

Effectiveness and Issues of ESMATE (Project of Making New Mathematics Textbooks for Primary and Secondary Schools): Contextualization of the Japanese Teaching Style Materials to Current Learning Situation in El Salvador

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Abstract

The low performance in mathematic skills is common in El Salvador, several results in several assessments and evaluations make this flagrant. Since 2016 in El Salvador a curriculum reform has been developed including new textbooks, for whole grades of primary and secondary school with the technical support of Japan. The national implementation has been held in 2018 and 2019 by proposing a curricular development strategy with the use of textbook. In order to measure the effectiveness of textbook and national strategy, an impact evaluation was carried out in 2018, first results showed the improvement of the mathematic performance of Salvadoran students and teachers' practices.

Keywords: El Salvador, Mathematics textbooks, Japanese teaching style, Curriculum of Mathematics.

1. Introduction

The development of scientific skills has become compulsory in education systems around the world due to current status of technological advances. Historically El Salvador has had a low performance in mathematic skills since ever (MoE, 2011, 2012, 2013, 2014 & 2015).

In 2016 a new policy in El Salvador was coming; it was based on changes on the current curriculum of that time and the elaboration of textbooks according to this changes. This policy was called ESMATE, its activities were conducted by the Ministry of Education of El Salvador (MoE) in collaboration with the Japanese International Cooperation Agency (JICA). The main objective was the contextualization of the Japanese teaching style into Salvadoran reality, hoping to achieve a successful performance based on Japanese experience and the success of Japanese education system (MoE, 2019).

Then, it will be related the Salvadoran experience with the contextualization of Japanese style, the first

findings of effectiveness of the ESMATE strategy, the final results of the implementation of ESMATE in all national schools and the future prospects and challenges for El Salvador.

2. Background

The achievement of mathematical skills in Salvadoran students is highly influenced by different factors (IEA, 2008). Some of them are unattainable, nevertheless, some others are possible to improve through technical endeavor and teachers' training. One of the most common features of Salvadoran education style is that most of the teachers apply a teacher-centered style, and students are just accustomed to receive the information in a passive learning style (MoE, 2019).

2.1 Low mathematical performance

The large-scale standardized tests are a common measure for education systems around the world, but

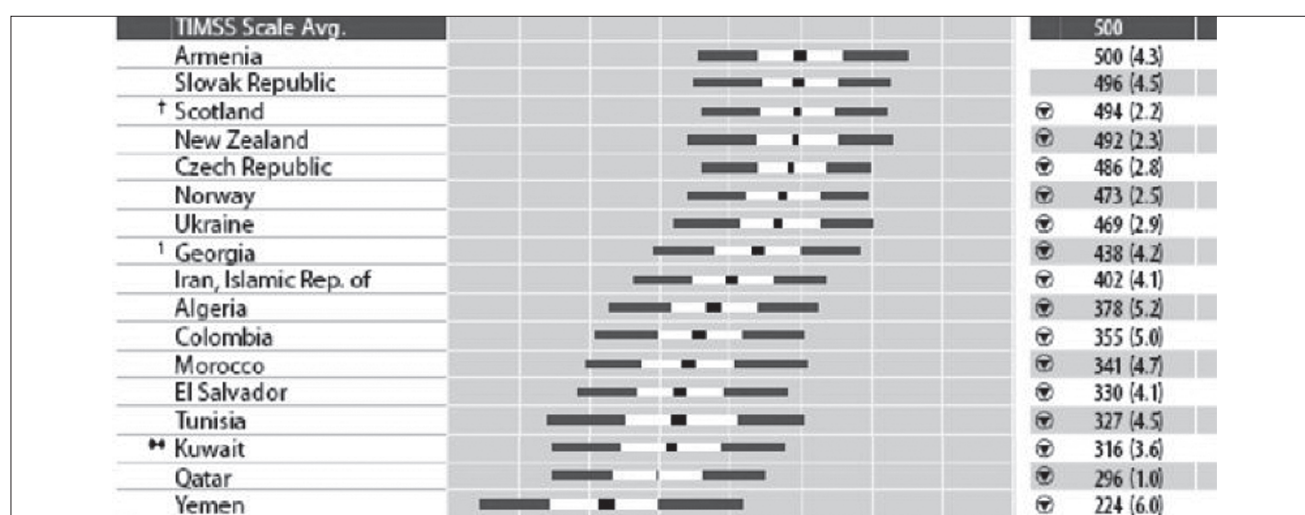


Figure 2.1 TIMSS 2007 Distribution of Mathematics Achievement in 4th grade
Data source: IEA, (2008, p. 34)

the last participation of El Salvador on these was in TIMSS 2007, and the low mathematic skills performance was very flagrant. In fact, the low performance in mathematic was not a surprise, because the Salvadoran standardized test called PAES (in Spanish: Prueba de Aprendizaje y Aptitudes para Egresados de Educación Media de El Salvador) has been showing a low performance in mathematic skills since ever.

2.1.1. TIMSS 2007

The performance of Salvadoran students was very low in both, 4th and 8th grade, as is shown in Figure 2.1, in which El Salvador ranked in 32nd among the 36 participating countries.

2.1.2. National evaluation (PAES)

The national standardized test PAES is applied to whole high school students at the second year of high school. This test has a summative purpose but is not required for starting the superior education – just teacher's career requires at least 7 as score – students do not need a minimum for graduating, the PAES score just represents a 25% of the final high school scores of each evaluated subject. In Table 2.1 it is possible to notice the change of the general average of PAES from 2011 to 2015.

2.2 Salvadoran teaching-learning style

In El Salvador most of the teachers think they have the knowledge and they need to transfer it to the students. This make the majority of students do not have the opportunity to face mathematic problems by themselves or make mistakes in the solutions and trials. The mindset in both, teachers and students, becomes fixed. Teachers think that they need to solve everything during the class, and students think that they cannot face and solve mathematic problems by themselves (MoE, 2019)

3. Framework

3.1 Approaches to develop mathematic skills in 21st century

The reality nowadays is very different from some years ago, and in particular, this is due to the development of the technology and social networks. Life routine is becoming different, and workplaces require different and new skills, capabilities and competences, because simple tasks have been automated by machines. Currently, it requires persons with skills to solve complex problems, and to interact socially with others professionals in order to solve those complex problems. Two of the main skills

Table 2.1 PAES results from 2011 to 2015

Year	2011	2012	2013	2014	2015
Average	4.85	5.00	5.30	5.20	5.30

Data source: MoE (2011, 2012, 2013, 2014 & 2015)

required in the 21st century are: individual problem solving and collaborative problem solving abilities, (Care & Kim, 2018).

Education systems around the world are changing in this trend, looking for providing to the society what is required for developing these skills. “It is imperative to enable learners to become more active and to give them more responsibility for arranging their own learning process, in particular because learning needs to continue after leaving school” (Nieveen & Plomp, 2018, p. 264). In this sense, the teacher’s role changes too, because “Encouraging and supporting active learning needed to acquire these skills implies that learning processes have to be organized in such a way that learners learn – with the help of teachers as professional ‘coaches’ – how to become more or less the architect of their own learning process” (Nieveen & Plomp, 2018, p. 264).

Currently, one of successful cases is Japan, which has developed an education system based on active learning of students, continuous teachers’ reflection and formative assessment (The Kansai Society for Educational Administration, 2018).

3.2 Japan experience learner-centered approach

In Japan, the curriculum is based on the development of students’ mind and body and to realize the educational objectives and goals of the school (The Kansai Society for Educational Administration, 2018), and in practice they try to enable students to develop 21st century skill by using a learner-centered approach.

The performance of Japan in large-scale standardized tests is well-known as very high, it is almost in top 10 or top 5 between best performance around the world (IEA, 2004, 2008, 2012 & 2016). The

success of Japanese education system is proved.

3.3 Research objectives

To summarize all the results of surveys conducted for ESMATE, in order to indicate the issues detected in the ESMATE intervention, to establish the background for an upcoming research.

3.4 Research methodology

It has been necessary an exhaustive review of the different products, and experiences recorded by different ways, systematizing the process and providing an overview of last El Salvador experience in Mathematics education.

4. ESMATE Hypothetical strategy

In El Salvador, since 2016 with the technical support of JICA, a strategy was developed with the purpose of improving math learning of students in primary and secondary school, it is conducted by the MoE and called ESMATE – because its meaning in spanish: El Salvador Matemática – it has been in operation until now. Before that, an exhaustive analysis about mathematic curriculum was carried out, making change in order to improve the sequence of the contents and avoid the repetition of contents among the 11 years of compulsory education. The new curriculum was planned to be covered in 80% of the available time, which means it is compulsory to cover the contents in 160 of 200 class hours¹.

After the curricular reform was over, it was designed the ESMATE strategy represented in Figure 4.1. It consists of three parts. First, quality textbooks – including workbook and teacher’s guide for each grade from 1st grade to 2nd year of high school –; second, active learning

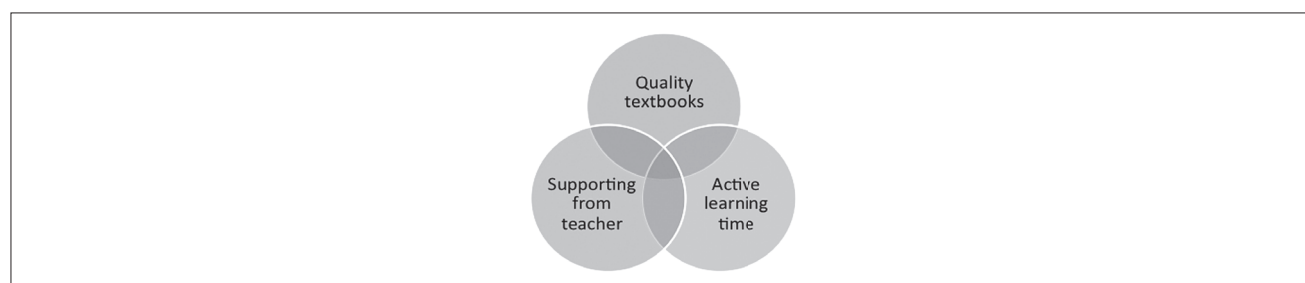


Figure 4.1 ESMATE strategy

Data source: MoE (2019, p. 6)

¹ In case of 1st grade is 210 of 280 and high school 192 of 240, but in general it will be used 160 for referring to this in whole article.

time warranted by teachers; and third, supporting from teachers, which is evidenced on the management of the time to provide the active learning to students.

4.1 ESMATE textbook editing strategy and proofreading

The general template of a page of the textbook follows these parts: initial problem, the solution, conclusion and problems section according to the class objective. Corresponding to the textbook, there exists a workbook which general template consists of: review of last two classes' contents, the conclusion and problems section according to the class objective. At last, a teacher's guide was made explaining the expectation for each part of each textbook's class and its formative assessment, providing the solutions of the problems, and at the end proposing a general blackboard planning.

Particular features of the editing strategy are the following: expectation of problems section increases the difficulty step by step, attempting the learning of low and high performances students; marked link between the objective of the class and the first item of the problem section.

In the teacher's guide some unit and trimestral tests were provided, both with a formative assessment expectation. ESMATE intends to collect samples of the students' results in these tests and some teachers' opinions about quality of the textbook, in order to proofread year by year the quality as well of the textbooks as the workbooks and teacher's guides.

4.2 Learner-centered approach

The student-centered learning is evidenced by the time that is expected to be provided by the teacher during the class for active learning. This could be during the initial problem solving of the class, analyzing the conclusion or facing the problems section, either individually or collectively (MoE, 2019).

In this sense, the MoE asked teachers to provide at least 20 minutes of active learning in individual or collaborative problem solving during each class. And in the same way it is expected that students have at least 20 minutes of active learning at home, by solving the problems in the corresponding class from workbook.

Finally, it expected to cover at least 160 of 200 class hours a year, by using textbook. This is called the 20-20-160 strategy of active learning (MoE, 2019).

4.3 Teachers' role and assessments

Considering the learner-centered approach, teachers become facilitators for the students, providing enough time for active learning. On the other hand, the teacher should make a formative assessment in order to know how much was understood by each student, and to provide the most suitable feedback and follow-up.

5. Pilot phase

At the end of 2016 a draft version of textbooks was finished, and in 2017 an action-research was carried out in some experimental and control schools around different departments of El Salvador. The objective of this action-research was "to validate the textbook effectiveness based on students' outcomes, classes observation and teachers' opinions" (ESMATE, 2017).

5.1 Action-research methodology

Starting 2017, a baseline was captured from both experimental and control schools. After this, the ESMATE strategy was implemented with the draft version of textbooks to 3rd and 8th grade in experimental schools. At the end of the academic year of 2017, an end-line was captured from both experimental and control schools. The results are presented as follows.

5.2 Qualitative results of action-research

The change in the teaching style was evident. The learner-centered approach was implemented in experimental schools. After some classes a sample of unit tests results were collected from some experimental schools, and followed by analysing the differences between the way of solving specific items – related to some baseline items –, which can be observed in Figure 5.1. The complete analysis per item was numerically systematized in graphs as showed in Figure 5.2.

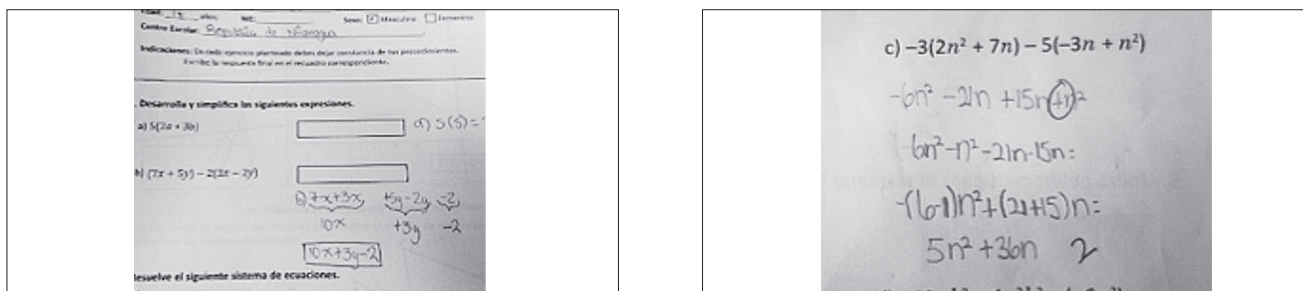


Figure 5.1 Baseline mistakes (left side) and unit test mistakes (right side)

Data source: ESMATE (2017)

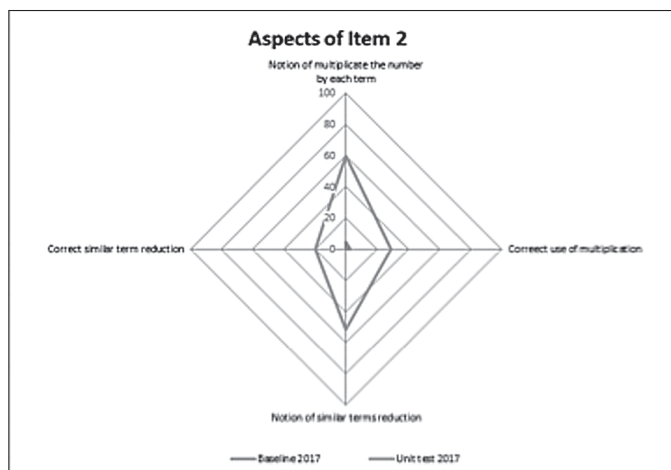


Figure 5.2 Example of analysis of the qualitative aspects of students' answer

Data source: ESMATE (2017)

5.3 Quantitative results of action-research

In the baseline, test score results of both experimental ($N = 120$ students) and control schools ($N = 132$ students) had a statistically significant difference ($p = 0.001 < 0.05$). Control schools had better performance than experimental ones. After the implementation of ESMATE draft version, in the end-

line the statistically significant difference disappeared ($p = 0.1042 > 0.05$), as Figure 5.3 indicates.

After completion of ESMATE action research, it was possible to identify some issues in the hypothetical ESMATE strategy, for planning the national intervention in 2018.

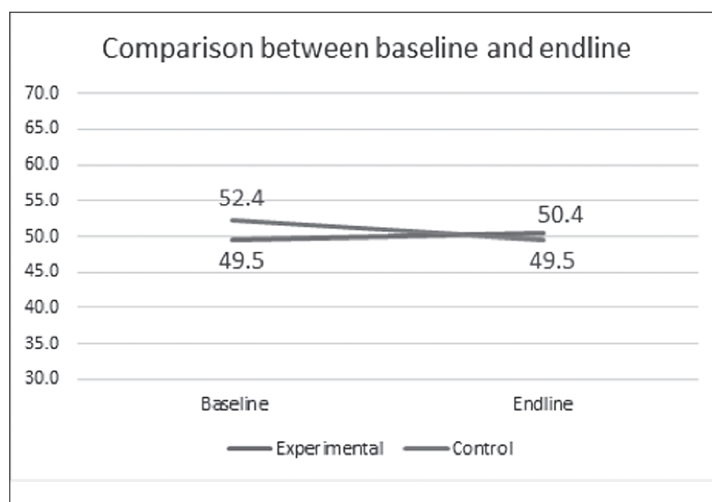


Figure 5.3 Comparison of test score between baseline and end-line on ESMATE action-research

Data resource: ESMATE (2017)

6. ESMATE National implementation

ESMATE national implementation was carried out in two parts. First it was implemented at low secondary level, from 7th to 9th grade in 2018, and second, for whole levels, from 1st grade to 2nd year of high school, in 2019 – including second edition of low secondary textbooks –.

6.1 Textbooks distribution logistics

During 2018 and 2019 distribution was carried by the provision of school supplies system and textbooks were successfully delivered to each school, just in some cases, the textbooks arrived a little late.

The great challenge for El Salvador was to face the mindset change in both teachers and students. But really the most complicated was the teachers – the experience in the action-research showed this – and for facing this, it was indispensable to plan teachers' training in service.

6.2 Teachers' training and tracing

For attending whole teachers around El Salvador was necessary to count with some teachers' support as facilitators of the teachers' training. Before starting the academic year in 2018, the MoE planned the first teachers' training in service. In addition, during the year, three teachers' reflection meetings were planned; in these meetings it was expected to improve the implementation of ESMATE strategy referring to the teachers' experience. Finally, in order to follow up the implementation at schools, it was planned to do school visits from different instances.

6.2.1. Induction for implementing ESMATE strategy

The main objective of the induction was to socialize the ESMATE strategy, the general template of textbook, expectation of the MoE, preliminary results, teachers' planification with textbooks and formative assessment included in teacher's guides. The inductions were held in each department of El Salvador, and it was necessary to prepare groups of facilitators in each zone. During this induction the teacher's guides for each grade were delivered.

6.2.2. Teachers reflection meetings

During these reflection meetings it is expected that teachers share their students' results during the trimestral period, identify the issues in teaching practices, and design an improvement plan for

implementing during the next trimestral period. Teachers with best results are called to share their strategies used at classroom during the meeting.

6.2.3. School visits

The school visits were planned to verify the exact way that teachers were, actually, using textbooks and implementing ESMATE strategy. This activity should be in charge, mainly, of the school principals, then of the local education inspectors and at the end for ESMATE technicians. There exists an instrument for making class observation specially based on students learning.

6.3 Teachers' pre-service curricula update

For concluding, as ESMATE is expected to be implemented as a long-term policy, it is indispensable that new teachers know about ESMATE textbooks and strategy. ESMATE was working with the universities that offer the teacher career and it was incorporated into the curricula of teachers' pre-service training, the contents and skills needed to teach mathematics by using ESMATE textbook and strategy.

7. Effectiveness of ESMATE

2018 was the time decided to prepare and carry out an impact evaluation for verifying the effectiveness of ESMATE strategy and textbooks on learning outcomes, and teaching and learning practices. It was carried by Human Development Department, JICA.

7.1. Impact evaluation methodology

For this impact evaluation a Randomized Controlled Trial methodology was used. The targeted grades were 2nd (primary) and 7th (low secondary), with the difference that on 2018 textbook was delivered for 7th grade around national terrain, but 2nd grade was not delivered until 2019. Because of the differences between 2nd and 7th grade, the design of impact evaluation was different for each grade. This could be checked on Figure 7.1 and Figure 7.2.

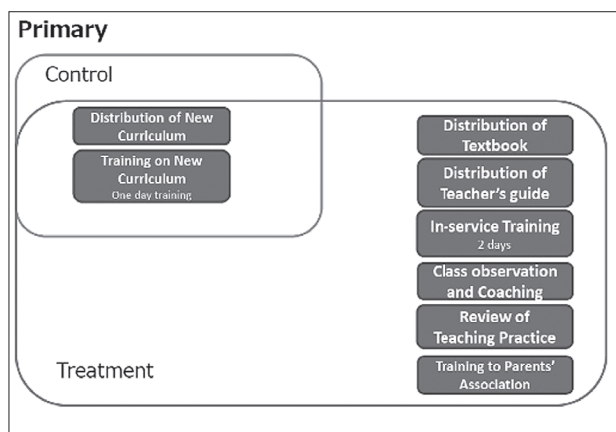


Figure 7.1 Design of impact evaluation for primary level

Data source: Maruyama & JICA (2018)

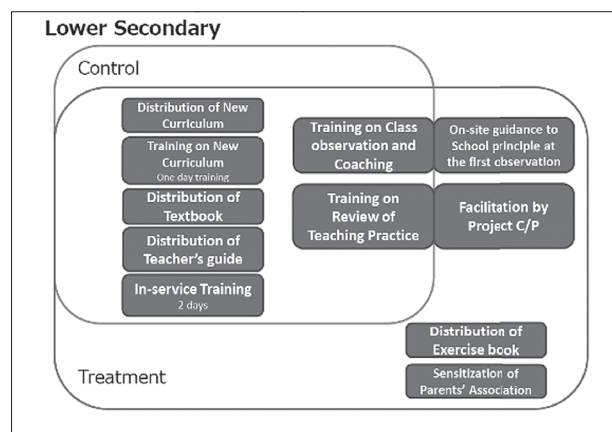


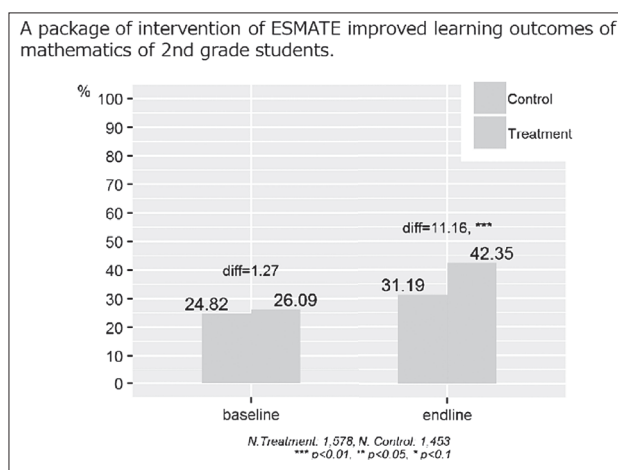
Figure 7.2 Design of impact evaluation of lower secondary level

Data source: Maruyama & JICA (2018)

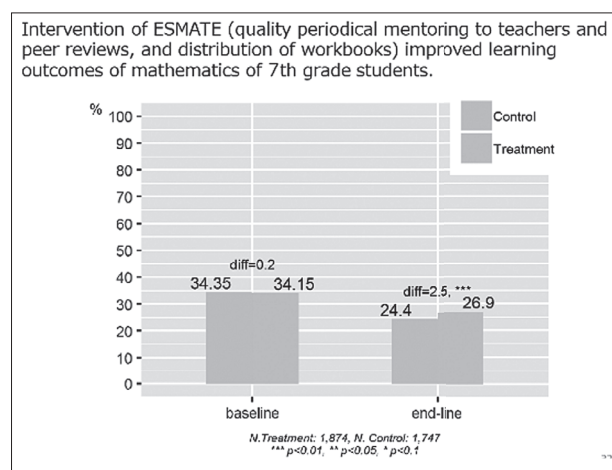
The sample for the impact evaluation considered public basic education schools which included primary and lower secondary levels, but which were not focused in education with special needs; school whose location were considered accessible by pick-up truck and the access to the site was not hampered by security concern. 250 schools were randomly sampled, stratified by department, rural and urban. 125 of these were randomly assigned to treatment group (N = 1578 students), and others to control group (N = 1453 students), stratified in the same way each group. This impact evaluation was carried out in 4 of the 12 departments of El Salvador.

7.2. Impact evaluation results

After applying the baseline, the ESMATE package of intervention was implemented on treatment schools in 2018. At the end of 2018, an end-line was applied, for both, 2nd and 7th grade, the results are showed in Figure 7.3 and 7.4. By analyzing these results, for 2nd grade, the improvement is noticeable, and the results are statistically significant ($p < 0.01$); analogously for 7th grade, the package of intervention changed, and considering that both groups had the textbook, it was possible to achieve a difference smaller than 2nd grade, but statistically significant ($p < 0.01$).

Figure 7.3 ESMATE intervention improved learning outcomes of mathematics of 2nd grade students

Data source: Maruyama & JICA (2018)

Figure 7.4 ESMATE intervention improved learning outcomes of mathematics of 7th grade students

Data source: Maruyama & JICA (2018)

8. Detected issues

Since 2017 has been possible to collect and systematize several data about the issues involved during this process. A brief overview of issues is described as follows.

8.1. Active learning approach issues

About the 20-20-160 strategy for active learning, there are issues for each part of this strategy. Some of these issues are going to overcome by the continuous use of strategy and textbooks year by year, but others will need an intervention from the MoE.

In the way of achieving 20 minutes of active learning during the class by using the textbook, it would be assumed that teachers are the main actor to achieve this prospect. The teachers' mindset is very fixed with the idea that teacher-centered approach is better than learner-centered approach. As a consequence, teachers spend too much time in explanation during class. They do not provide time to students for thinking about the initial problem or to face and solve problems section by themselves.

In order to achieve 20 minutes for active learning at home by using the workbook, it seems that many actors are involved to achieve this prospect. One of the most important actors in charge of improving the education quality is the society, and this is evidenced by the adults' commitment with the learnings of their children. But currently most of the parents do not care about the homework of children, and as a consequence, students are misusing the workbook. Then, teachers should have whole the responsibility of making students use the workbook in a correct way, at least demanding the homework regularly, but teachers are not doing it due to lack of free time.

For concluding, one of the biggest issues in the majority of schools seems to be the achievement of at least 160 class hours a year. One of the reasons whereby many classes would be missing after the end of the year is a direct consequence of teacher-centered teaching style. Many teachers cannot cover the problem section of the class. When a teacher does not cover it, next class is started with the problem section that missed, and spend one more class hour in the same lesson; for instance, if this happens on 25 classes a year, at least it will be missed 25 classes. In this sense, can be listed others factors like: lack of

planification for extracurricular activities and MoE's teachers' training, lack of regulation in intervention from others national institutions.

8.2. Support from teachers

Referred to the expectation about support from teachers, the most important issue would be assumed to be the ignorance of the formative assessment in each class. Almost anyone is implementing the formative assessment provided in teacher's guide, this consists of verifying the correct solving of the first item of the problem section for each class. The aim of each class should be that 100% of students solve the first item of the problem section. Teachers are called to check the process of students' solutions and give the suitable feedback. Also, the formative tests included in the teacher's guide is misused by teachers, they only use them as summative assessment.

In order to continue this process of improvement of the mathematic skills achievement in El Salvador, the next step planned is the design and creation of a national formative assessment system and the strengthening of the current national summative evaluation system.

9. Future prospects

Thinking about El Salvador expectation and needs, we are planning to carry out a new research in Salvadoran schools, specifically focused on the effectiveness of formative assessment and summative evaluation based on ESMATE textbook to improve math learning achievement and outcomes of students from primary and secondary school in El Salvador. Nowadays we are working on delimitate the focus issues expected to attend during the research, and its scope.

This research can be used by MoE for taking advantage of the results and limitation, these could be keys for the success and implementation of the new upcoming Salvadoran evaluation system reform.

10. Conclusion

Though the intervention of ESMATE is effective to improve learning outcomes of mathematics, it is still not sufficient to solve issues like "learning crisis" happening in El Salvador (Maruyama, 2018). The low

performance of El Salvador could be overcome step by step. For this it requires a long-term commitment between the national population, education actants and politicians in charge of education policies.

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