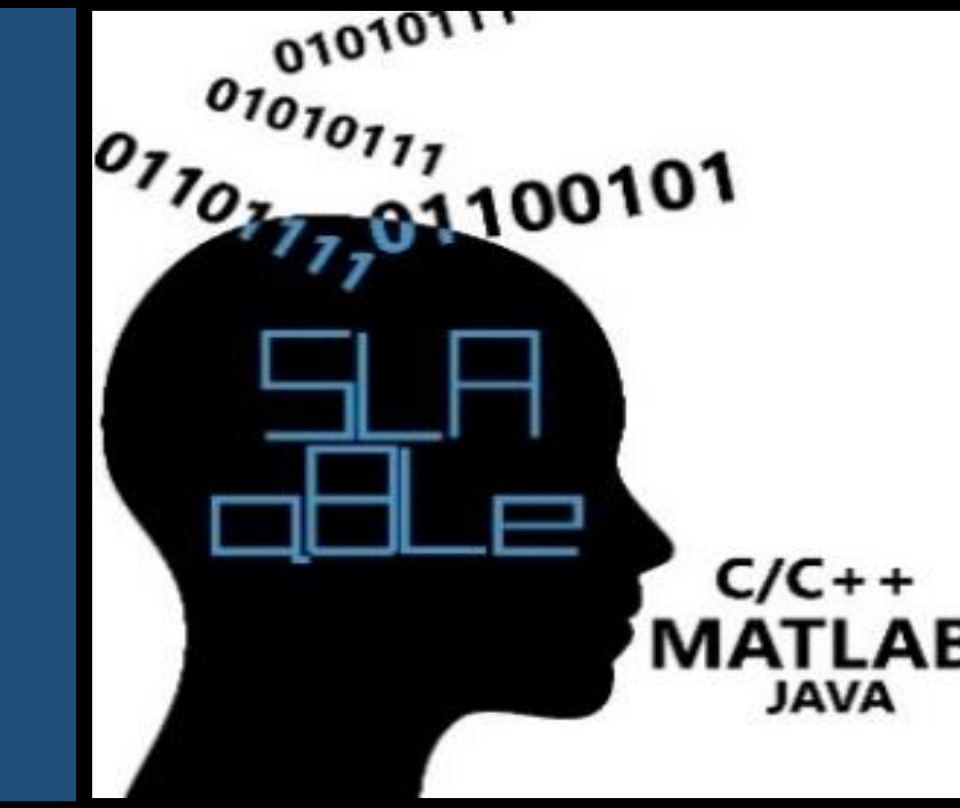


An Innovative Approach: Teaching Programming Languages Using A Second Language Acquisition Theory

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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 orientated 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.

Introduction

- The first contact with programming languages has proven to be intimidating for students, causing it to create an impression of programming as a tedious and over-complicated. This affects the performance and implication of students in these classes, which directly affects their understanding of concepts they will need for future courses.

SLA-aBLE

- Second Language Acquisition Applied to Blended Learning Environments (SLA-aBLE) takes a more intuitive approach to this learning process, breaking concepts into more elementary pieces and testing students frequently on their knowledge in small and simple blocks. Once the base for each topic is established, problem-solving techniques are emphasized before moving into problems with increasing difficulty.
- Programming is approached as a second language, applying the five stages of second language acquisition (Figure 1) to programming languages (Table 1).

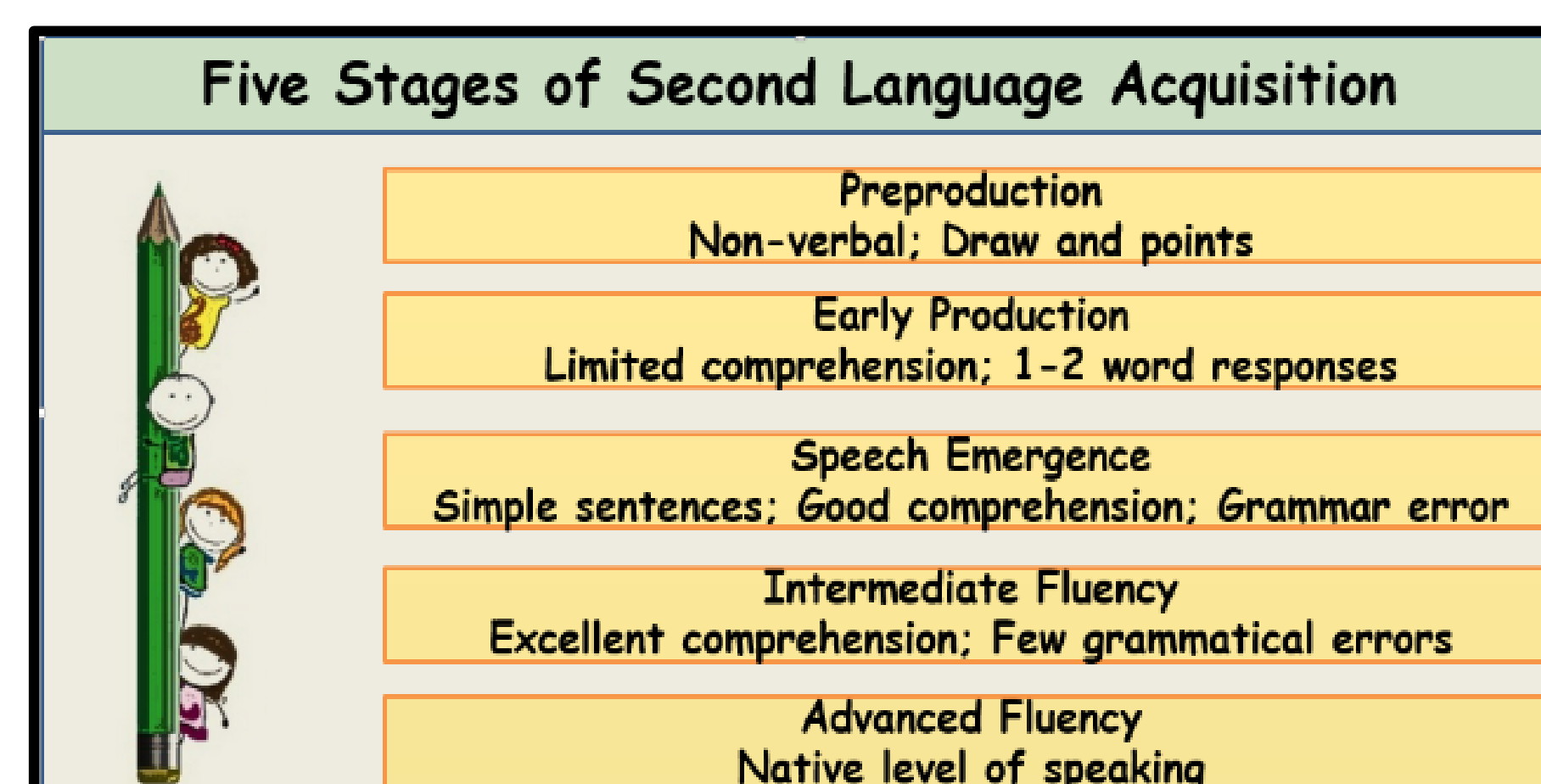
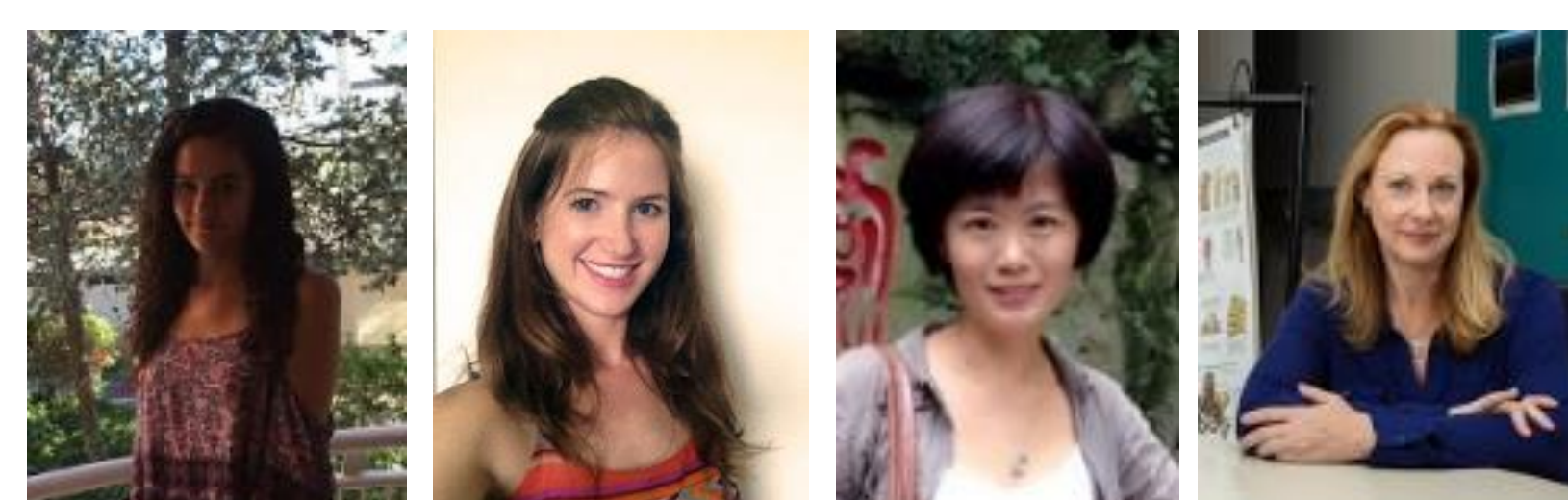


Figure 1. Five Stages of Second Language Acquisition.

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



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

| | Hybrid/Blended | SLA-aBLE |
|-----------------------------|--|--|
| Preproduction | <ul style="list-style-type: none"> Lacking visual aid Topics vaguely explained No embedded self testing | <ul style="list-style-type: none"> Add visuals Topics broken down into sections, simple explanations Embedded short quizzes |
| Early Production | <ul style="list-style-type: none"> Multiple choice quizzes Facebook, little or no discussion | <ul style="list-style-type: none"> Programming questions in quizzes used to reinforce learning Online Canvas discussion board used as online community |
| Speech Emergence | <ul style="list-style-type: none"> Solving engineering problems through programming | <ul style="list-style-type: none"> "Think-pair-share" programming task, reinforcing concepts through peer collaboration |
| Intermediate Fluency | <ul style="list-style-type: none"> Challenging and more complicated problems | <ul style="list-style-type: none"> Compare how different concepts are applied Justification of thought process |
| Advanced Fluency | <ul style="list-style-type: none"> Final open engineering programming project | <ul style="list-style-type: none"> Project presentation offered to students |

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.

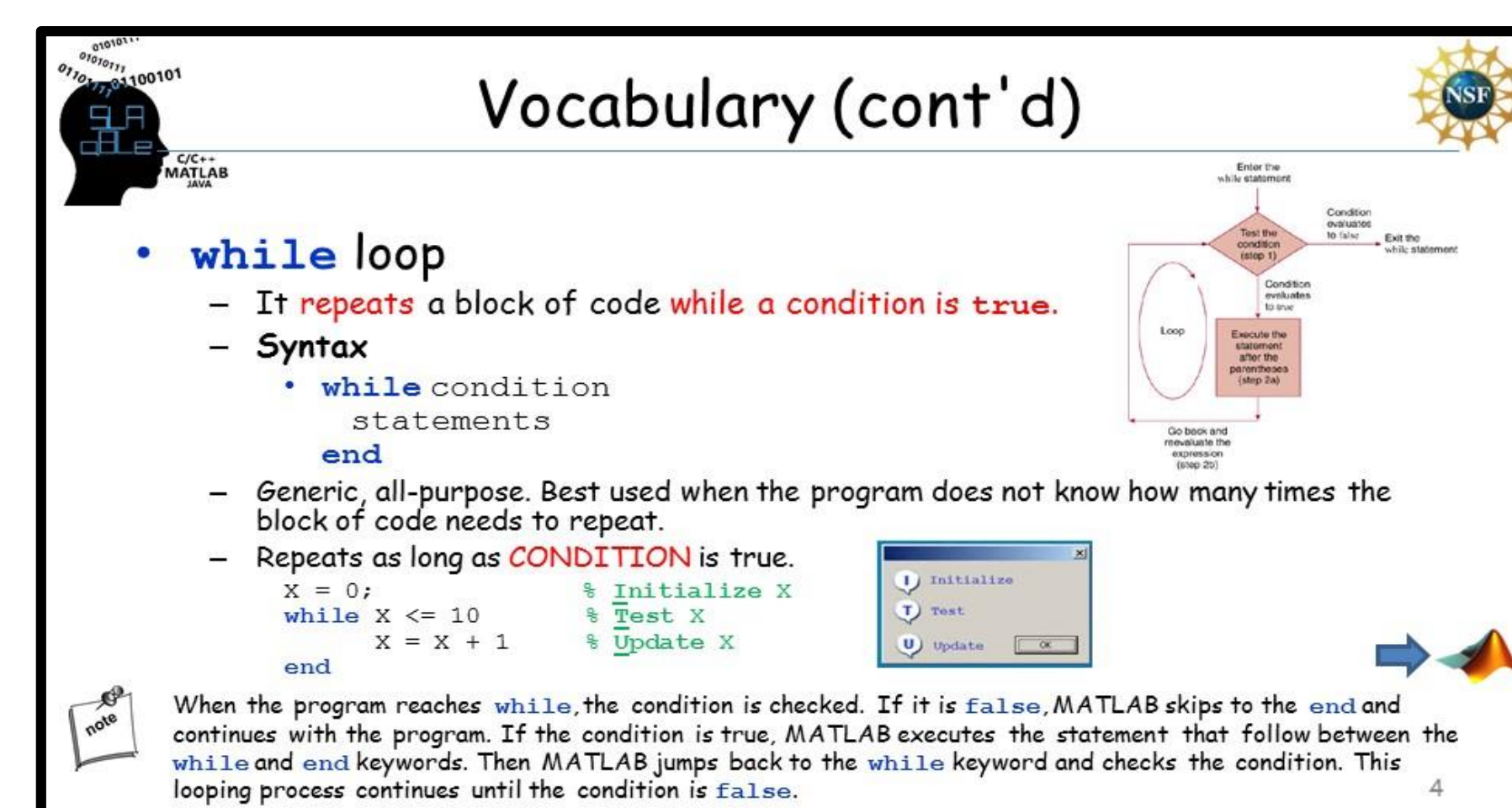


Figure 2. Slide example: Vocabulary.

Discussion Board, 2015

- Portal for students to interact with each other, sharing examples and asking questions about the online topics.
- Monitored by the 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.

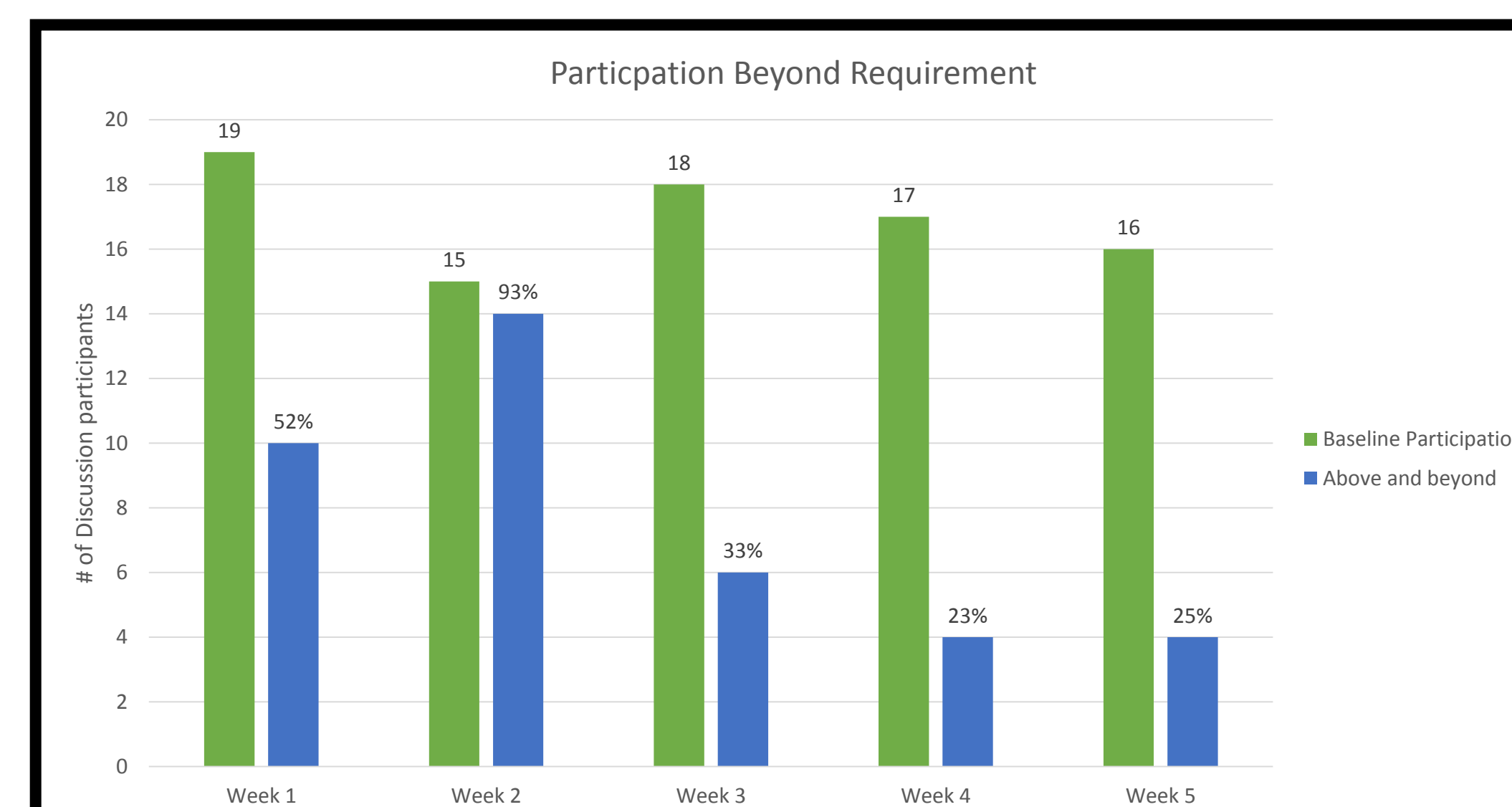


Figure 3. Participation beyond baseline. Discussion Board, Fall 2015.

Online Quizzes

- Online Canvas quizzes follow each video.
 - Include both multiple choice and open-ended programming questions.
- Multiple choice : test understanding of the syntax, vocabulary and punctuation of the concept.
- Open-ended : test application of concepts prior to the in-class Lab.



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

Results

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

| Grades (100 points max.) | Input Function | Advanced If Statement | While Loop General | While Loop, Catching Errors |
|------------------------------|----------------|-----------------------|--------------------|-----------------------------|
| Non SLA-aBLE control section | 81.00 | 82.96 | 88.76 | 79.69 |
| SLA-aBLE section | 86.50 | 90.84 | 90.71 | 82.64 |

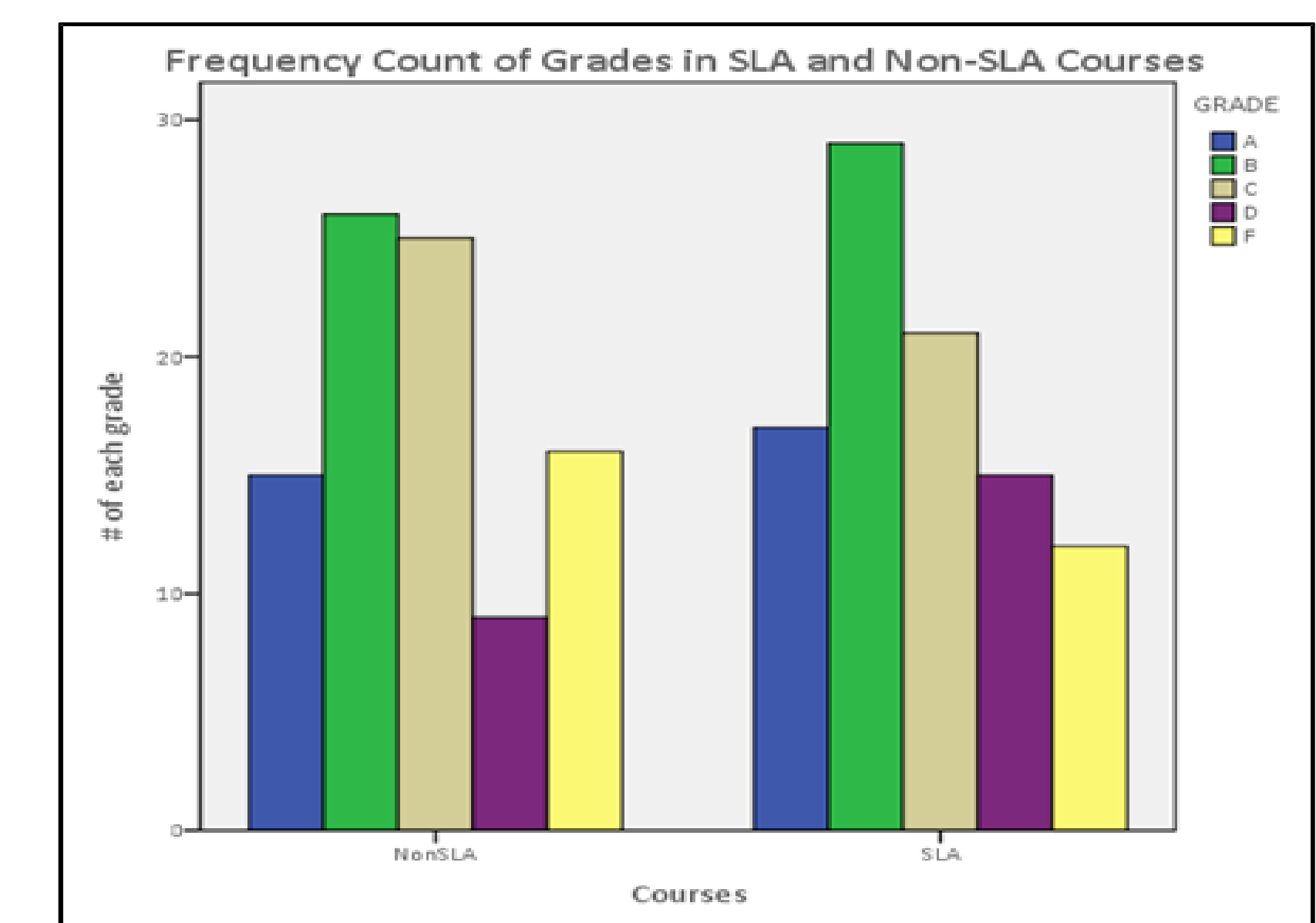


Figure 4. Final Grades. Fall 2015.

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.



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