

How do Japanese University Students' Speed and Accuracy of Typing English Text Develop through Writing Instruction?

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Abstract

The purpose of the present study was to investigate how Japanese undergraduate students' speed and accuracy of typing English text developed over an academic year as they went through English writing courses for English education majors at a university in Japan. Data on typing speed and accuracy collected in one first-year class (33 students) and two second-year classes (68 students in total) during the 2011 academic year were analyzed. Results of dependent sample *t*-tests showed significant increases in typing speed over the academic year with medium effects in all classes. Meanwhile, the pattern observed in typing accuracy was more complex. A significant drop in typing speed was observed in one second-year class, with a medium effect size, while no such change was observed in the typing speed means in the other two classes. These results are discussed in terms of the instructional content, the development of accuracy, fluency, and automaticity in cognitive skills, and students' typing training background based on post-hoc survey responses collected from a small subsample of students in these classes.

1 Introduction

With the rapid advancement of computer technology during the last few decades, opportunities for us to word-process various types of text have increased dramatically in daily life. For instance, word-processing is essential for writing business letters, preparing academic essays, and exchanging e-mail messages with others. Reflecting the nature of such writing activities in modern society, word-processing is now required in some standardized English writing assessments as well, while hand-writing responses used to be the standard practice in assessing writing ability. Tasks in the new types of writing assessments above often require the ability to type text accurately at a reasonable speed. For instance, the TOEIC® Speaking and Writing Tests (http://www.ets.org/toEIC/speaking_writing/about) require the examinee to read two e-mail messages and write responses to them within 10 minutes each. These recent changes in writing demands suggest that word-processing skills have become an integral part of one's written production skills for communication. Thus, it is imperative to provide English language learners with appropriate instruction on word-processing skills and evaluate them systematically as part of English-as-a-foreign-language (EFL) education.

The preliminary study presented in this paper describes efforts toward this direction in undergraduate English writing courses at a university in Japan. As part of the writing curriculum for English education majors at the university, students in the writing courses engaged in a variety of English writing tasks that required them to word-process English texts with computer keyboards. No focused exercises aiming specifically at typing skills development were provided in these courses. The purpose of the present investigation was to examine how the students' English word-processing skills—speed and accuracy of typing English text in particular—developed during their enrollment in the courses over an

academic year. It was expected that results from this study serve as data to reflect on the effectiveness of the English writing courses and inform future instructional planning.

2 Method

2.1 Participants

Participants in this study were undergraduate students in the Department of English Language and Literature in the School of Education at Waseda University. All participants were enrolled in three sections of two undergraduate English writing courses offered by the School of Education during the 2011 academic year. Among the 101 students who participated in this study, 33 were enrolled in a section of English Composition I, the first-year English writing course (Class 1), while the other 68 were enrolled in two sections of English Composition II, the second-year English writing course (33 students in Class 2, and 35 students in Class 3). Most students in these classes were native speakers of Japanese that had received English instruction in grade schools in Japan prior to admission to the university, while there were a small number of returnees from other countries as well¹.

2.2 English Writing Classes

English Composition I and English Composition II were required courses for all first- and second-year English education majors, respectively. Each class met for 90 minutes once a week for 30 weeks throughout the year (15 weeks each in the spring and fall semesters). While each course had multiple sections, there was no unified curriculum across sections within each course. Thus, instructors were allowed to select their own textbooks, teach content of their preference, and evaluate students using their own tests and evaluation criteria for each section. It is worth noting that, coincidentally, the same textbook (Jimbo, Elwood, Morita, Watanabe, Yamada, & Yoffe, 2008) was used as the course textbook in all three classes involved in this study. Meanwhile, there were some important differences between Class 1 and the two second-year classes in terms of the degree of students' involvement in word-processing in the classroom. As described in more detail below, Class 1 met in a regular classroom without PCs throughout the year except the first three weeks in the spring semester, when the classes were held in a computer lab. In contrast, Classes 2 and 3 met regularly in computer labs, where students had opportunities to word-process English text with keyboard during class. Furthermore, students in Class 1 participated in text-chat sessions requiring word-processing in computer labs out of class, while students in Classes 2 and 3 did not participate in such sessions. More detailed descriptions about the three classes follow.

2.2.1 Class 1 (English Composition I)

The primary goal of the section of English Composition I discussed in this paper was to develop students' skills to write well-formed English texts at the paragraph level. Thus, this class was conceptualized as a course for building foundations for writing longer essays in the second year and beyond. Students in this class engaged in three major activities throughout the academic year: (1) learning the notion of paragraph in English text and how

¹ No survey on the participants' educational and linguistic background was conducted as part of this study. Thus, no further information was available concerning the participants' background or the exact number of returnees in each class.

to write paragraphs in different rhetorical structures (e.g., process, cause/effect, comparison and contrast); (2) learning basic skills for word processing in English and formatting English texts by using PC; and (3) participating in weekly text-chat sessions with students at a partner institution in Korea with the aim of fostering cross-cultural understanding and developing fluency in production of written English text².

As mentioned above, a primary goal of Class 1 was to develop students' basic word processing skills in English. To this end, the students were engaged in various tasks that required them to word-process English text on PC throughout the year. In the spring semester, Weeks 1 through 3 was devoted to learning word processing and basic rules for formatting typewritten English documents. These classes were held in a computer lab. Starting Week 4, the class met in a regular classroom, while the students completed take-home writing assignments, in each of which students word-processed a paragraph of approximately 150 words in length. During the academic year, students completed a total of 16 paragraph writing exercises, comprising ten exercises that required them to produce paragraphs in different rhetorical structures based on the course textbook as well as the other six that required them to write paragraph-length summaries of the CCDL chat sessions. In addition, the students wrote a short essay comprising multiple paragraphs on daily topics of their choice at the end of the academic year. For each assignment, the students submitted typewritten documents, which were returned to the students with the instructor's written comments on content, grammar, usage, and mechanics.

In addition, students participated in the CCDL sessions held in computer labs out of class. In each session, they communicated through text-chat in teams of three to five Japanese and Korean students for about 40 minutes. In total, each student was scheduled to attend two weekly sessions in spring and four to five weekly sessions in fall. The students posted two on-line discussion board entries out of class to follow up on the text-chat discussions in each of the spring and fall semesters.

2.2.2 Class 2 (Second-Year Writing Course)

A general goal of this class was to foster students' English production skills through various classroom activities and assignments. Students in this class were engaged mainly in the following required activities throughout the academic year: (1) learning the notion of paragraph in English text and how to write paragraphs based on different rhetorical structures, which is basically the same as that of Class 1; (2) learning how to develop and deliver two-minute oral presentations based on the written paragraphs once every three weeks; (3) learning how to make effective and attractive slides for their presentations; and (4) learning how to write a five-paragraph essay at the end of the academic year incorporating what they have learned throughout the course.

To accomplish all the requirements above, the students were engaged in various tasks that required them to word-process English text on PC. Every activity described below required word-processing and other ICT skills. First of all, they wrote a 120-150 word paragraph based on different rhetorical structures on Microsoft® Word every week and then uploaded the file onto the class website powered by Google Site, which is a cloud-based interactive website shared among all the class members. The website enabled the students to browse their classmates' assignments and post comments on them. The

² The text-chat sessions were implemented as part of the Cross-Cultural Distance Learning (CCDL) Program at Waseda University. Generally speaking, the CCDL sessions conducted during the 2011 academic year followed the same format and procedure as those implemented in the 2010 academic year. For further details, see Sawaki (2011).

instructor also used the website to give them feedback. Secondly, the students prepared slides for their oral presentations. They were required to incorporate one supporting sentence from the written paragraph on one slide per presentation as well as a topic sentence and corresponding concluding sentence on each slide. The students also uploaded their presentation files onto the class website for review by other students. Some students developed elaborate presentation slides to make up for their poor language proficiency, while others purely enjoyed making their slides look attractive by employing photographs and animations.

Throughout the year, students completed a total of 12 paragraph writing exercises, including those in eight different rhetorical structures based on the course textbook as well as one five-paragraph essay on an academic topic of their interest. They were strongly encouraged to relate the topic of the essay to that of the seminar they had chosen for the following academic year. For example, a student who wished to study English literature wrote an essay on the life of Bernard Shaw, and one who planned to research on English education wrote about pros and cons of English education at the elementary school level. In addition, the students gave five oral presentations in total, four based on different paragraph rhetorical structures and one based on the final academic essay.

2.2.3 Class 3 (Second-Year Writing Course)

A general goal of this class was the same as that of Class 2: to foster students' English production skills through various classroom activities and assignments. As in Class 2, students in this class learned the notion of paragraph in English text and how to write paragraphs based on different rhetorical structures. They were also required to write a five-paragraph essay at the end of the course. The difference between this class and Class 2, however, was that learners in this class were not required to give oral presentations in the course, while those in Class 2 developed and delivered two-minute oral presentations based on written paragraphs every other week.

To accomplish all the requirements above, the students in Class 3 also completed various writing tasks that required them to type English text on PC. After they learned target expressions and/or rhetorical structures for a given class, they typed a 100-150 word paragraph based on different rhetorical structures every week on Microsoft Word and then submitted the file to the instructor, instead of posting it on a website. In the following week they were required to write feedback on other students' paragraphs as well as their own. The instructor then gave the feedback to the author of each paragraph. Sometimes they were required to type comments on other students' essays as well.

During the academic year, students completed a total of 20 paragraph writing exercises, including eight different rhetorical structures based on the course textbook as well as one five-paragraph essay on persuading smokers to quit smoking. All the topics offered in this class were related to students' daily life: what young people should do in order to get a job, whether Japan is a rich country or not, how one would feel if he/she had an organ transplant, and so on.

2.3 Materials and Procedure

For the purpose of testing students' skills to word-process English text, the typing test menu on the website of Sense-Lang.org (<http://www.sense-lang.org/typing/>) was used. Each trial of the typing test was 40 seconds. Among the Default, BBC News, and

Certification menus available on the website, the Default menu was employed. In this typing test menu, a single-line text appeared across the top of the screen. The user was required to type the letter displayed with an underline as fast and accurately as possible. When the character was typed correctly, the underline shifted to the next letter, which the student then typed. This process of typing the underlined letter and shifting to the next was continued for 40 seconds in one trial. Once the test was complete, the typing speed was reported in the number of words typed in a minute (WPM), along with three typing accuracy measures: the total number of letters typed, the number of letters typed incorrectly, and the accuracy rate (%).

In each class, the typing test was conducted twice as the pretest and the posttest during the 2011 academic year. The pretest was administered during the second week in the spring semester, while the posttest was administered during the last week in the fall semester. All classes had the tests in computer labs as part of regular classes. In each occasion, students accessed the typing test menu on the Sense-Lang.org website from individual PC platforms. At the outset, they were allowed to spend about 5-10 minutes to familiarize themselves with the test format. They then proceeded to take the test. Each student completed two trials and reported their typing speed (WPM) and accuracy (% accuracy) measures for each trial to the instructor. It took approximately 20-30 minutes for each student to complete the test procedure.

The test-retest reliability coefficients, calculated as the Pearson correlation coefficients between two typing test trials, were .96 for the pretest and .97 for the posttest, suggesting high consistency of the typing speed measures obtained across the two trials in each testing occasion. The test-retest reliability coefficients obtained for the % accuracy rates were .30 for the pretest and .55 for the posttest. These values are considerably low for test-retest reliability estimates; however, this result can be accounted for by the lack of variation in the students' % accuracy scores. As described in more detail below, the accuracy rates were generally high with limited score variability. Thus, they were not rank-ordered consistently across the two trials in each occasion.

2.4 Analysis

Based on the results from the pretest and the posttest the students submitted to their respective instructors, the means for WPM and % accuracy across two trials were calculated separately for the pretest and posttest for each student. The subsequent analyses were conducted based on those four mean scores: the mean typing speed measures (WPM) for the pretest and the posttest, and the mean typing accuracy measures (accuracy %) for the pretest and the posttest. Descriptive statistics were calculated for those four variables for the entire sample and for each class separately. Next, means on the typing speed and accuracy measures were compared across the pretest and the posttest. As described above, examining how students' word-processing skills developed in the three existing sections of English Composition I and II were the focus of this study. Thus, the instructional level and content were not controlled for a comparison of the three classes specifically for the purpose of this study. For this reason, the data were analyzed by conducting dependent sample *t*-tests between the pretest and the posttest measures, separately for each class. No statistical significance test for a simultaneous comparison of all three classes was conducted. All the data analyses were conducted by using PASW Statistics Version 18.

3 Results

In order to examine the trends in the development of typing speed and accuracy, all available cases (including those with missing data for either the pretest or the posttest) were plotted, and corresponding descriptive statistics were examined first. Figure 1 presents histograms for the typing speed data (WPM) by class for the pretest and posttest. For all classes, the score distributions for the typing speed data were positively skewed. The common trend seen across classes was that a majority of the students typed around the speed of 20 to 40 WPM, while a small number of students typed much faster at the speed of over 50 WPM. Despite the similarities observed in the overall distributional shapes, however, some differences were observed in the mean typing speed across classes and between the pretest and posttest. As can be seen in the left-hand portion of Table 1, the typing speed (WPM) of Class 1 (Mean = 28.6, SD = 11.4) was considerably lower than those of the two second-year classes (Mean = 33.1, SD = 11.0 for Class 2; Mean = 31.9, SD = 9.2 for Class 3) on the pretest. However, the gaps between Class 1 and the two second-year classes narrowed considerably on the posttest. The mean typing speed for Class 1 was 34.9 (SD = 10.9) for the posttest, which was comparable to those for Class 2 (Mean = 34.8, SD = 9.3) and Class 3 (Mean = 36.6, SD = 9.6). The increase in the mean typing speed of 6.3 WPM for Class 1 between the pretest and posttest was the greatest among the three classes, followed by the increase of 4.7 WPM for Class 3 and the increase of 1.7 WPM for Class 2.

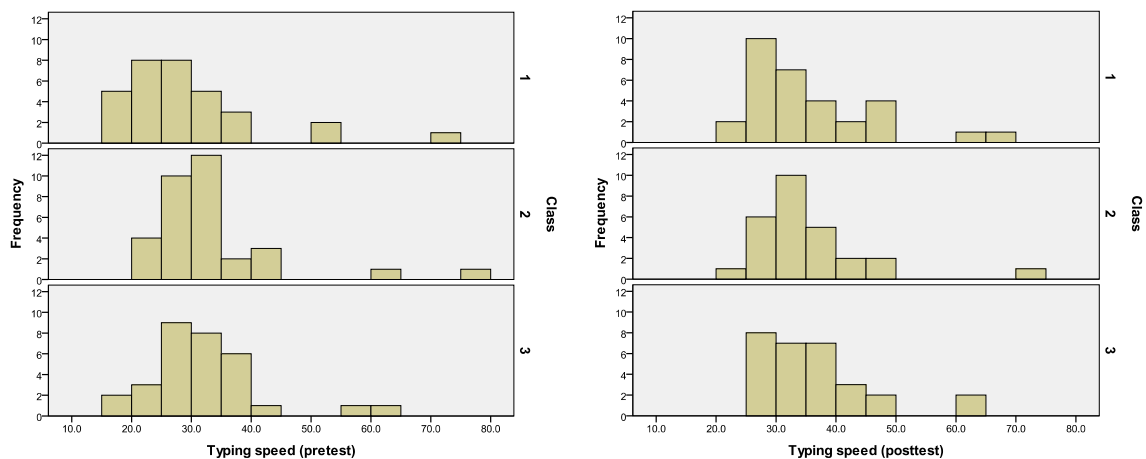


Figure 1. Comparison of typing speed (WPM) between the pretest and posttest

The histograms for the typing accuracy rate (%) are presented by class for the pretest and posttest in Figure 2. In contrast with the distributions of the typing speed data, the distributions of the typing accuracy data are all negatively skewed, suggesting that a majority of students in each class typed at high accuracy rates over 90% and that a small number typed with lower accuracy rates around 75-90%. As shown in the right-hand portion of Table 1, the mean accuracy rates were generally high in all classes on both the pretest and posttest, ranging from 94.0% (Class 3) to 95.8% (Class 2) on the pretest and from 93.8% (Classes 2 and 3) and 95.0% (Class 1) on the posttest. It is worth noting that, in all classes, the mean typing accuracy decreased slightly in fall, which will be discussed further below.

Table 1 Descriptive statistics for the entire sample and by class

Class		Speed (WPM)		Accuracy (%)	
		Pretest	Posttest	Pretest	Posttest
1	N	32	31	32	31
	Mean	28.6	34.9	95.6	95.0
	SD	11.4	10.9	3.4	3.2
	Minimum	15.5	21.5	86.0	88.0
	Maximum	70.0	67.5	100.0	100.0
2	N	33	27	33	27
	Mean	33.1	34.8	95.8	93.8
	SD	11.0	9.3	3.3	4.8
	Minimum	21.5	24.0	86.0	77.5
	Maximum	77.5	70.0	100.0	99.5
3	N	31	29	31	29
	Mean	31.9	36.6	94.0	93.8
	SD	9.2	9.6	3.7	3.8
	Minimum	15.5	25.5	83.0	82.5
	Maximum	62.5	63.5	99.5	99.0
Total	N	96	87	96	87
	Mean	31.2	35.4	95.2	94.2
	SD	10.6	9.9	3.5	4.0
	Minimum	15.5	21.5	83.0	77.5
	Maximum	77.5	70.0	100.0	100.0

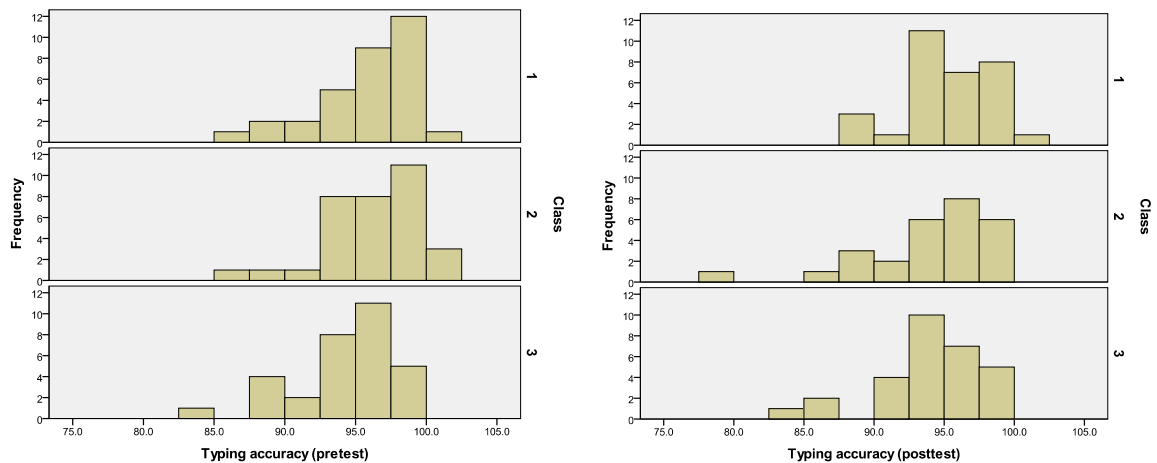


Figure 2. Comparison of typing accuracy (% correct) between the pretest and the posttest

Finally, the mean typing speed and accuracy measures were compared between the pretest and posttest by conducting a dependent sample *t*-test for each class separately. Only complete cases were included in this analysis. As shown in Table 2, the mean typing speed measures (WPM) were statistically significantly different between the pretest and posttest in all classes, suggesting increases in typing speed on the posttest ($t = -10.13$, $df = 29$, $p < .01$ for Class 1; $t = -2.78$, $df = 24$, $p < .05$ for Class 2; $t = -4.82$, $df = 26$, $p < .01$ for Class 3). The values of Cohen's *d* (Cohen, 1988) suggested that the effect sizes were medium for all classes ($d = 0.59$ for Class 1; $d = 0.53$ for Class 2; and $d = 0.50$ for Class 3).

As for typing accuracy rate (%), the mean on the posttest was significantly lower than that for the pretest for Class 2 ($t = 2.81$, $df = 24$, $p < .05$) with a medium effect ($d = 0.62$). In contrast, this difference was observed neither for Class 1 nor Class 3 ($t = 0.65$, $df = 29$, *n.s.*, for Class 1; and $t = -0.40$, $df = 26$, *n.s.*, for Class 3).

Table 2 Results of *t*-tests on typing speed (WPM) and accuracy (%) for each class

Class	N	Speed (WPM)				Accuracy (%)			
		Pretest	Posttest	df	<i>t</i>	Pretest	Posttest	df	<i>t</i>
1	30	28.0 (10.8)	34.4 (10.8)	29	-10.13**	95.5 (3.4)	95.1 (3.3)	29	0.65
2	25	30.2 (5.3)	33.2 (6.1)	24	-2.78*	96.0 (3.4)	93.5 (4.8)	24	2.81*
3	27	32.3 (9.2)	37.0 (9.7)	26	-4.82**	93.8 (3.8)	94.0 (3.7)	26	-0.40

* $p < .05$; ** $p < .01$

4 Discussion and Conclusion

The results of the present study suggested some notable trends in the development in speed and accuracy of typing English text among English majors in undergraduate-level English writing courses at a university in Japan. Key results of this study can be summarized in terms of four points. First, dependent sample *t*-tests conducted separately for each class showed that the mean typing speed increased significantly during the course of one-year writing instruction, with medium effects, in all three classes studied. As can be seen in the description of each class above, no exercise focusing specifically on the development of typing speed and accuracy was provided in these classes. Accordingly, a plausible explanation for the present findings is that the students' frequent and regular engagement in word processing activities for completing the various types of writing assignments such as text-chat discussion (Class 1 only) as well as paragraph and essay writing (in all classes) throughout the academic year contributed to the development of their speed in typing English text.

Second, the mean typing speed gain of 6.4WPM for Class 1 was relatively large compared to those for the two second-year classes. Moreover, the mean typing speed for Class 1 was relatively low on the pretest but it increased to the extent that it was comparable to those of Classes 2 and 3 on the posttest. Various explanations for this result seem possible, one of them being the increase in the amount of time spent for writing exercises involving word-processing for the first-year students compared to the previous years. Another important reason may be the Class 1 students' repeated engagement in the text-chat sessions as part of the CCDL program out of class in both the spring and fall semesters. A review of the students' chat logs from these sessions indicated that, most of the time, the students produced utterances at the phrase and sentence levels. Thus, linguistic characteristics of the text written by students during the text-chat sessions markedly differed from those of longer text such as the paragraphs they produced as writing assignments for the course. Nevertheless, the text-chat sessions required students to word-process text instantly in response to utterances made by other group members, suggesting the possibility that these text-chat discussions functioned effectively as a typing fluency development exercise.

Third, patterns observed in the development of typing accuracy were complex. While typing accuracy dropped significantly for one second-year class over the academic year with a medium effect, no such difference was observed between the pretest and posttest for the other two classes. Given the important role typing fluency plays in the long-term development of writing ability, the significant drop in typing accuracy in Class 2 over the

academic year, showing a medium effect, was intriguing. Previous research suggests that a tradeoff between speed and accuracy is often expected in performance engaging cognitive skills in general (e.g., MacKey, 1982). Moreover, less experienced writers are expected to engage primarily in bottom-up processing, with greater attention to accuracy than to speed. The more their writing skills develop, however, the more important their processing speed becomes. Accordingly, in the course of the development of writing skills, learners are expected to develop accuracy first, followed by fluency, and, eventually, automaticity (Segalowitz, 2010). From this perspective, the importance of typing speed should be recognized in particular, even if it means a compromise on accuracy, in long-term development of writing ability. If the view above concerning the fluency-accuracy tradeoff and the sequential development of accuracy, fluency, and automaticity is applicable to typing skills, it is possible to hypothesize that the faster one types text, the less accurate he/she becomes, and vice versa, and that a decrease in typing speed indicates development of the learner's writing ability. Examining such hypotheses seems an interesting direction for future research.

Finally, while the present study focused on the overall trends observed in the mean comparisons across two testing occasions in the academic year in each class, the data suggested that a small number of students' performance deviated from the overall trends seen among the majority of the students. Detailed investigation of these students' background variables would inform instructional planning. To this end, supplementary information was collected from students who typed relatively faster than others for a post hoc analysis. Five students whose typing speed exceeded 50 WPM were selected across the three classes for this analysis. The development of typing performance over the academic year shown in the pretest and posttest results varied across these students. Two students' typing speed increased by 7 to 11 WPM on the posttest; two other students' typing speed either stayed the same between the two occasions or decreased slightly on the posttest. The remaining one student's results were missing for one occasion, and thus such a comparison could not be made. These five students responded to a short survey via e-mail. In the survey, they were asked to provide their reflections as to why they were able to type faster than other students on the typing tests. All students responded to the survey in Japanese. The results revealed some commonalities in their background in typing. A notable point is that all of them had developed typing speed by the time they were in junior high school, no matter how they had learned how to type English text. Three students in the second-year classes were familiar with PCs because their parents used them when the students were small children; they started typing with computer keyboards as elementary school students; they learned typing through playing typing games; and they started touch typing when they were in junior high school. Below are English translations of excerpts from responses of three students in the second year, which provide illustrative examples of their previous word-processing experience concerning typing games in particular:

I think I became able to type fast because I started to play typing games on PCs in my early years in elementary school. The game was actually PC software for typing practice called "Uchimomo." To me playing the game was more like a play than an exercise. In particular, I focused on a game where I had to type randomly-ordered letters in the Roman alphabet. Level 1 was for practicing typing the letters in the row of the letter "A" on the keyboard; Level 2 was for the letters in the rows of the letters "A" and "Q"; Level 3 was for the letters in the rows of the letters "A," "Q," and "Z"; and Level 4 was for typing English words...I competed against my other family members on the game, so I enjoyed playing it even when I was in upper grades in elementary school and in junior high school. Since the game was for typing randomly-ordered letters in the Roman alphabet rather than Japanese characters, my hands remember the locations of the letters,

which I don't need to know when typing using the [kana] input mode. This I think is the reason why I type fast. (Student 1, Class 2)

I think I started typing during my early and middle years in elementary school. I used to play games where I could enter characters with keyboard often. (Student 2, Class 3)

I think I became able to type fast because I like typing games very much. You can beat your opponent if you type fast on those games. The games I used to play were for typing Japanese. I use the Roma-ji input mode when I type Japanese text. To me typing English text is not so different from typing Japanese text [in the Roma-ji input mode] because I know the locations of the letters in the Alphabet on the keyboard. I do not remember how I developed the typing skills that I have now because I enjoyed the games without thinking too much about practicing typing. As for how much I practiced, I think I played the typing game almost every day since I became interested. I think I reached my current level when I mastered the game... (Student 3, Class 3)

Meanwhile, the remaining two students (Students 4 and 5) were both in Class 1 and were returnees from English-speaking countries. Information as to whether the three second-year students above (Students 1, 2, and 3) grew up in Japan was not available to this study. Thus, no difference observed between those three students and the two first-year students can be attributed simply to where they grew up—either in Japan or overseas. However, survey responses obtained from Students 4 and 5 revealed unique experiences in typing training they received overseas, which seems quite distinct from what one might expect to experience in typical grade schools in Japan. Student 4 started typing in kindergarten, while Student 5 started in junior high school. While neither of them mentioned whether their parents used PCs as they grew up, both had typing classes regularly and were required to word-process their writing assignments or responses to test questions, as illustrated in the excerpts from their survey responses below:

When I lived overseas, I used to have typing lessons a few times a week since I was small. Each student practiced typing at his/her own pace, using typing exercise programs. From the beginning, the instruction focused on practicing touch typing. Those students who had habits of looking at the keyboard while typing were even required to use a cover so that they could not see the keyboard. I became confident about my typing because I continued to practice typing this way throughout my elementary school years. In addition, in schools overseas, it is often difficult to read students' responses to test questions due to their poor writing. Therefore, we were often required to word-process our responses to test tasks. I went through such a curriculum that is different from what we have in Japan, and that I think is the reason why I was able to develop the typing skills that I have now. (Student 4, Class 3)

I started typing after I entered junior high school. In junior high school I had typing classes almost every day. In high school the number of classes where we had to word-process text increased. We needed to use PCs to complete class assignments, and I was in a situation where I had to type [to do anything]. (Student 5, Class 3)

One notable finding of this post hoc survey was that some of the students who were able to type fast developed their typing skills as they were frequently engaged in word processing exercises while perceiving them as a form of entertainment (Students 1, 2, and 3) or took typing lessons in their early years of learning word-processing (Students 4 and 5). In addition, all of them reported that they engaged in word-processing for academic work and for daily communication with others. These results have important implications to planning

instructional content of writing courses such as those examined in this study. That is, having students engage in some form of focused typing speed and accuracy development exercises may be effective in early stages in particular. At the same time, however, the results of the statistical analysis and the post hoc student survey suggest that students may also be able to develop their word-processing skills incidentally through their engagement in other writing tasks involving word-processing such as authentic communication with others as well as writing for academic purposes.

While the present study yielded useful results for us to consider how one might go about making writing instruction at the undergraduate level more effective, it has some notable limitations as well. First, caution should be exercised so as not to over-interpret the present findings. This study did not employ a true experimental design where performance of groups receiving different types of instruction could be compared with that of a control group. For this reason, a separate investigation is required in order to examine the effects of the specific writing activities students in the three writing classes were engaged on the development of their typing accuracy and speed. A second limitation concerns the fact that this study separately examined two aspects of typing skills: speed and accuracy. A construct often studied in reading comprehension research, for instance, is reading efficiency, an index of one's global reading comprehension ability. A frequently-used measure of reading efficiency is the product of reading speed (e.g., the number of words read per minute; WPM) and reading accuracy level (e.g., proportion correct on reading comprehension test questions). Because the trend observed in the development of typing speed was not consistent with those observed for typing accuracy in this study, employing a measure of typing efficiency analogous to the one for reading efficiency described above would allow us to better understand how typing skills develop as a whole. Finally, the present study focused on statistical analyses of typing test data at a group level. However, such a group-level analysis does not address how individual students' typing skills develop over a period of time. Accordingly, it is worth exploring how individual students' typing skills develop in future studies as well.

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