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Application of Top-Down Approach to the First-Time Programing Language Learners

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1. Abstract

There are two approaches to programming language learning: Bottom Up Approach (BUA) and the Top Down Approach (TDA). BUA starts from learning basics such as data definition and grammar, then moves to actual programming, while TDA presents simple sample coding to the learners.

TDA is supposed to be for advanced programmers who already know one or more languages, but we found it is quite effective for first-time program language learning. We applied both TDA and BUA to students to prove the effectiveness.

2. Introduction

Programming language is not very easy to learn in particular for a beginner [1]. The programming language learning includes two approaches: TDA and BUA [2].

The BUA learning starts from the basics such as the naming convention, grammar, and data definition, then shifts to actual and practical programming.
For the beginner of the programming language, it is widely recognized that BUA is effective and suitable. Its problem, however, is the BUA takes much longer time to learn the language.

3. Top-Down Approach

The learning process of TDA is as follows:.

1. Read a block of source code with referring to the comments.
2. Guess and understand the meaning of a program sentence.
3. Change a part of the program sentence, then run the revised program to confirm the learner understands.
4. In the actual programming, copy-and-paste the sample programs.

Since the TDA process is to simply reiterate the above steps, it is applicable to the beginners who do not have any programming ability, or the first-time learners. Besides the programming ability, the learners can obtain the sense of the software reusability as well as readability in TDA.

4. Experiment

4.1. Overview

We applied TDA and BUA to 41 high school students to prove that the usefulness of TDA for a beginner.

4.1.1. Language Used

We selected JavaScript

4.1.2. Time Allocated

The total time was 150 minutes, including 120 pre-learning and 30-minute experience.

4.1.3. Two Groups

The BUA group has 21 students while TDA 20.

4.1.4. Programming Sentences to Be Learned

In the experience, the learner was expected to understand and learn the following program components:

- Displaying letters
- Learning “if” sentence
- Learning “for” sentence

4.2. Pre-Education

4.2.1. TDA Group

The TDA group has 20 students. We showed seven samples to the TDA group.

4.2.2. BUA Group

The BUA group consists of 21 students. The teaching materials were picked up from the JavaScript book [3]. Based on the teaching materials, a tutor taught the class. The study time was 120 minutes, and the tutor taught how to display letters, and to understand the if sentence, and for sentence.

4.3. Problem

A short problem was given to each group after the

Application to Programming Language Learning Using a Top-down Approach
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learning of 120 minutes. The problems given to the examinees were tailored to high school level. We gave the following the three problems.

5. Result and Analysis

5.1. Result

We show the result of each group. Table 1 is the result of the problem correct answer rate of TDA, and BUA.

Table 1, Result of the problem

	TDA	BUA
Problem1	6	8
Problem2	1	1
Problem3	0	0

BUA group is higher in the correct answer rate. We speak the detailed analysis in a following chapter

5.2. Analysis of problem 1

We analyzed the problem 1 that was high in a correct answer rate.

Table 2, Result of problem 1

	BU7	BU8	BU11	BU13	BU14	BU15	BU16	BU20
indent	N	N	N	N	N	N	N	Y
LOC	7	8	7	7	7	7	7	9
	TD4	TD7	TD8	TD16	TD17	TD19		
indent	Y	N	N	N	Y	N		
LOC	12	8	11	9	9	8		

5.2.1. Indentation

We analyzed indentation of the source code of JavaScript. BUA was 12.5%, i.e., 1 of 8 students. While TDA showed 50% (3 of 6). This has been affected by the sample code provided.

The indent is very important to furnish better readability [4].

5.2.2. LOC

We compared LOC, or Lines of Code. In the group of BUA, everyone developed almost the same number of lines. In the TDA group, TD4 and TD8 used blank lines for better readability.

This is because TDA students unconsciously did so by imitating the sample source code.

6. Future Work

We were carried out for Japanese high school students. We will carry out an experiment in future to prove further usefulness after having changed various age and a condition.

7. Conclusion

We applied TDA and BUA to 41 Japanese high school students to prove the usefulness of the top-down learning, and the applicability to the beginners.

The examinees took 120 minutes for pre-education, and 30 minutes for the actual programming experiment. Although both groups were unable to complete all the programming problems, the TDA group showed higher quality in source code.

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