

Development of Programming Learning Application for Smartphones Using Japanese

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Abstract

In recent years, programming education has garnered attention. Programming education has been introduced in elementary schools since the fiscal year 2020 in Japan. However, conventional programming education in Japan teaches programming in English. Programming in a language that is not your native tongue is difficult. For many Japanese, it is easier to understand if you can program using Japanese intuitively. This helps beginners to start acquiring basic programming skills. Error messages are sometimes displayed in long English sentences, which is another factor that hinders beginners from learning. In this material, the program description and error message specifications are written in Japanese. This study aims to develop learning materials for Japanese students to learn programming to experience the fun of acquiring programming skills. In this research, I have developed an application that allows Japanese students to learn to program smartphones in the Japanese language. The application has been designed for Android smartphones. Android Studio is used for Integrated Development Environment (IDE) and the programming language used is Java. The layout is written in Extensible Markup Language (XML). In this application, learners can learn about variables, operators, control statements, and arrays. For example, learners can learn how to program “determining even or odd numbers,” “assigning data to an array,” and so on. Using this application, learners can learn the basics of programming that they need to understand first. This will help them advance to their next step of learning a general-purpose programming language such as Java in English.

Keywords: Educational Technology, Learning Programming, Electronic Teaching Materials, e-Learning

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1. Introduction

In recent years, programming education has been emphasized, and in Japan, programming education has been introduced in elementary schools from the fiscal year 2020. The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) aims to develop qualities and abilities such as “knowledge and skills,” “thinking, judgment, and expression,” and “the ability to move toward learning and human nature. In the guide, programming education fosters “knowledge and skills” by realizing that computers are used in our daily lives and that there are necessary procedures to solve problems. In addition, programming education promotes “thinking, judgment, and expression” by encouraging programmatic thinking in line with developmental stages through attitude cultivation in using computer functions to improve life and society. To achieve that “power toward learning, humanity, etc.” are to be promoted.

In such a situation, a system to support learning programming is useful. Therefore, this research aims to develop a learning material to aid people in programming to experience the fun in programming.

2. Prior Research

2.1 Differences Between Visual and Textual Languages

In the paper “A Proposal of Educational Programming Languages Suitable for Elementary School Education,” the advantages and disadvantages of programming languages such as text-based, flowchart-based, rule-based, and block-based languages are described. In addition, some problems of block programming languages, which are often used as educational languages, are pointed out. The gap between block-type and text-type languages is mentioned in the article. Block-type languages can be used to construct programs by assembling prepared blocks. Thus, compared with text-type languages in which code must be input from scratch, block-type languages can be used to build programs easily without input. On the other hand, constructing a program differs greatly from text-based languages. Although a visual language such as a block-type language is a teaching material for cultivating programmatic thinking ability, it is difficult to make a smooth transition to learning a general-purpose text-type programming language. The reason is that its appearance and programming method are different from those of a text-type language. Therefore, this study aims to facilitate the transition to learning a general-purpose text-based programming language.

3. Proposed System

In this section, we describe the features and functions of the proposed system.

3.1 Programming in Japanese

The code description and error messages are written in Japanese. This is because a description in a language other than one's mother tongue is often a barrier to learning for beginners in programming. We aim to make it easy to understand the code contents in Japanese so that beginners do not get frustrated.

3.2 Applications That Users Can Use on Their Mobile Devices

Electronic devices such as smartphones, PCs, and tablet terminals are widely used in Japan. However, smartphones are considered the device with the highest ownership rate among individuals, including those who do not usually use computer devices. The system we propose in this paper makes it easier for people who do not have PCs to learn to program with their smartphones, easily accessible to many people.

3.3 Syntax Similar to General-Purpose Programming Languages

As shown in 2.1, the goal of this system is to facilitate the transition to learning a general-purpose programming language. Therefore, we do not want the system to focus too much on Japanese grammar, which differs greatly from the general programming grammar. Furthermore, the system uses similar syntax to the C programming language, commonly used in university courses.

4. Design and Development

4.1 Development Environment

In this study, we develop an Android application. The development tool is Android Studio, and the language is Java. XML is used for layout screen design.

4.2 Configuration

This application consists of four chapters. The contents of each chapter are summarized in Table 1.

Chapter number	Study contents
1	Basics (displaying strings, assigning to variables)
2	Operators
3	Control statements
4	Arrays

Table 1: Contents of the Study

In each chapter, students read explanations about the study contents and solve exercises related to the contents.

4.3 Example of Learning Screen

This section describes the flow of the exercise. First, the user should press the gray buttons on the input screen in the correct order. Then, press the “Run” button. If the description is right, the result will be displayed correctly. However, if the description is incorrect, an error message will be displayed, and the user will have to start typing again from the beginning.

As an example, let us illustrate the problem with a variable assignment. The problem is to assign “10” to a variable “a,” “Ya” to “b,” and “Arigato” to “c,” and output the contents. If the user can return all the three variables, a toast will be displayed, indicating the correct answer.

Figure 1 shows a program's description and execution results that assign numbers, letters, and strings to variables a, b, and c, respectively. It displays the three variables. When the program is written as shown on the left and the Run button is pressed, the execution result is displayed on the right. The toast of the correct answer is shown at the bottom of the screen.

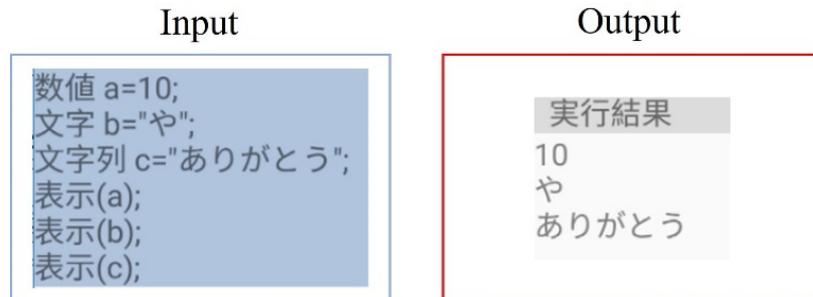


Figure 1: Variable (successful example)

Figure 2 shows the result of example 2 without the semicolon at the end of the sentence “string c = “ Arigato ” ;.” The result is shown on the right, and the toast of the incorrect answer is displayed at the bottom of the screen.

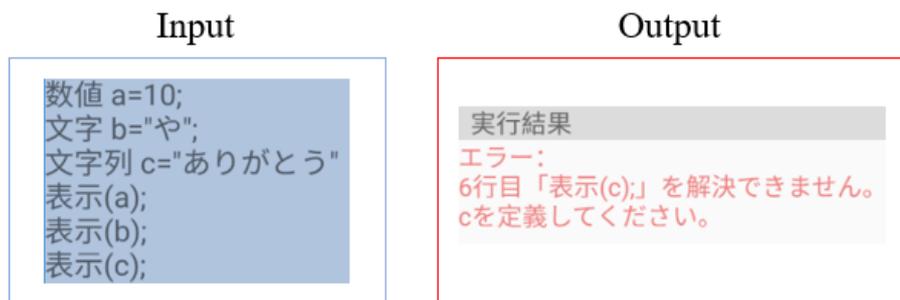


Figure 2: Variable (failure example)

Next, we explain an "if statement" problem. This problem is an exercise of assigning some numerical value to a variable x and executing a program to determine whether x is an even or an odd number. If the program is written as shown on the left of Figure 3 and executed, the result is shown on the right.

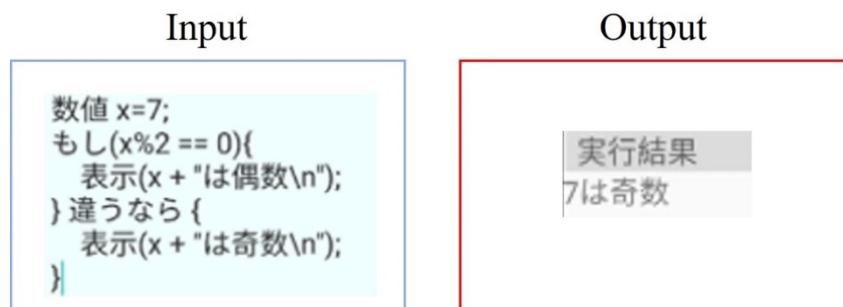


Figure 3: IF statement

Finally, we explain the array problem. This problem is to assign some numerical value to an array “a” and to display the stored value.

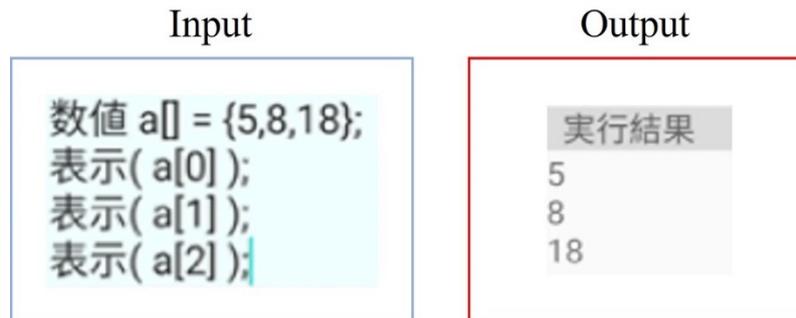


Figure 4: Array

5. Experiment

5.1 Experimental Method

The experiment was conducted with the cooperation of 18 Japanese who can handle tablet terminals, nine with programming experience, and nine with no experience. After completing the learning, we conducted a test to confirm the level of understanding and a questionnaire about the feeling of using the application. The experiment period was from October 25, 2021, to November 18, 2021.

5.2 Test Results

Table 2 summarizes the results of 18 participants used for the experiment.

Individual number	Scoring ratio (%)
1	69.57
2	18.75
3	56.52
4	6.25
5	52.17
6	60.71
7	43.48
8	14.29
9	43.48
10	26.09
11	75.00
12	34.78
13	73.91
14	62.96
15	70.97
16	88.89
17	96.30
18	62.97
Average	53.17

Table 2: Test Results

The average scoring percentage for all 18 players was 53.17%.

5.3 Questionnaire Results

First, Table 3 summarizes the results of the questions about the difficulty level of this material.

Answer	Number of people who answered
Difficult	5
A little difficult	8
Just the right level of difficulty	4
A little easier	0
Easier	0

Table 3: Responses to the Difficulty of the Teaching Materials (Everyone)

All the respondents selected “difficult,” “a little difficult,” or “just right,” and the largest number of respondents (eight) chose “just right.”

Next, Table 4 summarizes the responses of only the inexperienced students about the difficulty of the teaching materials.

Answer	Number of people who answered
Difficult	5
A little difficult	4
Just the right level of difficulty	0
A little easier	0
Easier	0

Table 4: Responses to the Difficulty of the Teaching Materials (Inexperienced People)

All of the inexperienced respondents selected either “difficult” or “a little difficult,” and the largest number of respondents (five) chose “difficult.”

Next, Table 5 summarizes the questionnaire results about the media used for learning programming.

Answer	Number of people who answered
PC	4
Smartphones and tablets	10
Use both together	4

Table 5: Answers to Questions about the Device Preferred for Learning (Everyone)

In this section, we asked, “Which media do you prefer when learning to program?” and provided the respondents’ options, including “PC,” “Smartphone/Tablet,” or “PC and Smartphone/Tablet together.” Table 5 shows that the largest number of respondents prefer “smartphone/tablet,” and about 80% of all respondents want either “smartphone/tablet” or “both PC and smartphone/tablet together.”

Device	Number of people who answered
PC	1
Smartphones and tablets	6
Use both together	2

Table 6: Answers to Questions about the Device Preferred for Learning (Inexperienced People)

Table 6 shows the responses to the same question as Table 5 only for those with no experience. "Smartphone/tablet" is the most preferred, accounting for about 90% of respondents.

The correlation between the test scores of the 18 students and preferred media for learning was examined using the uncorrelation test with a p-value of 0.047 ($p < 0.05$), which indicates that there is a correlation. The data of the scoring rate for the learning medium used are shown in Figure 5.

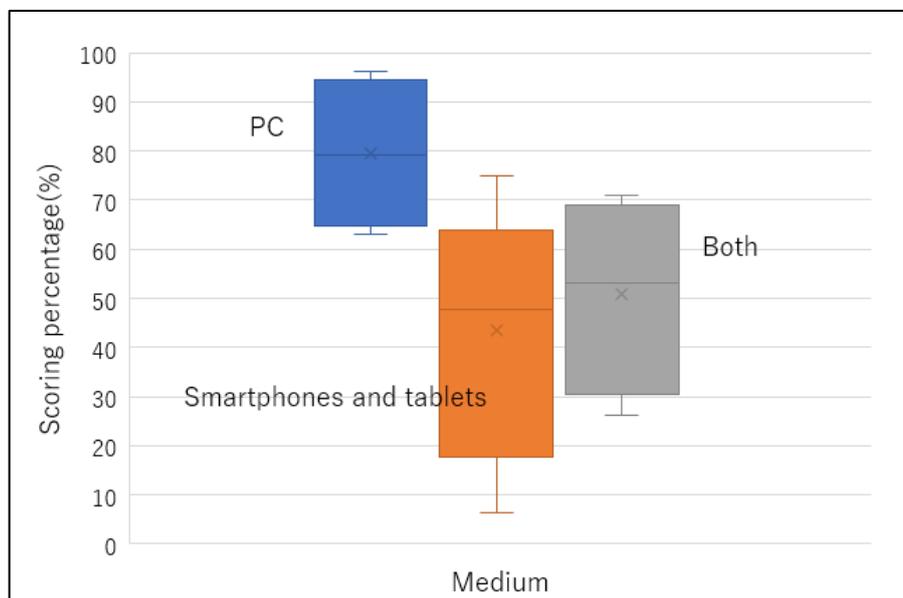


Figure 5: Percentage of Medium Scores Preferred by Users for Learning.

Next, Table 7 summarizes the responses to whether the students became interested in programming after learning this material.

Answer	Number of people who answered
Yes	15
No	3

Table 7: Answers to the Question, "Are You Interested in Programming?" (Everyone)

Fifteen respondents answered that they were "interested," and three responded, "not interested."

Next, Table 8 summarizes the responses to the same questions as in Table 7 only for those with no experience.

Answer	Number of people who answered
Yes	7
No	2

Table 8: Answers to the Question, "Are You Interested in Programming?"
(Inexperienced People)

Seven respondents answered that they were "interested," and two responded, "not interested."

Next, Table 9 summarizes the responses to the question, "Is programming in Japanese easy to understand?"

Answer	Number of people who answered
Hard to understand	0
A little confusing	4
I cannot say either way	2
A little easier to understand	3
Easy to understand	9

Table 9: Responses on the Ease of Understanding Programming Using Japanese

As shown in Table 9, the largest number of respondents (9) answered "Easy to understand" to the question of whether programming using Japanese is easy to understand. Next, four respondents answered "a little difficult to understand," 3 answered "a little easy to understand," 2 answered "undecided," and 0 answered "difficult to understand." About seven of the respondents answered either "easy to understand" or "a little easy to understand."

Next, we asked the participants to rate five items related to the application's usability on a five-point scale. The results are summarized in Table 10.

Evaluation items	5-point scale (average value)
Interesting content	4.28
Ease of viewing screen layout	4.17
Ease of understanding of explanations and diagrams	3.94
Ease of understanding of exercises	3.61
Ease of use	3.56

Table 10: Evaluation of the App's Usability

As shown in Table 10, the evaluation of the application usability was "Interesting content," "Ease of screen layout," "Ease of understanding of explanations and figures," "Ease of understanding of exercises," and "Ease of use."

The standard deviations of each item in Table 10 and the data on the understandability of programming using Japanese are summarized in Table 11.

Evaluation items	Standard deviation
Interesting content	0.87
Ease of viewing screen layout	0.76
Ease of understanding of explanations and diagrams	1.03
Ease of understanding of exercises	0.83
Ease of use	0.96

Ease of understanding programming using Japanese	1.23
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Table 11: Standard Deviation of Application Ratings

5.4 Discussion

Based on the fact that only about 30% of the inexperienced users scored over 60% in the test results provided in Table 2 and that all of them answered “difficult” or “slightly difficult” as displayed in Table 4, we can say that the contents of this material were difficult for beginner programmers.

From Tables 5 and 6, most respondents preferred mobile terminals such as smartphones and tablets for learning programming. Furthermore, as shown in Fig. 6, there is a correlation between the scoring rate and the media preference for learning, which indicates that many students, especially beginners, want to use smartphones and tablets for learning. Therefore, we believe it is meaningful to provide content that can be learned on mobile terminals such as smartphones and tablets as teaching materials for learning the basics of programming.

Table 11 shows the largest standard deviation for Japanese programming comprehensibility, and the data varies. Many respondents felt that programming in Japanese was easy to understand, while some respondents thought it was not easy to understand. Therefore, it is necessary to explore combining a general-purpose programming language and Japanese grammar to make it easier to understand.

6. Conclusions

In this paper, we proposed a smartphone application for beginner programmers using the Japanese language. In the future, we will explore better programming materials by referring to the results obtained in these experiments.

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