**Toward Facilitating Assistance to Students Attempting Engineering Design Problems**

Elena Glassman, Robert Miller, Ned Gulley

**Questions**

* Do showing students multiple questions change their attitudes? So would students think CS is a more creative field? Also: plagiarism -- will students cheat less if they think there is not One Right Answer to the problems?
* Does Engineering Design mean CS1 for engineering students? Or are we talking about a more advanced course? Do the assignments get reused? If so, then a repository of last year's student comments will be valuable to other students.
* Some discussion that showing students after the fact to show them various alternatives might good.
* What are the size limits of the problems you want students to solve and compare? A small function is fairly easy to expect a student to compare, but a larger function > 20 SLOCs would probably be prohibitive?
* This work makes me think about the difference between just collecting the end submission and looking at the progress to the solution as well. How much do we care whether the solution is aligned with instructional goals, or just works?
* Thought: would messages of the form "you're getting warm" and "you're getting cold" be helpful to students if they were produced interactively? (I.e., report the distance between the student's current solution and a known common solution).
* Is this just good for picking mentors? Do you want to pick mentors that have similar solutions, or very different solutions?
* I was honestly a bit concerned by one of your comments. You asked "So how can we use this kind of data in the classroom?" This is a common attitude, but I think a better question is "Is there a pedagogical need for this kind of data in the classroom?" So my question to you is, what's the pedagogical need you would like to see addressed and what is your hypothesis for why this system would address that need?
* Interesting article about Moocs that could be helpful. http://www.insidehighered.com/news/2013/07/18/citing-disappointing-student-outcomes-san-jose-state-pauses-work-udacity

**References**

* <http://dl.acm.org/citation.cfm?id=2493409&CFID=238986799&CFTOKEN=65408011> one trick for getting students to see multiple solutions: http://www.cs.toronto.edu/~patitsas/sigcse\_poster.pdf we have students in digital logic build a circuit \*and then\* to introduce /one/ error to it /somewhere/. The students then swap breadboards around the room and then they debug each others breadboards. The activity increased student engagement with learning debugging.
* Motivating project-based learning: Sustaining the doing, supporting the learning PC Blumenfeld, E Soloway, RW Marx, JS Krajcik, M Guzdial, A Palincsar Educational psychologist 26 (3-4), 369-398 The Project-based learning people have been thinking about these problems for years: How do you monitor a whole class working on the same problem but in different perspectives, how do you build support for the teachers in managing this work. Phyllis Blumenfeld and Joe Krajcik worked in this space for years, and you can find answers in that work. Elliot Soloway worked for years in developing technology to support students and teachers (see IByD -- Instruction By Design) to support ProjBL
* <http://dx.doi.org/10.1145/2157136.2157182> and <http://dx.doi.org/10.1145/2445196.2445369>
* This paper is awesome: <https://dl.acm.org/citation.cfm?id=2462476.2462505&coll=DL&dl=GUIDE&CFID=238855048&CFTOKEN=15706162> Also, talk to Kelly Rivers (krivers@cs.cmu.edu) at CMU. She is doing work to compute the ""distance"" between submissions for a large dataset. Also, we (Jaime Spacco and Dave Hovemeyer, whom you met at your poster) worked on a way to compute the ""distance"" between submissions (jspacco@knox) but we didn't end up able to publish it because it didn't quite work well enough (it was an undergrad project so it was actually really awesome, but not up to ICER standards). But we have been thinking about the same issues. And we have a couple of datasets of Java and C code we'd be happy to share with you!"
* Janet Kolodner's work on Learning By Design involved having students reflect on their projects (which supported learning), in order to create Cases that then inform students in later classes. This is work she did with Jakita Owesby Thomas. There's a chapter with Brian Dorn and Mark Guzdial that discusses the general issue of helping students learn from cases (captured reflection on prior experiences).
* Calculating Probabilistic Distance to Solution in a Complex Problem Solving Domain (2012) LA Sudol-DeLyser, K Rivers, TK Harris 5th International Conference on Educational Data Mining, 144-147. Kelly Rivers publication in AIED '13 is excellent. She is working off the Hint Factory work by John Stamper and Tiffany Barnes.

**Feedback**

* Try calibrated peer review, for a small number of marks, to get students to evaluate each other's solutions.
* Don't assume that online is the answer -- we found, for instance, that a paper-based approach to CPU simulation was more effective than computer-based visualization (<http://dl.acm.org/citation.cfm?id=2401820>). Good research topic :)
* Exciting, but you'll need to focus more for a dissertation.
* #4: Assume we have a working classification system, could we store snapshots of solutions instead of just the final submission? Then you could recognize what path someone's taking, then provide feedback based on errors others encountered who took that path.
* Parse tree size might be a bad measure. I'd like to see solutions that are most different from mine (to get inspiration, see other approaches), and ones that are similar to mine but more common.
* Again, we (Jaime Spacco and Dave Hovemeyer) would be ridiculously happy to collaborate with you! We have data, but we are small school academics with no graduate students, so we work very slowly. Any opportunity to work with MIT could be a career-making move for us!
* classifying answers as either ""right"" or ""wrong"" is missing out on granularity of correctness. An answer that works for 90% of the tests is considerably different than one that fails all tests. Classifying answers by \*which\* tests are failing may be more helpful than whether or not their solution passes all tests.. Also, an argument might be made for pairing students with desperate approaches would be helpful so they can learn from considerably different solutions."
* Could these be parameters?

Number of classes

Number of loops

Number of variables

Recursion

Function calls

Functions

Objects

References

* I talked to you about this at the conference, feel free to email me: [leighannsudol@gmail.com](mailto:leighannsudol@gmail.com)
* I don't think that there's much to be gained by statically presenting ""working"" solutions (from your implementation archive) to students who are stuck along the road to that solution. But if you could identify \*where\* students were stuck and then mine an archive (of dynamic traces of the development of other students' implementation) for examples of successful strategies for exiting that situation, then you might derive some constructive help. Alternate formulation: ""You seem to be stuck at 'point X'. Other students who were stuck here successfully tried 'this'."""
* Observation: when offering to show alternative solutions, one concern is creating a competition where some students will attempt to ""show off"" by producing the smallest solution, the first solution, etc. Also, would the knowledge that a strudent's solution might be shown to peers be inherently uncomfortable or stressful for some students?"
* I agree - this is an interesting system. I think it's value is most likely related to peer-assessment and/or uncovering common student misconceptions.
* From what I can see, the value of your research lies especially in possibly being able to identify different student solutions (possibly solutions we hadn't thought of). That way we can help the students to progress in their solution if they are stuck. I wonder however, if it is possible to automatically give good qualitative feedback on how students that are stuck should continue to work. But the idea of identifying different solutions I think is beautiful :-) maybe it would be of value to give more examples of where this happened or could be used in education?