Student diversity in CS1

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Michela Pedroni
Bertrand Meyer (ETH)
Manuel Oriol (University of York, UK)
Context

Introduction to Programming course at ETH Zurich

Since 2003
To “know your audience” is one of the fundamental rules of mass communication

In introductory programming courses:
high diversity of prior knowledge
Study setup

Questionnaire on computing and programming knowledge
- Computer literacy
- Programming experience
- Programming languages

Participants of ETH
- Beginning of Introduction to Programming 2003-2008
- On paper (2003), later online
- Answers from 753 of 1130 CS students

Participants of University of York
- 2008 only
- Online
- Answers from 77 of 101 CS & Math students
## Computer usage

<table>
<thead>
<tr>
<th>Time Frame</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \leq 1 ) year</td>
<td>0%</td>
</tr>
<tr>
<td>2 to 4 years</td>
<td>3%</td>
</tr>
<tr>
<td>5 to 9 years</td>
<td>42%</td>
</tr>
<tr>
<td>( \geq 10 ) years</td>
<td>59%</td>
</tr>
</tbody>
</table>

**Averages over 5 years, 2003-2007**
(yearly variations small)
Programming experience

![Chart showing programming experience trends over years for different categories of programs.]

- Small O-O programs
- No O-O
- No programming
- Large* programs


ETH York
Where learning occurs

- **Self-study**
  - At high school
  - At university

- **At high school**
- **Other**
- **ETH**
- **York**

<table>
<thead>
<tr>
<th>Year</th>
<th>Self-study</th>
<th>At high school</th>
<th>Other</th>
<th>ETH</th>
<th>York</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>60%</td>
<td>10%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>60%</td>
<td>10%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>60%</td>
<td>10%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>60%</td>
<td>10%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>60%</td>
<td>10%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>60%</td>
<td>10%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Number of languages known well or very well

- 1-2: 50%
- None: 30%
- 3 or more: 20%

No data available.
## Languages known by most students

<table>
<thead>
<tr>
<th>Year</th>
<th>ETH</th>
<th>1st place</th>
<th>2nd place</th>
<th>3rd place</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td></td>
<td>Basic</td>
<td>Pascal</td>
<td>C++</td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td>Eiffel</td>
<td>C++</td>
<td>JavaScript</td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td>C++</td>
<td>Java</td>
<td>PHP</td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td>PHP</td>
<td>JavaScript</td>
<td>Java</td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td>PHP</td>
<td>Java</td>
<td>JavaScript/C++</td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td>PHP</td>
<td>C++</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>York</td>
<td>VisualBasic</td>
<td>JavaScript</td>
<td>PHP</td>
</tr>
</tbody>
</table>
Comparisons

Changes over the years (ETH only)

- Many differences between 2003 and later years: In 2003, less exposure to computers, less programming experience, less languages known well/very well
- Only punctual differences involving other years: Laptop, specific programming languages (Basic and Eiffel)

York vs. ETH (2008 only)

- Only punctual differences
  - BSD operating system, computer tasks
  - Different knowledge of Java and VisualBasic

Situation is stable

Similar at both institutions
Implications on teaching

Students are mostly computer literate, but very diverse

- ~1/3 programming novices
- ~1/3 know one or two languages well or very well
- ~1/3 know more than two languages

Situation is stable and similar at two institutions
Is this a global phenomenon? Need more data...

Develop measures to adapt to diverse student body

- Teaching methodology: software framework, programming language choice, relate to prior knowledge
- Extra lessons for novices (e.g. CS0)
- Making student groups
- Individualized instruction
A complementary experiment

How are we doing?

Test in 2nd year, programming questions; first experience in February 2009

Language-independent, but uses programming language taught in introductory course

Analysis: 3 equal categories

Will do it again in February 2010
If you are willing to participate in the studies, please write to pedronim@inf.ethz.ch