An Innovative Approach: Teaching Programming Languages Using A Second Language Acquisition Theory
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Introduction to Computing for Engineers, EGR 115, has proven to be a challenging course for many students, especially if it is their first contact with programming languages. The purpose of Second Language Acquisition Applied to Blended Learning Environments (SLA-aBLe) is to make the process of learning MATLAB in hybrid courses more intuitive. The hybrid course material aims to enhance students’ understanding of the challenging, logic-oriented concepts by integrating Second Language Acquisition (SLA) theory into programming language study. This approach is based on emphasizing the problem-solving techniques necessary in these courses and approaching programming languages as new written or spoken languages with their own syntax, vocabulary, and punctuation.

Table 1. Five Stages of Second Language Acquisition applied to teaching methods in Introduction to Computing for Engineers.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Hybrid/Blended</th>
<th>SLA-aBLe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preproduction</td>
<td>• Lacking visual aid</td>
<td>• Add visuals</td>
</tr>
<tr>
<td></td>
<td>• Topics vaguely explained</td>
<td>• Topics broken down into sections, simple explanations</td>
</tr>
<tr>
<td></td>
<td>• No embedded self-testing</td>
<td>• Embedded short quizzes</td>
</tr>
<tr>
<td>Early Production</td>
<td>Multiple choice quizzes</td>
<td>Programming questions in quizzes used to reinforce learning</td>
</tr>
<tr>
<td></td>
<td>Facebook, little or no discussion</td>
<td>Online Canvas discussion board used as online community</td>
</tr>
<tr>
<td>Speech Emergence</td>
<td>• Solving engineering problems through programming</td>
<td>• “Think-pair-share” programming task, reinforcing concepts through peer collaboration</td>
</tr>
<tr>
<td>Intermediate Fluency</td>
<td>• Challenging and more complicated problems</td>
<td>Compare how different concepts are applied</td>
</tr>
<tr>
<td>Advanced Fluency</td>
<td>• Final open engineering programming project</td>
<td>Project presentation offered to students</td>
</tr>
</tbody>
</table>

Slides and Videos
- Different fixed sections: vocabulary, punctuation, syntax, examples and try-it-yourself. Example slide shown in Figure 2.
- Collected in videos
  - Further explanations of examples.
  - Embedded short questions aimed at testing the progressive understanding. Useful for students to test their own understanding.
- Positive feedback about the new videos, including the embedded quizzes and the broken smaller sections. Obtained from one-on-one interviews.

Discussion Board, 2015
- Portal for students to interact with each other, sharing examples and asking questions about the online topics.
- Monitored by research assistants with help from professors.
- Participation required.
- Participation beyond the baseline included any comments, questions, or answers to other, students posts beyond the required single post or response (Figure 3).
- Due to feedback of high workload participation optional Spring 2016.

Discussion Board, 2016
- Participation declined.
- Students active in one section: Addition of an “Exam 1 Questions” board. Active participation of professor.

Results

Table 2. Quiz grades, Spring 2016. Comparison between SLA and non-SLA sections.

<table>
<thead>
<tr>
<th>Grades (100 points max.)</th>
<th>Input Function</th>
<th>Advanced If Statement</th>
<th>While Loop General</th>
<th>While Loop, Catching Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non SLA-aBLe control section</td>
<td>81.00</td>
<td>82.96</td>
<td>88.76</td>
<td>79.69</td>
</tr>
<tr>
<td>SLA-aBLe section</td>
<td>86.50</td>
<td>90.84</td>
<td>90.71</td>
<td>82.64</td>
</tr>
</tbody>
</table>

Future Work
- Subtitle videos: for international students, for better and clearer understanding.
- Design changes to slides: Add examples as extra material.
- Shorten length. Add music.
- New approach to collecting feedback. Embedded in videos, include questions at the end.
- Modify quizzes reducing workload. Focus this change on open-ended questions.

Materials and Methods
- The four blocks of topics developed are:
  - Introduction to MATLAB
  - Script Files, Data-Types and Variables
  - If statements
  - Loops: While and For

Vocabulary
- while loop
  - If repeated a block of code while a condition is true. loop
  - repeat
  - executes the statements that follow the loop as long as the condition is true.
  - break
  - an exit command of a loop. When the loop command breaks, the program exits the loop and the instructions after the loop stop executing.

Discussion Board Posts, April 2015 and Fall 2015.

Figure 1. Five Stages of Second Language Acquisition.

Figure 2. Slide example: Vocabulary.

Figure 3. Quiz example question. Open-ended question.

Figure 4. Final Grades. Fall 2015.