

# A Working Group Proposal for ITiCSE 2001

## Assessment of Programming Skills of First Year CS Students: Do they know how to program?

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### 1. Introduction

Computer Science educators have been concerned with student's ability to learn to program almost since the first computer science course. Numerous studies have been conducted to uncover the issues of learning to program. [1,2,3] and many others have studied various aspects of the problem of learning to program. Mayer studied the learning of Basic, Pea looked at conceptual "bugs" of novice programmers, Spohrer and Soloway were similarly concerned with misconceptions of novice programmers. Many other researchers have looked at programming's similarity to mathematics learning, its similarity to second language learning, and its need to be learned at an early age. These studies have helped computer science educators improve the teaching of programming. But one issue remains. Do computer science students really know how to program? A second and equally important issue is are they learning to program in the introductory courses where the foundations of programming skills are supposed to be developed?

Asking the question, "Do computer science students know how to program", appears to be a sacrilege. Yet, there is anecdotal evidence that suggests many students do not know how to program, in particular in their first and second years. In our introductory programming classes at Georgia Tech, we have been observing that our students are not as proficient as we believed they were. Over the last year we have conducted some informal experiments to confirm our misgivings and are finding surprising results. The students don't know how to program nor do they have a grasp of the fundamentals of programming at the level of competence we expect. We have looked at data from both our first and second year courses and find results that are relatively consistent. The second year students obviously have more skill than the first year

students, but their skill is no where near the level we expected. We have also had conversations with colleagues in other computer science programs and their concerns are similar to ours.

This working group proposal wants to answer the question: "Do you know what your students' programming skills are and are those skills at the level you have established for your program?"

### 2. The goals of the working group are:

- Develop a shared understanding of the expected programming skills of first year students.
- Determine if students are operating at the level of expected skills.
- Generate a set of assessments that can be used in computer science curricula to collect more extensive data and to generate proposed interventions to improve programming skills.
- The activities of the working group will include:
  - Analyze a set of programming assessment data to be collected prior to the working group meeting at ITiCSE 2001. The data will be generated from a programming skill assessment problem given to the participants prior to the conference to collect data from their classes. The analysis will be used to benchmark the skill level of first year students. Though probably controversial, one of the sub-goals of this activity is to generate a quick assessment. A quick assessment is one or two problems that can be given to students that will provide a synopsis of their skills. This quick assessment is targeted at first year students where the breadth of their knowledge is relatively narrow and is focused on programming skill.
  - Develop a set of assessment instruments for future investigation and for dissemination to a wider audience for their use with the expectation they will contribute their results to the overall data set. These instruments may assess elements that were not contained in the original benchmarking assessment, or to probe more deeply specific areas of concern developed by the working group.

- Initiate the discussions on a recommended set of interventions to improve programming education practices. This assumes that the data from goal /activity 1 is commensurate with our informal data.

### 3. The working group plan is as follows:

#### 3.1 Pre-Conference Activities

- Distribute assessment instrument to participants for their use prior to the conference.
- Collect data generated by the assessment and perform first-cut analysis of the data prior to the conference.

#### 3.2 Conference Activities

- Meet to share analysis results and develop benchmark from the data.
- Critique the first instrument and develop more refined instruments if necessary.
- Develop a report outlining the results, the concerns, proposed instruments and interventions and the plans for future work.

### 4. Instrument

The instrument we have developed is a simple programming problem that is in three parts. Each part is additive and is based on the expected level of skill of the students as a function of the courses they have taken. It is essentially broken down into first semester, second semester and third semester.

### 5. Proposed call for participation

The call will include the information in the working group proposal and the following.

#### A Working Group on Programming Skill Assessment ITiCSE 2001

To participate in this working group a participant will apply an instrument we have developed to assess the skills of your students prior to the ITiCSE 2001 conference. The data from the assessment will be used to initiate dialogue on developing appropriate assessment instruments for determining the programming skills of your students. In no way will

any of the data be used to compare University X to University Y.

In addition to the "experiment", any other data you have collected will be welcome. Anecdotal commentary, though interesting, will not help us, though qualitative results are welcome.

We would like to answer two questions in this working group.

- Can a set of assessment tools be developed that will effectively assess individual student programming skill?
- Can set of data be generated that baselines the skill of students in computer science programs across America and Europe?

The results of this working group will likely impact the ways we teach programming, the ways we assess programming skill and the ways we view our novice programmer students.

### Participants

The working group will be open to all that contribute data. I intend to specifically invite:

Vicky Almstrum  
Mark Guzdia  
Marian Petre  
Sally Fincher  
Michael Lutz  
Tom Hilburn  
Matts Daniels  
Diane Hagan

### References

- [1] Mayer, R.E. (1981). A psychology of how novices learn computer programming. *Computer Surveys*, 1, 121-141.
- [2] Pea, R. (1986 ). Language independent conceptual bugs in novice programming. *Journal of Educational Computing Research*, 2(1), 25-36.
- [3]Spohrer, J. & Soloway, E. (1986). Novice mistakes: Are the folks wisdoms correct? *Communications of the ACM*, 29(7), 624-632.