Community-wide support for primary students to improve learning: Empirical evidence from Madagascar

Takao Maruyama*, Kengo Igei†, and Seiichi Kurokawa‡

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Very preliminary version. Your comments are most welcome.

Abstract:

More than 385 million children of primary school age are not reaching the minimum proficiency levels in reading and mathematics in the world. The learning crisis is especially acute in sub-Saharan Africa. In Madagascar, around 80 percent of students in primary last grade have not reached the minimum proficiency levels. The ministry of education in Madagascar experimented with a package of interventions that strengthens the capacity of school management committee in utilizing information on student assessments to sensitize and mobilize parents, teachers, and community members for joint actions. The package includes the pedagogical component that introduces teaching in basic reading and math that matches the student's proficiency level. We investigate whether the package realized the collaboration among the local stakeholders to improve the learning of primary grades 3 through 5, using the randomized controlled trial. We find that the package significantly increased the percentage of schools that organized the supplementary classes of remedial activities, mobilizing voluntary contributions from the local stakeholders. The package remarkably improved basic reading and math learning in all the targeted grades. The magnitude of impacts is largest in grade 3 students, then in grade 4 and 5. The average impact on math learning for grade 3 is estimated at 0.56 standard deviations of test scores. The package also increased the percentage of the grade 3 students who could read a paragraph written in the local language by 25 percentage points. Furthermore, the package decreased student dropouts and increased the transition rate to lower secondary education. This study demonstrates the power of community-wide support in improving learning even in the context of a low-income country.

JEL classification: I28, O15

Key words: Educational development; Reading and math learning; School management; Community engagement; Sub-Saharan Africa

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* Hiroshima University, Graduate School of Humanities and Social Sciences, International Educational program. Email: tmaru@hiroshima-u.ac.jp

† Metrics Work Consultants Inc.

‡ Japan International Cooperation Agency (JICA)

1. Introduction

More than 385 million children of primary school age are not reaching the minimum proficiency levels in reading and mathematics in the world. Over 80 percent of them are living in low- or lower-middle-income countries (UIS 2017). Furthermore, the recent long-term school closure under the COVID-19 pandemic has caused learning losses in children, especially in poor countries and families, which worsens the situation (UIS 2021). Since reading and math are foundational competencies, the learning crisis deprives children of the opportunity to fulfill their potentials in their economic and social lives.

Parents play an important role in their children's education, but in developing countries, they face challenges in supporting their children through schooling (lack of information on student academic achievement, not familiar with how to engage with teachers, low educational record, or lack of material to support their children learning at home, etc.). While teachers play an essential role in improving learning (Beasley and Huillery 2017), "unmotivated and unskilled teachers" is one of the principal causes of the learning crisis (World Bank 2018). While many children are left behind through daily classes, teachers are not so much conscious of their responsibilities to help them (Sabarwal and Abu-Jawdeh 2018).

One of the interventions to enhance the involvement of parents and teachers is the provision of information on student learning with them. Information on student academic achievement can update knowledge of parents and motivate them to take actions (Dizon-Ross 2019, Barrera-Osorio et al. 2020). It can be also used for teachers to provide better teaching with students (Banerjee et al. 2017). Sharing information on student learning widely among the community can also enhance the behavioral change of teachers (Pandey et al. 2009). The assessment results reveal the scale and seriousness of the learning crisis; then they can align the stakeholders in education to address it (World Bank 2018). Recent experiments on information-based intervention in education tried to enhance social accountability (Fox 2015). In the logic of social accountability, the beneficiaries (parents) are provided with or obtain information on the performance of the service provider (school). Parents monitor the performance and provide feed-backs and pressures for school when necessary. But when service providers are not motivated and capable of taking necessary actions, such intervention does not work well to improve the

quality of public service (Molina et al. 2017).

The other type of information-based intervention in education tried to empower parents and community members to take direct actions to improve learning (Lieberman et al. 2014). Since the assessment conducted by the ministry of education is often too technical to be understood by the public, local NGOs conduct simple assessments of children in basic reading and math, called "citizen-led assessment" (Results for Development Institute 2015). Community volunteers share the results with parents and community members to facilitate them to take direct actions like remedial activities. When practical examples of citizen-led actions to improve learning are provided with parents and community members, together with assessment results, community youth volunteers can be mobilized to organize direct actions like remedial activities in basic reading (Banerjee et al. 2010). But the participation of community volunteers in the activities is not stable (Banerji 2019; Duflo 2020). Then, can the information on student learning sensitize and mobilize the different stakeholders in education, not only parents or community members but also teachers, to jointly address the learning crisis in their community?

To fill the lack of understanding on the design of information-based intervention to align local stakeholders in education, i.e., parents, teachers, and community members, to improve learning, the ministry of education in Madagascar experimented with a package of interventions called "Paquet Minimum Axé sur la Qualité: PMAQ" (minimum package for quality learning) with the technical cooperation from Japan International Cooperation Agency (JICA). PMAQ was originally developed in Niger and adapted to the context in Madagascar (Hara et al. 2020). In PMAQ, the school conducts assessments of basic reading and math. Then, the secretariat of the school management committee (SMC) organizes a community general assembly to share the results with parents, teachers, and community members. With the facilitation of SMC representatives, they discuss the results and develop the school action plan. Once the school action plan is adopted, the plan is implemented through community-wide collaboration. Information on assessment results is utilized to build a common understanding among the local stakeholders on the learning crisis happening in school and mobilize them to address it jointly.

The joint action to improve learning is remedial activities in basic reading and math. Specifically,

PMAQ integrates the pedagogical approach called "Teaching at the Right Level (TaRL)" developed by the Indian NGO "Pratham" (Pratham 2020). Teachers organize the remedial activities in basic reading and math at school after the regular class, with the help of community volunteers. Children are grouped according to the assessment results of basic reading and math, regardless of the grades in school. Then, they learn basic reading and math through various activities that match their proficiency levels.

Through randomized controlled trial, this study investigates whether the package of interventions, called PMAQ-TaRL, creates joint action to improve student learning at the school level, and then evaluates the impacts on basic reading and math of the students from grades 3 through 5. This paper contributes to the extension of the literature on information delivery and educational development. In the concept of social accountability, the service provider side and the beneficiary side are separated. The beneficiaries monitor the quality of public service and raise voices when necessary (Bruns et al. 2011). On the other hand, the citizen-led assessment tries to empower parents and community members to support learning of their children directly. While the former approach does not work when the service providers are not motivated and capable of taking necessary actions, in the latter approach, the activities of community volunteers are not stable. As an alternative to those two approaches, PMAQ-TaRL proposes the model in which different local stakeholders in education collaborate to take joint actions to address the learning crisis happening in their school. In our experiment, we confirmed that all the treatment schools organized three to four months remedial activities in basic reading and math for all targeted grades. We also find that the treatment schools mobilized a significantly larger amount of voluntary contributions from the local stakeholders than the control schools.

Through several randomized control trials in India, Banerjee et al. (2017) presented two different models to scale up successful pedagogical approach, TaRL. One is called the government partnership model. The state government establishes a core team to organize teacher training and monitor activities at schools in the state. Partner organization provides technical supports to the state government throughout the process. The other is called the learning camp model, in which partner organization directly conducts TaRL at schools. While those two models are successful, they depend upon the initiative and capacity of the local government or the partner organization. As the third model of scaling-up TaRL, we present the community collaboration model in which parents, teachers, and community

members jointly take action to organize the remedial activities in basic reading and math. Through mutual commitments, parents and teachers prioritize the activities, which realize the continuous organization of remedial activities and student attendance. The community volunteers also help teachers to organize the remedial activities. The community collaboration model can complement the existing two models since it develops the initiative of local stakeholders at the school level to improve student learning. In our experiment, the package improved basic reading and math learning in all the targeted grades. The magnitude of impacts is largest in grade 3 students, then in grade 4 and 5. The average impact on math learning of grade 3 is estimated at 0.56 standard deviations of test scores. The package also increased the percentage of the grade 3 students who could read a paragraph written in the local language by 25.5 percentage points.

The remainder of this paper is organized into the following four sections. Section 2 describes the context and content of our interventions and the design of the randomized controlled trial. Section 3 reports the impacts on intermediate outcomes of PMAQ-TaRL, i.e., organization of the remedial activities and voluntary contributions from local stakeholders, and Section 4 presents the impacts on learning outcomes. Then, section 5 discusses the results and concludes.

2. Experimentation design

(1) Context and content of interventions

In Madagascar, the quality of primary education remains low. Around 80 percent of primary last grade (5th grade) students have not reached the minimum proficiency levels of reading (French) and mathematics (PASEC 2017; 2020). Such low performance of learning is observed in the early grades in primary education. Around 45 percent of primary 2nd grade students have not passed the minimum proficiency level of reading in Malgache (PASEC 2020). The low internal efficiency also characterizes the education sector in the country. The average repetition rate in primary education has been over 20 percentage points in these ten years. While the survival rate to the primary last grade is low in sub-Saharan Africa (the regional average: 56 percentage points in 2018), the situation in Madagascar is worse than the regional average. Around seven out of ten students drop out of primary education in the country before reaching the last grade. At the end of primary education, students take the certification

exam. In the 2016-17 school year, only half of students who sit for the certificate exam passed.

In this context, the ministry of education in Madagascar has developed a package of interventions, called "Paquet Minimum Axé sur la Qualité: PMAQ)" with the technical cooperation of JICA. The package of interventions is made up of two components: i.e., a component to strengthen the management capacity of SMC; and the other to improve the pedagogical skills of teachers and community volunteers on basic reading and math (the ministry of education in Madagascar 2019a; 2019b). Madagascar has introduced SMC to promote educational development through community participation since 2002, but the functionality of SMC remained low. The package of interventions tried to revitalize SMC to mobilize community-wide support for student learning.

The first component of the package of interventions consists of two sessions of training. School principals participate in the first training (one day) on the democratic establishment of SMC. They learn how to organize the community general assembly in coordination with the village authorities and conduct a secret ballot to elect the permanent office members of SMC, i.e., the president and the accountant.[1] Among various selection methods, the secret ballot is employed in PMAQ to elect the permanent office members who are motivated and capable of leading the activities to improve local education (Kunieda et al. 2020). After the democratic establishment of SMC, the president, secretary (school principal), and accountant participate in the second training of two days on the school action plan and resource management. The school action plan lists joint activities by local stakeholders to improve education. In the second training, they learn how to conduct basic reading and math assessments and facilitate information-sharing and discussions at the community general assembly.

After the adoption of the school action plan, teachers and community volunteers participated in the third training for seven days on the teaching method of basic reading and math, "Teaching at the Right Level (TaRL)" developed by the Indian NGO "Pratham."[2] In TaRL, students are grouped by the basic reading and math proficiency levels regardless of the grade. They learn basic reading and math through different kinds of activities (Pratham, 2020). Additionally, to strengthening student practice of

[1] SMC in Madagascar is mainly composed of three organs: permanent office, general assembly, and audit. In PMAQ, the audit is also elected through democratic election. The school principal takes the role of the permanent secretary in the permanent office.

[2] The third training is split to two parts; the training on basic reading, and the other on math.

solving math problems, the provision of math workbooks developed by JICA was included in the package. With the package of interventions, SMC develops the school action plan that integrates remedial activities, and teachers and community volunteers organize remedial activities, using TaRL, to improve student learning.

(2) Sampling and data collection

Among 22 regions in Madagascar, we targeted the Amoron'i Mania region located in the central part of the country. The educational situation in the region is close to the national average of the country. The net enrolment rate of primary education in the region is 75.9 percent (national average: 73.4 percent) (The ministry of education in Madagascar 2017). Average repetition rate from the grade 3 to 5 is around 30 percentage point (national average: 26.9 percentage point). In Madagascar, a large share of teachers is not certified. The percentage of certified teachers in the region is 18.4 percent (national average: 11.2 percent). A large volume of teachers is hired by the parent association at school. In the 2017-18 school year, there were 1,002 public primary schools in the Amoron'i Mania region, which accounted for around 4 percent of public primary schools in the country. The original sampling frame for this research consists of the schools. We excluded 96 schools from the sampling frame because of security concerns or difficulties in physical access. The total number of students in a school varied in the region from less than 20 students to more than 500. According to the school size, we categorized schools in the sampling frame either larger than the median scale (117 students) or smaller than the scale. We randomly sampled 140 schools from the sampling frame.[3] Half of the schools were assigned to the treatment group, and the other to the control group. Stratification variables were the district dummies, rural/urban designation, and the scale of the total number of students in school.

We conducted the survey in the 2018-19 school year. In Madagascar, the school year started in November and finished at the end of August in the next year. We started the baseline survey in October 2018. Due to the security concerns before the presidential election, 21 out of the 140 sampled schools

[3] We calculated the sample size with the following conditions: minimum detectable effect size: 0.30 standard deviation of math test scores; cluster size: 10 students on average per grade; significance level: 0.05; power: 0.8; and intra-cluster correlation coefficient: 0.30. In addition, considering the attrition risk of schools because of security issues, five schools were added respectively to the treatment and the control groups.

were replaced before the survey.[4] We targeted all the students in the grade 3 through 5 in the sampled schools. For the treatment group, the first training of PMAQ was organized in December 2018, the second in January 2019, and the third in February (basic reading: 3 days) and April (math: 4 days). All the 70 schools in the treatment group participated in the series of training. Then, we conducted the end-line survey in September 2019.

(3) Assessment tools of basic reading and math

The surveys employed the ASER tool to measure student basic reading proficiency. The tool was originally developed by Pratham in India (ASER center 2015).[5] The tool is a simple one-page format made up of four sections: (i) a set of letters; (ii) a set of words; (iii) a paragraph (a few lines); and (iv) a short story. Words written in the tool are daily ones like "cat" or "star," and the sentence and paragraph are from a part of a story for children (ASER Center 2015). The assessment is conducted by one-on-one interview, using the tool. ASER tool has been adapted to the different languages in other countries, including Kenya and Uganda (PAL Network 2020). The tool was adapted to the local language in Madagascar (Malgache) in this study.

Surveyors evaluated the student's basic reading in Malgache by the following five levels: (i) beginner; (ii) letter; (iii) word; (iv) paragraph; and (v) story level. The assessment started from the paragraph section in the tool. If the student can read the paragraph with less than three errors, the assessment moved to the story section. When the student made more than four errors in the paragraph section, the assessment moved to the word section. In such manner, student basic reading proficiency was measured one by one.[6] We also conducted written test of math for students. The test assessed student math learning of numbers and the basic four operations that should have been mastered at the

[4] Among the 21 schools, thirteen were in the treatment group, and eight were in the control group.

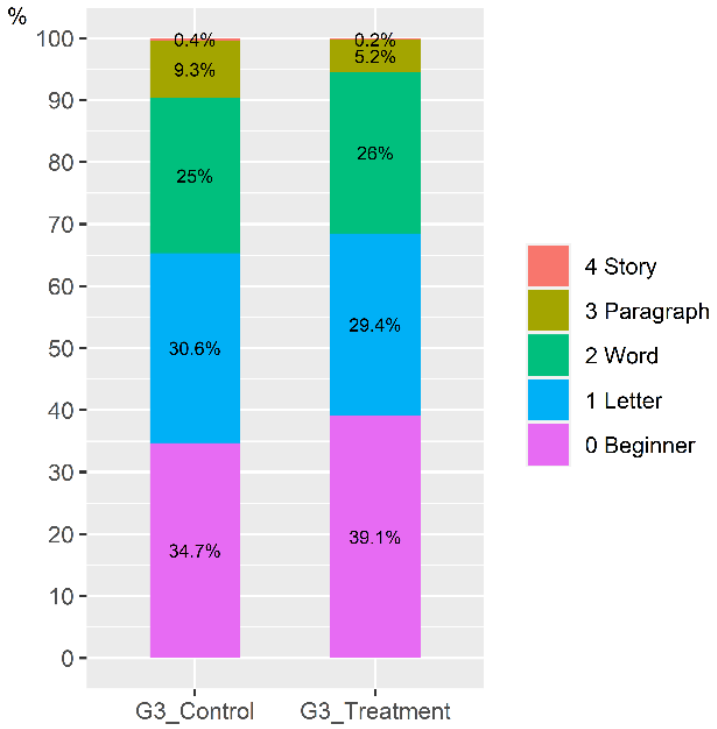
[5] ASER is an abbreviation of "Annual Status of Education Report."

[6] The assessment starts from the paragraph section of the tool. If the student can read the paragraph (with less than three errors), the assessment moves to the story section. If the student made more than four errors in the paragraph section, the assessment moves to the word section. The student chooses five out of ten words. She is assessed at the word level when she successfully read them (with less than one error). If she made an error in more than two words, the assessment moves to the letter section. She chooses five letters out of ten letters. There are several versions of the tool with different words, paragraph and story. Survey teams noted the type of tool posed for each student at the baseline survey and used different tool at the end-line survey.

end of 3rd grade. There were in total 44 items, including 4 problems posed in the texts of Malgache in the math test.[7] The same test was used for the grade 3 through 5. At the end-line survey, the same type of math test was prepared with different numbers and texts.

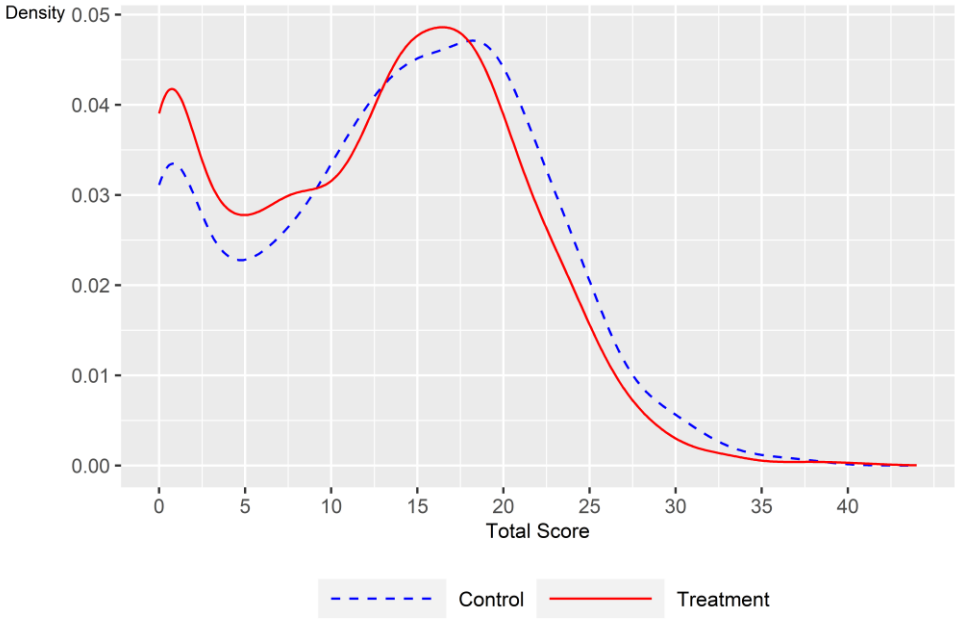
We describe the learning levels of students in basic reading and math, taking the examples of primary grade 3. As shown in Figure 1, around 30 to 40 percent of grade 3 students were at the beginner level at the baseline survey. Density curves of math test scores of grade 3 are also shown in Figure 2. When we look at the correct response rates by math items, the percentage of students who correctly responded to more than three items out of four in two-digit subtraction was around 20 to 25 percent.

Figure 1. Stacked chart of basic reading level at the baseline survey (grade 3)



[7] The math test is composed of two items on numbers, eight items on one-digit addition, eight items on one-digit subtraction, four items on two-digit addition, four items on two-digit subtraction, four items on one-digit multiplication, six items on two-digit multiplication, four items on division and four problems posed in the text.

Figure 2. Density curves of math test scores at the baseline survey (grade 3)



(4) Balance check

We compared the characteristics of SMC, schools, and students at the baseline survey. We conduct the balance check of basic reading level and math test scores. Basic reading level takes five values from 1 to 5, corresponding to the levels; (i) beginner; (ii) letter; (iii) word; (iv) paragraph; and (v) story. Math test scores are standardized by the mean and standard deviations of test scores in the control group. The results are presented in Tables 1 and 2. The basic reading levels are well balanced. While the standardized test scores in math are lower in the treatment group than the control group, the difference is not statistically significant in grades 3 and 5 (the p-value on the point difference is 0.289 for grade 3 and 0.142 for grade 5). The difference in the standardized test scores of grade 4 is statistically significant at the 5 percent level, but the difference in raw score points is small (2.11 score point difference out of 44). We control the baseline assessment results in estimating the impacts of the package of interventions on learning outcomes in basic reading and math. At the SMC and school levels, while we observe differences, including the percentage of multi-grade classes, there are not systematic differences in the characteristics of SMC, schools, and students. The results indicate successful randomization.

Table 1. Balance check of student characteristics at the baseline survey

	(1) Treatment	(2) Control	(3) (1)-(2)
Grade 3:			
Age	9.653	9.874	-0.221**
Female students	48.5%	46.4%	2.2%
Repeated last academic year	30.6%	29.8%	0.7%
Basic reading level: 1 to 5	1.977	2.103	-0.125
Math test scores (points): 0 to 44	12.33	13.59	-1.253
Math test scores (standardized)	-0.154	0.000	-0.154
Number of clusters	70	70	
Number of observations	1,895	1,615	
Grade 4:			
Age	11.09	11.04	0.051
Female students	48.5%	51.0%	-2.5%
Repeated last academic year	28.4%	27.4%	1.0%
Basic reading level: 1 to 5	2.755	2.849	-0.094
Math test scores (points): 0 to 44	19.96	22.07	-2.110**
Math test scores (standardized)	-0.252	-0.000	-0.252**
Number of clusters	67	68	
Number of observations	1488	1199	
Grade 5:			
Age	12.01	12.09	-0.078*
Female students	51.3%	52.9%	-1.6%
Repeated last academic year	31.3%	27.4%	3.9%
Basic reading level: 1 to 5	3.464	3.504	-0.039
Math test scores (points): 0 to 44	30.14	31.19	-1.048
Math test scores (standardized)	-0.140	-0.000	-0.140
Number of clusters	62	67	
Number of observations	1174	1086	

Notes: Column 3 reports the difference between the treatment and control groups and the result of the test for the difference in means between the two groups. The test controls for strata fixed effects constructed by the stratification variables in the random assignment (district, urban status, and the size of school). Robust standard errors clustered at the school level are used. ** $p<0.05$, * $p<0.1$.

Table 2. Comparison of school and SMC characteristics at the baseline survey

	(1) Treatment	(2) Control	(3) (1)-(2)
School:			
Total number of students	128.0	114.7	13.26
Ratio of female students per male students	99.8%	94.6%	5.2%
Ratio of school with a multi-grade class: Grade 3	22.9%	15.7%	7.1%
Grade 4	46.3%	60.3%	-14.0%**
Grade 5	43.5%	56.7%	-13.2%*
Ratio of students dropped out last academic year: Grade 3	5.8%	7.1%	-1.3%
Grade 4	6.0%	7.2%	-1.1%
Grade 5	13.4%	13.9%	-0.5%
Ratio of repeated students last academic year: Grade 3	33.4%	33.2%	0.2%
Grade 4	31.7%	29.2%	2.5%
Grade 5	39.9%	37.2%	2.7%
Ratio of students passing certificate exam in last academic year	47.6%	49.7%	-2.1%
Ratio of students moving to 6th last academic year	48.0%	49.4%	-1.4%
School Principal: Experiences (years)	10.64	8.500	2.143
School Principal: No certificate	51.4%	50.0%	1.4%
School Principal: In charge of class	97.1%	92.9%	4.3%
Number of teachers (incl. head master)	4.486	4.171	0.314
Average number of students per teacher	28.41	28.50	-0.095
Ratio of regular teachers	13.3%	14.0%	-0.7%
Ratio of contract teachers	19.0%	20.9%	-1.8%
Ratio of non-regular teachers (not including contract teachers) (salary is paid from the subvention of school.)	34.8%	42.0%	-7.2%*
Ratio of non-regular teachers (not including contract teachers) (salary is not paid from the subvention of school.)	32.8%	23.1%	9.7%**
Ratio of teachers without certificate	77.7%	73.5%	4.3%
Number of classrooms	5.271	5.071	0.200
School facility: electricity	0.0%	0.0%	0.0%
School facility: drinking water	8.6%	10.0%	-1.4%
School facility: toilet	82.9%	82.9%	0.0%
School facility: library	1.4%	1.4%	0.0%
School facility: kitchen	8.6%	10.0%	-1.4%
SMC:			
Years of existences of SMC	1.543	1.757	-0.214*
President's experiences (years)	1.457	1.571	-0.114
Have the action plan	5.7%	5.7%	0.0%
Sharing of test result of pupils at general assembly	5.7%	7.1%	-1.4%
Mobilize voluntary resource for any activities	31.4%	34.3%	-2.9%
Total amount of used voluntary resource (1000MGA)	138.2	137.3	0.952
Utilize Caisse Ecole for any activities	61.4%	68.6%	-7.1%
Utilize SAE for any activities	64.3%	61.4%	2.9%
Total amount of used external resource (1000MGA)	866.5	754.8	111.7*

Notes: Column 3 reports the difference between the treatment and control groups and the result of the test for the difference in means between the two groups. The test controls for strata fixed effects constructed by the stratification variables in the random assignment (district, urban status, and the size of school). Robust standard errors are used.
** p<0.05, * p<0.1.

(5) Student attritions

Among 3,510 grade 3 students present at the baseline survey, 642 students were absent at the end-line survey. Out of 2,687 grade 4 students present at the baseline survey, 488 students were absent

at the end-line. In grade 5, among 2,260 students present at the baseline survey, 293 students were absent at the end-line. We checked whether the differential attritions occurred between the two groups by regressing the student attrition dummy on the treatment assignment, student characteristics, and strata fixed effects constructed by district, urban status, and the school size (less than or more than the median level of total number of students). The coefficients of the treatment assignment in the regression are close to zero and not statistically significant for grade 3 through 5. The results indicate that the differential attritions did not occur between the two groups. The attrition occurred slightly larger for students with lower basic reading level.[8]

3. The impacts on voluntary contributions from local stakeholders

After the first training for the school principal, the confidence vote on the permanent office of SMC was organized at schools where SMC had already existed. When the confidence vote did not support the permanent office or a part of the members, the election was organized. Among 70 schools in the treatment group, 68 schools organized the confidence vote, and the remaining two directly organized the election of the permanent office members of SMC. Then, 36 schools elected the new president, and 45 schools elected the new accountant. At the other schools, the original person was elected.

In the 2017-18 school year, the previous year of this research, more than half of the sampled schools organized the additional classes for 5th grade students to support their preparation for the certification exam. But such supplementary classes were rare for the other grades. Less than 15 percent of the schools organized the supplementary classes for the grade 3 or 4 students. After the second training for the permanent office of SMC, all the SMCs in the treatment group organized the community general assembly to discuss local education and developed the school action plan, including extra-curricular remedial activities in basic reading and math for grades 3 through 5. According to the end-line data, the remedial activities in basic reading and math started in mid-April and finished in July 2019. The sampled

[8] The coefficient of the treatment assignment is -0.005 (standard error: 0.021) for grade 3, -0.001 (standard error: 0.025) for grade 4, -0.020 (standard error: 0.017) for grade 5. The results are available upon the request from the readers.

schools in the treatment group organized the remedial activities for around 80 hours in total on average per school.[9] On the other hand, only eight schools in the control group organized the supplementary classes for the grade 3 or 4 students in the 2018-2019 school year.

Parents, teachers, and community members voluntarily contributed to the organization of the extra-curricular remedial activities. Teachers took the primary role of organizing the remedial activities. Over 90 percent of teachers in the treatment group participated in the organization of the activities. In addition, at 59 schools, at least one community volunteer supported the remedial activities. In total, 293 teachers and 196 community volunteers were involved. In the remedial activities, the large class size can be a challenge in supporting students to be engaged in learning. When a teacher cannot monitor and provide good instructions to students, they would not be well engaged in learning. The help of community volunteers largely reduced the class size of remedial activity. A third of the community volunteers possessed an academic record of the baccalaureate or higher. Among 175 community volunteers involved in the remedial activities on basic reading, 108 were in charge of organizing the remedial activity class, and the others helped teachers organize remedial activities. In math, 122 were in charge of the remedial activity, and the others helped teachers organize remedial activities.

While all the schools in the treatment group organized the remedial activities in basic reading and math, the content of the school action plan varied, corresponding to the situation at schools. For example, eleven schools in the treatment group improved the school infrastructure by constructing classrooms with locally available materials or repairing tables and chairs to organize the remedial classes.

Parents, teachers, and community members voluntarily contributed monetary or non-monetary contributions (labor or material) to implement the school action plan, including the organization of remedial activities. We estimate the impact of the package of interventions on the voluntary resource mobilization by equation,

$$R_s = \theta + \lambda \text{Treatment}_s + \tau R_S^{base} + S_s \rho_S + D_s \rho_D + v_s \quad (2)$$

[9] Data source of volume of supplementary classes is the attendance check record per class at the treatment schools. While there were 374 classes of remedial activities in basic reading in the treatment group in total, the attendance records were available at 92.2 percent of the classes.

where R_s represents the monetary value of the total amount of voluntary contributions from parents, teachers, and community members. There are mainly three types of voluntary contributions, monetary, labor, and material contribution. We surveyed the unit prices and the volumes of labor and material contributions through the interview with the SMC permanent office. Based on the data, we calculated the monetary values of labor and material contribution. $Treatment_s$ is a dummy that takes the value 1 for the treatment group. Our interest of coefficient is λ, which indicates the impact of the package of interventions on the resource mobilization. S_s is a vector of school characteristics of school *s* at the baseline survey, such as the total number of students, the ratio of regular teachers, the amount of external resources like school grants. D_s is a vector of strata fixed effects constructed by the stratification variables in the random assignment, i.e., district dummies, the rural/urban dummy, and less than/ more than the median level of total number of students in school *s*. The error term is υ_s. Robust standard errors are used.

The regression results are presented in Table 3. The package mobilized voluntary contributions from parents, teachers, and community members. The monetary value of the average mobilized resources per school is estimated at around 754,000 Ariary (Ar.) (Column (1)-1). The amount in local currency is equivalent to about 210 US dollars. The estimated monetary value per student is around 6,850 Ar. (Column (1)-2). In Madagascar, the unit cost of primary education was 60,958 Ar. in 2014, and the average amount of household expenditure for education was 47,000 Ar. in the 2012-2013 school year (the ministry of education in Madagascar 2016). Considering the scale of the unit price and the household expenditure for education, the package of interventions increased a sizable amount of resources for supporting primary students to learn. As a comparison, we also regressed the amount of the external resources like school grants utilized for the school action plan on the treatment assignment and the control variables in equation (2). The coefficients of the treatment assignment are not statistically significant (Column (2)).

Table 3. Impacts on voluntary contributions from local stakeholders

	(1)-1	(1)-2	(2)-1	(2)-2
	Total amount of voluntary resource (1,000 Ar.)	Total amount of voluntary resource (per student) (1000 Ar.)	Total amount of external resource (1000 Ar.)	Total amount of external resource (per student) (1000 Ar.)
Treatment	754.1***	6.845***	103.0	-1.437
	(182.7)	(1.438)	(85.13)	(2.128)
Total amount of voluntary mobilized resources last academic year	0.731	0.003	0.195	-0.003
	(0.500)	(0.003)	(0.061)	(0.002)
Total amount of external mobilized resources last academic year	0.298	0.001	-0.098	-0.007
	(0.289)	(0.002)	(0.102)	(0.006)
Total number of students	5.127**	-0.005	0.487	0.015
last academic year	(2.279)	(0.013)	(0.717)	(0.025)
Average value in the control group	308.4	2.755	389.5	5.901
Covariates	Yes	Yes	Yes	Yes
Strata FE	Yes	Yes	Yes	Yes
Num. obs.	140	140	140	140

Notes: *** p<0.01, ** p<0.05.
(a) Voluntary resource includes monetary and non-monetary resources (labor and material provision). The monetary value of non-monetary resources is calculated by the local price, and shown in local money (Madagascar ariary: Ar.).
(b) Covariates in the regressions are characteristics of the school principal (academic record, experience years and in charge of class), the number of teachers, and the percentage of regular teachers at the school, in addition to those in Table. Strata fixed effects are constructed by district, urban status, and the size of the school. Robust standard errors are used.

4. The impacts on leaning outcomes

We estimate the impact of the package of interventions on the learning outcomes in basic reading and math by equation,

$$Y_{is}=\alpha+\delta \text{Treatment}_s+\gamma Y_{is}^{base}+C_{is}\beta_C+S_s\beta_S+D_s\beta_D+\varepsilon_{is} \quad (3),$$

where C_{is} is a vector of characteristics of student *i* at school *s*, such as age, sex, and repeated the same grade or not. S_s is a vector of characteristics of school *s*, such as the total number of students, multi-grade class or not, school infrastructure (number of classrooms and other school facilities listed in Table

2 except for electricity[1]), school principal in charge of class or not, and the ratio of regular teachers. Y_{is} takes either the basic reading proficiency level or the math test scores at the end-line survey. $Y_{is}^{base}$is the basic reading level or math test scores of student *i* at the baseline survey. Math test scores are standardized by the mean and the standard deviations of the control group at each survey round. Robust standard errors are clustered at the school level.

In equation (3), Y_{is} can also take different values to examine the impacts on learning outcome. Regarding the basic reading level, it takes a dummy variable of whether student *i* is at the beginner level or whether student *i* is above the paragraph level. In the cases, the estimate of δ demonstrates the percentage point change of students above the reading level. We also take sub-totals of math test items by the cognitive skills, i.e., knowing skill (Q1 through Q40) and applying skill (Q41 through Q44).

This study then investigates the heterogeneity of impacts on learning outcomes with respect to basic reading level and math test scores at the baseline survey. The equation (3) becomes

$$Y_{is}=\alpha+(\delta_1+\delta_2 Y_{is}^{base})\,\mathrm{Treatment}_s+\gamma Y_{is}^{base}+C_{is}\beta_C+S_s\beta_S+D_s\beta_D+\varepsilon_{is} \quad (4).$$

If δ_2 is negative and statistically significant, it indicates that the impact is larger for students with the lower baseline learning level. In equation (4), Y_{is}^{base} of basic reading level takes the value of proficiency level at the baseline survey subtracted by the average in the control group.

The regression results are presented in Tables 4 and 5. The package improved basic reading and math learning in all the targeted grades. The magnitude of impacts is largest in grade 3 students, then in grade 4 and 5 both in basic reading and math. For example, the average impact of the package of interventions for the grade 3 students on the basic reading proficiency level is estimated at 0.635 level points, which is statistically significant at the 1 percent level (Column 2 in Table 4). The package of interventions reduced the volume of students at the beginner level by nine percentage points and increased the volume of students above the paragraph level by 25.5 percentage points (Columns 3 and

[1] Since none of the schools had access to electricity, the variable is dropped from the control variable in the regression.

4).[2] While the heterogeneous impacts by the baseline reading level are not statistically significant for grade 3 and 5, the heterogeneous impact is positive and statistically significant for grade 4. The impact is weaker for grade 4 students with the lower baseline reading level.

Table 4. Impacts on basic reading level

	(1) Reading level	(2) Reading level	(3) Beginner level	(4) Above paragraph level	(5) Reading level
Grade 3:					
Treatment	0.597***	0.635***	-0.090***	0.255***	0.639***
	(0.069)	(0.062)	(0.019)	(0.034)	(0.061)
Treatment × Reading level at baseline					0.083 (0.063)
Number of clusters	140	140	140	140	140
Number of observations	2868	2868	2868	2868	2868
Grade 4:					
Treatment	0.488***	0.504***	0.002	0.256***	0.514***
	(0.068)	(0.069)	(0.008)	(0.044)	(0.068)
Treatment × Reading level at baseline					0.149*** (0.046)
Number of clusters	135	135	135	135	135
Number of observations	2199	2199	2199	2199	2199
Grade 5:					
Treatment	0.403***	0.383***	-0.002	0.145***	0.381***
	(0.071)	(0.067)	(0.003)	(0.033)	(0.066)
Treatment × Reading level at baseline					-0.047 (0.046)
Number of clusters	127	127	127	127	127
Number of observations	1967	1967	1967	1967	1967
Covariates	No	Yes	Yes	Yes	Yes
Strata FE	Yes	Yes	Yes	Yes	Yes

Notes: All variables on math test scores are standardized by the mean and the standard deviations of the control group at each round of the survey. Reading level in the interaction term is subtracted by the average in the control group at the baseline survey. All models control for the outcome variable at the baseline survey. Covariates include student characteristics (age, sex, and repeated the same grade or not) and school characteristics (total number of students, have a multi-grade class in the analyzed grade or not, number of classrooms, school facilities listed in Table 2 except for electricity, school principal in charge of class, and ratio of regular teachers). Strata fixed effects are constructed by the stratification variables in the random assignment (district, urban status, and the size of school). Robust standard errors clustered at the school level are used. *** p<0.01.

In math, the average impact of the package of interventions for the grade 3 students is estimated at 0.560 standard deviations of the test scores, which is statistically significant at the 1 percent level (Column 2 in Table 5). The impact on math is larger for the students with lower baseline scores in all the targeted grades (Column 5 in Table 5). When we divide the test items by the cognitive skills, the

[2] The percentage of students at the beginner level in the control group was 13.7 percent at the end-line survey.

magnitude of the impacts for grade 3 is larger in the applying skill than the knowing skill (Columns 3 and 5). Similar trends are observed in grade 4 as well. The result suggests that students could learn math better in the remedial activities after they have improved basic reading.[3] While the package improved math learning, there remains room in the package to be further improved. For example, the grade 3 students in the treatment group still had difficulty solving items of two-digit addition with carrying and items of two-digit subtraction items with borrowing.

Table 5: Impacts on math test scores

	(1) Total scores	(2) Total scores	(3) Scores of knowing skill	(4) Scores of applying skill	(5) Total scores
Grade 3:					
Treatment	0.525***	0.560***	0.500***	0.920***	0.556***
	(0.068)	(0.059)	(0.059)	(0.083)	(0.058)
Treatment × Total scores at baseline					-0.113**
					(0.047)
Number of clusters	140	140	140	140	140
Number of observations	2868	2868	2868	2868	2868
Grade 4:					
Treatment	0.402***	0.421***	0.340***	0.572***	0.411***
	(0.070)	(0.069)	(0.068)	(0.075)	(0.067)
Treatment × Total scores at baseline					-0.113**
					(0.054)
Number of clusters	135	135	135	135	135
Number of observations	2199	2199	2199	2199	2199
Grade 5:					
Treatment	0.349***	0.337***	0.295***	0.308***	0.329***
	(0.065)	(0.062)	(0.062)	(0.058)	(0.061)
Treatment × Total scores at baseline					-0.203***
					(0.072)
Number of clusters	127	127	127	127	127
Number of observations	1967	1967	1967	1967	1967
Covariates	No	Yes	Yes	Yes	Yes
Strata FE	Yes	Yes	Yes	Yes	Yes

Notes: All variables on math test scores are standardized by the mean and the standard deviations of the control group at each round of the survey. All models control for the outcome variable at the baseline survey. Covariates include student characteristics (age, sex, and repeated the same grade or not) and school characteristics (total number of students, have a multi-grade class in the analyzed grade or not, number of classrooms, school facilities listed in Table 2 except for electricity, school principal in charge of class, and ratio of regular teachers). Strata fixed effects are constructed by the stratification variables in the random assignment (district, urban status, and the size of school). Robust standard errors clustered at the school level are used. *** p<0.01.

[3] Among the grade 3 students in the treatment group who correctly responded to the two-digit subtraction problem, the correct response rate to the math item posed in text was higher for those with higher basic reading proficiency level. The remedial activities in basic reading improved the level in the treatment group; then the students could learn solving math items posed in text in the remedial activities in math.

After the end-line survey in September 2019, we conducted the supplementary survey to collect information on the repetition, dropout, passing rate of the primary certification exam, and transit to lower secondary at the school level. The schools in the treatment group regularly organized the community general assembly to share the progress of student learning, and included different activities like the preparation for the primary certification exam in the school action plan. The package of intervention can have positive impacts on education beyond the improvement in basic reading and math. We regressed the educational statistics at the school level on the treatment assignment, school characteristics, and the strata fixed effects.

The regression results are presented in Table 6. The package of interventions decreased the dropout rates in grades 3 by 2.5 percentage points and in grade 4 by around 4.4 percentage points. On the other hand, the impact on the repetition rate is not statistically significant. The results suggest that while the package prevented the grade 3 and 4 students from dropping out, those students who would have dropped out without the interventions repeated the same grades. The package decreased the repetition rate of grade 5 by 10 percentage points, and increased the passing rate of the primary certification exam and the transit rate to lower secondary education by 11 percentage points. The results indicate that the package significantly contributed to improve the internal efficiency of primary education in the treatment group.

Table 6. Impacts on school-level educational outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dropout rate			Repetition rate			Ratio of passing CEPE	Ratio of moving to G6
	Grade 3	Grade 4	Grade5	Grade 3	Grade 4	Grade5		
Without covariates:								
Treatment	-0.023*	-0.045**	-0.025	0.025	0.032	-0.092*	0.111**	0.118**
	(0.013)	(0.022)	(0.025)	(0.027)	(0.028)	(0.051)	(0.052)	(0.051)
With covariates:								
Treatment	-0.025*	-0.044*	-0.017	0.022	0.042	-0.102**	0.111**	0.111**
	(0.014)	(0.024)	(0.025)	(0.028)	(0.029)	(0.051)	(0.050)	(0.051)
Number of observations	140	135	128	140	135	128	127	127

Notes: Covariates include total number of students, have a multi grade class in the analyzed grade or not, number of classrooms, school facilities listed in Table 2 except for electricity, school principal in charge of class, and ratio of regular teachers. Strata fixed effects are constructed by the stratification variables in the random assignment (district, urban status, and the size of school). Robust standard errors are used. *** p<0.01, ** p<0.05, * p<0.1.

5. Discussions and Conclusions

Information delivery can update people's knowledge, motivate them to take action, and align different incentives towards a common purpose (World Bank 2018). A systematic review of the evidence suggests that the information-based intervention that combines the provision of information with the direct avenue of promoting action like facilitated meetings or school action plan is effective (Read and Atinc 2017). The information should be made actionable to promote the behavioral change of people. In PMAQ, the locally elected SMC facilitates parents, teachers, and community members to plan and implement joint actions to improve student learning in basic reading and math. This study demonstrates the existence of pathway from information provision to joint action by different local stakeholders in education. The collaboration among different stakeholders realizes the continuous organization of remedial activities and student attendance. According to the attendance records taken by the schools in the treatment group, average daily attendance rate to the remedial activities was around 90 percent in basic reading, and 85 percent in math.[4]

The involvement of community volunteers can weaken the participation of teachers in the remedial activities in basic reading and math (Banerjee et al. 2016). PMAQ is designed to avoid such risk through the preparatory processes and the coordination by the SMC permanent office. Before the basic reading and math assessments, the school principal organizes a meeting with teachers to sensitize them on the importance of measuring basic reading and math learning. Then, the assessment results are shared at the community general assembly, which raises the awareness of teachers to be involved in the activities to improve learning. The SMC permanent office calls the necessary number of community volunteers, considering the total number of teachers and remedial activity classes.

The package of interventions, PMAQ-TaRL, improved basic reading and math learning in all the targeted grades through the remedial activities by teachers and community volunteers. The magnitude of impacts is largest in grade 3 students, then in grade 4 and 5 both in basic reading and math. The

[4] Data source of attendance rate of supplementary classes is the attendance check record per class at the treatment schools. While there were 374 classes of remedial activities in basic reading in the treatment group in total, the attendance records were available at 92.2 percent of the classes. Average daily attendance rate is calculated by the following three steps, (a) calculate average attendance rate per class per 10 days, (b) calculate average attendance rate per class from (a), (c) calculate average attendance rate per school from (b). Since most SMC organized remedial activities for grade 2 through 5 students, the data includes the attendance of grade 2 students.

magnitude of impact is estimated at 0.63 level points in basic reading and 0.56 standard deviations in math test scores. Furthermore, the package decreased student dropouts and increased the transition rate to lower secondary education. This study demonstrates it possible to improve learning even in the context of a low-income country through the community-wide support for children.

Through several randomized control trials in India, Banerjee et al. (2017) presented two different models to scale up TaRL. One is called the government partnership model and the other learning camp model. As the third model, in this study, we present the community collaboration model in which parents, teachers and community members jointly organize the remedial activities using TaRL. Through mutual commitments, parents and teachers prioritize the activities, which realize the continuous organization of remedial activities and student attendance. The community volunteers also help teachers to organize the remedial activities. The community collaboration model complements the existing two models since it develops the initiative of local stakeholders at the school level to improve student learning.

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