



RIETI Discussion Paper Series 17-E-030

# **Impacts of an ICT-assisted Program on Attitudes and English Communicative Abilities: An experiment in a Japanese high school**

**HIGUCHI Yuki**

Nagoya City University

**SASAKI Miyuki**

Nagoya City University

**NAKAMURO Makiko**

Keio University



Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry

<http://www.rieti.go.jp/en/>

Impacts of an ICT-assisted Program on Attitudes and English Communicative Abilities:  
An experiment in a Japanese high school\*

HIGUCHI Yuki  
Nagoya City University

SASAKI Miyuki  
Nagoya City University

NAKAMURO Makiko  
Keio University

Abstract

We conducted a randomized experiment targeting 322 Japanese high school students to examine the impacts of a newly developed English learning program. The treated students were offered an opportunity to communicate for 25 minutes with English-speaking Filipino teachers via Skype several times a week over five months. The opportunities were offered as extracurricular activities and were not included in their grades. Results show that only 6% of the treated students completed the recommended number of lessons over the observation period. In addition, the Skype program made the treated students more interested in an international vocation and foreign affairs. However, probably due to the low completion rate, the students did not improve their English speaking and listening abilities as measured by a standardized test. Further investigation shows that the take-up rate was particularly low among students showing a tendency to procrastinate. These results suggest the importance of maintaining students' motivation to keep using such information and communications technology (ICT)-assisted learning programs if they are not already incorporated into the existing curriculum. Having procrastinators self-regulate may be especially crucial. However, significant positive changes in the students' attitude support the use of such programs even as extracurricular activities.

*Keywords:* Field experiment, Impact evaluation, English education, Information and communication technology, Applied linguistics, Procrastination

*JEL classification:* C9, I2, H4

RIETI Discussion Papers Series aims at widely disseminating research results in the form of professional papers, thereby stimulating lively discussion. The views expressed in the papers are solely those of the author(s), and neither represent those of the organization to which the author(s) belong(s) nor the Research Institute of Economy, Trade and Industry.

---

\* This study is conducted as a part of the “Measurement of the qualities of health and education services, and analysis of their determinants” project undertaken at the Research Institute of Economy, Trade and Industry (RIETI).

## I. Introduction

Providing students with high quality inputs is important in improving the quality of education. As an alternative to conventionally used inputs (e.g., textbooks, blackboard), the effects of using information and communication technology (ICT) have been recently examined in various areas in education (e.g., Bulman and Fairlie, 2016; Gee and Hayes, 2011; Levy, 2009). One of the advantages of adopting ICT in education is that it can provide personalized and self-paced learning opportunities whereas formal education generally provides uniform inputs for students in the same classroom. Examples of ICT-assisted education include an educational software designed to complement the primary school curriculum for the teaching of languages (Rouse and Krueger, 2004; Nakamuro and Kayaba, 2016) as well as for math (Carrillo, Onofa, and Ponce, 2010; Lai et al, 2013) and video-recorded tutorials used in cramming schools to prepare students for university entrance exams (Kono, Sawada, and Shonchoy, 2016). However, such ICT inputs are generally introduced as extra-curricular activities, and their utilization depends on the students' motivation to use them.

It is increasingly recognized among economists that various decisions in our life depends on our degree of self-control (e.g., Laibson, 1997; O'Donoghue and Rabin, 1999). A series of studies by Onji and Kikuchi (2011) and Onji (2013) illustrates how the self-control issue arises in education, where lack of self-control, including procrastination, can result in poor test performance. Based on these studies, we hypothesize that lack of self-control is also likely to hinder the utilization of ICT-assisted education programs, especially when provided as extra-curricular activities. The lack of self-control and consequent limited utilization is arguably a cause of mixed impacts of ICT education reported in the survey article by Bulman and Fairlie (2016). To shed light on the

relationship between students' use of ICT inputs, their degree of self-control, and effectiveness of the ICT inputs, we conducted a randomized experiment to analyze impacts of an ICT-assisted program provided as an English extra-curricular activity.

Methodologically, we experimentally introduced a newly-developed online English learning program, which makes use of Skype, to 322 students in Grade 10. The Skype program is an individualized, self-paced program in which students communicate with English-speaking Filipino interlocutors at mutually convenient times using learning materials of their own choice. We selected English education as our research target because the quality of English education has recently been one of the most serious political concerns in Japan due to its inefficiency (Butler and Iino, 2005). In contrast to the high internationally-normed performance of Japanese students' in math, reading, and science as measured by the OECD's Program for International Student Assessment (PISA) for Grade 9 students, their performance in English has been far from satisfactory. According to a nationwide English test conducted in 2014 by the Ministry of Education, Science, Sports, and Culture, Japan, (henceforth, MEXT), a majority of Grade 12 students were ranked at the lowest level (A1) in the Common European Framework of Reference for Languages (CEFR), with their speaking performance lowest among the four skills measured. Based on these results, MEXT recognized that the quality of English education, particularly in nurturing speaking abilities, should be improved (MEXT, 2015).

In our experiment, we introduced the Skype English Program with a cross-over design. First, we randomly selected half of our sample (161 students) to be given opportunities to use the program from July to November 2015 (five months), while the remaining 161 students were given opportunities to use the program during the following five months (from January to May 2016). While all the sample students had equal

opportunities to use the program by May 2016, only half of them had availed themselves of this opportunity in December 2015, when we conducted endline survey. We therefore called the students exposed to the program in the first round (July to November, 2015) the treatment group, and those exposed to it in the second round (January to May, 2016) the control group.

Combining program usage records and panel data collected before and after the introduction of the program to the treatment group (but not yet to the control group), three findings stand out. First, as the Skype program was introduced outside of the regular English curriculum, the utilization rate turned out to be low. Only 10 out of the 161 students in the treatment group took lessons 50 times or more over the five months, as recommended by the program provider, and 31 students did not take even a single lesson. In addition, Poisson regressions show that the take-up rate was particularly low among students with a tendency to procrastinate. Second, despite such a low take-up rate, the program positively changed the attitude of the treated students, especially in terms of their interest in an international vocation and foreign affairs. This finding is important because longitudinal studies of attitudinal changes in foreign language students are rare (Ortega and Iberri-Shea, 2005). In particular, LATE estimates suggest that the magnitude of impacts was larger for students with higher level of program utilization.

Third, despite the positive impacts on the students' attitude, the measured impacts on their English communication skills are not statistically significant. This may be attributed to the low take-up rate as well as the low intensity of the program (25 minutes per lesson) in comparison with the students' concurrent regular English classes (50 per lesson on most weekdays). These findings suggest that the Skype program can positively change students' attitudes toward an international vocation and foreign affairs, a factor

that has been found to lead to improvements in the English communication skills of Japanese students over time (e.g., Sasaki, 2011; Yashima, Zenuk-Nishide, and Shimizu, 2004). However, to make a contribution to the study of students' English proficiency development, this would have to be examined over a longer period. At present, this the study can only suggest that the program has the potential to improve the participants' English communicative abilities. Based on these findings and their implications, more research is warranted on how to improve and maintain students' motivation, particularly those with a tendency to procrastinate, to use self-regulatory programs such as the one targeted in this study.

The remainder of this paper is organized as follows. Section 2 explains the experimental design, including the context, timeline, and details of our intervention and checks for balance. Section 3 discusses the issue of program take-up, and Section 4 presents estimated program impacts. Finally, Section 5 contains a summary of the findings and implications for future studies.

## II. Experimental Design

### *Context and Timeline*

We collaborated with a public high school located in central Japan. The school belongs to the top tier in the region. For example, the school was selected as one of the 112 Super Global High Schools (SGH) among the 4,939 high schools in Japan as of 2015. SGHs are selected based on the school's strong determination to nurture globalized leaders with high levels of interest in societal problems, communication skills, and problem solving abilities, and selected schools receive special budgetary support from MEXT to nurture students who will play internationally active roles in the future. The school agreed to

introduce the Skype program as part of the extra-curricular activities.

Our sample consisted of all 322 first-year students enrolled in this high school (Grade 10).<sup>1</sup> As all of them had passed the same entrance examination, they formed a relatively homogeneous group, with high levels of academic achievement at the time of the experiment. As the school does not stream students into specialized classes in Grade 10, all of them were randomly assigned to one of eight classrooms, each consisting of 40 or 41 students (see Figure 1 for illustration). With regards to English teachers in this school, each of four English teachers was responsible for two of these eight classes. Using such classroom and English teacher assignment, we randomized the sample students at the teacher-classroom level, randomly selecting one of the two classes instructed by each English teacher to the treatment group and the other to the control group. In sum, we had four experimental classes (160 students), and four control classes (161 students).

Prior to introducing the program, we conducted a survey designed to collect information on the students' characteristics, including past exposure to English, current study environment, attitude toward English communication, and family background, including parental educational attainment. The survey was conducted in June 2015, using a mark-sheet questionnaire we developed. The timeline of our research is presented in Table 1.

[INSERT TABLE 1 ABOUT HERE]

Soon after the baseline survey was conducted, the sample students took the

---

<sup>1</sup> We provided all the parents of the sample students with the information on our research purpose before starting data collection and intervention. As parents of one student refused to provide data for our analyses, we excluded the data collected from that student, and thus the sample size is 321 in our empirical analyses.

Versant speaking test (Pearson Inc., 2008), a standardized test designed to evaluate the oral English skills (integrated listening and speaking) of non-native English speakers. We chose this particular test because of its reported high validity and reliability among populations similar to the participants in the present study and because it requires a relatively short time (20 minutes) to conduct compared to other English communication tests (e.g., TOEFL iBT). During the Versant test, the students listened to questions spoken in English and gave verbal answers in English. Their answers were recorded and scored online. The test was conducted in a computer room inside the school by class, and thus, the test-taking environment was essentially the same for all students. Due to the overburden of internet connection, however, the answers of some students were not properly recorded and were therefore removed from the subsequent analysis. Answers were scored according to four criteria: (i) sentence mastery; (ii) vocabulary; (iii) fluency; and (iv) pronunciation.

Following the survey and Versant test administered in June 2015, we began our intervention in July 2015. The students in the treatment classes were provided with opportunities to use the Skype program free of charge.<sup>2</sup> To mitigate inequality between the two groups (as mentioned above), we provided the same amount of intervention with a time lag, with the program being made available to the treatment classrooms from July to November, 2015 and to the control classrooms from January to May, 2016.

In December 2015, when only the treated students had received the program, we conducted an endline survey and Versant test. In other words, to investigate the effects of the Skype program, the treatment and the control classes were compared using difference

---

<sup>2</sup> Although the market price of the program is ¥5,800 (about \$52) per month, we provided the students with the Skype program free of charge. This included one 25-minute lesson for every day of intervention.



in differences design. In addition, in November 2015, the students took the GTEC for STUDENTS test, another standardized test developed and distributed by Benesse Co. to evaluate reading, writing, listening, and writing skills in English. The test consisted of 30 multiple-choice listening items (13 minutes), 30 multiple-choice reading items (24 minutes), 3 performative writing items (26 minutes), and 4 performative speaking items (12 minutes). As the test was taken when only the treated students were exposed the program, we compare the performance of the two groups. After the control group received the opportunities to use the Skype program from January to May 2016, all 322 students had been exposed to the same intensity of intervention (or lack thereof) by the end of May 2016.

### *Intervention*

Our intervention consisted of providing the sample students with opportunities to use the Skype program. In contrast to conventional face-to-face English learning methods, in this program, learners and teachers do not have to be present in the same space. In addition, learners can be matched with teachers on a more flexible basis because learners can select among available teachers at a time of their convenience. Such online English programs have become increasingly popular among Japanese business persons, partly because of the time flexibility and partly because of the low cost of such programs relative to similar face-to-face English learning programs offered by commercial conversation or cramming schools.<sup>3</sup> However, according to the baseline survey we conducted before the beginning of the intervention, 65% of the students have never heard of this type of online English

---

<sup>3</sup> This reduction in costs has become possible thanks to the hiring of English-speaking Filipino teachers, a development that constitutes a prime example of expanding business process outsourcing (BPO) to the Philippines.

learning program, only one was using the program, and another ten had used it in the past. In this baseline survey, 30% of the students responded that they would be very willing to use the program if given the chance, and another 50% responded that they were moderately willing to use it. Hence, while the program was new to most of the students, it was favorably perceived at the beginning of our intervention.

The Skype program was provided to the students outside of their regular English classes. Each lesson took 25 minutes, and the students were recommended to take one lesson every three days (i.e., ten lessons a month, or 50 in total) in order to take full advantage of the program. The students could make an appointment for a lesson at any time between 6 am and 1 am on the next day, and could choose any of the available teachers. If the student's preferred teacher was not available at the time of their convenience, they could choose another time slot or another available teacher in the same slot. The pool of teachers consisted mostly of current students or graduates of the University of the Philippines, the top national university in the country. Because English is the language of instruction in their home university and also because they were screened on the basis of the company's strict hiring criteria, we judged that the quality of the teachers was reasonably guaranteed. While some of the teachers spoke Japanese, participating students had to communicate entirely in English with the help of the chatting (texting) function in Skype. Students were free to choose appropriate study materials for each lesson from a wide range of materials provided by the program, including daily conversation, academic talk, grammar and vocabulary, and business English. In other words, the participants' choices of teachers, time slots, and study materials were totally up to them. Most importantly, while we provided the students with opportunities to use the program, it was ultimately up to them whether and how often to take lessons,

especially since their participation was not included in their grades.

### *Balance Check*

Table 2 presents the basic characteristics of students in the two groups. As we were interested in analyzing the effect of procrastination on the utilization of our program, we collected information on the tendency to procrastinate as well as information on (im)patience and present bias (see the next section for definitions). In addition, data on other characteristics that could potentially influence the take-up rate and impacts of the Skype program were collected. These included family background (number of books at home and parental educational attainment),<sup>4</sup> past exposure to English, and current study environment (having their own room, owning a smartphone, a personal computer, or a tablet, commuting time to school, and membership of a school sports club). Except for number of books at home, which is different between two groups at 10% significance level, their characteristics were balanced. Hence, we concluded that the randomization was successful.

[INSERT TABLE 2 ABOUT HERE]

### III. Program Utilization

#### *Measurement of Procrastination*

Procrastination was measured through six questions asking students to rate their perception of themselves taken from Osaka University (2013) and Honda and Nishijima

---

<sup>4</sup> Number of books at home is reported to be a good proxy of cultural capital (e.g., Lareau, 1987; DiMaggio, 1982).

(2007). The questions (originally written in Japanese and translated by the authors) included items such as: “Are you a person who postpones plans even when you make one?” “Are you a person who impulsively buys things you like?” and “Are you a person who is happy as long as you have fun now?” The students answered all six questions with categorical responses; *Yes*, *Moderately yes*, *50/50*, *Moderately no*, or *No*. We assigned a score of 4 to the answer *Yes*, 3 to *Moderately yes*, 2 to *50/50*, 1 to *Moderately no*, and 0 to *No*. We then aggregated the scores for all six questions in order to construct a single index of procrastination, which ranged from 0 to 24 (4 maximum by 6 items). These aggregated scores were normalized by subtracting the sample means divided by the standard deviations and were presented as *z*-scores.

In addition to the tendency to procrastinate, we elicited two other behavioral attributes, namely (im)patience and present bias, using standard questions to measure time preference (e.g., Frederick, Loewenstein, and O'Donoghue, 2002). We asked whether students would prefer to receive “¥2,000 (about \$18) today or ¥2,500, ¥3,000, or ¥3,500 a month later.” Based on the answers to these three questions, we computed the 1-month current discount rate from today. The impatience variable was scored 0 if the discount rate was less than 25%, 1 if 25-50%, 2 if 50-75%, and 3 if more than 75%. Similarly, we asked whether the students would prefer to receive “¥2,000 six months later or ¥2,500, ¥3,000, or ¥3,500 7 months later” in order to compute the 1-month future discount rate in sixth months' time. By comparing the two discount rates (current and in sixth months), we constructed a dummy variable for present bias, which was assigned one if the current discount rate was greater than the future discount rate.

### *Program Utilization*

Figure 2 shows daily changes in the number of students who took the lessons based on program usage records. Of the total 160 students assigned to the treatment group, the average number of students who took lessons per day was 25 in July 2015. However, if all students followed the recommended 10 lessons a month, that number should be 52 (=10 lessons times 160 students divided by 31 days). Thus, the take-up rate in the first month of the intervention was about half. Moreover, the number of students taking lessons gradually decreased, presumably as the novelty effect faded, with the average number falling to 15 in August, 12 in September, 6 in October, and 5 in November. The take-up rate among the control group also showed a declining tendency. However, the number of lessons taken up was much lower than in the treatment group throughout the five-month period. This can be explained by the change in students' orientation toward university entrance exams (as the share of listening in the Center Exam, the crucial entrance exam taken by most applicants for university admission, is small and speaking is not a part of the exam; see Sasaki, 2011) as well as by an increased study workload. In addition, reduced encouragement may also explain the lower take-up rate among the control group because we occasionally visited the school to ask the school principal and the English teachers to encourage the utilization of the program in the first period but not in the later one.

Panel A of Figure 3 shows the distribution of lessons taken in five months among the treated students. By the end of our first intervention, 31 (19%) of the 160 students never took any lessons, and 57 (36%) took 5 or fewer lessons. Only 23 students (14%) completed 25 or more lessons, which was only about half of the recommended number, of whom only 10 (6%) completed the recommended 50 or more lessons over the five months. Furthermore, Panel B illustrates that the utilization was even lower in the control

group, which received the Skype program after the treatment group's intervention. Of the 161 students in the control group, as many as 122 (76%) took no lesson at all, and only 1 completed the recommended number of lessons.

### *Procrastination and Program Utilization*

To identify factors associated with program utilization, we estimated Poisson regression models. Poisson models are adopted because the dependent variable of number of lessons taken over five months is a count variable with many observations with zero count. The explanatory variables include *z*-scores of procrastination and other characteristics of the sample students listed in Table 2. As a number of students refused to provide information on their parents' educational attainment, we omit these two variable (father's education and mother's education) from the regression models and only use the Number of Books at Home variable as a proxy of cultural capital.

Table 3 shows the estimated results of the Poisson regression models. In columns 1 and 2, both treated and control students are pooled a dummy variable taking the value of one for a treated student is included as an explanatory variable. Results with only the treated students are shown in columns 3 and 4 (corresponding to Panel A of Figure 3), whereas those with only the control students are shown in columns 5 and 6 (corresponding to Panel B of Figure 3). In even-numbered columns, the classroom dummies are additionally included as explanatory variables, and standard errors are clustered at the classroom level in all the columns.

[INSERT TABLE 3 ABOUT HERE]

In all the columns, the procrastination variable is negative and significant, illustrating the detrimental effect of procrastination on program utilization. This effect is observed both in the first period, when the novelty effect was likely to be large, and in the second period, when the control group were given opportunities to use the Skype but their interest in the program started to decrease. Evidently, the issue of self-control is a concern when a new ICT-assisted program such as the one used in the present study is introduced. In terms of size of the effects, marginal effects of procrastination is computed as -3.21 at the means of all explanatory variables; that is, a standard deviation increase in the procrastination index reduces the number of lessons by three times for an average student. Although the magnitude seems to be small, the first few trials of the program is critical for subsequent utilization. The program was new to most of the students and, according to our informal interviews with sample students, they started to like the program as they went through initial few lessons and talked with Filipino interlocutors.

To identify factors associated with the initial decision to try the program, we estimate Probit regression models, where the dependent variable is a dummy variable that takes the value of one if a student ever used a program and zero if he/she never took any lesson. As discussed above, the share of such never-taker is 19% in the first round and 76% in the second round. The estimated results are reported in Table 4 in a similar manner as Table 3. The coefficient of procrastination is negative and significant in all the columns. The estimated coefficient in column 1, i.e., -0.43, indicates that a standard deviation increase in the procrastination index increases the probability that a student never takes lesson by 11 percentage point, which is not negligible. Therefore, Tables 3 and 4 suggest that students' procrastination tendency hinders their first take-up and their subsequent utilization of the program.

[INSERT TABLE 4 ABOUT HERE]

In contrast to consistently significant coefficient of procrastination, variables representing impatience and present bias have weaker predictable power for program utilization. These two variables are based on questions asking their preference in monetary trade-off, and students in Grade 10 may not be accustomed to such monetary trade-off of ¥2,000 (about \$18) in their daily life. Instead, our procrastination variable, which is based on a number of questions asking their general tendency in real life, has stronger predictable power. The English in Primary School variable has unexpectedly negative sign in both Tables. This indicates that students who started to be exposed to English from their younger age are less likely to start and continue using the program although such students are expected to have lower psychological barrier to communicate with English interlocutors. Another notable point illustrated in these Tables is the negative and significant coefficients of commuting time and sports club participation. It seems that the utilization of time-consuming extra-curricular ICT lessons is constrained by students' available time. Particularly, participation in extra-curricular sport activity appears to be an intervening factor.

#### IV. Impacts of Skype Program

##### *Outcome Measures*

We included two sets of outcome measures to evaluate the impacts of the Skype program: Attitudes and English communicative abilities. To quantitatively measure any changes in student attitudes toward English communication before and after the



intervention, we employed two motivational attributes, which have been found to influence students' second language development: International posture and Willingness to communicate (WTC) (e.g., Yashima et al., 2004). First, the construct of International posture was operationally defined as a composite of four sub-constructs: (1) Intercultural orientation; (2) Interest in an international vocation; (3) Reactions to different customs, values, or behaviors; and (4) Interest in foreign affairs. These sub-components and corresponding items were adapted from those made available on the homepage of Professor Tomoko Yashima, the researcher who first introduced this construct in the field of applied linguistics (e.g., Yashima et al., 2004).<sup>5</sup> Using all 22 items available (7 for Sub-component 1, 6 for Sub-component 2, 5 for Sub-component 3, and 4 for Sub-component 4), we further changed these into yes/no questions. We then computed a score for each of the four sub-components of International posture and then computed total scores, which ranged from 0 to 22, with higher score indicating a more internationally oriented student. Although original version of the 22 questions were asked with a six-point Likert scale, we simplified to yes/no questions in order to avoid causing excessive fatigue to the students, who had to respond to many questions in our survey.

The second motivational variable (WTC) has also been found to have significant and complex relationships with second language learner confidence, motivation, and actual language use (e.g., MacIntyre, 2007). As in the case of International posture, we took the eight items that measured WTC from the above-mentioned homepage because they have been successfully used with Japanese high school students learning English as a second language (e.g., Yashima, 2009).<sup>6</sup> The questions asked whether the students

---

<sup>5</sup> Retrieved on March 10, 2017 from: <http://www2.ipcku.kansai-u.ac.jp/~yashima/data/kokusai.pdf>

<sup>6</sup> Retrieved on March 10, 2017 from: [http://www2.ipcku.kansai-u.ac.jp/~yashima/data/wtc\\_scale.pdf](http://www2.ipcku.kansai-u.ac.jp/~yashima/data/wtc_scale.pdf)

would communicate in English in hypothetical situations such as “group discussions on an English course,” “giving a speech in public,” and “a chance meeting with a foreign friend in the street.” A six-point Likert scale offered the following choices; *always*, *usually*, *sometimes*, *not very often*, *seldom*, and *never*. We assigned 5 points to the answer *always*, 4 to *usually*, 3 to *sometimes*, 2 to *not very often*, 1 to *seldom*, and 0 to *never* and compute z-value of the total points.

To quantify the students’ English communicative ability, we use Versant and GTEC test scores. As discussed in Section II, we collected data for the attitude measures and Versant test scores both before and after our intervention in order to measure the development of these variables. With regard to GTEC scores, we had only cross-sectional data collected after the intervention.

### *Econometric Specification*

To analyze the impacts of the Skype program, we applied two econometric specifications: Value-added regression and Fix-effect regression. Let  $y_{ijt}$  be an outcome variable, which can be attitude or English communicative ability, of student  $i$  in classroom  $j$  at the time  $t$ . The Value-added specification is written as:

$$y_{ijt} = \alpha + \beta Treatment_{ij} + \gamma y_{ijt-1} + \varepsilon_{ijt}, \quad (1)$$

where  $Treatment_{ij}$  is a dummy variable taking the value of one for the treated student in class  $j$ ,  $y_{ijt-1}$  is an outcome variable at  $t-1$  (as we have only two time period,  $t-1$  stands for the baseline and  $t$  stands for the endline), and  $\varepsilon_{ijt}$  is a standard error clustered at the classroom level.  $\beta$  is our parameter of interest, which captures the intention-to-treat (ITT)

impacts of the program. In addition to the conventionally adopted Value-added specification in analyzing academic performance, we also adopt a standard Fixed effect model to control for unobserved time-invariant student-level heterogeneity,  $v_i$ , with the following specification;

$$y_{ijt} = \alpha + \beta Treatment_{ij} * Endline_t + \delta Endline_t + v_i + \varepsilon_{ijt}. \quad (2)$$

where  $Endline_t$  is a dummy variable taking the value of one if the data is collected in the endline, i.e., after the intervention.  $v_i$  is removed by estimating Equation (2) with Fixed-effect specification.  $\beta$  is our parameter of interest, capturing the ITT program impacts whereas  $\delta$  captures changes in the outcome variable from the baseline to the endline, which are mostly consequences of regular school curriculum as well as other changes that are commonly occurred to all students.

Next, to analyze the differential impacts of the Skype program by level of its utilization, we use an instrumental approach to estimate local average treatment effect (LATE) (Imbens and Angrist, 1994). Specifically, we replace  $Treatment_{ij}$  in Equations (1) and (2) with  $Lessons^k_i$ , which takes the value of one if student  $i$  took at least  $k$  lessons during the intervention period. We use  $Treatment_{ij}$  as an instrument for  $Lessons^k_i$  to estimate the program impact for students in compliance by changing the threshold number of lessons. As the assignment of the treatment was random,  $Treatment_{ij}$  works as a valid instrument.

### *Estimation Results*

Panel A of Table 5 shows ITT estimates of program impacts on students' attitudes. Odd-

numbered columns report estimated results of Equation (1) whereas even-numbered columns report those of Equation (2). Although not significant, column 1 and 2 show positive coefficients of the Treatment on the total international posture score. In the Fixed effect estimation in column 2, coefficient of the Endline is negative, indicating that overall international posture score tended to decline from the baseline survey in June 2015 to endline survey in December in the same year. This is likely because that students became more oriented toward university entrance exams and lost interest in international communication as their school curriculum shifted toward preparation for entrance exams. The coefficient of the Treatment is 0.47 whereas the coefficient of the Endline is -0.46 (not significant but  $p$ -values is close to 0.1), suggesting that the Skype program helped mitigating the reduction in international posture score.

[INSERT TABLE 5 ABOUT HERE]

When we take a closer look at sub-constructs of the total score, this is more evident in Sub-component 2 (interest in international vocation) reported in columns 5 and 6. The coefficient of the Treatment is 0.26 whereas the coefficient of the Endline is -0.20, both of which are statistically significant, indicating that students generally became less interested in international vocation after they spend half a year in Grade 10 but the Skype program helped retain their interest in international vocation. In addition, columns 9 and 10 suggest that the program helped students to have their interest in foreign affairs. Taken together, we can claim with some confidence that communication with the English-speaking Filipino teachers via online lessons positively altered student attitudes despite the low level of program take-up.

Panel B of Table 5 shows ITT estimates of program impacts on students' English communicative abilities. Despite the suggestive evidence of changes in students' attitudes, we do not find any significant changes in their English communicative abilities. However, attitudinal attributes have been reported to lead to eventual improvement in their second language (e.g., Sasaki, 2011; Yashima et al., 2004), and significant impacts of the Skype program may appear in a longer-term. Unfortunately, due to the experimental designs to guarantee equality, all the sample students received the same length of Skype intervention by the end of May 2016, and thus, we do not have variations to evaluate such longer-term impacts. Another important point to note from Panel B is the significant coefficient of the Endline dummy in odd-numbered columns. As scores of the standardized Versant test are comparable over time, the positive and significant coefficients suggest that students' communicative abilities increased from June to December, most likely due to their regular English curriculums. In columns 11 and 12, we report the results of GTEC exams. Since we only have scores of November 2015, these are results of cross-sectional regressions by regressing GTEC scores on the Treatment dummy with standard errors clustered at the classroom level. Same as the Versant scores, the coefficients are not significant with  $p$ -value close to zero, and thus, the program does not improve students' scores on GTEC exam.

Next, we report LATE estimates of program impacts in Table 6. Columns 1 and 2 correspond to columns 1 and 2 in Table 5 as a benchmark. When we set  $k=0$ , the Lesson dummy becomes equivalent to the Treatment dummy. In columns 3 and 4, where  $k=5$ , the Lesson dummy takes the value of one if a student took at least five lessons in the intervention period, and thus, the coefficient captures the impacts of the Skype program for students who completed at least five lessons. As expected, the size of coefficient

becomes larger as  $k$  increases, indicating that students who took more lessons benefited more from the program. The coefficient is significant in columns 3, 5, and 7. In column 7, for instance, students who took at least 25 lessons gained on average 3.90 points in their total international posture score. The size of coefficient is large compared to the baseline mean reported at the bottom of Tables. Therefore, the program has a potential to dramatically change students' attitudes if used continuously. In Panel B, although coefficients are not statistically significant, the size of the coefficient increases as  $k$  increases. This also supports our argument that students who can regularly use the program may largely benefit from the program.

[INSERT TABLE 6 ABOUT HERE]

## V. Conclusion

We conducted a unique field experiment in collaboration with a Japanese high school to provide students with an ICT-assisted program for English. Through the examination of program usage records and panel data collected before and after the experiment, we analyze factors associated with the program utilization and estimate the program impacts. With ITT specification, we found that the program significantly changed attitudes of the treated students but not their English communicative abilities. We could justifiably speculate that the insignificant improvement in English communication was due to the low take-up rate of the targeted program. In fact, we find suggestive evidence that students who regularly utilized the program largely benefited from it, using LATE specification. Hence, it is important to consider how to encourage students to use ICT-assisted programs including the one under this study. To the extent that we find students

showing a tendency to procrastinate were less likely to start and continue using the program, it is particularly important to consider how to motivate such students to use ICT-assisted programs.

Together with the overall results showing that the participating students significantly improved in their attitudinal attributes, which can have a positive impact on their English development on a long-term basis, the findings of the study have important implications for English education in Japan. The findings also suggest the direction in which future research should be directed since the problem remains of how to motivate and maintain use of ITC-assisted programs offered outside of regular English classes.

## References

- Bulman, G., Fairlie, R.W. 2016. "Technology and Education: Computers, Software, and the Internet," in Hanushek, E.A., Machin, S.J., and Woessmann, L. (eds.) *Handbook of the Economics of Education*, Volume 5, 239-280. Amsterdam: Elsevier.
- Butler, Y.G., Iino, M. 2005. "Current Japanese Reforms in English Language Education: The 2003 Action Plans." *Language Policy*, 4, 25-45.
- Carrillo, P., Onofa, M., Ponce, J. 2010. "Information Technology and Student Achievement: Evidence from a Randomized Experiment in Ecuador," *Inter-American Development Bank Working Paper*.
- DiMaggio, P. 1982. "Cultural Capital and School Success: The Impact of Status Culture Participation on the Grades of US High School Students," *American Sociological Review*, 47(2), 189-201.
- Frederick, S., Loewenstein, G., O'Donoghue, T., 2002. "Time Discounting and Time Preference: A Critical Review," *Journal of Economic Literature*, 40(2), 351-401.
- Gee, J.P., Hayes, E.R. 2011. *Language and Learning in the Digital Age*. London: Routledge.
- Honda, Y., Nishijima, H. 2007. "*Toritsu koukouseino seikatsu koudou ishiki nikansuru ankeeto*" [Survey of Lifestyles, Behaviors, and Attitudes of High-schoolers in Tokyo]. Retrieved on March 10, 2017 from:  
[http://berd.benesse.jp/berd/center/open/report/toritsu\\_kousei/2009/pdf/siryou\\_01.pdf](http://berd.benesse.jp/berd/center/open/report/toritsu_kousei/2009/pdf/siryou_01.pdf)
- Imbens, G., Angrist, J., 1994. "Identification and Estimation of Local Average Treatment Effects," *Econometrica*, 62(2), 467-476.



- Kono, H., Sawada, Y., Shonchoy, A.S. 2016. "DVD-based Distance-learning Program for University Entrance Exams: Experimental Evidence from Rural Bangladesh," *CIRJE Discussion Papers*.
- Laibson, D. 1997. "Hyperbolic Discounting and Golden Eggs." *Quarterly Journal of Economics*, 112(2), 443-477.
- Lareau, A. 1987. "Social Class Differences in Family-school Relationships: The Importance of Cultural Capital," *Sociology of Education*, 60(2), 73-85.
- Lai, F., Zhang, L., Qu, Q., Hu, X., Shi, Y., Boswell, M., Rozelle, S. 2013. "Computer Assisted Learning as Extracurricular Tutor? Evidence from a Randomized Experiment in Rural Boarding Schools in Shaanxi," *Journal of Development Effectiveness*, 5(2), 208-231.
- Levy, M. 2009. "Technologies in Use for Second Language Learning." *Modern Language Journal*, 93(s1), 769-782.
- MacIntyre, P.D. 2007. "Willingness to Communicate in the Second Language: Understanding the Decision to Speak as a Volitional Process." *Modern Language Journal*, 91(4), 564-576.
- MEXT. 2015. "Heisei 26 nendo eigokyouiku kaizen notameno eigoryokuchousa jigyouhoukoku" [Results of the English Test Conducted to Improve English Education in Japan in 2015]. Retrieved on November 23rd, 2016 from:  
[http://www.mext.go.jp/a\\_menu/kokusai/gaikokugo/1358258.htm](http://www.mext.go.jp/a_menu/kokusai/gaikokugo/1358258.htm)
- Nakamuro, M., Kayaba, Y. 2016. "Studying Alone or Together: How Do the Incentives Make Students More Productive?" *RIETI Discussion Paper Series*, 16-J-028.
- O'Donoghue, T., Rabin, M. 1999. "Incentives for Procrastinators." *Quarterly Journal of Economics*, 114(3), 769-816.

- Onji, K. 2013. "Estimating the Effects of Procrastination on Performance: A Small Sample Study," *Journal of Socio-Economics*, 44(1), 85-90.
- Onji, K., Kikuchi, R. 2011. "Procrastination, Prompts, and Preferences: Evidence from Daily Records of Self-directed Learning Activities," *Journal of Socio-Economics*, 40(6), 929-941.
- Ortega, L., Iberri-Shea, G. 2005. "Longitudinal Research in Second Language Acquisition: Recent Trends and Future Direction," *Annual Review of Applied Linguistics*, 25, 26-45.
- Osaka University. 2013. "*Kurashino konomito manzokudo nitsuiteno ankeeto*" [Survey of Preference Parameters at Osaka University]. Retrieved on March 10, 2017 from: [http://www.iser.osaka-u.ac.jp/survey\\_data/doc/japan/questionnaire/japanese/2013QuestionnaireJAPAN.pdf](http://www.iser.osaka-u.ac.jp/survey_data/doc/japan/questionnaire/japanese/2013QuestionnaireJAPAN.pdf)
- Pearson Inc. 2008. "Consistency of Versant English Test Scores Over Multiple Administrators." *Unpublished internal manuscript*, Pearson Inc.
- Rouse, C.E., Krueger, A.B. 2004. "Putting Computerized Instruction to the Test: A Randomized Evaluation of a 'Scientifically-Based' Reading Program," *Economics of Education Review*, 23(4), 323-338.
- Sasaki, M. 2011. "Effects of Varying Lengths of Study-Abroad Experiences on Japanese EFL Students' L2 Writing Ability and Motivation: A Longitudinal Study," *TESOL Quarterly*, 45(1), 81-105.
- Yashima, T. 2009. "International Posture and the Ideal L2 Self in the Japanese EFL Context." In Dörnyei, Z. and Ushioda, E. (eds.) *Motivation, Language Identity, and the L2 Self* (pp. 144-163). Clevedon: Multilingual Matters.

Yashima, T., Zenuk-Nshide, L., Shimizu, K. 2004. "The Influence of Attitudes and Affect on Willingness to Communicate and Second Language Communication." *Language Learning*, 54, 119-152.

Table 1. Timeline

---

2015 June	Baseline survey and Versant test
2015 July-November	Online English program for the treatment group
2015 November	GTEC English test
2015 December	Endline survey and Versant test
2016 January-May	Online English program for the control group

---

Table 2. Balance Check

	Treatment	Control	Difference
	(mean)	(mean)	<i>p</i> -value for equality in means
Procrastination (z-score)	-0.03	0.03	0.62
Impatience <sup>a</sup>	0.5	0.7	0.12
Present bias (1=yes)	0.18	0.19	0.80
Male (1=yes)	0.51	0.50	0.96
Number of books at home <sup>b</sup>	2.7	2.3	0.06*
Father's education <sup>c</sup>	3.3	3.2	0.51
Mother's education <sup>c</sup>	2.8	2.8	0.99
English in primary school <sup>d</sup>	1.2	1.2	0.41
Been abroad (1=yes)	0.38	0.36	0.70
Own room (1=yes)	0.88	0.83	0.22
Own smartphone (1=yes)	0.96	0.96	0.99
Own PC (1=yes)	0.08	0.12	0.19
Own tablet (1=yes)	0.23	0.16	0.11
Commuting time <sup>e</sup>	1.2	1.3	0.40
Belongs to sports club (1=yes)	0.63	0.55	0.15

Note: \* indicates a 10% level of statistical significance. a. One month discount rate; 0=less than 25%, 1=25-50%, 2=50-75%, 3=over 75%. b. Number of books at home; 0=none, 1=approx. 20, 2=approx. 50, 3=approx. 100, 4=approx. 200, 5=over 300. c. Educational attainment; 0=junior high school, 1=high school, 2=vocational school, 3=two-year college, 4=university, 5=graduate school. d. Started English in primary school; 0=grade 5 or later, 1=grade 3 or 4, 2=grade 1 or 2. e. Commuting time in minutes; 0=20 or less, 1=21-40, 2=41-60, 3=over 61.

Table 3. Poisson Model Estimation of Program Utilization

	(1)	(2)	(3)	(4)	(5)	(6)
	Number of lessons taken in five months					
	All classes		Treated classes only		Control classes only	
Procrastination	-0.42***	-0.43***	-0.39**	-0.39**	-0.83***	-0.84***
[z-score]	(-3.87)	(-4.08)	(-2.16)	(-2.14)	(-5.75)	(-6.36)
Impatience	-0.058	-0.086	-0.14	-0.22	0.079	0.12
[0-3]	(-0.58)	(-0.81)	(-0.97)	(-1.42)	(0.48)	(0.84)
Present bias	0.30	0.32	0.46	0.49	0.19	0.21
(1=yes)	(0.80)	(0.83)	(0.97)	(0.98)	(0.42)	(0.34)
Male	-0.28	-0.34	-0.23	-0.28	-0.82	-0.74
(1=yes)	(-1.03)	(-1.16)	(-0.64)	(-0.73)	(-1.11)	(-1.03)
English in primary	-0.14	-0.12	0.014	0.057	-0.69***	-0.78**
[0-2]	(-0.96)	(-0.75)	(0.14)	(0.58)	(-2.74)	(-2.29)
Been abroad	0.079	0.033	0.11*	0.034	0.18	0.27
(1=yes)	(0.43)	(0.19)	(1.83)	(0.58)	(0.25)	(0.36)
Own room	-0.29	-0.30	-0.34	-0.29	-0.52	-0.94
(1=yes)	(-0.84)	(-0.92)	(-0.70)	(-0.62)	(-0.45)	(-0.74)
Own PC	-0.16	-0.15	0.33***	0.26	-2.52***	-2.30***
(1=yes)	(-0.47)	(-0.48)	(4.15)	(1.46)	(-3.22)	(-3.30)
Own smartphone	-0.91*	-0.99**	-1.29**	-1.22**	0.95	0.80
(1=yes)	(-1.89)	(-2.19)	(-2.37)	(-2.08)	(0.44)	(0.37)
Own tablet	0.25	0.19	0.062	0.0023	1.26**	1.23*
(1=yes)	(0.94)	(0.70)	(0.37)	(0.01)	(2.48)	(1.91)
Commuting time	-0.075	-0.066	-0.0067	0.035	-0.44***	-0.49***
[1-4]	(-0.71)	(-0.66)	(-0.05)	(0.31)	(-3.71)	(-3.91)
Sports club	-0.38**	-0.28*	-0.19	-0.10	-1.29***	-1.29***
(1=yes)	(-2.07)	(-1.72)	(-1.22)	(-0.60)	(-3.22)	(-3.42)
Number of books	0.0016	-0.025	-0.028	-0.056	0.17	0.089
[1-6]	(0.02)	(-0.34)	(-0.35)	(-0.79)	(1.47)	(0.69)
First round class	1.39***					
(1=yes)	(4.13)					
Classroom dummies	N	Y	N	Y	N	Y
N	305	305	152	152	153	153

Note: Estimated coefficients reported. \*\*\*, \*\*, and \* indicate the 1%, 5%, and 10% levels of statistical significance, respectively. Numbers in parentheses are *t*-statistics based on standard errors clustered at classroom level.

Table 4. Probit Model Estimation of First Program Take-up

	(1)	(2)	(3)	(4)	(5)	(6)
	= 1 if completed at least one lesson in five months					
	All classes		Treated classes only		Control classes only	
Procrastination	-0.43***	-0.44***	-0.53**	-0.53**	-0.44***	-0.44***
[z-score]	(-4.70)	(-4.66)	(-1.97)	(-2.21)	(-2.76)	(-2.68)
Impatience	0.19***	0.17*	0.14	0.098	0.19*	0.20*
[0-3]	(2.65)	(1.72)	(1.20)	(0.36)	(1.83)	(1.83)
Present bias	0.036	0.088	-0.045	0.13	0.018	0.00037
(1=yes)	(0.16)	(0.35)	(-0.11)	(0.29)	(0.05)	(0.00)
Male	-0.61**	-0.60**	-0.81**	-0.62***	-0.60*	-0.60*
(1=yes)	(-2.46)	(-2.35)	(-2.53)	(-2.59)	(-1.66)	(-1.65)
English in primary	-0.30***	-0.31***	-0.20**	-0.082	-0.39***	-0.42***
[0-2]	(-5.14)	(-3.98)	(-2.13)	(-0.42)	(-5.16)	(-5.02)
Been abroad	-0.24	-0.27	-0.72	-0.72	-0.058	-0.072
(1=yes)	(-0.99)	(-1.03)	(-1.45)	(-1.50)	(-0.17)	(-0.20)
Own room	-0.35	-0.45	-1.54***	-1.89***	-0.025	-0.12
(1=yes)	(-1.19)	(-1.50)	(-4.85)	(-4.28)	(-0.05)	(-0.28)
Own PC	-0.52*	-0.62*	-0.53**	-0.87***	-0.50	-0.49
(1=yes)	(-1.93)	(-1.79)	(-2.23)	(-2.59)	(-0.79)	(-0.76)
Own smartphone	0.37	0.54	0	0	0.23	0.22
(1=yes)	(0.75)	(0.88)	(.)	(.)	(0.25)	(0.24)
Own tablet	0.25	0.24	0.80	0.89	-0.059	-0.057
(1=yes)	(1.33)	(1.30)	(1.47)	(1.60)	(-0.36)	(-0.31)
Commuting time	-0.12	-0.035	-0.11	0.18	-0.14	-0.15
[1-4]	(-1.26)	(-0.38)	(-0.60)	(1.62)	(-1.12)	(-1.26)
Sports club	-0.53***	-0.52***	-0.73***	-0.85**	-0.50***	-0.51***
(1=yes)	(-7.39)	(-6.12)	(-2.63)	(-2.04)	(-4.41)	(-4.57)
Number of books	0.16**	0.15*	0.31***	0.36***	0.026	0.0049
[1-6]	(2.08)	(1.73)	(5.42)	(9.01)	(0.25)	(0.05)
First round class	1.94***					
(1=yes)	(6.55)					
Classroom dummies	N	Y	N	Y	N	Y
N	305	305	152	152	153	153

Note: Estimated coefficients reported. \*\*\*, \*\*, and \* indicate the 1%, 5%, and 10% levels of statistical significance, respectively. Numbers in parentheses are *t*-statistics based on standard errors clustered at classroom level.

Table 5. Impacts of Skype Program (ITT Estimation)

Panel A: Attitudes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Total		Sub1. Inter-cultural orientation		Sub 2. International vocation		Sub 3. Different customs		Sub 4. Foreign affairs		Willingness to communicate	
Treatment	0.57	0.47	0.028	-0.020	0.28***	0.26*	0.013	-0.011	0.30*	0.23*	0.14	0.077
	(1.50)	(1.27)	(0.15)	(-0.11)	(4.66)	(2.27)	(0.09)	(-0.08)	(2.28)	(2.29)	(1.84)	(0.77)
Baseline outcome	0.78***		0.69***		0.72***		0.42***		0.58***		0.65***	
	(15.23)		(12.32)		(22.65)		(10.12)		(8.17)		(9.93)	
Endline (1=yes)		-0.46		-0.23		-0.20**		-0.015		-0.0086		-0.24**
		(-1.58)		(-1.37)		(-2.43)		(-0.13)		(-0.51)		(-3.44)
Baseline mean in control group	11.3	11.3	4.1	4.1	3.2	3.2	2.4	2.4	1.8	1.8	-0.07	-0.07
N	308	627	309	628	309	628	308	627	309	628	293	610



Panel B: English Communicative Abilities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Overall		Sub1. Sentence Mastery		Sub 2. Vocabulary		Sub 3. Fluency		Sub 4. Pronunciation		GTEC total	GTEC speaking only
Treatment	0.42 (0.78)	0.18 (0.31)	0.17 (0.31)	-0.70 (-0.99)	1.25 (1.51)	0.98 (1.01)	0.56 (0.97)	0.28 (0.49)	0.28 (0.57)	0.19 (0.49)	1.16 (0.20)	-0.41 (-0.21)
Baseline outcome	0.78*** (14.66)		0.55*** (7.21)		0.50*** (4.21)		0.76*** (14.19)		0.72*** (12.41)			
Endline (1=yes)		2.22*** (4.55)		3.25*** (7.11)		3.51*** (4.14)		1.52** (3.08)		0.69** (3.12)		
Baseline mean in control group	30.8	30.8	34.6	34.6	33.8	33.8	26.2	26.2	29.2	29.2	511.2	107.6
N	243	553	243	553	243	553	243	553	243	553	318	317

Note: Estimated coefficients reported. \*\*\*, \*\*, and \* indicate the 1%, 5%, and 10% levels of statistical significance, respectively. Numbers in parentheses are *t*-statistics based on standard errors clustered at classroom level. In columns 11 and 12 in Panel B, we only have cross-sectional observation.

Table 6. Impacts of Skype Program (LATE Estimation)

Panel A: Attitudes (Total international Posture Score)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	<i>k</i> =0		<i>k</i> =5		<i>k</i> =10		<i>k</i> =25		<i>k</i> =50	
Lesson at lease <i>k</i> times	0.57 (1.50)	0.47 (1.27)	1.10* (1.74)	0.92 (1.37)	1.74* (1.79)	1.45 (1.40)	3.90* (1.70)	3.30 (1.34)	9.53 (1.42)	8.07 (1.13)
Baseline outcome	0.78*** (15.23)		0.78*** (15.80)		0.77*** (16.07)		0.80*** (19.09)		0.80*** (19.42)	
Endline (1=yes)	-0.46 (-1.58)		-0.46 (-1.58)		-0.46 (-1.58)		-0.46 (-1.58)		-0.46 (-1.58)	
Baseline mean in control group	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3
N	308	627	308	627	308	627	308	627	308	627

Panel B: English Communicative Abilities (Overall Versant Score)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	<i>k</i> =0		<i>k</i> =5		<i>k</i> =10		<i>k</i> =25		<i>k</i> =50	
Lesson at lease <i>k</i> times	0.42 (0.78)	0.18 (0.31)	0.77 (0.86)	0.32 (0.31)	1.35 (0.83)	0.56 (0.31)	3.36 (0.87)	1.45 (0.31)	7.66 (0.79)	3.38 (0.31)
Baseline outcome	0.78*** (14.66)		0.77*** (16.74)		0.77*** (17.65)		0.78*** (15.24)		0.79*** (13.33)	
Endline (1=yes)	2.22*** (4.55)		2.22*** (4.55)		2.22*** (4.55)		2.22*** (4.55)		2.22*** (4.55)	
Baseline mean in control group	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8
N	243	553	243	553	243	553	243	553	243	553

Note: Estimated coefficients reported. \*\*\*, \*\*, and \* indicate the 1%, 5%, and 10% levels of statistical significance, respectively. Numbers in parentheses are *t*-statistics based on standard errors clustered at classroom level. The Lesson dummy takes the value of one if a student took at least *k* lessons, and this dummy variable is instrumented with the Treatment dummy.

Figure 1. Randomization

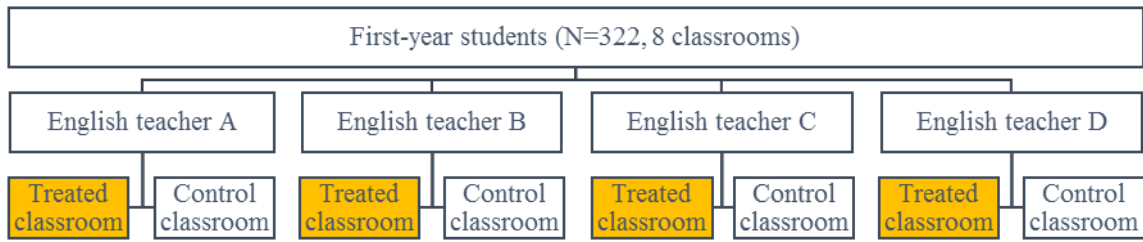


Figure 2. Daily Change in Number of Students Taking Lessons

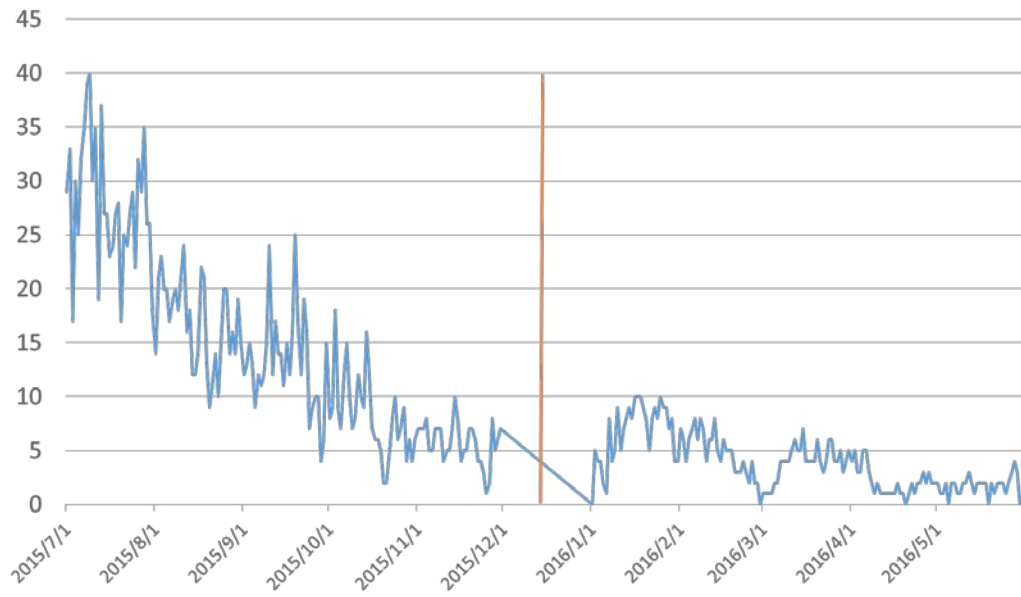
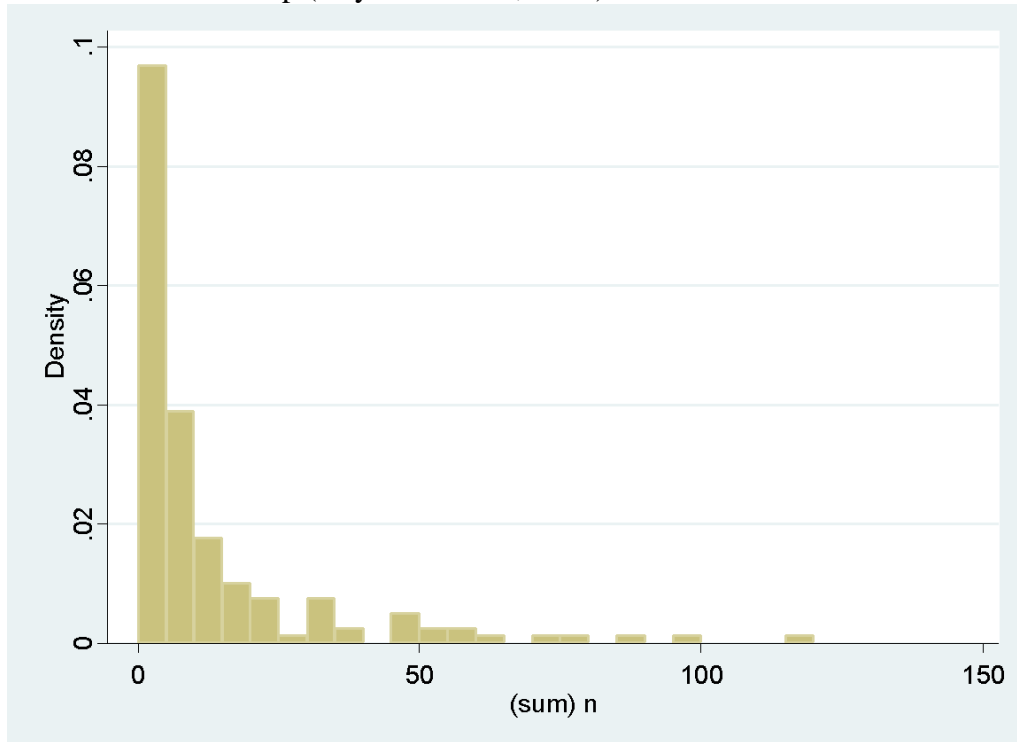


Figure 3. Distribution of Lessons Taken by a Student over Five Months

Panel A: Treatment Group (July-November, 2015)



Panel B: Control Group (January-May, 2016)

