Interest and Awareness of Japanese University Students Regarding Computer Programming

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Abstract
Although developing computer programming skills is essential, students' levels of readiness to learn programming are different. This study thus investigates the interest and awareness that Japanese university students possess regarding computer programming. A questionnaire study using a five-point Likert scale was conducted for 90 students from three classes: one in science and two in humanities. The findings suggest three main points. (1) Regarding the requirement of programming skills in students' future careers, the average scores for all three classes were four or higher, and no statistical differences were found among the three classes. These findings suggest that both humanities and science students believe that programming skills are extremely valuable for their future careers. (2) Regarding interest in computer programming, the average scores for the three classes ranged from 2.9 to 3.4, and no statistical differences were found among the three classes. Further, statistical differences were observed among the three classes for students' responses to programming interest and to the requirement for programming skills in their future careers. These results suggest that all students were fully aware of the importance of programming skills; however, their interest in programming was low in all classes. (3) To raise students' interest in programming, it is important to design syllabi or prepare teaching materials that closely correlate to students' future careers and that foster their logical thinking. Additionally, the curriculum flow should be designed so that students learn information literacy before they learn computer programming.

Keywords: Programming Education, Programming Skills for Future Career Plans, Student Interest in Computer Programming, Information Technology Literacy

Introduction

Developing computer programming skills is demanded globally. In response to this demand, Japan's Ministry of Education, Culture, Sports, Science, and Technology (MEXT, 2018) is promoting computer programming education nationwide.

Despite these efforts, learners are known to have different experiences in programming, and their interests and awareness of programming learning are known to differ depending on the individual learners. To promote programming education, relevant stakeholders should first understand the current situation of individual learners' interest, awareness, necessity, and experience, then plan and implement programming education based on that understanding.

This study investigates the interest and awareness that Japanese university students possess regarding computer programming to ultimately explore their current situation and identify countermeasures to the problems that emerged in the investigation. The researchers conducted a questionnaire study with 90 Japanese university students to answer the following research questions:

1. Do students perceive that they need computer programming skills for their future careers? Are there any differences in how needs are perceived according to faculty?
2. Are students interested in computer programming? Are there any differences according to faculty?
3. Is students' interest in computer programming related to their logical thinking attitudes, software experiences, or perceived requirement of programming skills for their future careers? Are there any differences according to faculty?

In the following sections, this paper first examines related studies, then provides the methods used for the present study, delivers the results, and discusses the findings. Finally, the researchers present their conclusions and recommendations for further studies.

Literature Review

Following the global demand for programming education, MEXT decided to strongly promote computer programming education, which has commenced in Japan's elementary schools in 2020 (MEXT, 2020). Further, the subject of "Information" will be introduced into the Common Test for University Admissions in 2025 (The National Center for University Entrance Examinations, 2021).

As a part of the promotion policy of programming education (MEXT, 2018), computer programming education is currently being promoted from the elementary school level (MEXT, 2019) to the university level. Various efforts have been demonstrated regarding how programming education is considered a type of general information education at the university level. For example, Ishiguro, Sasaki, and Sassa (2017) discussed how "Introduction to programming" was a liberal arts subject in common education. Another study investigated first-grade students' experiences in their college computer literacy classes regarding the subject of Assembly Language Programming (Kuno et al., 2018).
However, according to the survey by Fuse and Okabe (2016), less than 20% of their students received programming education by the time they entered university. Fewer programming classes than expected are currently observed in high schools (Fuse, 2018). Students exhibit different levels of experiences and interests in, and awareness of, programming; so designing

programming classes that are catered for beginners is required—even in the general education level at universities (Fuse, 2018).

Considering university students' current situation, the curriculum, arguably, should account for students' backgrounds and awareness of computer programming. Our previous study (Kashiwagi, Kang, & Ohtsuki, 2021) thus explored the relationships between Japanese university students' interest in computer programming, their logical thinking, and their IT literacy. Our previous study also suggested that students' fields of study and future career plans must be considered when designing and implementing computer education. Therefore, we further attempted to investigate the relationships that existed between students' interest in computer programming and their future career plans.

Methods

Participants

This study's participants comprised 90 first-year students from three classes at a university in Japan—35 students from the Faculty of Engineering, 26 from the Faculty of Global Human Sciences, and 29 from the Faculty of Letters (see Table 1). These classes are the classes assigned when taking liberal arts and science subjects.

Class	Grade	Faculty	Number of Students
A	First year	Engineering	35
B	First year	Global Human Sciences	26
C	First year	Letters	29

Table 1: Number and Faculty of Participants

Data Collection and Analysis

A questionnaire was distributed to the participants to gather their subjective responses to items relating to their requirement of programming skills for future careers, their interest in computer programming, their logical thinking, and their experiences of software use (see Table 2 for the questionnaire items). The participants' responses were scored on a five-point Likert scale, in which 1 point correlated to "Strongly Disagree," 2 points to "Moderately Disagree," 3 points to "Neutral," 4 points to "Moderately Agree," and 5 points to "Strongly Agree."

Items Relating to Students' Requirement of Programming Skills for Future Careers, Interest in Computer Programming, Logical Thinking, and IT Literacy
Q1. I need programming skills for my future career.
Q2. I am interested in computer programming.
Q3. I am good at thinking about things in order.
Q4. I am good at thinking about things logically.
Q5. I often use software applications (e.g., Microsoft Word, Excel, and PowerPoint).

Table 2: Questionnaire Items

In this study's analysis, a Kruskal-Wallis test was used to investigate any statistical differences found among the difficulty ratings of the three classes. Further, a Wilcoxon signed-rank test and correlational analysis were also used to investigate how the items related to one another and whether any statistical differences were found between the difficulty ratings of the questionnaire items.

Results and Discussion

This study analyzed the questionnaire results to answer the research questions regarding students' requirements of programming skills for their future careers, their interest in computer programming, and the relationship between their interest in programming and other items. This section describes the overall questionnaire results and any data trends observed. The questionnaire response results are listed in Figures 1–5, as well as the percentages of participants who selected answers for each respective item. Figure 1 correlates to item Q1, which concerns students' requirement of programming skills for their future careers; Figure 2 correlates to item Q2, which concerns students' interest in computer programming; Figures 3 and 4 correlate to items Q3 and Q4 respectively, which concern students' logical thinking; and Figure 5 correlates to item Q5, which concerns students' computer software experiences.

First, this study examined how the participants indicated their agreement with Q1 (i.e., their requirement of programming skills for their future careers). According to the results for item Q1 (see Figure 1), 88.5% of the participants in class A (Engineering) indicated their agreement—that is, they replied positively to "I need programming skills for my future career." In class B (Global Human Sciences), 88.45% of participants indicated their agreement with Q1. In both classes, almost 90% overall indicated a positive agreement with Q1. Additionally, 76% of participants in class C (Letters) indicated their agreement with Q1. Regarding students' requirement of programming skills for their future careers, 80% to 90% of the participants in all classes indicated positive responses.

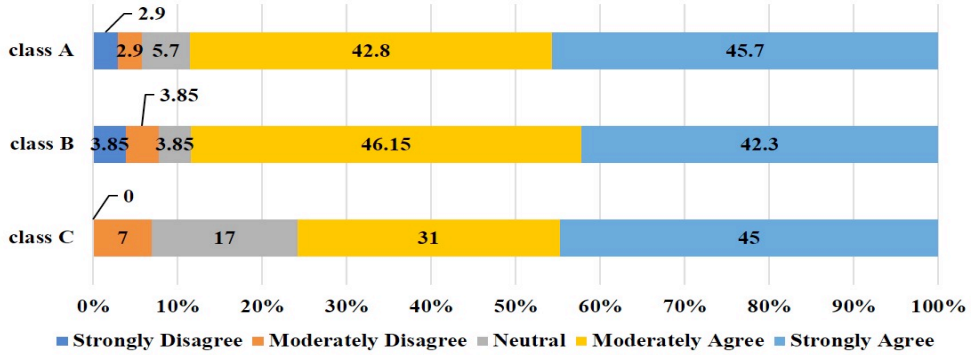

Figure 1: Percentage of participants' responses to item Q1.

Second, this study analyzed how the participants indicated their agreement with item Q2 (i.e., their interest in computer programming). According to the Q2 results (see Figure 2), 52% of the participants in class A (Engineering) indicated their agreement with item Q2—that is, they responded positively to "I am interested in computer programming." Similarly, class C (Letters) demonstrated that 48% of the participants indicated their agreement with item Q2. Additionally, 34.6% of participants in class B (Global Human Sciences) indicated their agreement. Regarding students' interest in computer programming, it was observed that slightly more participants in the Engineering and Letters classes than those in Global Human Sciences responded positively to the item. It can also be noted that fewer positive responses were given to Q2 when compared to Q1.

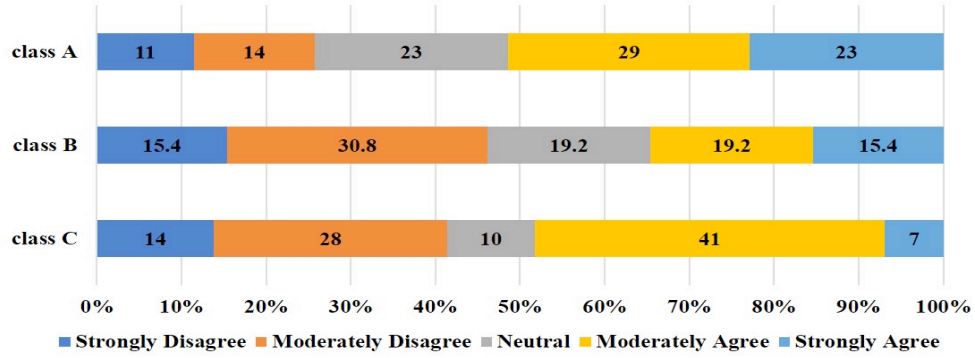

Figure 2: Percentage of participants' responses to item Q2.

Third, this study investigated how the participants indicated their agreement with items Q3 and Q4 (i.e., their logical thinking attitudes). According to the Q3 results (see Figure 3), 40% of the participants in class A (Engineering) indicated their agreement—they responded positively to "I am good at thinking about things in order." Similarly, class C (Letters) demonstrated that 41% of participants indicated their agreement with item Q3. Notably, fewer participants (23%) in class B (Global Human Sciences) indicated that they agreed with item Q3.

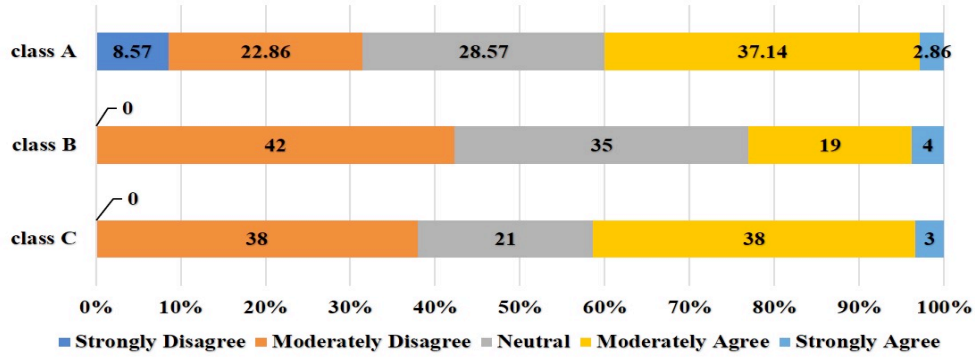

Figure 3: Percentage of participants' responses to item Q3.

According to the Q4 results (see Figure 4), 66% of the participants in class A (Engineering) indicated their agreement—that is, they responded positively to "I am good at thinking about things logically." Slighter fewer participants (48.4%) in class C (Letters) agreed with Q4, and even fewer participants (35%) in class B (Global Human Sciences) indicated their agreement with Q4. Notably, no participants selected the option of "Strongly Agree" for this item. Regarding student logical thinking attitudes, it can be noted that overall fewer participants in class B (Global Human Sciences) indicated positive responses for items Q3 and Q4.

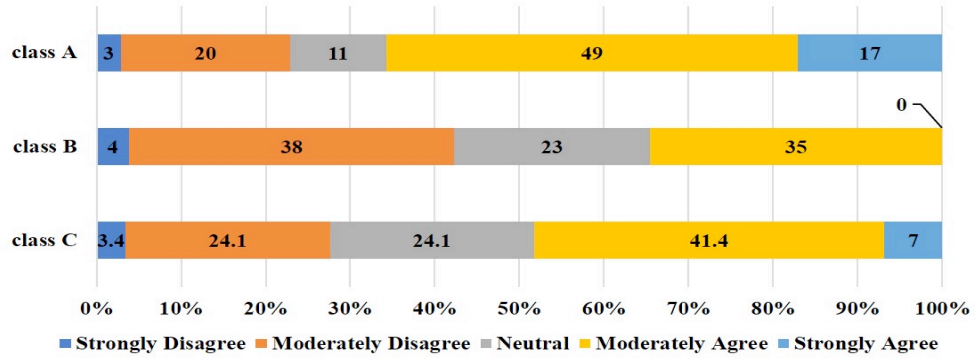

Figure 4: Percentage of participants' responses to item Q4.

Finally, this study analyzed how the student participants indicated their agreement with Q5 (i.e., their computer software experiences). According to the Q5 results (see Figure 5), 48% of participants in class C (Letters) agreed with the item—they responded positively to "I often use software applications, such as Microsoft Word, Excel, and PowerPoint." Notably, fewer participants (20%) in class A (Engineering) indicated their agreement, while even fewer participants (27%) in class B (Global Human Sciences) agreed with item Q5. Regarding computer software experiences, the results suggest that participants' responses did not depend on whether they were in the science or humanities classes.

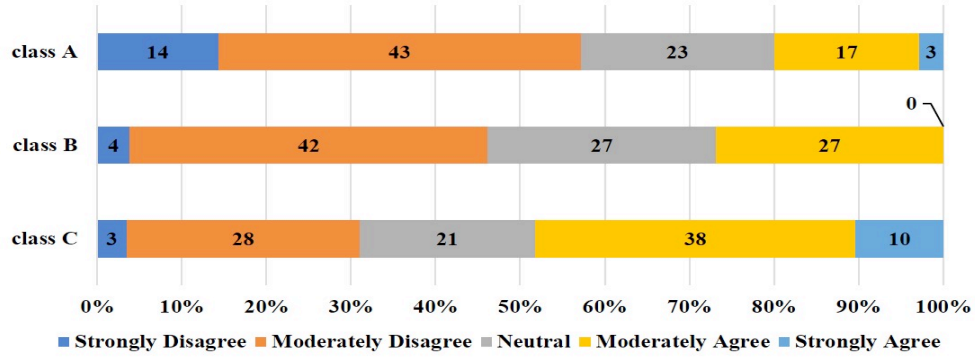

Figure 5: Percentage of participants' responses to item Q5.

Research question 1: Do students perceive that they need computer programming skills for their future careers? Are there any differences in how needs are perceived according to faculty?

To address the first research question, this section analyzes how the participants demonstrated their agreement with Q1 (i.e., their requirement of programming skills for their future careers). The Kruskal-Wallis test was conducted on the Q1 data to determine whether the three classes differed from one another in a statistically significant manner at the 0.05 level.

The average scores of their responses were calculated using a five-point Likert scale for each respective class to investigate overall student perceptions. The average scores were 4.3 for class A (Engineering), 4.2 for class B (Global Human Sciences), and 4.1 for class C (Letters). Regarding the percentages of participants who agreed with Q1, 88.5% of class A (Engineering), 88.45% of class B (Global Human Sciences), and 76% of class C (Letters) indicated that they agreed. Given these high percentages, it can be surmised that many

students across all classes perceived that they require computer programming skills for their future careers.

The Kruskal-Wallis test was then used on the Q1 data to analyze whether the participant responses from the three classes were statistically different. However, the results revealed no significant differences among the three classes ($p = 0.8752$).

These results ultimately suggest that the student participants from all classes strongly perceived that they needed computer programming skills for their future careers.

Research question 2: Are students interested in computer programming? Are there any differences according to faculty?

To address the second research question, this section analyzes how the participants demonstrated their agreement with item Q2 (i.e., their interest in computer programming). The average scores for the three classes were 3.4 for class A (Engineering), 2.9 for class B (Global Human Sciences), and 3.0 for class C (Letters). From the percentage results indicating agreement with item Q2, it was observed that approximately 50% of students from the Engineering and Letters classes agreed with the item, while only 34.6% from the Global Human Sciences class agreed.

Using the Kruskal-Wallis test on the Q2 data, the researchers then analyzed whether the participant responses from the three classes were statistically different. However, the results revealed no significant differences among the three classes ($p = 0.2986$). Given this final result, the students exhibit a low interest in computer programming—which is notable, considering they strongly perceived that they needed computer programming skills in their future careers.

Further, a Wilcoxon signed-rank test was conducted on the Q1 and Q2 data at the 0.05 level to analyze whether any statistical differences were present in the responses regarding students' interest in computer programming and those regarding the perceived requirement of programming skills for each respective class. The results revealed significant differences between the Q1 and Q2 data for all three classes (Engineering, $p = 0.0007$; Global Human Sciences, $p = 0.0007$; Letters, $p = 0.0004$).

These results reveal that students are fully aware of the importance of programming skills, regardless of whether they study science or humanities. However, it should be noted that their interest in computer programming was low for all three classes. Given this finding, it is necessary to consider a curriculum for computer programming that effectively interests students.

Research question 3: Is students' interest in computer programming related to their logical thinking attitudes, software experiences, or perceived requirement of programming skills for their future careers? Are there any differences according to faculty?

From the results obtained for the second research question, this study needed to investigate what facilitates programming learning. To explore the elements that raise students' interest, this study investigated how students' interest in computer programming was related to their logical thinking attitudes, computer software experiences, or their perceived requirement of programming skills for their future careers.

To analyze the data related to the third research question, this study calculated Spearman's rank-order correlation coefficients between items Q2 and Q1, Q2 and Q3, Q2 and Q4, and Q2 and Q5 from the questionnaire (see Table 3).

	Class	Q1	Q2	Q3	Q4	Q5
Q1	A	—				
	B	—				
	C	—				
Q2	A	0.39*	—			
	B	0.14	—			
	C	0.35	—			
Q3	A	-0.35*	-0.13	—		
	B	-0.20	-0.06	—		
	C	0.07	0.21	—		
Q4	A	-0.08	-0.03	0.44*	—	
	B	-0.14	0.15	0.37	—	
	C	0.16	0.42*	0.55*	—	
Q5	A	0.12	0.02	0.08	0.04	—
	B	0.18	0.42*	-0.16	-0.17	—
	C	0.28	0.15	0.03	0.06	—

*Correlation represents statistical significance at the 0.05 level ($p < .05$).

Table 3: Correlations Among Questionnaire Items.

The results of the correlation coefficients between Q1 and Q2 in the three classes as outlined in Table 3 demonstrated that a significantly weak positive relationship exists between students' interest in computer programming and their perceived requirement of programming skills for their future careers only in class A ($r_{Q1Q2} = 0.39$). However, the correlation coefficients between Q1 and Q2 were not statistically significant for both class B ($r_{Q1Q2} = 0.14$) and class C ($r_{Q1Q2} = 0.35$).

Regarding the perceived requirement of programming skills for future careers, a weak relationship was observed between students' interest in computer programming and their perceived requirement for programming skills only in class A (Engineering). This might be partly because of the students' major fields. The results and analysis ultimately suggest that the students' perceived requirement of programming skills for their future careers might slightly influence their interest in computer programming.

Further, this study also calculated the correlation coefficients between items Q2 and Q3, and Q2 and Q4 to examine how students' interest in computer programming related to their logical thinking attitudes.

The results of the correlation coefficients between Q2 and Q3 in the three classes as illustrated in Table 3 (class A, $r_{Q2Q3} = –0.13$; class B, $r_{Q2Q3} = –0.06$; class C, $r_{Q2Q3} = 0.21$) demonstrate that no significant relationship exists between students' interest in computer

programming and their logical thinking attitudes. Further, the results of the correlation coefficients between Q2 and Q4 reveal that a significantly weak positive relationship exists between students' interest in computer programming and their logical thinking attitudes only in class C ($r_{Q2Q4} = 0.42$). However, the correlation coefficients between Q2 and Q4 were not statistically significant for both class A ($r_{Q2Q4} = -0.03$) and class B ($r_{Q2Q4} = 0.15$).

These findings pertaining to students' logical thinking attitudes reveal that only in the Letters class was a weak relationship found between students' interest in computer programming and their logical thinking attitudes. This suggests that students' logical thinking attitudes might only slightly influence their interest in computer programming.

Finally, this study also calculated the correlation coefficients between Q2 and Q5 to investigate how students' interest in computer programming related to their computer software experiences.

The correlation coefficient results between Q2 and Q5 revealed a significantly weak positive relationship between students' interest in computer programming and their computer software experiences only in class B ($r_{Q2Q5} = 0.42$). However, the correlation coefficients between Q2 and Q5 were not statistically significant for both class A ($r_{Q2Q5} = 0.02$) and class C ($r_{Q2Q5} = 0.15$). Overall, regarding computer software experiences, a weak relationship between students' interest in computer programming and their computer software experiences was observed only in the Global Human Sciences class.

These results also suggest that students' computer software experiences might slightly influence their interest in computer programming.

Findings

Although this study can be further improved, its results reveal critical findings regarding the interest and awareness that Japanese university students possess regarding computer programming. This study's questionnaire results revealed that students were fully aware of how vital programming skills were for their future careers, regardless of whether they studied science or humanities. However, their interest level for programming was low in all classes. Considering a computer programming curriculum that deliberately interests students is thus necessary. This study's results suggest that students' interest in programming should be increased by designing syllabi and preparing teaching materials that directly relate to students' future careers and that foster their logical thinking attitudes—with the ultimate intention of promoting their readiness for, and awareness of, computer programming. Additionally, designing a curriculum flow in which students learn general information literacy before they learn computer programming will most likely reduce their psychological resistance to programming and instead encourage them to become more interested.

Limitations and Recommendations

The present study was a preliminary investigation into the interest and awareness that Japanese university students possess regarding computer programming. Considering the results obtained, more detailed relationships between students' fields of study and future career plans must be considered. Additionally, a survey must be taken after conducting actual programming classes. Finally, further studies should gather and analyze objective data to evaluate students' computer programming abilities, along with their subjective responses.

Conclusions

To develop students' computer programming skills, this study investigated the interest and awareness that Japanese university students possess regarding computer programming. A questionnaire using a five-point Likert scale was conducted for 90 students, with the results suggesting three main findings. (1) Regarding the perceived requirement of programming skills for students' future careers, the average scores that participants gave from all three classes were four or five out of five, with no statistical differences found among the three classes. It was suggested that students from both the humanities and science classes believed that programming skills were extremely valuable for their future careers. (2) Regarding student interest in computer programming, the average scores given for the three classes ranged from 2.9 to 3.4, with no statistical differences found among the three classes. However, statistical differences were found between the participants' responses for each class regarding their interest in programming and their perceived requirement of programming skills for their future careers. Overall, these results suggest that both humanities and science students were fully aware of how critical programming skills were for their future careers, even though their interest levels in programming were low in all classes. (3) This study also determined that to raise students' interest in programming, syllabi should be designed and teaching materials should be prepared that deliberately foster their logical thinking and relate to their future careers. Finally, this study recommends that designing a curriculum flow in which students learn general information literacy before they learn computer programming will encourage all students to become more familiar with programming.

As a continuation of this study, the researchers recommend that future research more thoroughly examine the relationships between students' interest in computer programming and their perceived requirement of programming skills for their future career plans, with a specific emphasis on students' fields of study.

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