RIETI Discussion Paper Series 17-E-108

Do Teaching Practices Matter for Students' Academic Achievement? A case of linguistic activity

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

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August 2017

Do Teaching Practices Matter for Students' Academic Achievement?

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Abstract

This paper analyzes the effects of teaching practices on the educational achievement of elementary school students. Using unique student-level test score data and controlling for school fixed effects, we estimate the impact of linguistic activity in the classroom on reading and mathematics test scores of sixth grade students. We find that linguistic activities improve students reading and mathematics test scores and that their impacts are substantial. We find heterogeneity in the effect of these activities across class size environment and home environment such as cram schooling. These findings indicate that the types of language teaching practices matter for students' academic achievement, and the effectiveness may depend on the learning environment in school and at home.

Keywords: Education, Test scores, Japan
JEL classification: I21, I26

[1]This study is conducted as a part of the project “Transformation of the Japanese Labor Market: Toward a labor market for all” undertaken at the Research Institute of Economy, Trade and Industry (RIETI). The authors are grateful for helpful comments and suggestions by Professors Hideo Owan (Univ. of Tokyo), Daiji Kawaguchi (Univ. of Tokyo), Ayako Kondo (Univ. of Tokyo) and the participants of Japanese Economic Association Meeting Fall 2016 at Waseda University, OEIO workshop at Osaka University, and Discussion Paper seminar participants at RIETI. All remaining errors are solely ours. The opinions expressed in this article are the authors’ own and do not reflect the view of affiliated organizations.

1 Introduction

Education is one of the key factors for economic growth of nations. A simple version of human capital theory states that human capital investment, typically in the form of education, has a positive impact on economic growth. Many empirical investigations have tried to confirm this theoretical prediction. Barro and Lee (1994) and Benhabib and Spiegel (1994), among many others, provide empirical facts about the positive relationship between stock of human capital, typically measured by average years of education and enrollment rate at various stages of education, and subsequent economic growth. Moreover, Hanushek and Woessmann (2012) and Hanushek (2013) provide evidence for the importance of not only the quantity but also quality of human capital measured by national average test scores for economic growth.

In view of the positive role of human capital investment for economic growth, many policy measures have been taken to foster human capital. One such typical policy measure is to improve teaching practices in classrooms. One can easily find episodes of the educational authority trying to improve the educational outcome of students by adopting "good" teaching practices in classrooms.

From the perspective of efficiency and accountability of educational authorities and the government, we need to answer the question of how these teaching practices can improve educational outcomes of students in schools. However, this question cannot be answered in a straightforward manner. One reason for this could be that the degree of implementation of these policy measures is widely diverse across regions, municipalities, schools, and classes. Furthermore, even if a classroom teacher facilitates uniform teaching practices, students may benefit differently from these measures.

The main purpose of this paper is to explore empirically how teaching practices matter for students' academic achievement. In particular, we focus on the effect of students' linguistic activities led by classroom teachers to promote logical thinking through linguistic communication. Linguistic activity is considered one of the most important teaching practices to improve educational outcomes under the current primary school curriculum guidelines set by the Ministry of Education, Culture, Sports, Science and Technology of Japan (hereafter, MEXT). Hence, the evaluation of the impact of linguistic activity on the academic achievement of students can provide important information for politicians and practitioners as well as for academic scholars.

In this study, using unique student-level test score data of one municipality in Japan, and controlling for school fixed effects and the potential endogeneity of linguistic activity variables, we estimate the impact of linguistic activities in classrooms on reading and mathematics test scores of sixth grade students. We find that some

types of linguistic activities, such as expression of the goal of learning at the beginning of each class and reflection activity at the end of each class, among many other practices, improve students' reading and mathematics test scores. We find heterogeneity in the effect of these activities across class sizes and home environments, such as cram schooling. These findings indicate that teaching practices matter for the academic achievement of students and their effectiveness may depend on the students' learning environment in schools and at home.

This paper is related to a strand of the literature of the effect of school resources on academic achievement in schools. As surveyed in Hanushek (2006), the effects of school resources are hard to identify using simple regression analysis. One of the most important school resources is classroom teachers. Rockoff (2004) estimates teacher quality by estimating the teacher fixed effects using panel data of students' test scores, to find substantial variation in the quality of teachers.

It would be natural to see teaching practices as one of the determinants of teacher quality. Several papers investigate how teaching practices in classrooms affect the non-cognitive and cognitive abilities of students as learning outcomes. Lavy (2011) empirically examines the effects of classroom teaching, for example, traditional and modern teaching practices, on student achievements, to find heterogeneous, but overall very large, effects of teaching practices, especially in comparison with those of other potential interventions such as reducing class size or increasing school hours. Aslam and Kingdon (2011) find that it is not the teachers' characteristics based on curriculum vitae, which is often used to determine teacher salary, but the teaching "process" in the classroom that matters significantly for student achievement in Punjab, Pakistan. Schwerdt and Wuppermann (2011) investigate the relationship between the lecture style of teaching and student achievement in the U.S., exploiting the between-subject variation to control for unobserved student characteristics, to find the traditional lecture style of teaching associated with significantly higher student achievement. Using data from the Trends in International Mathematics and Science Study (TIMSS), Bietenbeck (2014) shows that traditional and modern teaching practices promote different cognitive skills in students. We will not compare the traditional and modern teaching practices by themselves, but will examine the effects of a specific teaching practice, linguistic activity.[1]

The quantitative analysis of the effect of school resources on student test scores in Japan has been conducted by several authors. Shinozaki (2008) estimates the relationship between school resources and test scores, to find no systematic relationship between them. Hojo (2012), Hojo and Oshio (2012), and Hojo (2013) estimate the re-

[1] Algan et al. (2013) show that teaching practices in schools affect student beliefs and thus the formation of social capital.

lationship between the characteristics of students, family, and teachers and the academic achievement of students, using data from TIMSS. They find large influence of the home environment, but a small impact of school factors, on the test scores of junior high school students. Although they find no statistically significant effect of small class size, class formation by proficiency is found to be positively related to student test scores. Niki (2012) is another example of the estimation of class size effect on academic achievement using TIMSS with the regression discontinuity design. She finds no class size effects on math and science test scores. Akabayashi and Nakamura (2014) estimate the effect of small class size on the language and mathematics test scores of sixth and ninth grade students. Estimating a value-added model with regression discontinuity design based on the Maimonides rules, they find the effect of small class size only for the sixth grade language scores. Senoh et al. (2014) estimates the effects of class size using student-level test scores data, to find the test scores of sixth grade Japanese language students dropping and those of ninth grade Japanese language and mathematics students *increasing* as the class size expands. These studies mainly focus on the positive effect of class size, as well as family and school characteristics of students. Our current analysis examines the effect of teaching practices in classrooms in addition to these effects.[2]

This paper is also related to the literature of educational sociology: Kariya (2001), Shimizu (2009), Kawaguchi (2011), Sudo (2013), and Mimizuka et al. (2014), among many others. The research in this field mainly focuses on the effects of family and parental background and their implication for intergenerational mobility. This paper focuses on the effects of teaching practices in classrooms and school resources, controlling for family and home environment effects as much as possible.

The structure of the paper is as follows. Section 2 gives a concise description of the Japanese schooling system, the nationwide achievement test, and linguistic activities as teaching practices in classrooms. Section 3 presents a simple theoretical estimation framework. Section 4 reports our summary statistics, and Section 5 explains our estimation results. Section 6 provides more results as robustness checks. Section 7 concludes the paper.

2 Institutional Background

In this section, we describe the Japanese compulsory education system, the nationwide educational achievement tests, and linguistic activities as educational treatment

[2] As another example, Yoshida et al. (2009) estimate the impact of school choice on the educational achievement of primary and secondary school students in a municipality in Tokyo Metropolis.

in classrooms.

2.1 Compulsory Education System in Japan

The current compulsory education system in Japan is based on the Fundamental Law of Education Act passed in 1947. Compulsory education consists of six years of primary education and three years of secondary schooling. Children of age 6 as on April 1 start the first grade in primary school on that day. Students are assigned to a public school in their residential area, and public schooling is provided free of charge during the compulsory education period. Although students are allowed to attend a private school by paying tuition and various pecuniary and non-pecuniary costs, the majority of students attend the assigned public school.[3]

The contents of teaching in Japan are highly centralized at the national level. The Central Education Council revises the School Curriculum Guideline for all subjects every ten years. Since this guideline basically sets the minimum contents to be taught in schools at each level of education, some variation exists in its implementation across schools and classes.[4] On top of the variation in implementation of the guideline, the education committee at the local municipality level has some discretion in implementation and can introduce their own contents in addition to those determined by the guideline. Thus, some variation exists in the intensity of educational treatment across regions and even schools and classes.

2.2 National Achievement Test

MEXT conducts nationwide surveys ("National Scholastic Ability and Learning Situation Survey"; hereafter we call this "national achievement test," or "national achievement survey") sine 2007 to grasp the academic achievement of children. The subjects are sixth and ninth grade students in public schools, representing more than 90 percent of all students in those ages.[5]

The purpose of the survey is to understand and analyze the academic and learning situation of all students, verify the achievements and challenges of educational policies, and promote equal opportunities, as well as maintenance and improvement of the level of compulsory education. Through such efforts, the survey aims to establish a

[3] In 2016, 98.5 percent of students were enrolled in public primary schools (School Basic Survey by MEXT, 2016).

[4] Part of the current English version of the guideline can be obtained from the website of MEXT.

[5] The survey also asks questions to principals of schools about the school environment and teaching practices implemented in their school. As shown in 3, we use the information about teaching practices at the school level taken from the responses of school principals as an instrumental variable.

continuous improvement cycle for education and to assist in improving the learning situation for education guidance to school students.

The survey consists of academic tests in reading and mathematics and a questionnaire on life habits and school environment of students.[6] Academic tests of reading and mathematics consist of two types of questionnaires, basic questions, which we call "A," and advanced question, which we call "B." The basic questions mainly deal with the basic knowledge of subjects, while the advanced questions deal with the ability of students to apply their basic knowledge to real-life problems. Overall, the questions are similar to those in TIMSS.

These surveys are conducted in April. Since the academic calendar in Japan starts from April 1, the national test measures the students' outcome up to the previous grade. For example, the national achievement survey for 2015 was conducted on April 17, 2015. Hence, the survey for the sixth grade students is designed to evaluate their academic achievement up to the fifth grade.

This survey includes a questionnaire about the students' life habits, school environment, and home environment. It includes questions such as on the hours of study at home and the use of educational services outside of school (cram schooling). It also asks students about the teaching practices followed by teachers in the classroom, which form the most important information for the current study. We will explain in detail which type of teaching practices we focus on in the following subsection.

2.3 Linguistic Activity

The current version of the curriculum guideline for elementary and junior high schools was introduced in 2009 and implemented in all elementary and junior high schools in 2012. The current primary school curriculum guidelines state that enhancing linguistic activity through general educational activities of the school is one of the most important points to improve educational outcomes.

In the school curriculum guidelines, linguistic activity is shown to promote logical thinking through linguistic communication. Linguistic activity is defined by the subjects. According to the teaching manual by The Ministry of Education, Culture, Sports, Science and Technology (2011), linguistic activity in the national language (language arts) subject is described as follows. "In each area of 'speaking and listening, writing, and reading,' teachers are required to instruct continuously so that students can acquire the skills required in everyday life such as recording, describing, reporting, introducing, expressing, and debating. For this purpose, it is important to develop the

[6] Although the subject on linguistic capability is called "national language" in the national achievement survey, we call it "reading" in this study.

ability to interpret and understand through deepening mutual thinking by picking up the necessary texts and materials according to the task and taking advantage of the fundamental and basic knowledge and skills."

Linguistic skills are usually taught under the subject of language arts in elementary and secondary schools. However, the activities to enhance linguistic skills matter not only for itself as language arts subject, but also for all the other subjects. The teaching manual by The Ministry of Education, Culture, Sports, Science and Technology (2011) explains the importance of linguistic activities for mathematics as follows. "The ability of mathematical thinking, judgment, and the power of expression plays a very important role in order to enhance rational and logical thinking and to achieve the intellectual communication of each other. Teachers must emphasize the learning activities to enhance logical thinking with prospect and a basis in order for students to acquire the ability of mathematical thinking, judgment, and the power of expression. In addition, teachers must emphasize the learning activities to enhance the ability to use and understand the tools such as words, numbers, formulas, diagrams, tables and graphs and their interrelation, to solve the problem by applying these tools, and to exchange their ideas and thoughts to each other."

We can easily find examples of activities to enhance linguistic skills in classrooms. Practical teaching to encourage students to express their thoughts and opinions in classrooms can be considered an example of linguistic activities. Students expressing the goals of their lessons at the beginning of each class can also be considered as a linguistic activity, in that it helps students to think logically what they will learn from each class.

$[Table\ 1]$

For our econometric analysis, we use the answers given to the questions relating to linguistic activities in the students' questionnaire of the national achievement test explained above. We focus on the following four types of linguistic activity: Goal Clarification, Reflection, Presentation Opportunity, and Discussion. The variable of Goal Clarification is obtained from the response to the question, "In the classes up to fifth grade, do you think that the goal of each lesson was expressed clearly at the beginning of each class?" Similarly, the variable of Reflection is obtained from the response to the question, "In the classes up to fifth grade, do you think that time was provided at the end of each class to reflect on the contents of lessons?" The variable for Presentation Opportunity is obtained from the response to the question, "In the classes up to fifth grade, do you think that opportunities to present were provided?" Finally, the variable for Discussion is obtained from the response to the question, "In the classes up to fifth grade, do you think that opportunities to discuss with classmates

were provided?" The responses to these questions take the value of 3 for "agree," 2 for "somehow agree," 1 for "somehow disagree," and 0 for "disagree." We interpret that these variables capture the intensity of the linguistic activities each student is exposed to in classes up to fifth grade.

Table 1 summarizes the definition of the variables (i.e., standardized test scores, four linguistic activity variables, and other controls). We provide a detailed explanation of the summary statistics of these variables in Section 4.

3 Econometric Framework

We estimate the effects of educational inputs on educational outcomes measured by test scores using the following regression model:

$$Y_{ji} = T_{ji}\beta + X_{ji}\gamma + \alpha_j + \epsilon_{ji} \tag{1}$$

where Y_{ji} is the test score of student i in school j; T_{ji} is a variable of interest, that is, a measure of intensity of linguistic activities; X_{ji} is a vector of covariates, such as class size, attendance of cram school, hours of home study, and hours of reading at home; α_j is school fixed effect; and ϵ_{ji} is an error term assumed to be uncorrelated to T_{ji} and X_{ji}.

School fixed effects α_j capture the time-invariant school-specific characteristics affecting the average level of test scores in each s chool. Both observable and unobservable characteristics specific to the school district are controlled for as long as they are stable over time. As we will show later, all the characteristics in our empirical exercise stable for two years are controlled for by inclusion of school fixed effects. As a benchmark, we first perform ordinary least squares (OLS) estimation of the equation with school fixed effects.

By controlling for school fixed effects, we identify the coefficients on linguistic activities from the variation of test scores and linguistic activities reported by the students in school. However, since we use the variation of linguistic activity at the student level, this activity measure may be correlated to the individual unobserved heterogeneity captured by ϵ_{ji} in equation 1. To deal with this potential endogeneity problem, we employ an instrumental variable method. Our instrument is the school average of the intensity of linguistic activity in each year. If a school decides to implement an intensive linguistic activity program in a year, the average intensity in this year is higher than those in other years. We feel that the variation of the school average intensity captures the changes in teaching programs at the school level, which is assumed to be exogenous to each individual student. In our estimation with this instrument, we

assume that the school average of the linguistic activity measure is excluded from the test score equation, and we test this assumption using overidentifying restriction of the instruments.

4 Data

The main data source for our econometric studies is the national achievement test results for sixth grade elementary school students in 2014 and 2015. We obtain the microdata of students in a middle-sized municipality with a population of about 500,000. Our dataset gives the test score information for both reading and mathematics (A and B, respectively) as well as the answers to the questions about life habit and home environment in the students questionnaire.

The outcome variables are the reading and mathematics test scores (A and B, respectively). We standardized these test scores with a mean of 50 and standard deviation of 10 for each subject and each type for each year. Hence, the coefficient on linguistic activity measure in equation 1 should be interpreted as the change in academic achievement relative to the mean of each year.[7]

The main variable of interest is the intensity of linguistic activities. We focus on the response of students to questions on four linguistic activities: Goal Clarification, Reflection, Presentation Opportunity, and Discussion. We evaluate the overall intensity of linguistic activities using a variable we constructed, which is the sum of the above four linguistic activity variables. This variable takes the value from 0 to 12, where the larger the variable, the more intensively is a student exposed to linguistic activity in classes up to fifth grade. In our benchmark analysis, we focus on the overall effect of linguistic activity using this overall intensity measure. We further explore which of the four activities are more effective to improve the students' test scores by including the four variables separately in the regression equation.

All the time-invariant school characteristics are controlled for by including school fixed effects. In addition, we include class size in the regression equation to control for time-variant school characteristics. To control for family and home environment as much as possible, we include information on hours of study at home, whether the student uses cram schooling as educational services outside of school, whether the student talks to family members (other than siblings) at home about schooling, whether the student reads newspapers, whether the student watches news on broadcasting or Internet, and so on.

[7] This is because the National Achievement Test is not designed to evaluate the changes in academic achievement across years.

[*Table* 2]

Table 2 reports the summary statistics of the variables used for analysis. After dropping the samples with missing values for any of the variables listed in Table 1 and test scores, we have 8511 students for our analysis. Test scores are normalized to have a mean of 50 and standard deviation of 10 in each year of the original sample. Sample selection after deleting the missing observations for other variables makes the sample mean of the test scores for each subject slightly larger and the standard deviation slightly smaller.

Of the four linguistic activities, Goal Clarification shows the highest proportion of students' positive answers. Presentation Opportunity shows the second highest proportion of students' positive answers, followed by Discussion. Reflection shows a substantially low proportion of students' positive answers.

The average class size is about 30 students, with the size ranging from 19 (the smallest class) to 40 (the largest) students, which is the cap for class size in Japanese public elementary schools. As regards home environment, over 90 percent of students study more than 30 minutes per day at home. Furthermore, 49 percent use cram schooling as educational services outside of school. About half of the students respond that they talk to family members about their school at home, read newspapers more than once a month, and check news programs on broadcasting and/or Internet.

We use the within-year school average of the four linguistic activities as an instrument variable for linguistic activity measure reported by students. The bottom panel of Table 2 shows the summary statistics of the school average of the intensity of these linguistic activities. We can confirm that the mean of the average of Goal Clarification is the largest and that of Reflection is the smallest among the four activities.

On top of these four school averages of linguistic activity intensity measures, we use the overall intensity of the same four linguistic activities (divided by four) reported by school principals. The use of this variable may mitigate the overall measurement error of the intensity measure constructed from the responses of students. The intensity of linguistic activities reported by the principals of school could be much higher than that based on the students' responses.[8] Since the students' responses reflect the actual intensity of linguistic activities in the classroom more accurately than the principals' report, we use the former as the variable of interest and the latter as an instrument to mitigate the problem caused by measurement error of the intensity of linguistic activities.

[8] The mean of the linguistic activity reported by students is 9.11. When we divide this value by 4, we obtain 2.28, which is much lower than the mean of the intensity reported by school principals, 2.64.

5 Results

In this section, we report the estimation results of the regression equation explained in Section 3. In particular, we report three sets of results: the OLS estimates of equation 1 with and without school fixed effects as benchmark, and the estimates by an instrumental variable method. We first show the overall impact of linguistic activities on reading and mathematics test scores. We then explore the impact of each linguistic activity, to evaluate which type improves effectively the academic achievement of students measured by the test scores of these subjects.

5.1 Overall Impact of Linguistic Activity

The overall impact of linguistic activity is examined by estimating equation 1 with the activities' intensity measure; that is, the sum of intensities of the four activities. Table 3-1 reports the coefficient estimates of equation 1, with reading test scores as the dependent variables. The standard errors robust to the correlation of error terms within school in each year are reported in parenthesis.

$$[Table\ 3-1]$$

The first four columns in this table report the coefficient estimates of the explanatory variables when the test score of reading A is used as an outcome variable. The first column gives the specification without school fixed effects. The coefficient on the linguistic activity variable is positive and statistically significantly different from zero. The coefficient estimate of 0.71 means that an improvement in linguistic activity by one point increases the standardized reading A test score by 0.07 standard deviation. In other words, an improvement in intensity of linguistic activity by one standard deviation (2.2 points) is associated with an increase in the test score of reading A by 16 percent of standard deviation.

The second column reports the estimation results for the same specification with school fixed effects. The coefficient on language art activity measure is slightly smaller (0.6849) than that without school fixed effects, indicating robustness of the results.

The third and fourth columns report the results obtained using an instrumental variable method. The coefficient in the third column gives the estimate without school fixed effects under the instrumental variable m ethod. The coefficient is larger, but without school fixed effects, the exclusion restriction of the instruments (i.e., school-year average of four linguistic activities and the activity measure reported by the school principal) are rejected at the 5 percent significance level. With school fixed effects,

however, the exclusion restriction is not rejected at the conventional 5 percent significance level. However, the coefficient of linguistic activity is smaller and statistically insignificant.

The fifth to eighth columns report the same set of coefficient estimates with the reading B test score as dependent variable. The coefficients on linguistic activity show similar patterns as with reading A scores. The coefficient on linguistic activity is now positive and statistically significant at the 10 percent significance level. The endogeneity test of the linguistic activity variable in the equation with reading A and B scores cannot reject the null hypothesis that this variable is exogenous. Hence, we feel that the OLS estimation results with school fixed effects is more efficient than those obtained with an instrumental variable method.

$$[Table\ 3-2]$$

Table 3-2 reports the coefficient estimates of equation 1 with mathematics test scores as dependent variables. The coefficients on linguistic activity are positive and statistically significantly different from zero in all specifications, whether of mathematics A or B. The coefficient on linguistic activity estimated with OLS and school fixed effects is 0.6524 for math A and 0.7154 for math B. From these coefficients, an increase in intensity of linguistic activity by one standard deviation is associated with an increase in the test score of math A (B) by 14 percent (16 percent) of standard deviation.

The fourth and eighth columns report the estimation results using instrumental variable methods. The coefficients are larger than even the OLS estimates. The coefficients are 2.0146 for math A and 1.6676 for math B. These estimates imply substantial impacts of linguistic activity on math test scores: an increase in linguistic activity intensity by one standard deviation is associated with an increase of the test score of math A (B) by 45 percent (26 percent) of standard deviation.

Some of the coefficients on covariates are worth me ntioning. The coefficient on study time is always positive and highly significant statistically for all subjects. Cram schooling has a positive and significant effect on test scores for all subjects, except reading B. Conversation with family members (other than with siblings) about school has a positive effect on reading A and B scores, but not on mathematics scores. Reading newspapers, watching news program on broadcasting and Internet, use of library, and parental involvement in school events are positively and significantly associated with the test scores of all subjects. These results confirm the importance of home environment for the formation of academic outcomes, as indicated in the literature. Interestingly, reading books for more than 30 minutes a day is positively associated with the test scores of reading A and B but negatively associated with the scores of

math A and B. This may be the effect of study time allocation between subjects.

5.2 Impact of Each Activity

In our benchmark analysis, we evaluate the overall impact of linguistic activities. This subsection further explores the effects of individual activity on test scores.

It is noteworthy that these four activities are positively correlated. Table 4 shows the correlation coefficient of these four linguistic activities' intensity measures as reported by students.

$[Table\ 4]$

Although it could be difficult to identify the effect of each activity due to collinearity of the variables, we can still obtain point estimates of the coefficients of these variables in case of lack of perfect collinearity. Table 5 reports the estimation results by replacing the overall intensity measure with the four linguistic activity variables.

$[Table\ 5]$

This table reports the coefficients on the four ac tivities. Focusing on the estimates based on the instrumental variable method, we can observe that Goal Clarification activity has a positive and statistically significant effect on the test scores of all subjects. Reflection activity has no statistically significant effect on reading test scores, but has a positive effect on math A and B. We find no statistically significant effect of Presentation and Discussion activities. Since Goal Clarification activity is the most widespread of the four activities, the natural interpretation of this positive effect could be due to low scores in classes or schools with weak intensity of this activity.

In summary, we find a positive effect of linguistic a ctivity. These positive effects are robust to potential endogeneity of the intensity measure of the activities reported by students. As for point estimates, these positive effects are larger for mathematics than for reading, and as regards the individual effect of each activity, Goal Clarification activity has a positive and substantial effect on the test scores of all subjects. Reflection activity has no statistically significant effect on reading test scores, but has a positive and statistically significant effect on the test scores of mathematics.[9]

[9]Goal Clarification and Reflection may require teacher skills more than the other two. Presentation Opportunity and Discussion need the active involvement of students. We constructed two variables, the sum of Goal Clarification and Reflection, and the sum of Presentation Opportunity and Discussion, and estimated the regression equation with the two variables as regressors. While the first variable is found to be statistically significant, the other is not.

6 Discussion

In the previous section, we reported the estimation results of the effect of linguistic activities on average. However, the effect of these activities may be heterogeneous by household and school-class characteristics. In this section, we further perform subsample analysis to investigate whether the effects of linguistic activities are heterogeneous across different class sizes and cram schooling status of students.

6.1 Heterogenous Effects by Class Size

Our sample has high variation in class size. As the class size in each school is almost solely determined by the total enrollment in a grade, class size is systematically related to school size. As discussed in Angrist and Lavy (1999), school size may capture not just the class size by itself, but also other effects of confounding factors such as location and population density of the district. Although we control for the average effects of school district by including fixed effect in our analysis, it would be interesting to examine whether the heterogeneity of the effects of linguistic activities as well as other school and home environment characteristics depend on class size. For this purpose, we split our sample into two, one with class size more than 30, and the other with class size at most 30.

[$Table$ 6]

Table 6 summarizes the estimates of coefficient on linguistic activity for various subjects and class sizes. The top panel of this table is for the reading test score results. The first two columns of reading A give the estimates with and without school fixed effects. The coefficients are larger for the sample with small class size, but the magnitude of the difference is modest. With an instrumental variable method, we lose the statistical significance of these coefficients in the specification with school fixed effects. Hence, we observe no big difference in the effects of linguistic activity on reading test scores across different class sizes.

The bottom panel of Table 6 summarizes the estimates of coefficients on linguistic activity for mathematics test scores. Contrary to the case of reading test scores, we find relatively large difference in the coefficient on the activity between large and small classes. The coefficient estimates on the activity with an instrumental variable method is much larger for students in small classes than for those in large classes. This observation indicates that linguistic activity is more effective in a small class than in a large class for teaching mathematics.

Summarizing, we find similar effects of linguistic activity on reading test scores between small and large classes, but the effect on mathematics test scores is larger for students in relatively smaller classes.

6.2 Heterogenous Effects by Cram Schooling Status

One unique phenomenon in Japanese education is the popularity of cram schooling. In our sample, 48 percent of students respond that they use education services out of school (cram schooling). Cram schooling may substitute or complement formal school education. If it complements, we expect the students with cram schooling to show a stronger relationship between test scores and linguistic activities in school. To investigate this issue, we estimate the model using the sample of students with and without cram schooling respectively.

[$Table$ 7]

Table 7 reports the estimation results of the effect of linguistic activity for each student's cram schooling status. The coefficient estimates tend to be larger for students with cram schooling. In particular, the estimates with OLS and school fixed effects are larger for reading test scores for both A and B. Similarly, the estimates with the instrumental variable method and school fixed effects are much larger for students with cram schooling for mathematics test scores. These results indicate the possibility that linguistic activities and cram schoolings complement each other in classroom teaching. This result may reflect the fact that because teachers in cram schools emphasize goal clarification and reflection, students with cram schooling are good at these activities in regular school classrooms.

7 Conclusions

This paper studies the effects of teaching practices on the educational achievement of elementary school students, with special focus on the impact of linguistic activity in classrooms on language and mathematics test scores. We find that some types of linguistic activities such as expressing the goal of learning at the beginning of each class and reflecting on the activity at the end of each class, among many other practices, improve the students' reading and mathematics test scores. We find heterogeneity in the effect of these activities across the class size and home environments, such as cram schooling. From these findings, teaching practices matter for the academic achievement of students, with their effectiveness depending on the learning environment of

students in schools and at home.

Note importantly that the findings of this study are based on several years of observations of one municipality. Needless to say, in order to draw general conclusions on the effectiveness of linguistic activities, we need to conduct further analysis with data from multiple municipalities. Furthermore, our analysis is based on repeated cross-sectional data of students. To obtain more precise estimates of the effects of linguistic activities by controlling for individual fixed effects, it is essential to consider student-level panel data. Unfortunately, the national achievement test that we used considered cross-sectional data without panel structure. Thus, we strongly encourage educational authorities and the government to collect panel data at the student level.

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Table 1: Definition of Variables

Variable	Explanation of variable
Test Scores	
Reading A	Standardized test score of National Language A (Basic Reading) with mean 50 and standard deviation 10
Reading B	Standardized test score of National Language B (Advanced Reading) with mean 50 and standard deviation 10
Math A	Standardized test score of Mathematics A (Basic Math) with mean 50 and standard deviation 10
Math B	Standardized test score of Mathematics B (Advanced Math) with mean 50 and standard deviation 10
Teaching Practices	
Goal Clarification	In the classes up to 5th grade, do you think that goal of lesson was expressed clearly at the beginning of classes? (=3 if agree, =2 if somehow agree, =1 somehow disagree, =0 disagree)
Reflection	In the classes up to 5th grade, do you think that time to reflect contents of lessons were provided at the end of classes? (=3 if agree, =2 if somehow agree, =1 somehow disagree, =0 disagree)
Presentation Opportunity	In the classes up to 5th grade, do you think that opportunities to present were provided? (=3 if agree, =2 if somehow agree, =1 somehow disagree, =0 disagree)
Discussion	In the classes up to 5th grade, do you think that opportunities to discuss with classmates were provided? (=3 if agree, =2 if somehow agree, =1 somehow disagree, =0 disagree)
Language Arts Activity	Sum of the above four variables (from 0 to 12)
Controls	
Class Size	Class size of 6th grade
Study Time	How long do you study out of school? (=1 if time is longer than 30 minutes a day, =0 otherwise)
Cram School	Do you attend a cram school (including private tutoring) (=1 if yes, =0 otherwise)
Conversation at home	Do you talk to your family member other than siblings about school? (=1 if yes, =0 otherwise)
Newspaper	Do you read newspaper? (=1 if more than once a month, =0 otherwise)
News	Do you check news on TV and/or internet? (=1 if check often, =0 otherwise)
Library	How often do you go to library? (=1 if more than once a month, =0 otherwise)
Reading Time	How long do you read books? (=1 if time is longer than 30 minutes a day, =0 otherwise)
Parental Involvement	Does you family member other than siblings come often to school events? (=1 yes, =0 otherwise)
Breakfast	Do you eat breakfast every day? (=1 yes, =0 otherwise)
Bedtime	Do you keep your bedtime every day? (=1 yes, =0 otherwise)
Wake-up Time	Do you keep your wake-up time every day? (=1 yes, =0 otherwise)
Year2015	=1 if observation is from 2015 survey, =0 otherwise

Table 2: Descriptive Statistics

Variables	Mean	Standard Deviation	Min.	Max.
Reading A	50.12	9.93	13.40	63.80
Reading B	50.08	9.93	22.90	67.30
Math A	50.12	9.93	8.10	61.20
Math B	50.10	9.97	26.40	71.20
Language Arts Activity	9.11	2.20	0	12
Goal Clarification	2.45	0.77	0	3
Reflection	1.94	0.87	0	3
Presentation Opportunity	2.42	0.76	0	3
Discussion	2.31	0.74	0	3
Class Size	30.26	3.45	19	40
Study Time	0.93	0.25	0	1
Cram School	0.49	0.50	0	1
Conversation at home	0.55	0.50	0	1
Newspaper	0.46	0.50	0	1
News	0.51	0.50	0	1
Library	0.44	0.50	0	1
Reading Time	0.35	0.48	0	1
Parental Involvement	0.80	0.40	0	1
Breakfast	0.86	0.34	0	1
Bedtime	0.35	0.48	0	1
Wake-up Time	0.58	0.49	0	1
Year2015	0.51	0.50	0	1
School Average of Teaching Practices				
Goal Clarification	2.44	0.14	2.14	2.79
Reflection	1.94	0.17	1.47	2.37
Presentation Opportunity	2.41	0.12	2.04	2.67
Discussion	2.31	0.13	2.04	2.69
Language Arts Activity from School Questionnaire	2.64	0.30	1.5	3

Number of observation is 8511

Table 3-1: Estimation Results of the Effect of Language Arts Activities (Reading Test Scores)

	Reading A	Reading A	Reading A	Reading A	Reading B	Reading B	Reading B	Reading B
Language Arts Activity	0.7074***	0.6849***	1.4435***	0.3015	0.7152***	0.7058***	1.1262**	0.6964*
	(0.0566)	(0.0564)	(0.4979)	(0.3635)	(0.0638)	(0.0626)	(0.4823)	(0.3868)
Class Size	−0.0482	0.0052	−0.0598	0.0043	−0.0458	0.0270	−0.0523	0.0270
	(0.0490)	(0.0325)	(0.0494)	(0.0321)	(0.0465)	(0.0370)	(0.0455)	(0.0367)
Study Time	5.3869***	5.1177***	4.7655***	5.4199***	5.3119***	5.1530***	4.9649***	5.1604***
	(0.4943)	(0.5047)	(0.6376)	(0.5784)	(0.5063)	(0.4907)	(0.5961)	(0.5470)
Cram School	0.8966***	0.7410***	0.9239***	0.7314***	0.1114	−0.0611	0.1266	−0.0614
	(0.2443)	(0.2317)	(0.2512)	(0.2274)	(0.2698)	(0.2620)	(0.2691)	(0.2579)
Conversation at home	0.9917***	1.0384***	0.4919	1.2994***	1.2083***	1.2401***	0.9292**	1.2465***
	(0.2140)	(0.2057)	(0.4123)	(0.3018)	(0.2323)	(0.2254)	(0.4081)	(0.2977)
Newspaper	1.6061***	1.5152***	1.3693***	1.6374***	1.5459***	1.4230***	1.4137***	1.4260***
	(0.1916)	(0.1926)	(0.2441)	(0.2152)	(0.2063)	(0.2125)	(0.2676)	(0.2687)
News	1.1686***	1.1409***	0.8770***	1.2967***	1.0004***	0.9266***	0.8376***	0.9304***
	(0.2428)	(0.2509)	(0.2862)	(0.2925)	(0.2522)	(0.2514)	(0.2910)	(0.2921)
Library	1.3998***	1.5417***	1.2629***	1.6036***	1.5271***	1.6976***	1.4507***	1.6991***
	(0.2168)	(0.2170)	(0.2362)	(0.2219)	(0.2253)	(0.2338)	(0.2355)	(0.2370)
Reading Time	0.8863***	0.9082***	0.7642***	0.9704***	0.5126**	0.5258**	0.4445*	0.5273**
	(0.2321)	(0.2354)	(0.2448)	(0.2532)	(0.2358)	(0.2281)	(0.2412)	(0.2378)
Parental Involvement	1.2184***	1.2206***	1.1231***	1.2716***	0.9855***	1.0101***	0.9323***	1.0113***
	(0.2750)	(0.2699)	(0.2816)	(0.2729)	(0.2768)	(0.2786)	(0.2870)	(0.2834)
Breakfast	1.2051***	1.1478**	−0.1670	1.8531**	1.2540***	1.2104***	0.4879	1.2276
	(0.4514)	(0.4459)	(1.1007)	(0.7883)	(0.4275)	(0.4178)	(1.0102)	(0.8293)
Bedtime	−0.4252*	−0.3702	−0.5286**	−0.3215	−0.4562*	−0.4068*	−0.5139**	−0.4056*
	(0.2327)	(0.2228)	(0.2404)	(0.2187)	(0.2477)	(0.2439)	(0.2463)	(0.2458)
Wake-up Time	−0.3714	−0.3429	−0.4592*	−0.2984	−0.2695	−0.2194	−0.3185	−0.2183
	(0.2515)	(0.2546)	(0.2541)	(0.2575)	(0.2439)	(0.2427)	(0.2508)	(0.2438)
Year2015	0.0188	0.0537	−0.2351	0.1864	−0.0329	−0.0366	−0.1747	−0.0333
	(0.3445)	(0.1676)	(0.3962)	(0.2184)	(0.3220)	(0.1521)	(0.3590)	(0.2197)
Constant	35.2091***	34.3896***	31.5313***		35.6778***	32.6035***	33.6242***	
	(1.6551)	(1.3479)	(2.9665)		(1.7248)	(1.5719)	(3.2748)	
School Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes
Observations	8511	8511	8511	8511	8511	8511	8511	8511
r2	0.1197	0.1396	0.0984	0.1081	0.1119	0.1287	0.1053	0.1082
Hansen's J stat			10.0994	3.8547			12.7418	8.3799
p-value			0.0388	0.4260			0.0126	0.0786
LM test statistic for underidentification			177.1940	83.2346			177.1940	83.2346
p-value			0.0000	0.0000			0.0000	0.0000

=*** 1%; =** 5%; =* 10% significance level. Clustered standard errors at school and year level are reported in parentheses.

Table 3-2: Estimation Results of the Effect of Language Arts Activities (Math Test Score)

	Math A	Math A	Math A	Math A	Math B	Math B	Math B	Math B
Language Arts Activity	0.6631***	0.6524***	1.5467***	2.0146***	0.7226***	0.7154***	1.5121***	1.6676***
	(0.0665)	(0.0661)	(0.5419)	(0.4184)	(0.0657)	(0.0651)	(0.4598)	(0.3207)
Class Size	0.0157	0.0541	0.0018	0.0573	−0.0366	0.0153	−0.0491	0.0175
	(0.0594)	(0.0417)	(0.0576)	(0.0423)	(0.0495)	(0.0352)	(0.0496)	(0.0362)
Study Time	5.2357***	5.1793***	4.4898***	4.1055***	4.5033***	4.4030***	3.8368***	3.6525***
	(0.5098)	(0.5179)	(0.7213)	(0.5846)	(0.4574)	(0.4759)	(0.5716)	(0.5292)
Cram School	1.2151***	1.0163***	1.2478***	1.0503***	0.6645**	0.4385*	0.6937***	0.4623*
	(0.2523)	(0.2459)	(0.2582)	(0.2507)	(0.2548)	(0.2402)	(0.2586)	(0.2421)
Conversation at home	0.3018	0.2836	−0.2982	−0.6440*	0.1518	0.1264	−0.3842	−0.5220*
	(0.2094)	(0.2015)	(0.4587)	(0.3596)	(0.1999)	(0.1917)	(0.3984)	(0.2923)
Newspaper	1.4878***	1.4321***	1.2036***	0.9979***	1.8611***	1.7878***	1.6071***	1.4843***
	(0.2031)	(0.2101)	(0.2737)	(0.2744)	(0.2050)	(0.2073)	(0.2474)	(0.2391)
News	0.9474***	0.9240***	0.5974**	0.3704	0.9917***	0.9516***	0.6789**	0.5647**
	(0.2377)	(0.2443)	(0.3043)	(0.2709)	(0.2323)	(0.2359)	(0.2786)	(0.2628)
Library	1.0566***	1.1840***	0.8922***	0.9641***	1.4238***	1.5389***	1.2770***	1.3852***
	(0.2545)	(0.2570)	(0.2705)	(0.2741)	(0.2379)	(0.2396)	(0.2555)	(0.2514)
Reading Time	−0.4880*	−0.4760*	−0.6345**	−0.6971***	−0.5258*	−0.5023*	−0.6567**	−0.6568**
	(0.2545)	(0.2531)	(0.2594)	(0.2650)	(0.2697)	(0.2694)	(0.2824)	(0.2811)
Parental Involvement	1.0492***	1.0760***	0.9349***	0.8948***	1.1113***	1.1079***	1.0092***	0.9813***
	(0.2896)	(0.2859)	(0.3107)	(0.2823)	(0.3063)	(0.3055)	(0.3042)	(0.2965)
Breakfast	1.7373***	1.7002***	0.0904	−0.8058	1.3890***	1.3069***	−0.0826	−0.4447
	(0.4381)	(0.4262)	(1.1466)	(0.9772)	(0.3910)	(0.3858)	(1.0128)	(0.7711)
Bedtime	−0.2132	−0.1722	−0.3374	−0.3453	−0.1731	−0.1072	−0.2840	−0.2282
	(0.2243)	(0.2222)	(0.2198)	(0.2288)	(0.2315)	(0.2259)	(0.2511)	(0.2412)
Wake-up Time	−0.5369**	−0.4976**	−0.6422***	−0.6556***	−0.4607**	−0.4198*	−0.5548**	−0.5303**
	(0.2171)	(0.2175)	(0.2413)	(0.2396)	(0.2227)	(0.2245)	(0.2341)	(0.2373)
Year2015	−0.0059	−0.0053	−0.3106	−0.4769**	0.0083	−0.0000	−0.2640	−0.3296*
	(0.3439)	(0.1929)	(0.3785)	(0.2032)	(0.3233)	(0.1616)	(0.3568)	(0.1689)
Constant	34.5451***	33.3258***	30.1306***		36.4505***	34.2890***	32.5060***	
	(1.9587)	(2.0249)	(3.7326)		(1.6279)	(1.4907)	(3.0681)	
School Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes
Observations	8511	8511	8511	8511	8511	8511	8511	8511
r2	0.0948	0.1134	0.0641	0.0181	0.0943	0.1118	0.0700	0.0546
Hansen's J stat			7.8608	2.7203			9.9426	4.3230
p-value			0.0968	0.6057			0.0414	0.3641
LM test statistic for underidentification			177.1940	83.2346			177.1940	83.2346
p-value			0.0000	0.0000			0.0000	0.0000

=*** 1%; =** 5%; =* 10% significance level. Clustered standard errors at school and year level are reported in parentheses.

Table 4: Correlation Coefficients among Four Variables of Language Arts Activities

	Goal Clarification	Reflection	Presentation Opportunity	Discussion	Language Arts Activity
Goal Clarification	1.00				
Reflection	0.35	1.00			
Presentation Opportunity	0.34	0.25	1.00		
Discussion	0.29	0.32	0.36	1.00	
Language Arts Activity	0.70	0.71	0.69	0.69	1.00

Table 5: Estimation Results of the Effect of Each Activity

	Reading A	Reading A	Reading B	Reading B	Math A	Math A	Math B	Math B
Goal Clarification	2.2035***	2.8476**	2.0022***	2.9907**	1.7858***	3.0016**	2.0285***	2.8181*
	(0.1714)	(1.4377)	(0.1762)	(1.2770)	(0.1698)	(1.3131)	(0.1651)	(1.4705)
Reflection	−0.7377***	−1.0581	−0.5453***	0.3936	−0.5717***	1.9962*	−0.8181***	2.3010***
	(0.1504)	(0.9253)	(0.1592)	(0.7840)	(0.1370)	(1.0676)	(0.1448)	(0.6117)
Presentation Opportunity	2.4239***	−1.0797	2.2095***	1.0753	2.3687***	2.2570	2.6420***	1.1867
	(0.1571)	(1.3817)	(0.1659)	(1.1946)	(0.1775)	(1.9568)	(0.1596)	(1.5281)
Discussion	−1.1022***	1.4674	−0.7906***	−2.2754	−0.9258***	0.3964	−0.8839***	−0.6605
	(0.1792)	(1.7432)	(0.2138)	(1.8157)	(0.2030)	(1.5628)	(0.1852)	(1.5903)
School Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8511	8511	8511	8511	8511	8511	8511	8511
r2	0.1840	0.0894	0.1615	0.1178	0.1478	0.0398	0.1559	0.0542
Hansen's J stat (p-value)		0.6680		0.1816		0.3187		0.3095
Underidentification Test (p-value)		0.0000		0.0000		0.0000		0.0000

=*** 1%; =** 5%; =* 10% significance level. Clustered standard errors at school and year level are reported in parentheses.

Table 6: Estimation Results of the Effect of Language Arts Activities by Class Size

	Reading A	Reading A	Reading A	Reading A	Reading B	Reading B	Reading B	Reading B
Language Arts Activity								
Small Classes	0.7401***	0.7153***	1.4837**	0.7717	0.7173***	0.6911***	1.3421*	0.0832
	(0.0783)	(0.0761)	(0.6884)	(0.7252)	(0.0930)	(0.0897)	(0.7010)	(0.5465)
Large Classes	0.6752***	0.6544***	1.4401**	−0.5886	0.7094***	0.7023***	0.9844*	−0.2976
	(0.0808)	(0.0823)	(0.6961)	(0.7301)	(0.0834)	(0.0838)	(0.5729)	(0.3524)
School Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes
	Math A	Math A	Math A	Math A	Math B	Math B	Math B	Math B
Language Arts Activity								
Small Classes	0.7524***	0.6985***	2.2778***	2.2083**	0.7309***	0.7006***	1.9396***	1.6843**
	(0.0919)	(0.0897)	(0.6591)	(0.9429)	(0.0949)	(0.0921)	(0.5849)	(0.7120)
Large Classes	0.5898***	0.5983***	0.8739	1.5935***	0.7147***	0.7182***	1.2340*	1.3539***
	(0.0909)	(0.0920)	(0.7319)	(0.4412)	(0.0874)	(0.0873)	(0.6607)	(0.4061)
School Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes

=*** 1%; =** 5%; =* 10% significance level. Clustered standard errors at school and year level are reported in parentheses.

Table7: Estimation Results of the Effect of Language Arts Activities by Cram Schooling Status

	Reading A	Reading A	Reading A	Reading A	Reading B	Reading B	Reading B	Reading B
Language Arts Activity								
Without Cram Schooling	0.6827***	0.6512***	1.3943***	−0.2796	0.7081***	0.6945***	0.9889*	0.4365
	(0.0785)	(0.0805)	(0.5081)	(0.4966)	(0.0754)	(0.0766)	(0.5360)	(0.5588)
With Cram Schooling	0.7345***	0.7271***	1.4268**	0.4942	0.7220***	0.7119***	1.2438*	0.4670
	(0.0763)	(0.0750)	(0.6477)	(0.6078)	(0.0885)	(0.0850)	(0.6760)	(0.5653)
School Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes
	Math A	Math A	Math A	Math A	Math B	Math B	Math B	Math B
Language Arts Activity								
Without Cram Schooling	0.6831***	0.6642***	1.4108**	1.2436**	0.7106***	0.6933***	1.4274**	0.7750
	(0.0862)	(0.0880)	(0.5686)	(0.6021)	(0.0790)	(0.0793)	(0.5587)	(0.4942)
With Cram Schooling	0.6387***	0.6325***	1.6802**	2.6257***	0.7282***	0.7334***	1.5575**	2.2742***
	(0.0846)	(0.0792)	(0.6573)	(0.4952)	(0.0859)	(0.0835)	(0.6126)	(0.5649)
School Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes

=*** 1%; =** 5%; =* 10% significance level. Clustered standard errors at school and year level are reported in parentheses.