COMPS: Updating and Improving a Web-based Application for Collaborative Educational Computer-Monitored Problem-Solving Discussions

John Carden
Advisors: Drs. Jung Hee Kim, Michael Glass, and Kelvin Bryant
Department of Computer Science
North Carolina A&T State University

Introduction

COMPS (Computer-Mediated Problem Solving) is web-delivered chat application employed at NC A&T for small-group problem-solving. Students collaborate to answer questions in Computer Science classes at A&T, focusing on learning and applying Java concepts. COMPS chat interaction logs have been used in studies of text analytics and the dynamics of collaborative learning.

The COMPS server runs Java while the client uses JavaScript, both communicating through WebSockets. WebSockets is an advanced API which permits highly interactive communication between a server and browser, the students can see and respond to each other’s keystrokes in real time.

My role is to develop and maintain the application and work with the website team to facilitate communication between the COMPS website and the COMPS chat application.

Example Session

Figure 1 shows an exchange between 3 students who are solving problem 2 shown below and to the right. You can see the students collaborative problem solving skills in action as they work to find the problem’s solution. Interactions like these further the understanding we have of how students learn and how we can improve that process.

In pursuit of improving the accuracy of our research, I have updated the application to allow for the IP addresses to be logged in every message. This permits messages to be connected to survey results directly and improves the accuracy of the analytics research our team performs.

Problem 2: What output is produced by the following code sequence?

Scanner scan = new Scanner( System.in );
int number = 0;
try {
  // User enters 12, ENTER
  number = scan.nextInt();
  System.out.println( "1: " + number );
  // User enters 56, hits ENTER
  number = scan.nextInt();
  System.out.println( "2: " + number );
  // User enters 99ABC, hits ENTER
  number = scan.nextInt();
  System.out.println( "3: " + number );
  catch( Exception e )
    String s = scan.nextLine();
    System.out.println( "4: " + number );
  finally
    // User enters 100, hits ENTER
    number = scan.nextInt();
    System.out.println( "5: " + number );
  }
Answer (4 times):
1: 12 2: 56 3: 56 4: 56 5: 100

Using the application allows the students to reach an agreement, then validate their answer with the teaching assistant. They can then repeat the process for each question.

Following this method engages all students, prompts them to articulate their reasoning, and reduces shallow reasoning and guessing.

Learning Result

We analyzed learning gains according to the relative position of each student in a discussion group (highest, middle, lowest), based on pre-test score. The high student in each discussion lost ground on average, the other two gained.

Table 1. Average Learning Gains

<table>
<thead>
<tr>
<th>Group</th>
<th>Highest</th>
<th>Middle</th>
<th>Lowest</th>
<th>Class average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab3 (n=32)</td>
<td>-0.32</td>
<td>0.45</td>
<td>0.34</td>
<td>0.23</td>
</tr>
<tr>
<td>Lab4 (n=24)</td>
<td>0.02</td>
<td>0.34</td>
<td>0.47</td>
<td>0.32</td>
</tr>
</tbody>
</table>

However the post-test scores for high, mid, and low students tended to become more alike.

Table 2. Lab 3 Pre-test and Post-test Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test Mean / SD</th>
<th>Post-Test Mean / SD</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>12.25 / 3.41</td>
<td>9.75 / 6.06</td>
<td>t (11) = 1.94</td>
<td>p = 0.078</td>
</tr>
<tr>
<td>Mid</td>
<td>5.92 / 5.05</td>
<td>12.25 / 4.41</td>
<td>t (11) = -3.74</td>
<td>p = 0.003</td>
</tr>
<tr>
<td>Low</td>
<td>3.75 / 3.1</td>
<td>9.25 / 4.56</td>
<td>t (7) = -4.72</td>
<td>p = 0.002</td>
</tr>
</tbody>
</table>

Students rated the last two labs more highly than the first two labs, possibly as they became more accustomed to the group exercises.

Table 3: After lab surveys

<table>
<thead>
<tr>
<th>Group</th>
<th>Effectiveness of group work Mean / SD</th>
<th>Understanding of concept Mean / SD</th>
<th>Interest in lab Mean / SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab3</td>
<td>3.17 / 0.68</td>
<td>3.45 / 0.96</td>
<td>3.19 / 0.94</td>
</tr>
<tr>
<td>Lab4</td>
<td>3.08 / 0.93</td>
<td>3.42 / 1.05</td>
<td>3.08 / 0.93</td>
</tr>
<tr>
<td>Lab5</td>
<td>3.47 / 0.71</td>
<td>4.03 / 1.06</td>
<td>3.65 / 0.76</td>
</tr>
<tr>
<td>Lab6</td>
<td>3.40 / 0.61</td>
<td>3.78 / 0.85</td>
<td>3.17 / 0.89</td>
</tr>
</tbody>
</table>

Future Work

Other people in the COMPS project are working on text analytics to produce measures of conversation quality, e.g. how much students are participating and how often they show evidence of understanding. We plan to add an instructor dashboard to the COMPS server, using text analysis to monitor the conversations in real time.

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