National Institute for Educational Policy Research FY 2013–2014 Project
Research Report on "Study on the Efficacy of Pupil-teacher Ratio Reduction in Terms of Class Size and Learning-group Size"
Class Size Effects on Students' Academic Performance and its Process (Outline)

1. Purpose of the Research

■ Purpose   This study aims to clarify what effects class size has on students' academic achievement and how it is processed, based on the insights and related subjects learned from the prior research on class sizes in Japan and overseas. It was investigated how students' academic performance changes differently depending on class size or the number of classes per grade, and the difference of teaching methods depending on class size or the number of classes per grade. Then it was attempted to reveal the effects on students' academic achievement depending on class size and its process with bringing these results together.

■ Overview   We examined if the relationship of academic achievement in a prior versus the subsequent period differs depending on class size, using the results of an academic performance survey executed twice in around six-month intervals. We also examined whether the prior-subsequent academic achievement relationship differs depending on class size and the number of classes per grade, using the results of an academic performance survey executed twice in a two-year interval. Furthermore, we examined execution status of formative evaluation depending on class size, daily efforts to improve learning guidance, and in-class human relationship differences depending on class size and the number of classes per grade. The discussion about these results was argued with combining the homework engagement status depending on class size obtained by the past project research, and the research result of differences in the teacher's voice and audibility in a classroom.

2. Overview of each Research Results (partial)

2.1 The difference regarding the relationship between academic achievement in a past period and the ones in subsequent periods depending on class size (Research 1)

■ Method   Re-analysis of the data obtained from the nationwide survey carried out between July and December 2006, targeting the second and fifth grade of elementary school studnets, with Japanese language as a target subject.

■ Result   As a result of a multi-level model analysis for the second grade, if comparing schools that have the same school average level in the score in past academic achievement surveys, it was indicated that students in smaller classes marked higher scores in the subsequent period if looking at students who marked approximately the average score in the past survey (Figure 1). For the fifth grade, however, no difference was

Figure 1. Relationship between scores in the first and the second survey of academic achievement (second grade of elementary school)

identified regarding the relationship between academic performance in a past period, and the one in the subsequent period depending on class size.

■ The difference regarding the relationship between academic performance in a past period, and ones in subsequent periods depending on class size and the number of classes per grade (Research 2)
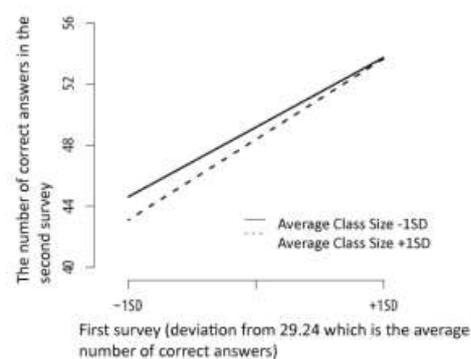
■ Method   Re-analysis of the data obtained from the survey carried out in Kyoto Prefecture between July and December 2006, targeting the second (48 schools, 4,321 pupils) and fifth grade (56 schools, 5,052 pupils) of elementary school, with Japanese language as a target subject.

■ Result   As a result of a multi-level model analysis, if we look into the strength of the relationship between academic achievement in a past period, and the one in subsequent periods after adjusting school averages of the correct answer ratio in the past academic performance survey, there is a difference between schools having two classes of 30 or less students per grade and schools having more than two classes of 30 or less students per grade. The enhancement of academic performance indicated such that students whose prior achievement were lower (Figure 2).
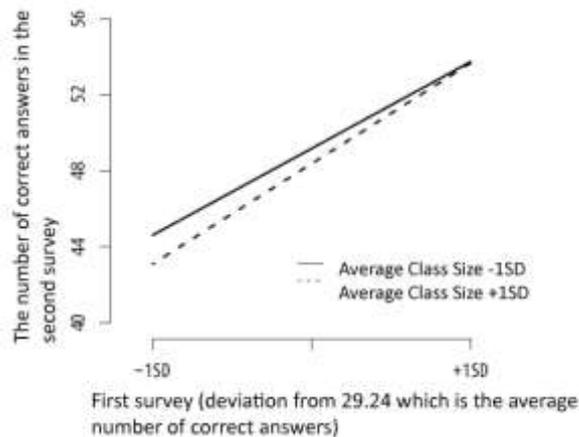
2.2   Class size and feedback as formative evaluation (Research 4)

■ Method   The research was carried out in April 2014, targeting 64 elementary school teachers in Miyagi Prefecture with one year teaching experience, regarding the execution status of feedback in lessons for the class they were in charge of in the previous year.

■ Result   The result of logistic regression analysis revealed that feedback for students while independently working on subjects was less executed in larger classes, as well as teaching via walking around the class to point out correct/incorrect answers and giving scores (Figure 3), or to show ways of thinking to solve subjects and explain reasons for correct/incorrect answers.
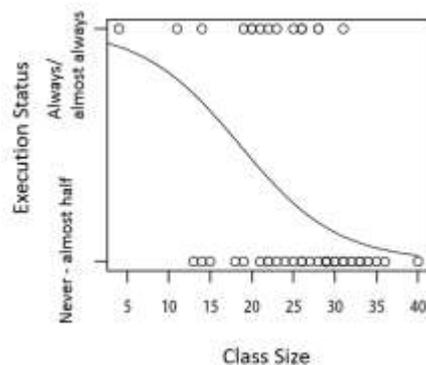
Figure 3. Execution status of Feedback (correct/incorrect and scoring) and Class Size

2.3   The difference regarding efforts to improve learning guidance depending on class size (Research 5)

■ Method   Targeting 32 elementary schools in Morioka City in Iwate Prefecture, the research was carried out in November 2014. With the first, third and fifth grades of elementary schools respectively, the research was carried out for three classes of 5−10 students, 15 students, 20 students, 25 students, 30 students and around 35 students (±1) each, and for two classes of around 40 students. Homeroom teachers were asked to fill-out, in a free format, three to ten bullet items that they thought they could or could not perform as daily teaching and learning guidance, because of their class size.

Result   As a result of correspondence analysis, it was indicated that among various daily support systems, personal guidance, opportunities for everyone to appeal or experience, firm learning increased in classes with 20 or fewer students, diversity-oriented support increased in classes with 35 or more students. It was also suggested that support execution depends on class size when it is 20 or less or 35 or more, but does not depend on the size when it is around 25 (Table 1).

Table 1. Relationship between Teaching and Learning Guidance and Class Size

Classification Number	Category Name	5	10	15	20	25	30	35	40
A	Respect each pupil's thinking								
B	Note-taking guidance						O	×	×
C	Prepare for individual guidance	O	O	O	O			×	×
D	Homework guidance	O	O	O	O				
E	Opportunities for each pupil to appeal						×	×	×
F	Opportunity for experiences	O	O	O	O				
G	Utterances by everyone	O	O	O	O			×	×
H	Observe groups	O	O	O	O				
I	Individual guidance/evaluation	O	O	O	O		×	×	×
J	Firm Learning	O	O	O	O				
K	Group-think with pupils' diversity	×	×	×	×			O	O
L	Discussion	×	×	×	×				
M	Groups interaction								O
N	Role allotment among pupils							O	O
O	Interaction among diverse pupils	×	×	×	×			O	O
P	Learning activities needing many people	×	×	×	×			O	
Q	Constructive learning	×	×	×	×				
R	Think out proper size grouping	×	×	×	×				
S	Secure health and safety								

1 O : Teaching and learning support that is thought to be successfully done because of the current size
2 × : Teaching and learning support that is thought to be unsuccessfully done because of the current size

2.4   The effects that the number of classes per grade and class size have on solutions of students guidance or human relationship problems due to re-shuffling (Research 6)

■ Method   Re-analysis of the research carried out in July 2010, targeting 35 principals of junior high schools in Yamagata Prefecture, that were asked the total number of students who were the same grade, and may cause guidance problems if they were in the same class during the timing of a second grade re-shuffle, and the total number of students among them for whom guidance and student relationship problems were resolved because of re-shuffling.

Figure 4. Solutions for students' guidance or human relationship problems vs. Class size and classes per grade

■ Result   As a result of a multi-level probit regression model analysis, it was indicated that if a class size is between 23 and 33, schools having five to nine classes per grade or having classes of less than 30, have a relatively higher solution ratio of guidance and student relationship problems from re-shuffling, compared to schools having two to four classes per grade, and classes of 31 or more (Figure 4).
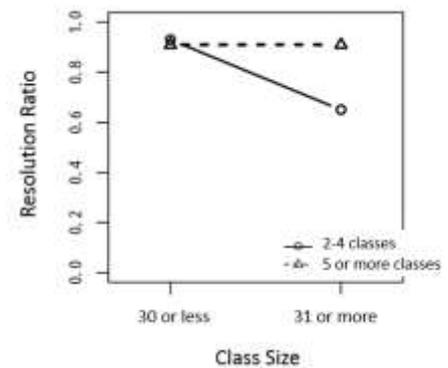
3.   Comprehensive Findings

   Figure 5 shows the summary of results above, together with "A comparison of average scores between schools with and without additional teachers assigned to reduce student-teacher ratios" (Research 3), "Class size effect on homework engagement and its change" (Research 7) and "Differences in the way teachers' voices were transmitted in classrooms depending on class size" (Research 8) stated in the report.
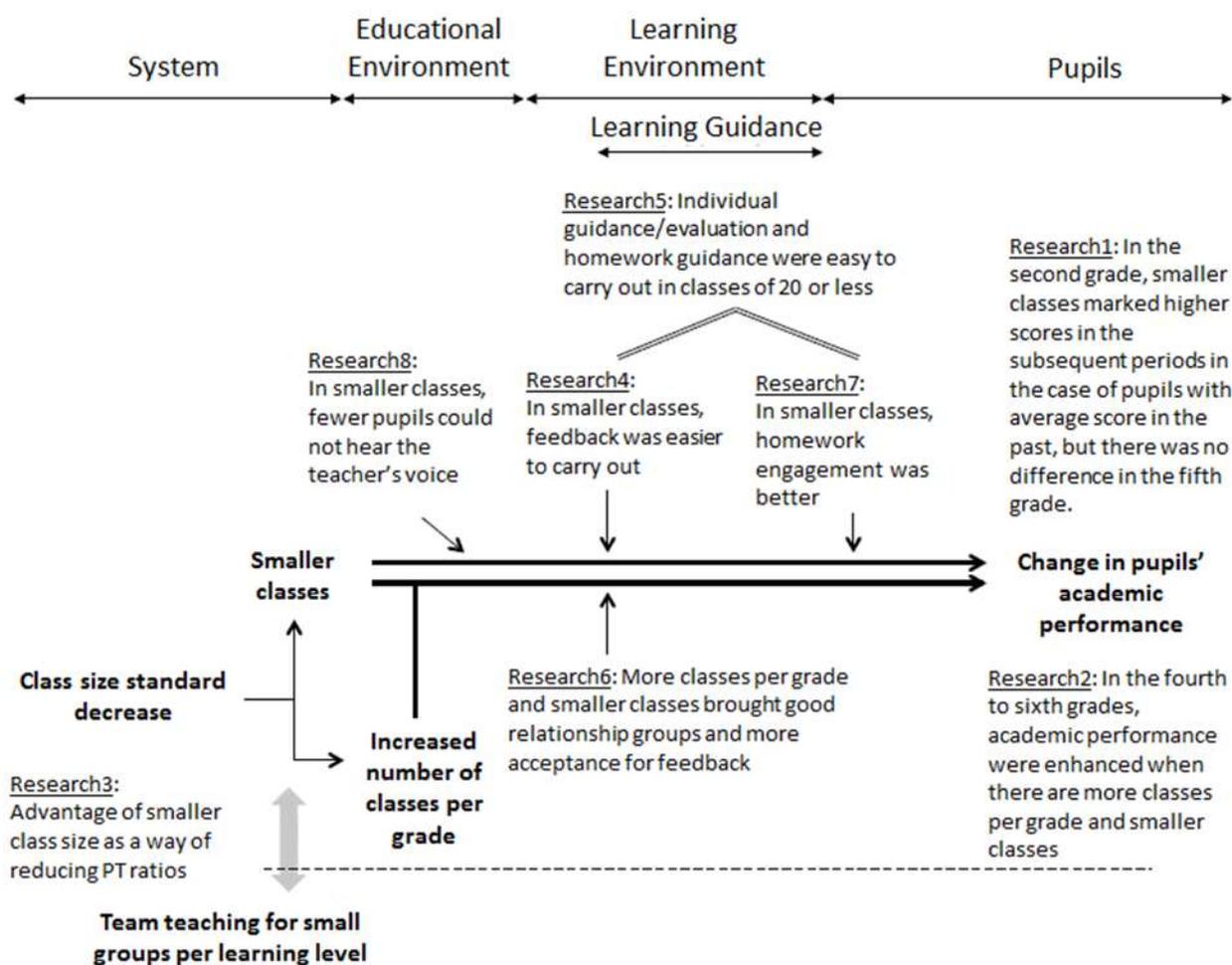
Figure 5. Summary of the Research Results

It suggests that students' academic achievement changes differ according to class size for lower grades in elementary schools. For a short term, if compared among schools with the same level of school averages in past academic achievement, it was indicated that students in smaller classes marked higher scores in the subsequent period in case of students who marked average scores in their past achievement, but there were no academic achievement differences according to class sizes in higher grades. Looking into the long term by adding factors that classes per grade increase simultaneously, however, the class size reduction seemed to improve of academic achievement even in higher grades, because there are more classes per grade and smaller classes. Smaller classes make it easier to hear a teacher's voice, easier to give feedback as a formative evaluation and helps to improve homework engagement, which are considered the main factors affecting changes in students' academic achievement.

The result of the research, in this way, indicates various merits of smaller classes but also indicates that smaller classes are not necessarily good in terms of changing students' academic achievement. Especially for higher grades of elementary schools, the reason why students' subsequent achievement is improved whose prior achievement is lower when they belong to both more classes grade and smaller class would be seemed that an advantageous combination effect of both small class and more classes per grade. Considering that Japan's class formation standards prescribes not only class size but also the number of classes per grade, the results of this study can be one of the insights that support a policy to reduce class sizes.