scratchpad that supports calculations, statistical analysis, modeling, graphics, and applications development" (Aarons, 1986). PC:SOLVE was a modeling language consisting of seven tools for use in problem solving: a mathematical toolbox, a relational data management tool, a graphing system, a modeling language, a report writing tool, a statistical analysis system, and a high-level programming language (Beyerlein, Ford, & Apple, 1993)

In the course of providing customer support to our end users, it became clear that many professionals who used these systems regretted not having had the same software resource to help them become more effective problem solvers when they were in college. Pacific Crest then decided to put our technology, teacher training, and resources to work in supporting higher education by helping those in educational settings improve learning and problem solving. Within five years, Pacific Crest built a large population of technology users (over 500 site-licensed colleges) who then built libraries of learning objects and learning systems for use in statistics, physics, calculus, and quantitative methods courses (Pacific Crest, 1992).

While so much of what we do is web- and browser-based, it is critical to recall that prior to 1990, all Internet browsers were text-only (Berners-Lee, 2015). In conjunction with the rapid evolution of the Internet and other technologies, the strictly text-based online learning systems of the 1990s gave way to more sophisticated course management systems (CMS). In response to the evolution of CMS technology, Pacific Crest offered the *Interactive Learning Systems Booklet* (Apple, 2000) to coach authors and designers in building learning systems that implemented and/or supported the principles of Process Education; this also included an analytical rubric for rating interactive learning systems (Apple, 2001). Shortly thereafter, Pacific Crest took the next step and created the Interactive Learning Systems Institute to help faculty and professional staff in



Point Five: A New Way Of Looking at Numbers

PC HANDS ON

Better than spreadsheets for some scientific, statistical uses.

BY RICHARD AARONS

The spreadsheet enabled millions of managers, academics, and engineers to look at numbers in an entirely new and efficient way. Now a product that holds promise of marking yet another milestone in the way we use PCs to examine numbers has been introduced by Pacific Crest Software: *Point Five*.

What *Point Five* does is easier seen than described, but basically it's an interactive mathematical scratchpad that supports calculations, statistical analysis, modeling, graphics, and applications development.

BASIC has an interactive calculator mode; for instance, you type "?31.5 * 8" and BASIC answers "252". *Point Five* works in a similar fashion but is vastly more powerful. It supports 150 functions—financial, statistical, graphical, matrix, and sensitivity, as well as handling basic data manipulation.

According to Dan Apple, president and founder of Pacific Crest Software, "We created *Point Five* to overcome users' frustrations with the cumbersome mechanics, limited functionality, and confining structure of conventional programs. We wanted a tool that would be fast, flexible, and responsive—a tool that lets users structure a problem one way, take a look at the results, and then restructure it quickly for a different type of analysis."

The illustration shows the *Point Five* screen. The lower portion is the scratchpad, where formulas are entered and edited. Answers appear on the top screen, scrolling up from the screen break.

Matrix Analysis

Point Five variables can represent a single data element or a two-dimensional table of data elements. A table variable can be used anywhere a single data element can be used, so masses of data can be manipulated with a single command or in a function or procedure. Obviously, matrix analysis is one of *Point Five*'s strong features.

In a typical application, a user creates and loads variables, then manipulates these variables with constants to produce interim results that are posted above the scratchpad. The user always has an audit trail and can go back to edit an earlier expression.

A block of work can be marked as an application or subroutine to be used again in the current worksheet or transported to other *Point Five* worksheets.

Point Five makes use of the function keys for calling help screens, invoking the editor, and making full and partial copies to disk. It also uses several Alt-key combinations for word-processor-style block, copy, and cut-and-move commands. (These commands are used to move formulas around just as they are used to move words or phrases in a word processing environment.)

On-disk Help

Point Five's on-disk help is good but not context sensitive. If you can define your help needs at the command level (for example, seeking help for a specific statistical function), *Point Five* will take you directly to the appropriate help page. Otherwise, you are prompted to step through a series of point-and-shoot menus to get to the page you need.

Documentation comes in three parts and is excellent: it is well written, has good graphics, and—most important—offers thorough explanations of *Point Five* functions. A 68-page tutorial, which can take 2 or 3 hours to complete, demonstrates *Point Five*'s major features. There is also a lesson file on the distribution disk.

An important element of the documentation is a 180-page reference manual: its first section covers *Point Five*'s operational features, while the bulk of the manual is devoted to an in-depth explanation of each of the 150 functions.

Room for Improvement

While the core of *Point Five* is in good shape, some of the peripheral features need help. The graphics portion is not as powerful as that of standalone programs, the use of color is nil outside of graphics, and there's no way to import or export files to and from *1-2-3* worksheets. However, *Point Five* can read and write ASCII and DIF formats.

During our review, *PC Magazine* showed *Point Five* to three technical types—a technical writer who spends hours daily crunching numbers for reports, an aviation sales engineer, and a law enforcement statistician. All work with spreadsheets daily. They played with *Point Five*'s tutorial for about an hour and then tried their own applications.

Each of the three found *Point Five* has an intuitiveness about it that makes on-the-fly calculations (the old paper-and-pencil thinking technique) much easier than they were in the spreadsheet environment. The informal technical panel also agreed that while *Point Five* does not pose a direct threat to Lotus's *1-2-3* and other spreadsheets, in the future serious spreadsheet users may turn to *Point Five* for heavy-duty analysis.

PC FACT FILE

Point Five
Pacific Coast Software Inc.
887 NW Grant Ave.
Corvallis, OR 97330
(503) 754-1067
List Price: $195
Requires: 256K RAM, two floppy disk drives. Supports 8087/80287 coprocessor.
In Short: A free-form calculating environment that supports multidimensional variables and provides 150 math, scientific, statistical, and financial functions. A new way of looking at numbers; for some applications, better than a spreadsheet. Not copy protected.

CIRCLE 426 ON READER SERVICE CARD

Point Five formulas are entered and edited on a scratchpad on the bottom half of the screen, with answers scrolling up the top half. The $195 program supplies 150 math, statistics, and finance functions; for some applications, it's superior to a spreadsheet.

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higher education develop this same expertise with learning systems technology (Apple & Krumsieg, 2002).

Inspired by this work, Wolfskill and Hanson at Stony Brook University obtained grants to develop the LUCID system for learning and assessment (Learning and Understanding Through Computer-Based Interactive Discovery), publishing the results of their work in the article, *LUCID — A New Model for Computer-Assisted Learning* (Wolfskill & Hanson, 2001).

Building interactively upon the work of Hanson and Wolfskill, Apple and Krumsieg produced the specifications and methodologies for designing quality online courses (including hybrid or blended courses) and effective interactive learning systems, published in the *Interactive Learning System Handbook* (2002). In 2013, Stony Brook University expanded its use of the LUCID system to apply to all of its 1,500+ general chemistry students; it built a learning laboratory capable of accommodating 192 learners working simultaneously in groups of 3 (Stony Brook University, 2015; see Figure 1). It is worth noting that this lab looks very similar to the lab described in the article, Developing a Laboratory for Process Education (Evans, 1998).

Institutes Online

Since the 1990s, Pacific Crest has offered a variety of professional development institutes at physical campuses throughout the United States, bringing faculty together for intensive workshops focused on different aspects of Process Education. In 2011, a version of the Teaching Institute was first made available online and presented at the 2012 Process Education conference in a poster session titled, *The Teaching Institute from Pacific Crest: Taking it Online* (Hintze, 2012; see Figure 2).

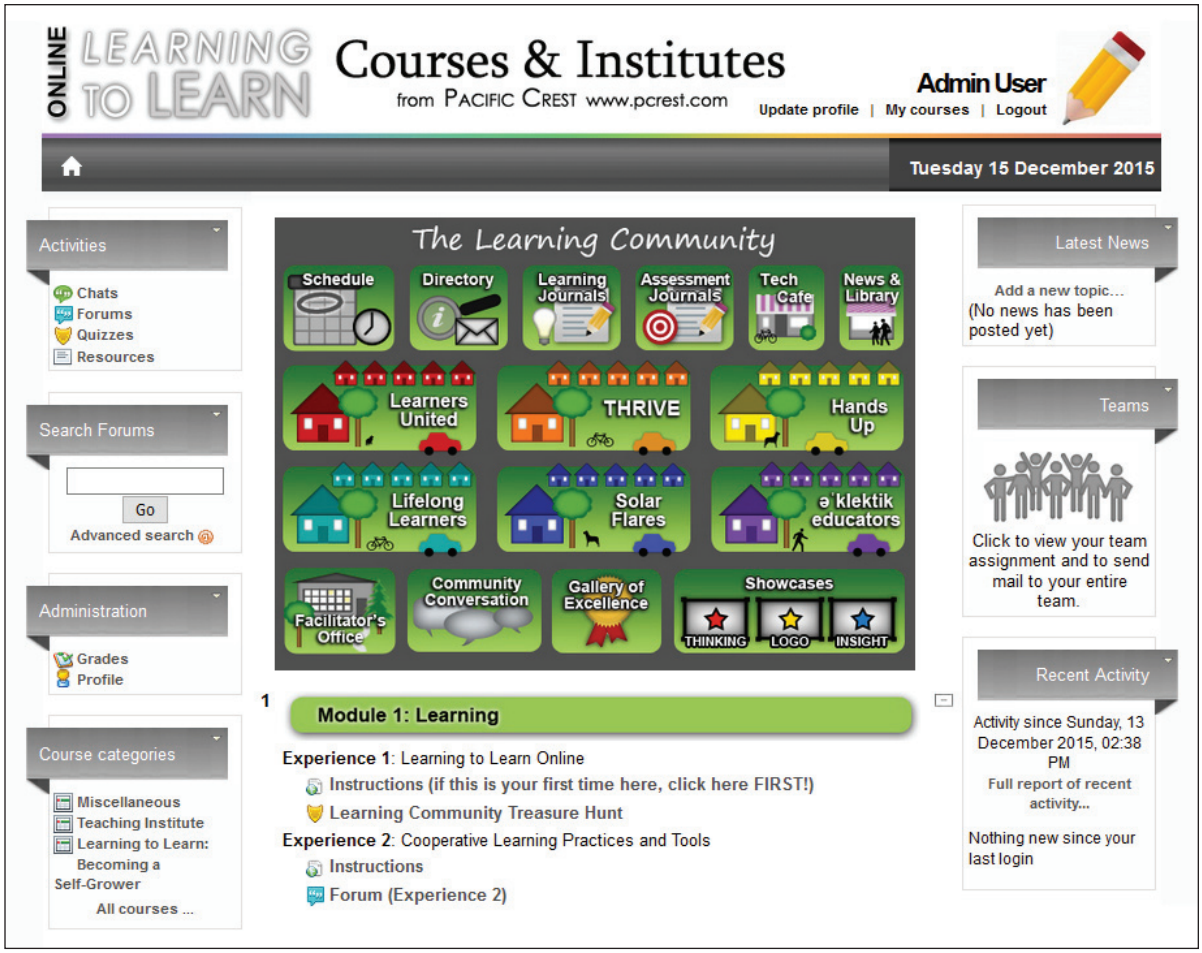
In 2014, Pacific Crest adapted *Learning to Learn: Becoming a Self-Grower* (Apple, Morgan, & Hintze, 2013) as an online course, offering a version for students as well as a version for instructors or mentors to work with as part of the training for a learning to learn camp. Another version of this same online course was created and first used in 2014 to help train faculty to facilitate the improvement of learning and academic performance in students who were on academic probation or at risk for dismissal.

The current Online Teaching Institute (Figure 3) is web-based, runs on a Moodle platform, and makes use of interactive discussion forums, interactive forms, image map navigation, online quizzes, and linked and embedded readings. It challenges participants to explore how technology affects the practices of Process Education (e.g., in one activity, participants are asked to envision and describe online adaptations of more familiar face-to-face learning interventions); it also challenges them to explore new and different tools in order to improve their ability to plan, collaborate, report, and learn (Pacific Crest, 2015). While the virtual environment may be more inviting and user-friendly than what was first offered nearly 23 years ago, the goal of any interactive learning system used to deliver a Process Education-based learning experience remains exactly the same: to design and use technology so that it best implements and/or supports the principles of Process Education.

Figure 1 The Active Learning Classroom, Frey Hall (© 2016 Troy Wolfskill)

Figure 2

Figure 3



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