Informatics Education for University Students based on Text Input Time

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Abstract: Japan is rapidly changing the ICT environment for students due to the Global and Innovation Gateway for All (GIGA School) since 2019. Students educated in various ICT environments will soon enter universities, and higher education will need to be optimized in these environments. For current university students in the transitional stage of ICT education, we measured the time required to input text using multiple methods, including laptops and smartphones, and the age when they started using the devices. For university students, smartphone input time is shorter than laptop input time, and individual differences are insignificant, suggesting that smartphone use may be effective in higher education. We also observed that the students who use devices such as smartphones and laptops from earlier educational stages have better typing skills. It will be necessary to design classes assuming a variety of students.

Keywords: ICT device, Informatics Education, Touch-typing, Smartphone, Laptop

1. Introduction

Information literacy is one of the essential liberal arts required today. To acquire information literacy, using ICT in learning activities is recommended; PISA reported that among OECD member countries, Japan spent the least amount of time using digital devices in school classes (NIER, 2019). The Ministry of Education, Culture, Sports, Science and Technology announced the Global and Innovation Gateway for All (GIGA School) to expand the educational ICT environment, making one terminal per student available nationwide in elementary and junior high schools (MEXT, 2019). This terminal includes not only laptop computers but also tablet devices. They also have established an intra-school communication network for elementary, junior high, and high schools.

With realizing the GIGA School, universities will enroll students who have studied in various ICT environments. One can imagine that new students are particularly susceptible to the informatics education curriculum they have received through high school. Most current informatics education assumes the use of laptops, and only individual practice reports have been published on teaching methods that use other types of terminals. It is considered inappropriate for students to take classes based solely on the laptop, as in the past. Examining how ICT can provide better education to university students is necessary.

However, the ability to use information devices is not apparent regarding current university students, for whom the environment for information education was not developed. Our research question is to what extent they can use information devices. We surveyed the age at which students started using laptops and smartphones, the time required for typing as an ICT skill, and students' willingness to use devices. We also discuss effective informatics education for students who will be educated under the GIGA School in the future.

2. Related research

Japanese university students are known to be familiar with the operation of mobile phones. Teaching materials are also being developed using tablets and cellphones. Delcker, Honal,

et al. (2018) suggested from a survey of U.S. university students that tablet devices may provide new university students with the ability to find effective learning strategies and easy access to course materials. The effectiveness of regular delivery of English teaching materials via cell phones was reported to improve reading and grammar skills at a Japanese university (Smith & Wang, 2013). However, the effectiveness of ICT education in Japan does not appear uniform. Gougeon & Cross (2021) suggested differences among Japanese universities in assessing ICT skills.

3. Method

This study measured the time spent touch-typing on a laptop, typing on a smartphone, reading aloud sentences and writing on paper among first-year university students at University H. There are 1345 eligible students, including 187 in the School of Medicine, 410 in the School of Engineering, 75 in the School of Dentistry, 81 in the School of Information Sciences, 80 in the School of Biotechnology and Production, 127 in the School of Integrated Arts and Sciences, 130 in the School of Law, 54 in the School of Pharmacy, and 201 in the School of Science.

Two types of texts were prepared for input exercises. The texts are shown in romaji input, which is commonly used to enter Japanese on a keyboard,

1. Wagahai ha neko dearu. Namae ha mada nai. Dokode umareta ka tonto kentou mo tsukanu. Nandemo jimejime sita tokoro de nya-nya- naiteita koto dake ha kioku siteiru.
2. AI toha Artificial intelligence no ryaku desu. Artificial toha ‘jinkou teki na’, intelligence ha ‘tisei’ to iu imi de, jinkou tinou to yakusaremasu.

Sentence 1 is a passage from ‘I Am a Cat’ by Soseki Natsume. It is assumed that students who use Japanese daily can read the text easily. Sentence 2 is a brief explanation of Artificial intelligence. Students are required to input Japanese characters and English words.

The time measurement method was not specified. Each student measured the time in each possible way and entered the assignment form. Some students reported times in units of time finer than seconds. However, all data were corrected to the nearest second in the analysis since the accuracy of the reported time varied with this method.

To investigate the relationship between the timing of device use initiation and text input skills, a questionnaire was sent out on when each device was first used. Five options were available: before elementary school, elementary school, junior high school, high school, and after high school. We also surveyed preferences for the terminal used for text input. The survey target, University H, has adopted a “Bring Your Own Device” policy, requiring students to provide their own laptops for use in class. Therefore, almost everyone surveyed should have a laptop and a smartphone and be able to answer these surveys.

4. Result

Figure. 1 lists the time taken by each input method for sentences 1 (left (a)) and 2 (right (b)). Using Tukey’s outlier removal method, data exceeding 1.5 times the interquartile range are removed. The figure displays the results of outlier removal. Notches in the figure mean 95% confidence limits the median. In both cases, sentences 1 and 2, the input time on the smartphone is faster than the input time on the laptop. The variation in input time is found to be smaller for laptop, smartphone, hand, and aloud, in that order. This trend is more pronounced for sentence 2 than for sentence 1.

We compared the average input times for laptops and smartphones. Table 1 shows the mean input time for sentence 1 and 2. In the case of sentence 1, the t-test results showed $t = 24.912$, $df = 2194.5$, confirming a significant difference at $p<0.001$. The same analysis was performed for sentence 2, resulting in $t = 13.922$, $df = 2536.2$, also a significant

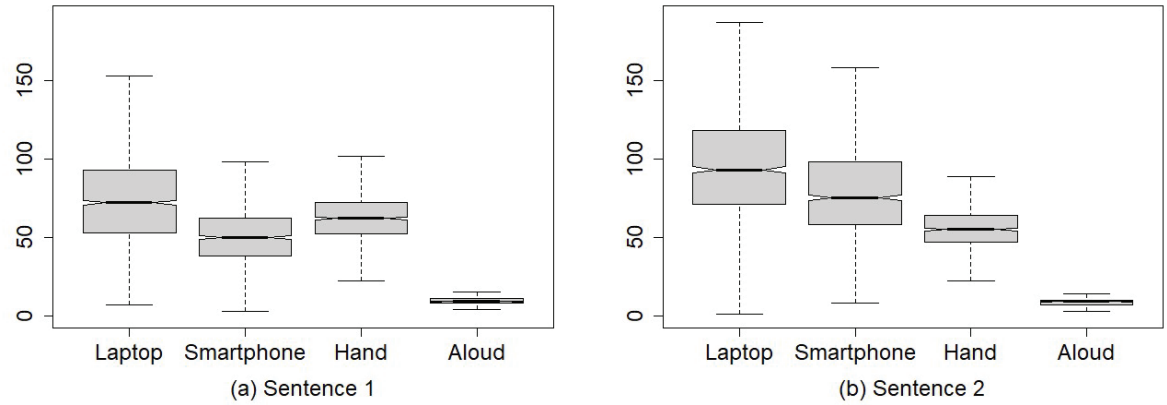

Figure 1. Text input time for laptops, smartphones, handwriting, and speechreading.

Table 1. *Mean of Input time for sentences 1 & 2.*

Method	Sentence 1		Sentence 2	
	Num	Mean (S.D.)	Num	Mean (S.D.)
Laptop	1303	73 (28)	1312	94 (34)
Smartphone	1275	49 (18)	1288	77 (28)

difference at $p<0.001$. It can be said that students spend more time typing on laptops than on smartphones.

Figure 2 summarizes the mean input time for sentence 1 by the time when the device was first used. The links connecting the elements at the top of the figure are represented by '**' for significant differences at $p<0.01$ and '*' for substantial differences at $p<0.05$ based on multiple analyses by ANOVA. Figure 2(a) summarizes the age of starting to use laptops and input time. It can be seen that those who began using laptops after graduating from high school spent more time (77s, 95%CI is from 74 to 84) inputting data than those who started using laptops before entering elementary school (61s, 95%CI is from 53 to 68), elementary school (70s, 95%CI is from 67 to 72), or junior high school (71s, 95%CI is from 67 to 74). Even if they started using laptops in high school, their input time is found to be longer than that of those who started using laptops before junior high school. If students want to improve

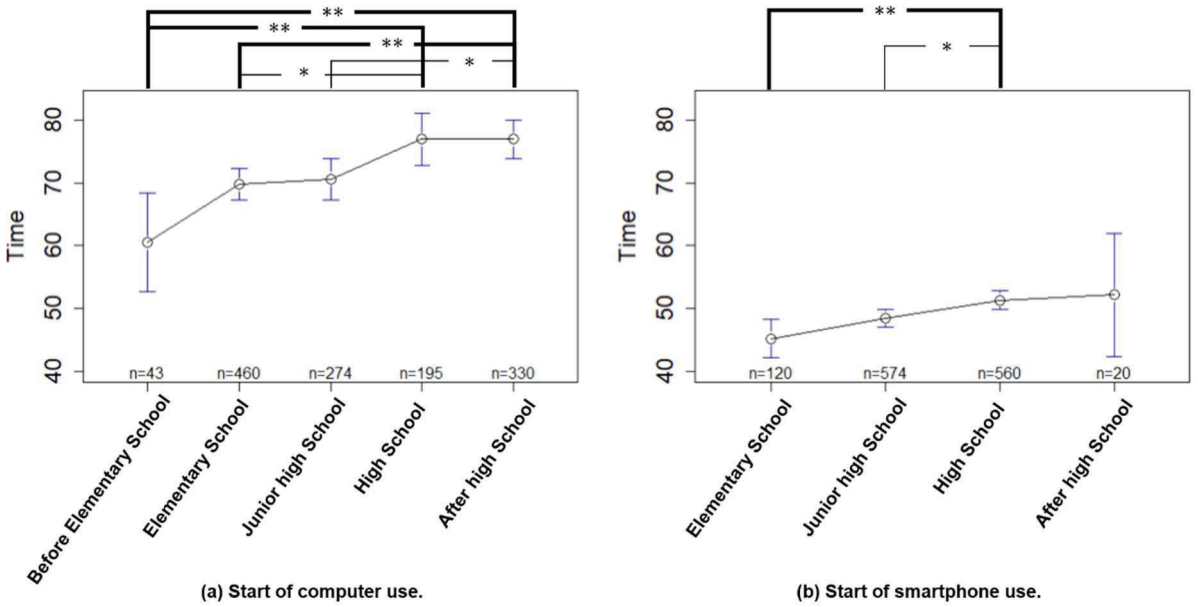

Figure 2. Means of input time for sentence 1 by the device start date of use.

their touch-typing skills, it is adequate to start using laptops from elementary school.

Figure 2(b) summarizes the text input time by the start of smartphone use. None of the subjects were students who began using smartphones before elementary school. It was found that those who started using smartphones in high school (52s, 95%CI is from 42 to 63) took longer to input text than those who started using smartphones in elementary (45s, 5%CI is from 42 to 48) or junior high school (49s, 95%CI is from 47 to 50). As with laptops, starting to use smartphones in elementary and secondary school is more effective in improving smartphone input skills.

Table 2 summarizes the results of a survey of students on which device was faster to input devices for sentence 1 and whether they would prefer to input 200 characters on a smartphone or a laptop. 579 students (about 43% of all) preferred the laptop for inputting 200 characters, but were slower to enter sentences and faster on the smartphone. This indicates that some students' preference for text input devices does not match their choice.

Table 2. Cross table of devices that had the fastest input time for sentence 1 and devices that took the student less time to input 200 characters.

Devices with short text input time	The device you want to use to type 200 characters.		Total
	Laptop	Smartphone	
Laptop	222	26	248
Smartphone	579	492	1071
Same	20	6	26
Total	821	524	1345

5. Discussions

5.1 The Importance of ICT Education in the Elementary and Secondary Curriculum

A comparison of the time spent for each input method showed that keyboard input time to the laptop varied widely among individuals. Furthermore, there was less variation in the time spent on handwriting and reading aloud. The phenomenal speed with which the Japanese write on paper was also noted by Houser & Thornton (2004). This is likely because it is repeated early and integrated into the primary and secondary education curriculum (Ministry of Education, Science and Culture, 1980). This suggests that teaching methods such as handwriting and reading aloud may reduce individual differences in device input skills.

A study of the relationship between the timing of device use and input time showed that students who started using devices by junior high school had a faster input time than those who began using devices after high school age. This result suggests that ICT education would be necessary in primary and secondary education.

5.2 Why Text Input Times Differ Depending on When Device Use Begins

This study found that students using laptops in primary and secondary education had shorter text input times. This can be attributed to the fact that ICT education, such as touch typing, is being provided enthusiastically in some Japanese primary and secondary schools. However, special education was not provided for entering text into smartphones, and this reason cannot explain the shorter time required to enter text on smartphones. For both devices, students who had had the devices for longer periods had shorter text entry times, possibly due to their daily experience with the devices.

Another possible cause is the influence of handwriting skills on device input skills. A study comparing touch-typing and handwriting speeds among elementary school students in

the United Kingdom reported that students with no handwriting speed problems were able to type faster on the keyboard than by hand in the upper elementary grades, even without any education on keyboard input (Connelly, V., Gee, D., & Walsh, E., 2007). Our study results show that students are faster at typing by hand. Therefore, these handwriting skills may have influenced their input time to smartphones and laptops. However, this study cannot reveal the causes of these factors; continued research is needed to clarify the impact of continuing education, especially for students who will enter university in the future as a result of the GIGA School, since their learning process up to that point was different from that of previous students.

5.3 University Information Education: Optimal Content and Environment

Smartphone input is faster than laptops, indicating individual variation. This suggests that smartphones save time in situations such as simple communication in class or a quick exchange of opinions in group work. They are also expected to be more efficient in writing reports and essays. Hubert (2017) discussed using English smartphone applications for Japanese students learning English. Although laptops can also use English translation functions, smartphones are faster to type and more suitable for university students.

Some papers question the inclusion of text input methods in informatics education for university students. Zollman (2012) argued that voice input technology advancements will make typing skills unnecessary, eliminating the need for text input classes. Voice input performance has improved significantly in terms of speed and accuracy, as reported by Ruan (2018). University students were found to read text than they typed it, suggesting that lectures on using voice input for better outcomes align with informatics education goals.

For students who have low typing speeds when they enter university, it is better to avoid situations where slow typing speeds prevent them from participating in classes rather than to increase their typing speeds. They are generally given remedial courses, but it is better to teach them practical ways to output what they want to write as quickly as possible rather than just having them do the typing. For example, voice input is suggested for students who take a long time to type on smartphones and computers. In this study, as reading aloud takes the shortest time. Using a voice input system is expected to encourage students to participate in the class actively.

Around 40% of respondents prefer labor-intensive text input devices. This may a lack of accurate understanding of ICT utilization skills among students. This highlights the need to incorporate opportunities for students to gain correct knowledge of ICT utilization skills into their learning. A more detailed survey of student attitudes is necessary to clarify the relationship between text input device choices and self-assessment of ICT utilization skills.

It is increasingly difficult to specify which devices to utilize for university students. ICT education is now provided from elementary education, and many students will have some device before their university course. Thus, it isn’t easy to strongly request university students to purchase a specific device for their university classes. In particular, classes such as information literacy are held in the first year. Their content is aimed at learning a wide range of primary education, so there should be no discrimination in the ease of learning depending on the terminal students' own. Teachers should develop classes assuming students can access class materials and practice from various devices.

6. Conclusion

This study aimed to clarify the extent to which current university students have the ability using information devices and to examine how information education for university students should be conducted. To this end, we investigated text input time by device and the age at which students began using the devices. Since individual differences in text input time on

smartphones are smaller than on laptops, smartphones would be more time-efficient for simple communication in class and for exchanging opinions in a short period in group work.

The study also showed that students who owned ICT terminals in elementary and junior high schools spent less time inputting text on laptops and smartphones. Therefore, when the children and students who are the target of the Global and Innovation Gateway for All (GIGA School) become university students, their text input skills may have improved more than those of today's university students. The devices they use in elementary and junior high schools and high schools vary, as like laptops or tablets and so on. It is difficult to identify which devices they have the best input skills. Individual students may have different input methods in which they excel. It isn't easy to decide which device is more suitable for them. University classes need to construct course content that does not limit the types of ICT devices.

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