

## **Building Confidence in Programming: Taking a Look at DrScheme**

Since 1998, workshops have been held, funded in part by the National Science Foundation, to encourage the adoption of DrScheme, a language specifically designed for teaching novice programmers at the high school and college levels.

This summer one hundred teachers attended these TeachScheme! workshops. As Technology Coordinator at Saint Edward's School, an independent school in Vero Beach, Florida, I applied for the grant because after four years of helping a handful of students learn Visual Basics I am on a mission to discover why more students and especially more females are not enrolling in elective computer science courses. Lacking a math background, I anticipated a grueling week at the University of Utah and was further intimidated when the majority of educators turned out to be mathematicians. Much to my delight, I completed the week with a tremendous sense of achievement and awareness that I had discovered a remarkably different approach to teaching programming. By writing this article I hope to encourage others to consider TeachScheme! for their schools.

The best way to describe what DrScheme is to share its "mission statement" as described on the PLT website, <http://www.teach-scheme.org>:

The TeachScheme! Project wants to turn Computing and Programming into an indispensable part of the liberal arts curriculum. Computing and Programming teach skills just as fundamental as, and closely related to, essay writing in English and problem solving in mathematics. Students who learn to design programs properly learn to analyze a problem statement; express its essence, abstractly and with examples; formulate statements and comments in a precise language; evaluate and revise these activities in light of checks and tests; and pay attention to details. This benefits all students, not just those who wish to study computing.

Rice University extended the original DrScheme language founded at MIT creating a language specifically for new programmers. Other universities including Brown, Northeastern, University of Utah, University of Chicago, and Worcester Polytechnic have also contributed to its development.

DrScheme lacks the brand recognition of C++ or Java, but that has not deterred many high schools and colleges from adopting it as well (a list of schools as well as some testimonials of satisfied teachers follow this article). The language can be used for industrial strength applications. Lisp, of which Scheme is a dialect, was successfully used in many such applications. An example was an automotive design system developed for two of the major auto manufacturers in the USA to shorten design time. Lisp was used to implement the system. One of the main advantages of using Lisp was to develop the system quickly. It would have taken much longer if a different language such as C++ was used according to Professor Arthur Lee at the University of Utah.

DrScheme is designed as a pre-AP Computer Science learning environment. It is based upon the principle that the first computer science course should not be about learning a programming language but about learning to solve problems algorithmically. To this end, only language constructs necessary to teach programming principles need be introduced. DrScheme is pedagogically based on three unique premises, as stated on their website:

1. A *design method* that helps everyone (especially weak students) proceed methodically from problems on paper to well-designed programs.
2. A *student-friendly programming environment* that introduces the language as a series of layers, so that students are not inadvertently affected by advanced features.
3. A *syntactically simple, highly expressive, programming language* that serves as an ideal introduction to other languages like Java, and reflects the current state of computer science.

Where does DrScheme fit in teaching AP Computer Science? Suradet Jitprapaikulsarn, an experienced C++ instructor at the Gilmore School, spoke of his experiences at our workshop. He began by teaching DrScheme for three marking periods and then switched to C++ for the last period before the exam. All but one of his students earned a 5 on the AP exam and the other, a 4. Another workshop teacher, Michael Perry, offered DrScheme to weaker math students and reported that their math teachers noticed improvements in their math skills.

Schools benefit from the fact that DrScheme is platform independent and that both the software and textbook are available online at no charge ensuring that students have what they need to work both at school and at home.

Our nation faces a shortage of high-tech workers. Universities face two dilemmas: a dwindling pool of rising high school students interested in computer science and low rates of retention within the major. To address these problems, high schools need to build interest in the field of computer science; one way is to increase the probabilities for success within their programming classes.

Dr. Stephen Bloch, a professor at Adelphi University and early workshop attendee, offers a wealth of information, resources, and testimonials about DrScheme at both his website (Bloch) and article cited below (Bloch, 2000). He suggests that what may be keeping females and others away from programming is the stereotype of “hackers,” defined by the huge number of hours they are willing to relentlessly devote to “programming.”

DrScheme eliminates the arcane and often illogical syntax rules and error messages, thereby leveling the playing field to allow creative thinking rather than memorization of vocabulary and syntax. In this way programming is open to those with aptitudes in writing and communication skills. Block (2000) found that for three years while teaching only C++, females had done worse than males and dropped out at much higher rates. Teaching Java as a first programming language produced a similar experience: 49 students started the first semester, 36 passed the first semester, 18 started the second semester, and 16 passed the second semester. When the beginning language was switched

to Scheme, the correlation between gender and first-semester grades dropped almost to zero.

An extensive listing of universities and secondary schools using Scheme and DrScheme is cited below. Beginning this fall, DrScheme will be required of every new Georgia Tech student in beginning programming.

As educators, we seek to encourage students to apply higher order thinking, to read carefully and think logically, and always proof their work. We are eager to see the smile of accomplishment as students realize that they have successfully mastered a difficult challenge. In this transitional period as computer science departments gear up to change to JAVA for next year's AP courses, it is time to consider offering students a confidence-building jumpstart to their programming experience. This is the opportunity DrScheme offers.

### References

The TeachScheme! Project with links to DrScheme books & software: <http://www.plt-scheme.org/>

Schools Using Scheme <http://www.schemers.com/schools.html>.

Bloch, S. A. (May 31, 2002). *Why Scheme for Introductory Programming?* Retrieved July 12, 2002, from <http://home.adelphi.edu/~sbloch/class/archive/hs/jan2001/testimonials/>

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