**EIA0082849: Formal Methods Education
and Programming Effectiveness**

Investigator: Rex Page
University of Oklahoma

Website: http://www.cs.ou.edu/~beseme
Google "beseme"

Project Description:
- Measure effects of practice in reasoning about software on proficiency in software development.
- Develop lectures, projects, exams, solutions, and tools for education in reasoning about software
- Statistically significant improvements in software development abilities
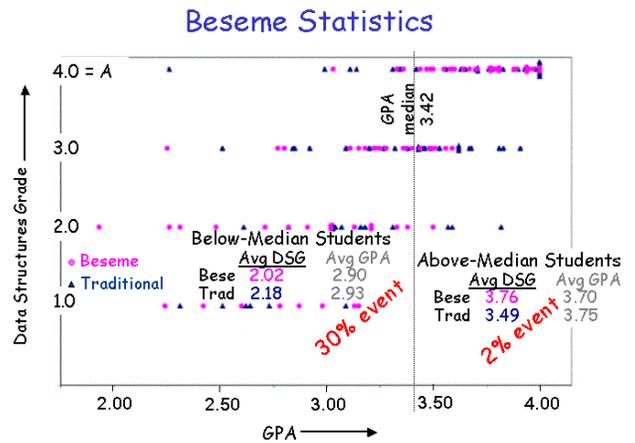
People

Students whose education includes experience in reasoning about software become better software developers than students whose educational experiences lack a software reasoning component. An EIA-supported study known as the Beseme Project (EIA 0082849) offered students a choice of two courses in discrete mathematics. One course followed traditional lines, while the Beseme Project course took pains to illustrate every concept in mathematical logic with examples devoted to reasoning about properties of software artifacts. The study has gathered data on approximately 150 students. These students chose one or the other discrete math option in equal numbers, and students from the traditional group had an average GPA just slightly higher than those in the Beseme group (3.34 versus 3.26 on a 4.0-point scale — an insignificant difference, statistically).

After completing the discrete mathematics course, most students enroll in a data structures course, which has a heavy software development component. Good performance in this course correlates well with skill in software development. There was no statistically significant difference between the two groups in their overall performance in the data structures course, nor was there a significant difference between the two groups for students in the bottom half of the population (that is, students whose GPAs were in the bottom half of those of all students enrolled in the data structures course). But, these averages mask an important part of the story.

The study found a **statistically significant difference** between the traditional group and the Beseme group for above-average students (that is, students whose GPAs were in the top half of those taking the data structures course). The traditional group had an average grade of 3.49 in the data structures course, while the Beseme group averaged 3.76 (on a 4.0-point scale). A statistical analysis shows that, with 98% confidence, this difference is not a random effect. Many explanations of the difference are possible, but course material seems likely to be an important factor. The results are sufficiently encouraging to motivate other educators to try the Beseme Project approach.

A paper describing the project and its results appeared in the proceedings of the 2003 International Conference on Functional Programming. The paper is accessible at
http://www.cs.ou.edu/~beseme/sfwIsDMpaper.pdf