Labster: A Web-Based Tool for Interactive Program Visualization in EECS 280

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What is Labster?
Labster is a web-based, interactive program visualization system designed for use in introductory programming courses. Students write their own code and Labster provides an interactive visualization that illustrates how the program would execute on a computer. Both the flow of code and the contents of memory are visualized in a natural way, and each individual step in the evaluation of expressions is clearly animated. Students have several options for navigating through their program's execution, moving both forward and backward in time. Labster also offers educational feedback based specifically on the code each student writes and the behavior of that code at runtime.

Methods and Experiment
We conducted a before-and-after subjects experiment to evaluate the impact Labster has on students’ learning. As part of the regular curriculum for the EECS 280 course at the University of Michigan, students work through interactive “lab-style” exercises during discussion sections. The “Arrays and Pointers” lab requires students to write short functions to traverse and manipulate arrays using pointers. Students during discussion sections. The “Arrays and Pointers” lab requires students to write short functions to traverse and manipulate arrays using pointers. Students tested after using Labster had significantly improved scores over those tested before the lab (U=6957, z=4.161, p<0.0005) and those tested after completing the same lab without Labster (U=2271, z=2.696, p<0.007). Students tested before/after the lab without Labster did not receive significantly different scores (U=1674, z=1.123, p=0.262).

What are Students Saying about Labster?
“Labster is great. Truly the best tool we have at our disposal for learning topics such as what has been taught so far in EECS 280. This would have been a nice tool to have in EEC182.”

“...I'm a visual learner, so the representations of memory are very very helpful!”

“...I wish I was shown this thing when I started coding...”

“...I honestly didn't understand recursion until I ran through the programs on Labster...”

“...we should use it all the time for everything and I don't understand why.”

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References