On Interpreting the Effects of Repetition: Solving a Problem Versus Remembering a Solution

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Extreme Scaffolding in the Teaching and Learning of Programming Languages
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Abstract: We report on the design and implementation of an e-learning framework that can be used to produce tutoring modules with an arbitrary degree of scaffolding. Each module teaches by problem-solving; instant feedback is built in the scaffolding and provides the learner with the reinforcement (negative or positive) that conditions learning. Although the tutoring system guides the learner's actions, it does not restrict them excessively and significant number of degrees of freedom remain. This encourages the learners (as they prioritize their problem-solving steps) to become active constructors of knowledge through direct experimentation. By analogy with the principles of extreme (or agile) programming, we call the adjustable scaffolding technique used in our system "extreme" because it too can be set up in micro-increments and tunes the learners into the same behavioral pattern as they analyze, design, test, integrate and deploy their problem-solving steps.

Keywords: extreme scaffolding, agile instruction.

Table 1: Pre- and post-test results.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Monday lecture</th>
<th>Wednesday lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong or no idea</td>
<td>27</td>
<td>9</td>
</tr>
<tr>
<td>Some idea, in the right direction</td>
<td>19</td>
<td>21</td>
</tr>
<tr>
<td>Recognizable (but unfinished) solution</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Complete, correct solution</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

5. Conclusions

Significant improvement can be seen in the table: on Monday 45% of the students are hopelessly lost. Wednesday, after being asked to work with the tutoring module once, a larger percentage (49%) are able to produce a recognizable solution (with two thirds of these students actually providing a complete, correct solution). We don't know how much time students actually spent playing with the template, and what else they did besides that. We didn't grade, review or otherwise bring up the lab assignment in e-mail, blogs, on-line forums, individual and/or office hours communication with the students during this time (from Monday to Wednesday). The motivation presented to the students for completing a tutoring module was that they were going to provide usability feedback to us on the tool.

In written, open-ended anonymous comments 8% (5 students) indicated they didn't work with the template for whatever reasons (didn't have time, confused about location on the web or their browser didn't seem to work, intended to but forgot etc.). Of the remaining 54 students 76% (41 students) indicated that they had found it useful in some respect and enjoyed interacting with it. Half of these cited the ability to actively create a guided exploration as the most useful instructional aspect. The remaining half was evenly split between the built-in interactivity and the actual scaffolding per se.

There is evidence that working with a tutoring module builds endurance: "I had to look at [it] over and over to figure it out," wrote one student. "It forced me to spend time on task" wrote another. And as they learn to better monitor their own understanding students also tend to become more confident: "It made me slow down and made me think about each part [...] the things I could complete I was proud of and the things I thought I couldn't turn out to be easy to figure out eventually."

Your current score 96

```java
class Counter {
    private int count;
    public Counter() {
        count = initialValue;
    }
    public void addOne() {
        count++;
    }
    public void println(String message) {
        System.out.println(message);
    }
    public static void main(String[] args) {
        Counter c = new Counter();
        int a = c.addOne();
        c.addOne();
    }
}
```

Define the simplest type of objects that can count...

References