Improving Student Learning Grant 2009

**Title:** Automatic, Formative Assessment Tools for Timely Feedback to Support Student Learning in Software Engineering and Programming Units

**Project Coordinator:** Rachel Cardell-Oliver (School of Computer Science & Software Engineering)

**Researchers / Tutors:** Lesley Zhang, You Hai Lim, Rieky Barady, Asad Naveed (CSSE)

**Overview**

Software engineering students develop computer programs and submit them for assessment as a core component of many units in their degrees. Their computer programs are required to meet a range of software quality standards from simple attributes such as syntactic and basic functional correctness to more complex quality attributes such as readability, robustness, efficiency, and usability. In this project we sought to improve students’ learning by providing immediate, formative feedback on quality attributes of their programs. In addition we developed tools for lecturers to use for automatic assessment of these attributes so enabling explicit evaluation of attributes that have previously been too difficult or time-consuming to assess by hand.

**Outcomes**

Student programming exercises and projects were evaluated from three different cohorts: CITS1220 Semester 2 2009 (SE09), CITS1220 in 2008 (SE08) and CITS1200 in 2009 (Java09-1). This provided quantitative data to benchmark quality attributes of over 450 student submissions and enabled us to identify common problem areas where feedback should be targeted.

Significant improvements were observed for the quality of student submissions between SE08 and SE09. The quality requirements stated in marking criteria for assignments had *not* changed between the cohorts we studied. Formative assessment exercises and tool support were used only in SE09. Thus the provision in SE09 of immediate feedback and explicit assessment of how well student programs met the desired quality attributes does appear to have had a significant positive effect on the quality of student program submissions.

Student feedback on their learning experience in SE09 has been very positive. For example, SURF scores show improvement on all questions from 2008 (48 replies) to 2009 (40 replies) with the unit average for Q5 “Overall this unit was a good educational experience” improving from 3.1 to 3.4.

Limitations of the current quality assessment tools, threats to validity and areas for further work have been identified and documented in a full project report.

**Project Outputs**

1. A **software quality model** of attributes important for a first year software engineering unit together with a set of software tools able to measure each attribute and be configured to provide formative feedback in the laboratory as well as being used by lecturers for automatic assessment.

2. Checkstyle **Beginner style rules for Java**, a set of rules used to provide feedback and assessment of readability and maintainability of student programs.

3. A suite of **programming exercises and JUnit tests** to be used in CITS1220 throughout the semester. Test suites assess the functional correctness of student programs under normal and exceptional conditions, offering hints when student code fails a particular test. A set of sample tests with feedback has also been developed for existing CITS1200 laboratory exercises.

4. **Program quality datasets** for benchmarking and analysis of quality attributes of over 450 student programs from three different first year cohorts.
5. A collection of automatic marking scripts for lecturers that measure and report quality attributes automatically for a set of submitted assignments.

Publications and Presentations


3. We plan to submit an article on this work to an ISI journal and a presentation on the final project results will be given at UWA in February/March 2010.

Budget Acquittal Statement

<table>
<thead>
<tr>
<th>Budget Item</th>
<th>Budget $</th>
<th>Actual $</th>
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<tbody>
<tr>
<td>Student focus group tests of lab. exercises</td>
<td>$800</td>
<td>$675</td>
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<tr>
<td>Development of lab. exercises and lab. supervision</td>
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<td>Assessment and Refinement of lab. exercises</td>
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Total: $3048 (*processing not completed on these final honorariums)

In kind: The project co-ordinator would like to acknowledge that the success of this project was enhanced by significant in-kind input from the research students, well beyond their paid contributions, as well as the significant efforts and enthusiasm of students in CIT1220 in 2009.

Improving Student Learning

In summary, we believe that this project has met its goals of improving student learning in the following ways:

1. First year students have demonstrated their ability to meet rigorous software quality assurance standards.
2. First year students have been exposed to professional software engineering development environments, standards and tools.
3. Our general framework for feedback and automatic assessment can be transferred to other units and will undergo continuous improvement.
4. Formative feedback is accessible to students at home on their own computers and it supports different learning styles. This maximises the reach of this teaching approach and embeds the quality framework into students’ future working practice.

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