

Ministry of Education
National Autonomous University of Nicaragua, Managua
National Autonomous University of Nicaragua, Leon
Republic of Nicaragua

Project for the Friendly Learning of Mathematics in Secondary Education in the Republic of Nicaragua

Project Completion Report

September 2019

Japan International Cooperation Agency (JICA)

Koei Research & Consulting Inc.

HM
JR
19-043

Pictures of Project Activities



Courtesy visit to the Presidential Adviser
Salvador Vanegas (Feb. 2017)



Diagnostic survey -Diagnostic test-
(Mar. 2017)



Diagnostic survey -Interviewing teachers-
(Mar. 2017)



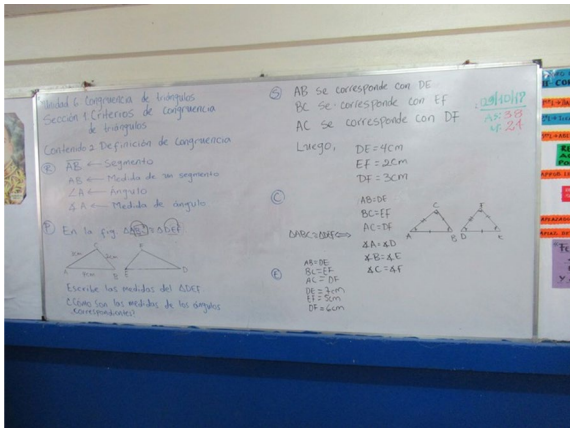
Project office in the Ministry of Education
-Writing Textbooks- (May 2017)



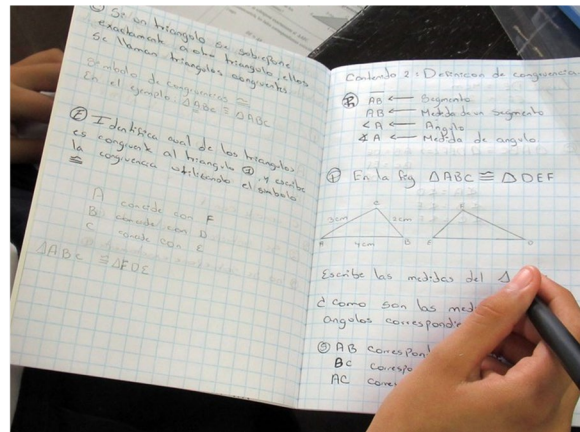
Validation of materials (Trial)
-Lesson by a Textbook writer- (Oct. 2017)



Validation of materials
-Checking student notebooks- (Oct. 2017)



Structured board-writing (Oct. 2017)



Arranged student notebooks (Oct. 2017)



Individual work in a lesson
(Oct. 2017)



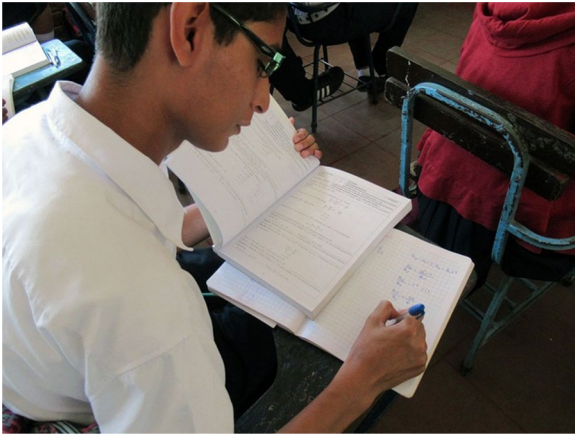
Mutual learning
(Nov. 2017)



2nd Regional Seminar in El Salvador
(Dec. 2017)



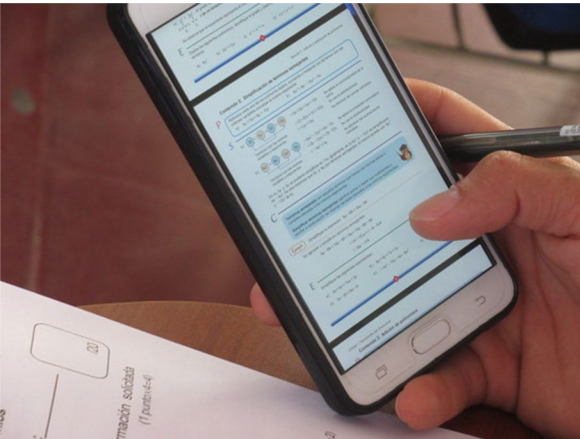
2nd Meeting of JCC
(Feb. 2018)



Students using the NICAMATE Textbook
(Apr. 2018)



Materials introduction training
-Making board-writing plan- (Jan. 2019)



NICAMATE Textbook on Smartphone
(Jan. 2019)



NICAMATE workshop for UNAN Leon
Regional Center (Feb. 2019)



Introduction of NICAMATE activities and
materials to all private schools (Jun. 2019)



Statistical analysis workshop for counterparts
(Jun. 2019)

List of Abbreviations

BICU	Bluefield Indian and Caribbean University
BLS	Baseline Survey
C/P	Counterpart
CA	Colectivo de Autores (Author of the materials)
CNU	National Council of Universities
DAC	Development Assistance Committee
DTP	Desktop publishing
ELS	Endline Survey
EPI	Mutual-Learning Pedagogical Meeting
ESMATE	Project for the Improvement of Mathematics Teaching in Primary and Secondary Education in El Salvador
EU	European Union
FAREM	Regional Faculties of Multidiscipline
FEI	Faculty of Education and Languages
GMD 5	Mathematics and its Didactics Guide 3
ICT	Information and Communication Technology
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
KRC	Koei Research & Consulting Inc.
M/M	Man-Month
MINED	Ministry of Education
NICAMATE	Project for the Friendly Learning of Mathematics in Secondary Education
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
PDM	Project Design Matrix
PO	Plan of Operation
PROMECEM	Project for Improvement on the Quality of Mathematics Teaching in Primary Education
R/D	Records of Discussions
UNAN	National Autonomous University of Nicaragua
UNESCO	United Nations Educational, Scientific and Cultural Organization
URACCAN	University of the Autonomous Regions of the Nicaraguan Caribbean Coast

Annexes

- Annex 1. List of Dispatched Experts
- Annex 2. List of Equipment Provided
- Annex 3. Brochure of Board-writing Plan
(“MANUAL INTERACTIVO SOBRE EL PLAN PIZARRA”)
- Annex 4. Flow Chart of Activities
- Annex 5. Plan of Operation (PO)
- Annex 6. Report of Diagnostic Survey
- Annex 7. Induction Training Program
- Annex 8. Minutes of Joint Coordination Committee (JCC) Meeting
- Annex 9. Report of Baseline Survey (BLS)
- Annex 10. Report of Endline Survey (ELS)
- Annex 11. Project Newsletters
- Annex 12. Project Design Matrix (PDM)
- Annex 13. Test Data Analysis Workshop
- Annex 14. Records of Discussions (R/D)
- Annex 15. Products of the Project (Separate Volume)

Table of Contents

Pictures of Project Activities

List of Abbreviations

Annexes

I.	Outline of the Project	1
II.	Achievement of the Project	4
1.	Input and Activities of the Project	4
1-1	Input by the Japanese Side	4
1-2	Input by the Nicaraguan Side	8
1-3	Activities	12
2.	Achievement of the Project	31
2-1	Status of the Achievement of the Project Output	31
2-2	Status of Achievement of the Project Purpose	32
3.	PDM Modifications	33
3-1	PDM Modifications	33
4.	Others	33
4-1	Environmental and Social Considerations	33
4-2	Considerations on Gender/Peace Building/Poverty Reduction	33
III.	Results of the Project Evaluation	34
1.	Results by DAC Five Evaluation Criteria	34
2.	Major Factors Influencing Project Implementation and Outputs	39
3.	Evaluation of Project Risk Management	41
4.	Lessons Learned	42
IV.	Toward Achievement of Super and Overall Goal after Project Completion	43
1.	Achievement of Overall Goal	43
2.	Achievement of Super Goal	43
3.	Recommendations to the Nicaraguan Side	44
4.	Plan of Operation and Implementation Structure of the Nicaraguan Side toward Achievement of Overall Goal and Super Goal	45

List of Tables

Table 1	Details of M/M of the Japanese Experts	4
Table 2	Members and Duration of Missions and Technical Support	5
Table 3	Employment in Nicaragua	5
Table 4	List of Equipment	5
Table 5	Materials Covered by the Japanese Sides	6
Table 6	List of Participants for the Training in Japan.....	6
Table 7	Outline of the Regional Seminars and Study-Visit to ESMATE.....	7
Table 8	List of Participants of the Regional Seminars and Study-Visit to ESMATE	7
Table 9	List of C/P from Nicaragua.....	9
Table 10	Materials for Which Nicaragua Covered Printing Costs.....	11
Table 11	Outline and Results of the Diagnostic Survey	12
Table 12	Target Schools for the Second Validation	15
Table 13	Outline of Materials Introduction Training.....	23
Table 14	Activities and Purposes of the Materials Introduction Training	23
Table 15	Modules Related to Didactics of Mathematics in the UNAN Managua and UNAN Leon.....	25
Table 16	Outline of Each JCC	27
Table 17	Mean Percentage of Correct Answers by School and Difference in Common Items	29
Table 18	Status of materials distribution	32
Table 19	Evaluation of Relevance	34
Table 20	Evaluation of Effectiveness	35
Table 21	Evaluation of Efficiency	36
Table 22	Evaluation of Impact.....	37
Table 23	Evaluation of Sustainability.....	38
Table 24	Risk Management of the Project.....	39

List of Figures

Figure 1	Technical Strategy of the Project.....	13
Figure 2	Sample Page of Students' Textbook (G8: Simultaneous First-Degree Equations, Addition/Subtraction Method).....	19
Figure 3	Sample Page of Teachers' Guide (G8: Simultaneous First-Degree Equations, Addition/Subtraction Method	20
Figure 4.	Sample Page of Students' Activity Notes (G8: Multiplication of Multi-nominal).....	21
Figure 5	Follow-Up Plan of NICAMATE	46

I. Outline of the Project

1. Country

Republic of Nicaragua

2. Title of the Project

Project for the Friendly Learning of Mathematics in Secondary Education (NICAMATE)

3. Duration of the Project

From 18 January 2017 - To 31 October 2019 (Approximately two years nine months)

4. Background of the Project

In Nicaragua, the Ministry of Education (MINED) together with the Japan International Cooperation Agency (JICA), has implemented technical support for strengthening mathematics education in primary education (first to sixth grades) and Teacher Training Colleges for primary education focusing on the following activities: the development of educational material such as students' textbook, teachers' guide, and the Guide of Mathematics and its Didactics, all of which are results of the "Project for Improvement on the Quality of Mathematics Teaching in Primary Education (PROMECEM)" Phase 1 (from 2006 to 2011), Phase 2 (from 2012 to 2015).

Net enrolment rate in secondary education has increased following the improvement at the primary level. Comparing 2010 and 2013, the rate improved from 41.9% to 89.4% in the lower secondary education and from 23.8% to 48.5% in the upper secondary education (UNESCO, 2016; MINED, 2013). However, the secondary education in the country still has the challenge to improve learning achievement in mathematics—the pass rate of the examination to enter the National Autonomous University of Nicaragua (UNAN) was only 8.66% in January 2014¹. Based on this background, MINED in August 2014 requested Japan to provide technical assistance to improve the quality of education through training for mathematics teachers at the primary and secondary levels after performing a needs survey.

In May 2016, the Japan International Cooperation Agency (JICA) conducted a preliminary survey for project formation in order to grasp the requests from the Nicaraguan side more specifically. It was confirmed that the requests from MINED and National Council of Universities (CNU) was for technical assistance for development of mathematics textbooks and teachers' guides in secondary education, reinforcement of in-service teacher training, and teacher training programs at UNAN Managua and UNAN Leon. Based on discussions and agreements in the preliminary survey, the Detailed Planning Survey was implemented in June 2016. As a result, with the aim of realizing efficient and effective mathematics education, the Project was launched to achieve the development of students' textbook, teachers' guide and students' activity notes in mathematics in the five grades of secondary education. The Project aims at developing educational materials that are systematic and easy to understand, just as the students' textbook of PROMECEM, and at enhancing teacher education in mathematics to effectively use the materials.

The Project is a part of the Regional Project of mathematics education cooperation in Central America implemented by JICA, aiming at (a) improving the quality of mathematics education in and out of the region, and (b) strengthening JICA's external communications and outreach to the world. Regional cooperation is implemented in the four countries in Central America—El

¹ Even if the students do not pass the mathematics test, their admission to the university is judged based on the mean score of the results including the tests in other subjects. Even if the students failed to enter a department, they could still get an admission for other departments which have vacancy. The pass rate of the university was about 70% in 2014.

Salvador, Honduras, Guatemala and Nicaragua—to support the development, revision and distribution of textbooks and teachers' guides in primary and secondary mathematics education and teacher training. Experiences of the projects are shared in regional seminars held in El Salvador once a year. In addition, in South American and other international academic conferences and seminars, it is planned that the results and experience of this cooperation are delivered to enhance the learning.

5. Super Goals, Overall Goal, Project Purpose and Expected Outputs

(1) Super Goals

- 1) The academic performance in mathematics in secondary education is improved.
- 2) Mutual cooperation for improving in teaching methods in mathematics is promoted at regional level.

(2) Overall Goal

Educational activities in accordance with the revised mathematics curriculum are implemented in secondary education.

(3) Project Purpose

Educational activities in accordance with the revised mathematics curriculum are introduced in secondary education.

(4) Expected Outputs

- Output 1) The students' textbook, teachers' guide and students' activity note in the area of mathematics for five (5) grades in secondary education are created.
- Output 2) The induction system for the use of materials created in the Output 1 for mathematics teacher in general course in public secondary education is strengthened.
- Output 3) The program of the Special Didactics of Mathematics for secondary teacher education in the UNAN Managua and the UNAN Leon is revised.

6. Implementing Organizations

Ministry of Education (MINED)

National Autonomous University of Nicaragua, Managua (UNAN Managua)

National Autonomous University of Nicaragua, Leon (UNAN Leon)

7. Beneficiaries

- 270,199 students in general course in public secondary education (MINED 2016)
- 2,012 mathematics teachers in general course in public secondary education (MINED 2016)
- 738 mathematics teachers in private secondary education with and without subsidy² (MINED 2016)
- 86,746 students in private secondary education with and without subsidy (MINED 2016)
- 40 teachers in the Department of mathematics in the Faculty of Education and languages (FEI) and Regional Faculties of Multidiscipline (FAREM) in the regional branch schools

² Although private schools in Nicaragua are not obliged to use the national textbooks, the MINED recommends the teachers in private schools to utilize the educational materials developed by the Project. Teachers, directors and students in private schools can also download the digital data of the materials freely in the portal of the MINED.

of the UNAN Managua (National Council of Universities (CNU 2016)

- 14 teachers in the Department of mathematics in the Faculty of Education and Humanities Sciences of the UNAN Leon (CNU 2016)
- 1,237 university students (pre-service teachers) in the FEI and FAREM in the regional branch schools of the UNAN Managua (CNU 2016)
- 331 students in the Department of mathematics of the Faculty of Education and Humanities Sciences of the UNAN Leon (CNU 2016)
- Approximately 50 persons in MINED including counterparts (C/P) etc.

II. Achievement of the Project

1. Input and Activities of the Project

1-1 Input by the Japanese Side

(1) **Total Cost Covered by the Japanese Side:** 247 million Yen

(2) **Dispatch of Experts**

The total man-months (M/M) of the Japanese experts were 49.84 (40.44 M/M in Nicaragua and 9.40 M/M in Japan) during the implementation of the Project for two years nine months. Details of the man-months of the Japanese experts are presented in Table 1. (See Annex 1 for more details.)

Table 1 Details of M/M of the Japanese Experts*

Name	Designation	No. of trip	M/M (Actual)	
			Nicaragua	Japan
Ken Furukawa	Leader/Mathematics Education Specialist 1	12	11.13	2.30
Miho Ota	Sub-Leader/Mathematics Education Specialist 2	3	1.37	0.00
Kazumi Katsumata	Mathematics Education Specialist 3	9	16.37	2.90
Koji Watanabe	Mathematics Education Specialist 4	3	1.50	1.00
Sayaka Goda	Mathematics Education Specialist 5/ Coordinator (To April 2018)	7	6.40	0.00
Kanae Abe	Mathematics Education Specialist 5/ Coordinator (From June to December 2018)	1	0.87	3.00
Shunsuke Nishioka	Mathematics Education Specialist 5/ Coordinator (From February 2019)	2	2.80	0.20
Total		37	40.44	9.40

* Table 1 only counts the M/M covered by JICA. The dispatch of 15 days in total (0.50 M/M) paid by Koei Research & Consulting Inc (KRC) is not included.

(3) **Technical Support/Consultative Mission**

Technical support and consultative mission were implemented two times each during the implementation period of the Project by the Japanese experts working in other countries of the Regional Project. Members and duration of the missions and technical support are shown in Table 2.

Table 2 Members and Duration of Missions and Technical Support

Purpose	Duration	Name	Organization/Position
Technical support	06-10 Feb 2017 (5 days)	Eiichi Kimura	Special Advisor, JICA
Technical support	17-19 Jul 2017 (3 days)	Eiichi Kimura	ESMATE ³ Expert for Mathematics Education, JICA
Consultative Mission	22-25 Oct 2017 (4 days)	Norihiro Nishikata	Senior Advisor, JICA
Consultative Mission	05-08 Mar 2019 (4 days)	Norihiro Nishikata	Senior Advisor, JICA
		Miki Morita	Project Officer, JICA

(4) Employment in Nicaragua (Long-term employment only)

The Project employed a coordinator and Desktop-Publishing (DTP) operator and six teachers of the UNAN for the development of educational materials. Table 3 shows the position and duration of contract of the employees.

Table 3 Employment in Nicaragua

Position	Duration	M/M
Coordinator and DTP operator ⁴	Feb 2017-Jun 2019	29 M/M
Personnel for production of educational material	Sep 2017-Jun 2019	88 M/M in total
Part-time worker for Baseline Survey	Nov 2017-Dec 2017	0.28 M/M*
Interpreter (English – Spanish)	Feb 2017 (1 day)	0.03 M/M

*67 working hours in total. (1 day = 8 hours, 1 M/M = 30 days).

(5) Equipment: Approximately 3.1 million Yen

Equipment shown in Table 4 was procured and handed over to the C/P organizations at the end of the Project (See Annex 2).

Table 4 List of Equipment

Equipment	Quantity	Handed over to:
Photocopier	1	MINED
Laser Printer	1	MINED
Desktop PC	4	MINED
Laptop PC	11	MINED (3 PCs) UNAN Managua (4 PCs) UNAN Leon (4 PCs)
Projector	1	MINED
Microsoft Office	15 Licenses	MINED (7 Licenses) UNAN Managua (4 Licenses) UNAN Leon (4 Licenses)
MathMagic	4 Licenses	MINED

(6) General Operational Costs: 51 million Yen

³ ESMATE: Project for the Improvement of Mathematics Teaching in Primary and Secondary Education in El Salvador

⁴ María José López SamQui, who also worked for PROMECM and PROMECM 2, was employed as a coordinator and DTP operator.

(7) Cost for Printing Educational Materials

The Japanese side covered the cost for printing the materials for the purpose of validation and materials introduction training for mathematics teachers (See Table 5). Originally, the funds from European Union (EU) would cover the printing and distribution costs of the textbooks and activity notes for all students in the country; however, the budget became unavailable due to the socio-political instability in Nicaragua from April 2018. Although the government of Nicaragua found new funding, it was not sufficient to cover the cost for printing the textbooks of all grades. In response to the letter of request submitted from the general director of Secondary Education Direction of MINED to the representative of the JICA Nicaragua Office, JICA provided financial support for the printing costs of the textbooks for the 10th and 11th grades students. This request was officially approved in the fourth Joint Coordination Committee (JCC) held on 31 May 2019.

Table 5 Printed Materials Covered by the Japanese Side⁵

Material	Quantity	Total Cost ⁶
Textbooks for validation for G7-G11 students (MS-Word format with white cover pages)	5,680	1,397,888 Yen (US\$ 12,861)
Textbooks for G7-G11 students for materials introduction training and teacher training courses	17,600	4,253,118 Yen (US\$ 39,130)
Teachers' guides for G7-G11 teachers for materials introduction training and teacher training courses	15,360	3,524,338 Yen (US\$ 32,425)
Students' activity notes for G7-G11 for materials introduction training and teacher training courses	12,000	634,217 Yen (US\$ 5,835)
Textbooks distributed for all G10-G11 students in Nicaragua	110,000	23,405,518 Yen (US\$ 215,338)

(8) Training (Knowledge Co-creation Program) in Japan

The training named “Improving the Quality of Mathematics Education in Secondary Education” was held in the Okayama University in October and November of 2017 and 2018, at which five C/P in total including technical officials in the MINED and teachers in the UNAN Managua and Leon participated. (Before the launch of the Project, two technical officials from MINED, Francisco Díaz and Humberto Jarquín, participated in the same training in 2016.) Participants are listed in Table 6. All of them worked for the Project as the C/P mainly for the development of the educational materials. The training aimed at improving teaching techniques of mathematics teachers and promoting learner-centered lesson, targeting those who would be the focal points in mathematics education and teacher training in Nicaragua.

Table 6 List of Participants for the Training in Japan

Period	Participants	Organization/Position
25 Oct-18 Nov 2017	Alberto García	Technical official, Education Planning Direction, MINED
	Melissa Velázquez	Teacher, UNAN Managua
	Célfida López	Teacher, UNAN Leon

⁵ Printing of these materials is covered by the General Operational Costs. Table 5 only includes materials bounded as books. Materials printed by the photocopiers of the Project, such as materials for validation and test papers for surveys, are not included.

⁶ Monthly Exchange Rate of JICA in August 2019: USD/JPY 108.692000

29 Oct-21 Nov 2018	Armando Huete	Teacher, UNAN Managua
	Benito González	Teacher, UNAN Leon

(9) Regional Seminar and Study-Visit to ESMATE

Regional Seminars were held by ESMATE three times (December 2017, December 2018 and May 2019). 27 persons in total including the MINED C/P, the UNAN Managua and Leon and the Japanese experts participated. Tables 7 and 8 show the list of participants and outline of the Regional Seminars and the study-visit to ESMATE.

Table 7 Outline of the Regional Seminars and Study-Visit to ESMATE

Seminar/Study Visit	Period	Activity
Study-Visit to ESMATE	04-06 Jun 2017	<ul style="list-style-type: none"> Observe validation activities of the textbooks developed by ESMATE Discussion about the textbook of NICAMATE
2 nd Regional Seminar	06-08 Dec 2017	<ul style="list-style-type: none"> Co-review of the textbooks of the four projects. (Major authors of each project exchanged their comments on the project textbooks.) Comparison of textbooks in Central and South America and Japan Introduction of education evaluation activities in Mexico Sharing of experiences from ESMATE in terms of validation activities
3 rd Regional Seminar	06-08 Dec 2018	<ul style="list-style-type: none"> Sharing of lessons learned and experiences among the four projects regarding curriculum revision and development of textbooks
4 th Regional Seminar	16-17 May 2019	<ul style="list-style-type: none"> Sharing of achievement among the four projects Sharing of follow-up plans of the four projects Sharing of the results of ESMATE impact evaluation Sharing of good practices of ESMATE

Table 8 List of Participants of the Regional Seminars and Study-Visit to ESMATE

Seminar/Study-Visit	Participants	Organization/Position
Study-Visit to ESMATE	Francisco Díaz	Technical Official in Secondary Education Direction, MINED
	Alberto García	Technical Official in Education Planning Direction, MINED
	Melissa Velázquez	Teacher, UNAN Managua
	Armando Huete	Teacher, UNAN Managua
	Ernesto Gallo	Teacher, UNAN Leon
	Kazumi Katsumata	Expert (Mathematics Education Specialist 3), KRC
2 nd Regional	Francisco Díaz	Technical Official in Secondary Education

Seminar		Direction, MINED
	Humberto Jarquín	Technical Official in Secondary Education Direction, MINED
	Gregorio Ortiz	Technical Official in Teacher Training Direction, MINED
	Juan Carlos Caballero	Technical Official in Primary Education Direction, MINED
	Alberto García	Technical Official in Direction of Education Planning, MINED
	Aracelly Barreda	Teacher, UNAN Managua (Esteli)
	Melissa Velázquez	Teacher, UNAN Managua
	Armando Huete	Teacher, UNAN Managua
	Marlon Espinoza	Teacher, UNAN Managua
	Primitivo Herrera	Teacher, UNAN Managua
	Ernesto Gallo	Teacher, UNAN Leon
	Benito González	Teacher, UNAN Leon
	Célfida López	Teacher, UNAN Leon
	Felipe Aráuz	Teacher, UNAN Leon
	Ken Furukawa	Expert (Leader/Mathematics Education Specialist 1), KRC
Kazumi Katsumata	Expert (Mathematics Education Specialist 3), KRC	
Sayaka Goda	Expert (Mathematics Education Specialist 5/Coordinator), KRC	
3 rd Regional Seminar	Francisco Díaz	Technical Official in Secondary Education Direction, MINED
	Melissa Velázquez	Teacher, UNAN Managua
	Felipe Aráuz	Teacher, UNAN Leon
4 th Regional Seminar	Melba María López Montenegro	General Director of Secondary Education Direction, MINED
	Alina González	General Director of Teacher Training Direction, MINED
	Alejandro Genet	Dean of the Faculty of Education and language, UNAN Managua
	Martha Lorena Guido de Moreno	Dean of the Faculty of Education and Humanities Science, UNAN Leon
	Francisco Díaz	Technical Official in Secondary Education Direction, MINED
	Primitivo Herrera	Teacher, UNAN Managua
	Felipe Aráuz	Teacher, UNAN Leon

1-2 Input by the Nicaraguan Side

(1) C/P of the Project

In total, 15 members of the author group for the materials (Colectivo de Autores: CA) and three DTP operators worked for the Project during the implementation period from February 2017 to June 2019. Table 9 shows the list of the C/P.

Table 9 List of C/P from Nicaragua

Name	Organization / Position	Period of Assignment	Contract Type, etc
María Elsa Guillén	General director, Secondary Education Direction	Feb 2017- Jul 2018 (18 months)	Project coordinator Member of JCC
Melba María López Montenegro		Oct 2018-Jun 2019 (9 months)	
Jacinta Mercedes Cerda Farga	Technical coordinator of the pedagogical assessors and acting general director of Secondary Education Direction, MINED	01 Jul-21 Oct 2018 (4 months)	Acting Project coordinator
Julio Canelo Castillo	Director, Secondary Education/Regular Education Direction	Feb 2017-Jun 2019 (29 months)	Assistant Project coordinator
Arejandro Genet	Dean, Faculty of Education and Language, UNAN Managua	Feb 2017-Jun 2019 (29 months)	Member of JCC
Martha Lorena Guido	Dean, Faculty of Education and Humanities Sciences, UNAN Leon	Feb 2017-Jun 2019 (29 months)	Member of JCC
Gloria Parilla	Former Representative of Mathematics Division, Faculty of Education and Language, UNAN Managua	Feb 2017-Dec 2018 (23 months)	Member of JCC
Francisco José Barrios	Director of the Science Education Department, UNAN Managua	Mar 2019-Jun 2019 (4 months)	Member of JCC
Francisco Díaz	Technical Official in Secondary Education Direction, MINED	Feb 2017-Jun 2019 (29 months)	Full Time Leader of CA
Humberto Jarquín	Technical Official in Secondary Education Direction, MINED	Feb 2017-Jun 2019 (24 months)	Full Time Member of CA
Gregorio Ortiz	Technical Official in Primary Education Direction, MINED	Feb 2017-Dec 2017 (11 months)	Full Time Member of CA
Juan Carlos Caballero	Technical Official in Teacher Training Direction, MINED	Feb 2017-Aug 2018 (19 months)	Full Time (Feb-Dec 2017) Part Time (Jan-Aug 2018) Member of CA
Alberto García	Technical Official in Direction of Education Planning, MINED	Feb 2017-Dec 2017 (11 months)	Full Time (Feb-May 2017) Part Time (Jun-Dec 2017) Member of CA
Aracelly Barreda	Teacher, UNAN Managua	Feb 2017-Aug 2018 (19 months)	Part Time (3 days a week) Member of CA

Name	Organization / Position	Period of Assignment	Contract Type, etc
Melissa Velázquez*	Teacher, UNAN Managua	Feb 2017-Dec 2018 (23 months)	Part Time (3 days a week). 5 days a week in Jul-Dec 2017. Member of CA
Armando Huete*	Teacher, UNAN Managua	Feb 2017-Jun 2019 (29 months)	Part Time (3 days a week). 5 days a week in Jul-Dec 2017. Member of CA
Marlon Espinoza*	Teacher, UNAN Managua	Aug 2017-Dec 2018 Mar 2019-Jun 2019 (21 months)	Part Time (3 days a week). 5 days a week in Jul-Dec 2017. Member of CA
Primitivo Herrera*	Teacher, UNAN Managua	Aug 2017-Jun 2019 (23 months)	Part Time (2-3 days a week) Member of CA
Ernesto Gallo	Teacher, UNAN Leon	Feb 2017-Dec 2017 (11 months)	Part Time (3 days a week) Member of CA
Benito González	Teacher, UNAN Leon	Feb 2017-Dec 2018 (23 months)	Part Time (3 days a week) Member of CA
Célfida López	Teacher, UNAN Leon	Feb 2017-Dec 2018 (23 months)	Part Time (3 days a week) Member of CA
Felipe Aráuz*	Teacher, UNAN Leon	Aug 2017-Jun 2019 (23 months)	Part Time (2-3 days a week) Member of CA
Orlando Ruíz*	Teacher, UNAN Leon	Mar 2018-Jun 2019 (16 months)	Part Time (2-3 days a week) Member of CA
Lisette Serrano	Secondary Education Direction	Feb 2017-Jun 2019 (29 months)	Full Time DTP Operator
Grettel Morán	Secondary Education Direction	Jan 2018-Jul 2018 (7 months)	Full Time DTP Operator
Maribel Cuarezma	Secondary Education Direction	Sep 2018-Jun 2019 (10 months)	Full Time DTP Operator
Aníbal Aguilar	Driver, MINED	Feb 2017-Jun 2019 (29 months)	Full Time

* The Japanese side bore part of work allowances that MINED could not cover.

(2) Working Environment

The Project was provided two furnished office spaces in MINED with extension, internet, and access to the file-storage server of MINED. Electricity cost was also covered by MINED. The Project team, however, could not freely use emails or browse websites due to the restricted use of the internet for security reasons from June 2018.

(3) Printing and Distribution of the Materials Developed by the Project

The government of Nicaragua achieved the funds that covered the printing costs for the materials shown in Table 10 as well as the distribution costs of all the materials to the entire country. The textbooks and students' activity notes are in process of printing as of August 2019

and will be distributed to the entire country after the delivery of the materials to MINED by September and November 2019 respectively. In addition, MINED developed and distributed a leaflet of board-writing plan in July 2019 in order to improve the board-writing techniques of teachers and promote the use of the board-writing plan. (See Annex 3.)

Table 10 Printed Materials Covered by the Nicaraguan Side

Material	Quantity
G7 Textbook	109,500
G8 Textbook	83,000
G9 Textbook	70,000
G7 Students' activity notes	130,000
G8 Students' activity notes	90,000
G9 Students' activity notes	88,000
G10 Students' activity notes	77,000
G11 Students' activity notes	70,000
Leaflet for Board-Writing Plan	5,000

(4) Other Input from the government of Nicaragua

MINED bore all the implementation costs except for the printing costs of the materials used for the materials introduction training for teachers in January 2019. Expense for the nationwide monitoring activities following the training was also covered by the Nicaraguan side.

1-3 Activities

1-3-1 Achievement and Activities for Output 1

(Output 1: the students' textbook, teachers' guide and students' activity notes in the area of mathematics for five (5) grades in secondary education are created.)

[1-1] To define the technical and methodological criteria for the preparation of the students' textbook, teachers' guide and students' activity note.

Prior to formulating the technical strategy for the development of educational materials, a diagnostic survey was conducted in five target schools in order to understand the actual situation of mathematics education in Nicaragua. Major results and outline are shown in Table 11.

Table 11 Outline and Results of the Diagnostic Survey

Purpose	<ul style="list-style-type: none"> To investigate the situation of mathematics education in Nicaragua, such as the readiness and learning of students, teachers' subject knowledge, how they implement lessons, and what kind of teaching and learning materials are used in classroom. Results of the survey will be references for the development of educational materials created by the Project. Project members from both Nicaragua and Japan share a common understanding on the actual situation of mathematics education in the country. 																		
Date of Survey	1-3 March 2017																		
Target School and Sample Size	<table> <tbody> <tr> <td>Salomon Ibarra Mayorga (Urban, Managua)</td> <td>G8: 78,</td> <td>G11: 64</td> </tr> <tr> <td>Benjamin Zeledón (Urban, Managua)</td> <td>G8: 80,</td> <td>G11: 46</td> </tr> <tr> <td>INDO (Urban, Granada)</td> <td>G8: 95,</td> <td>G11: 56</td> </tr> <tr> <td>Tomás Borges Martínez (Rural, Mateare)</td> <td>G8: 60,</td> <td>G11: 49</td> </tr> <tr> <td>Bertha Pacheco (Rural, Granada)</td> <td>G8: 90,</td> <td>G11: 42</td> </tr> <tr> <td>Total</td> <td>G8: 403,</td> <td>G11: 257</td> </tr> </tbody> </table>	Salomon Ibarra Mayorga (Urban, Managua)	G8: 78,	G11: 64	Benjamin Zeledón (Urban, Managua)	G8: 80,	G11: 46	INDO (Urban, Granada)	G8: 95,	G11: 56	Tomás Borges Martínez (Rural, Mateare)	G8: 60,	G11: 49	Bertha Pacheco (Rural, Granada)	G8: 90,	G11: 42	Total	G8: 403,	G11: 257
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Bertha Pacheco (Rural, Granada)	G8: 90,	G11: 42																	
Total	G8: 403,	G11: 257																	
Survey Tool	<ul style="list-style-type: none"> Mathematics test for students Lesson observation, Interview for mathematics teachers 																		
Mean % of Correct Answers	<table> <tbody> <tr> <td>G8</td> <td>Approximately 29% (Primary-level items: 34%, G7-level items: 21%)</td> </tr> <tr> <td>G11</td> <td>Approximately 23% (Primary-level items: 25%, G7-level items: 27%, G8-level items: 18%)</td> </tr> </tbody> </table>	G8	Approximately 29% (Primary-level items: 34%, G7-level items: 21%)	G11	Approximately 23% (Primary-level items: 25%, G7-level items: 27%, G8-level items: 18%)														
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G11	Approximately 23% (Primary-level items: 25%, G7-level items: 27%, G8-level items: 18%)																		

Major Results	<ul style="list-style-type: none"> • Majority of the students do not have good proficiency in the four basic arithmetic operation, especially in operation of negative number, decimal number and fraction. • Many students do not sufficiently understand basic concept and terminologies in mathematics such as area, perimeter and proportion. • No statistically significant difference was found in the results between male and female students in G8. In G11, male students had slightly better performance. However, the difference is not notable. • Many teachers deemed that their lessons encouraged active participation of the students; however, in eight mathematics lessons in five schools observed in the survey there were few opportunities for students to individually work on exercises by themselves and confirm their understanding in the 45-minute lessons. • Teachers often used examples and exercises that included complicated numbers, and students had a difficulty in calculation of those exercises and therefore could not understand the main objectives of the lessons well. This also caused many students to use calculators because the exercises in lessons required complicated calculation.
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Based on the results of the diagnostic survey, the technical strategy shown in Figure 1 was formulated by the Project and approved in the first JCC held on 27 April 2017. The Project developed the educational materials and implemented the materials introduction training in line with this strategy.

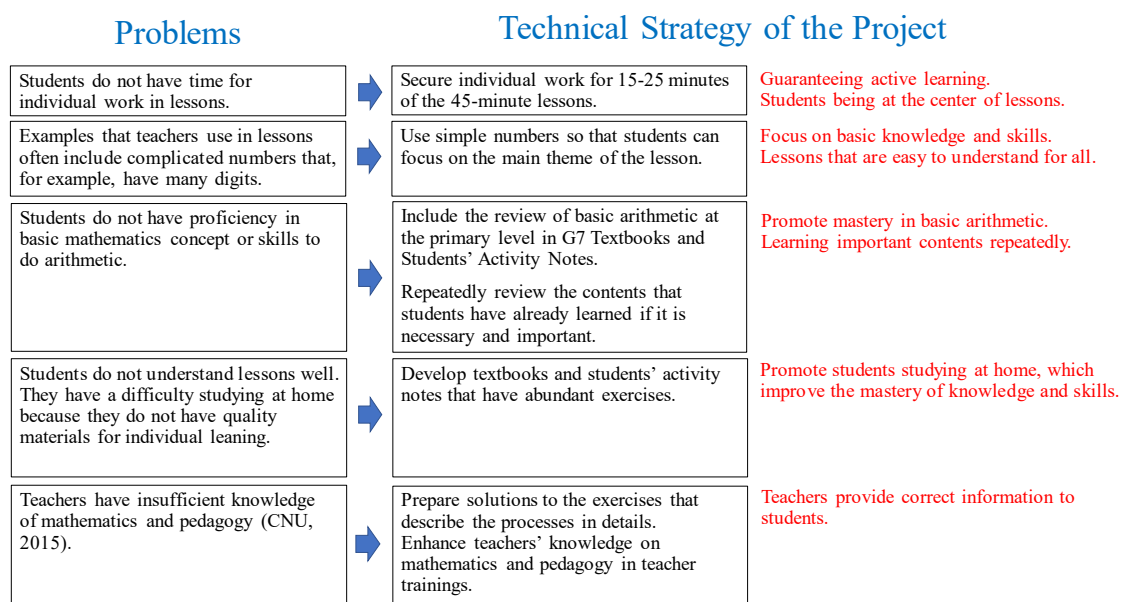


Figure 1 Technical Strategy of the Project

[1-2] To analyze the preliminary curriculum of mathematics in secondary education.

In late-October 2016, Mr. Norihiro Nishikata and Mr. Eiichi Kimura, JICA advisors, visited Nicaragua prior to the launch of the Project and implemented a workshop about the curriculum revision of secondary mathematics. The Project created a mathematics curriculum flow chart of

didactic sequence based on the draft of curriculum revision developed in the workshop and analyzed the curriculum flow of mathematics education in Nicaragua.

[1-3] To distribute themes and contents in accordance with the revised curriculum.

[1-4] To create the annual lesson plan by grade.

Following the launch of the Project, Mr. Kimura visited Nicaragua from 6 to 10 February 2017 and held a workshop where the Project members created the Unit Teaching Plan Table in function domain based on the draft of curriculum revised in October 2016. After the workshop the CA revised learning contents and allocation of time for each unit in the Annual Teaching Plan and developed unit teaching plans. Since MINED requests that 70% (140 days) of the 200 school days be allocated to normal lessons, the Annual and Unit Teaching Plans created by the Project have up to 140 periods of lessons for each grade (one lesson period equals to 45 minutes).

The CA were divided into groups of two-three persons, and each group developed the Annual and Unit Teaching Plans of the grades assigned to them. In addition to this group work, a whole-group workshop was implemented in order to adjust the learning contents and sequence across the plans of each grade.

Besides, the CA adjusted the allocation of teaching time and structure of each unit in the curriculum during the development and validation of the textbooks. The final version of the Annual Teaching Plan Table for each grade is located in the corresponding teachers' guide.

[1-5] To create the draft students' textbook and teachers' guide for validation.

The Project aimed to create textbooks that are easy to understand for teachers and students. The textbooks suggest that teachers basically proceed by only one page in each lesson, which consists of the following four basic steps: P (Problem), S (Solution), C (Conclusion), and E (Exercise). The first draft of G7-G11 textbooks (MS-Word version) was completed by the CA with the support of the Japanese experts in December 2017. The textbooks were developed referring to the materials of the Project for the Improvement of Teaching Method in Mathematics Phase 3 in Honduras, those of ESMATE in El Salvador and mathematics textbooks produced in Japan.

Originally, the textbooks and teachers' guides were to be developed in parallel; however, the Project modified the Plan of Operation (PO) so that the development of teachers' guide comes after the finalization of the textbook in January 2018. The delay in the provision of the teachers' guide of ESMATE was part of the reason for this change of plans. More importantly, the Project made this decision since it would not have been efficient to develop teachers' guide without finalizing the textbooks according to the experiences in other countries. This modification of PO was approved in the first JCC (See Annex 5-2).

The design of a page of the teachers' guide includes the copy of textbook page at its center, the objectives of the lesson, relations with the next and previous lessons, other important points of teaching and board-writing plan. The first draft of teachers' guide was completed in December 2018 despite the original plan of June 2018. One reason for the delay was the socio-political instability from April 2018. In addition, the development was delayed because the Project needed to revise the guides every time the textbooks were modified. While all the CA worked on the development of the part of board-writing plan, five of the CA who understand the intention and effective use of the textbooks wrote other components of the guides such as the important points of teaching.

When developing the draft of textbook and teachers' guide, the CA made the first manuscript, on which the Japanese experts gave feedback, and then the CA modified the manuscript again and again. The development of the draft required this repetitive revision process between the CA and the Japanese experts before the quality of the materials became acceptable for validation in schools. The CA used MS-Word and GeoGebra to create these materials.

[1-6] To coordinate activities for the validation with selected schools.

Validation activities are divided into two steps: the first validation implemented in two schools near MINED in June-July and October in 2017 and the second one in 10 schools in four Departments from February 2018. Before the implementation of the first validation, the Project gathered the mathematics teachers and directors of the two schools, representatives in the education department office in Managua and local offices in May 2017 and explained the outline of the Project and agreed that why and how the validation of the educational materials would be implemented. In the second validation, the Project team visited target schools in March 2018 and gave explanations to the directors, mathematics teachers and the pedagogical assessors (asesores pedagógicos) in person. Then, the implementation was agreed to by the participants.

[1-7] To implement the validation.

(1) First Validation

The purpose of the first validation was to examine if the difficulty level of the textbooks and activity notes was appropriate for teachers and students on the ground and to identify the problems that will emerge when actually introducing the materials in classrooms. Two schools near MINED, Fernando Gordillo (morning shift) and Clementina Cabezas (afternoon shift), were selected since the team could visit these schools easily. The validation was implemented in some selected units in G7 to G10. G11 was excluded because some students in G11 needed to take the university entrance examination soon. Copies of the textbook manuscripts were provided to all students in the target schools for validation purpose. During the validation period, the CA and the Japanese experts visited the target schools two-three times a week, observed the implementation of lessons by teachers and provided support. The CA also demonstrated a lesson using the textbooks of the Project so that the CA could directly feel the proficiency level of the students.

(2) Second Validation

The second validation aimed at collecting feedback from the teachers who have taught all the units of the textbooks for a longer time and at a larger scale compared to the first validation. The 10 schools in the four Departments were selected in total, adding eight schools to the ones in the first validation. G7-G11 textbooks of MS-Word version (in black and white with white cover page) were provided to all the teachers and students of the 10 schools so that they use the materials in lessons in 2018. In March 2018, the Project visited the newly-targeted eight schools twice each and explained about the validation and revision of the curriculum. During the visit, the CA demonstrated a model lesson using the textbooks of the Project and asked the teachers in the schools to implement lessons by themselves.

The Project team could not visit the schools from April 2018 due to the socio-political instability in Nicaragua. Feedback from the teachers were thus collected via phone or school visits after the Japanese experts came back to the country in October 2018.

Table 12 Target Schools for the Second Validation

No.	Department	Municipality	School Name
1	Managua	San Rafael del Sur	Colegio San Cayetano
2		Mateare	Tomas Borge* ¹
3		Managua	Fernando Gordillo* ²
4		Managua	Clementina Cabeza* ²
5	Carazo	Jinotepe	Instituto Juan José Rodríguez
6		Diriamba	Colegio La Salle* ¹
7	Chinandega	Chinandega	San Benito #1
8		Posoltega	Instituto Público Rubén Darío* ¹
9	León	León	John F. Kennedy
10		León	Salomón de la Selva

*¹ Target schools in the Baseline Survey*² Target schools in the first validation (2017)

[1-8] To review the students' textbook and teachers' guide taking into consideration of the experiences of the validation.

In the reflection session after the validation activities, the CA and Japanese experts proactively exchanged their observations. Results of the validation indicated that the difficulty level of the textbooks needed to be adjusted because many students were struggling to master the basic knowledge and skills that they had already learned. One idea to deal with this issue was to increase the pages for the review of the basics; however, in that case the teachers might not be able to complete all the units in the textbook within a year. Eventually, following the discussion with C/P, the Project adjusted the difficulty level of the textbooks aiming that 50% or more of the students in a classroom could solve the first exercise of the respective textbook pages. As a response to students who did not retained the basic knowledge and techniques which they had already learned, the Project added some notes relevant to such knowledge and techniques.

The validation also revealed issues about the effective use of the textbooks in classroom. In the observed lessons, teachers often invited students to the whiteboard and had them answer exercises that the students had never seen previously. The teachers did this to encourage the active participation of their students; however, it led to the shortage of time for individual work of the students in lessons. The Project therefore suggested for the material introduction training that teachers give detailed explanations of the solutions to the exercises so that their students learn for the first time and refrain from having them answer such exercises on the whiteboard. In addition, some pages of the textbooks that had too much information were simplified in order to secure sufficient time for individual work of the students. The revised textbooks also included solutions to all the exercises at the end of the textbook so that the students could review their answers by themselves.

Comments from the teachers in the target schools in the second validation were reflected in the textbooks, teachers' guides and the programs of the material introduction training. Most of the comments were about minor errors in the textbooks that could be modified immediately.

One of the side benefits of the validation was that the CA who implemented the model lessons realized that the students had less proficiency than they expected and understood what type of errors that the students typically make. They also realized that the percentage of correct answers in the tests significantly changes depending on the numbers used in test items.

Based on the experience of textbook validation, the teachers' guides were revised to include useful information for teachers such as the solutions to the exercises that explain the processes in detail, model of Annual Teaching Plan, detailed board-writing plans, and how to use the unit tests.

[1-9] To set up a strategy for the preparation of students' activity note.

In consideration of the validation experience of the textbooks and the amount of time left for the development of students' activity notes, the Project decided the following development strategy for the activity notes.

- Main purpose of the activity notes is to encourage students to review at home what they have learned in lessons.
- Develop exercises with the premise that students study at home for at least 20 minutes a day.
- Explain important formulas and theories at the beginning of each session.
- Develop basic exercises for each session that are about the same level as in the textbooks. Advanced-level exercises are only placed at the end of each session.
- Specify the textbook page number that corresponds to each exercise.
- Describe the process of solutions as much as possible so that students can study by themselves.
- Save the printing costs by creating the notes in letter size with two facing pages in black and white.

[1-10] To prepare students' activity note.

Originally, the textbooks and students' activity notes were to be developed in parallel. However, the Project team found that it would be more efficient to develop the activity notes after finalizing the textbooks. A change in PO was therefore made and approved in the second JCC in February 2018, postponing the deadline of the activity notes by December 2018 so that the development of the notes could be resumed after the finalization of the textbooks (See Annex 5-3). However, the textbooks were eventually finalized in December 2018 due to the socio-political instability that continued from April 2018 in Nicaragua. The second modification of the PO was thus made and approved in the third JCC in December 2018, and the development of the activity notes resumed following the materials introduction training for teachers held in January 2019 (See Annex 5-4).

Basic exercises were developed relatively smoothly since the exercises are similar to those in the textbooks. However, development of advanced problems required much effort. Some CA made exercises that are too difficult, and some developed exercises by just complicating the numbers used in the basic exercises. Therefore, while Japanese experts showed CA examples of good quality problems that require thinking skills, those problems were improved with CA one by one. The activity notes have solutions that explain the processes in detail so that students could study by themselves. The manuscript of the activity notes (MS-Word) was completed in March 2019.

[1-11] To edit the students' textbook, teachers' guide and students' activity note.**(1) Editing of Textbooks**

The editing of the manuscript of the textbooks (MS-Word) revised in the first validation started in December 2017 using Adobe InDesign. The first draft of G7-G11 textbooks in InDesign format was completed in May 2018. In the process before editing with InDesign, a Japanese doctor confirmed and revised the manuscript of the MS-Word version from an academic perspective.

In consultation with MINED, the Project asked two expert teams in Nicaragua, the Mathematics

Association and the team of Dr. Gloria in the UNAN Managua, to review the first draft of InDesign version in May 2018. Although the review was originally planned to be done in June, the security issues in Nicaragua made it difficult for the reviewer to deliver their feedback in time, and the Project therefore needed to receive the comments from Dr. Gloria little by little until the end of September. While some of the comments received from the expert teams in Nicaragua helped to improve, there were many comments following traditional Nicaraguan mathematics education, such as trying to handle more detailed contents than necessary. The comments were reviewed and selected by the CA and Japanese experts and reflected in the second InDesign draft accordingly. The second draft was finalized after the confirmation of the Education Planning Direction of MINED in November 2018 and submitted for printing in December. The printing cost was covered by the budget of the Japanese side. These textbooks were distributed to the teachers who participated in the materials introduction training in January 2019. In order to promote the use of the new Textbooks in secondary mathematics teacher training courses, the new Textbooks of 7th-11th grades were distributed to four public universities such as UNAN. In addition, the new Textbooks of 7th-9th grades were distributed to primary teacher training institutions aimed at students' understanding of mathematics content at lower secondary education level as basic knowledge.

In addition, the Project team added unit tests to the final version of the draft textbooks to promote formative assessment following the advice of the consultative mission in March 2019.

(2) Editing of Teachers' Guide

The completion of the first draft of the manuscripts of the teachers' guides was delayed due to the delay in the completion of the textbooks. In addition, DTP operators needed to participate in activities outside the Project from May to October 2018 due to socio-political instability in Nicaragua and could only edit the materials for a limited time. For these reasons, there was a delay in producing the edition of the teachers' guides.

The edition of the teachers' guides started in October 2018 using InDesign from the pages whose quality was accepted by the Japanese experts and CA. Teachers' guide of InDesign version was eventually completed in June 2019 since modifications of the textbooks was still in process, and the Project team needed to revise the pages of the teachers' guide every time a new modification was made in the textbooks.

(3) Editing of Students' Activity note

Students' activity notes of InDesign version started to be edited in April 2019. The final version of the activity notes was completed at the end of May 2019.

Sample pages of the textbooks, teachers' guides and students' activity notes are shown in Figures 2, 3 and 4. In addition, the Project posted the digital data of the students' textbooks, teachers' guides and students' activity notes on the MINED portal⁷ so that the materials could be downloaded by smartphones and PCs from anywhere and by anybody. QR code is attached to the back cover of the materials to promote the use of the digital data.

⁷ <https://nicaraguaeduca.mined.gob.ni/proyecto-para-el-aprendizaje-amigable-de-matematica-en-educacion-secundaria-nicamate/>

Unidad 2: Sistema de Ecuaciones de Primer Grado

Sección 3: Método de reducción

Contenido 1: Sistemas de dos ecuaciones con una variable que tiene coeficientes opuestos

P

Resuelva el sistema sin utilizar el método de sustitución.

$$\begin{cases} 2x + y = 20 & \textcircled{1} \\ x - y = 4 & \textcircled{2} \end{cases}$$

S

1. Se suman las ecuaciones $\textcircled{1}$ y $\textcircled{2}$, para eliminar la variable y y se resuelve la ecuación en x .

$$\begin{array}{r} 2x + y = 20 \quad \textcircled{1} \\ +) \quad x - y = 4 \quad \textcircled{2} \\ \hline 3x = 24 \\ \frac{3x}{3} = \frac{24}{3} \\ x = 8 \end{array}$$

2. Se sustituye $x = 8$ en $\textcircled{1}$ y se resuelve para y :

$$\begin{array}{l} (2)(8) + y = 20 \\ 16 + y = 20 \\ y = 20 - 16 \\ y = 4 \end{array}$$

El par ordenado $(8, 4)$ es la solución del sistema.

C

Para resolver un sistema de dos ecuaciones de primer grado con dos variables, donde una de estas aparece con coeficientes opuestos, se procede así:

1. Se suman las ecuaciones lado a lado para eliminar una variable y se resuelve la ecuación que resulta en la otra variable.
2. Se sustituye en cualquiera de las ecuaciones del sistema el valor encontrado en 1., y se resuelve la ecuación resultante. El par ordenado formado por los valores encontrados, es la solución del sistema.



Este procedimiento se conoce como **método de reducción**.

E

Resuelva los siguientes sistemas de ecuaciones:

a) $\begin{cases} 2x + y = 7 \\ x - y = 2 \end{cases}$ b) $\begin{cases} 4x + 2y = 20 \\ 5x - 2y = 7 \end{cases}$ c) $\begin{cases} x + 3y = 1 \\ -x + 2y = 4 \end{cases}$ d) $\begin{cases} 5x + 7y = 50 \\ -5x + 3y = 0 \end{cases}$

Figure 2 Sample Page of Students' Textbook (G8: Simultaneous First-Degree Equations, Addition/Subtraction Method)

1 Sistemas de dos ecuaciones con una variable que tiene coeficientes opuestos

Unidad 2: Sistema de Ecuaciones de Primer Grado

Sección 3: Método de reducción

Contenido 1: Sistemas de dos ecuaciones con una variable que tiene coeficientes opuestos

P Resuelva el sistema sin utilizar el método de sustitución.

$$\begin{cases} 2x + y = 20 & \textcircled{1} \\ x - y = 4 & \textcircled{2} \end{cases}$$

S

- Se suman las ecuaciones $\textcircled{1}$ y $\textcircled{2}$, para eliminar la variable y y se resuelve la ecuación en x .

$$\begin{array}{r} 2x + y = 20 & \textcircled{1} \\ +) x - y = 4 & \textcircled{2} \\ \hline 3x = 24 \\ \frac{3x}{3} = \frac{24}{3} \\ x = 8 \end{array}$$

- Se sustituye $x = 8$ en $\textcircled{1}$ y se resuelve para y :

$$\begin{array}{r} (2)(8) + y = 20 \\ 16 + y = 20 \\ y = 20 - 16 \\ y = 4 \end{array}$$

El par ordenado **(8, 4)** es la solución del sistema.

C

Para resolver un sistema de dos ecuaciones de primer grado con dos variables, donde una de estas aparece con coeficientes opuestos, se procede así:

- Se suman las ecuaciones lado a lado para eliminar una variable y se resuelve la ecuación que resulta en la otra variable.
- Se sustituye en cualquiera de las ecuaciones del sistema el valor encontrado en 1. y se resuelve la ecuación resultante. El par ordenado formado por los valores encontrados, es la solución del sistema.

Este procedimiento se conoce como **método de reducción**.

E

Resuelva los siguientes sistemas de ecuaciones:

a) $\begin{cases} 2x + y = 7 \\ x - y = 2 \end{cases}$ b) $\begin{cases} 4x + 2y = 20 \\ 5x - 2y = 7 \end{cases}$ c) $\begin{cases} x + 3y = 1 \\ -x + 2y = 4 \end{cases}$ d) $\begin{cases} 5x + 7y = 50 \\ -5x + 3y = 0 \end{cases}$

Aprendizajes esperados

Aplica el método de reducción en la solución de sistemas con una variable que tiene coeficientes opuestos.

Secuencia:

En la primera unidad se estudió la suma de polinomios, y en la sección anterior se resolvieron sistemas de ecuaciones de primer grado, utilizando el método de sustitución.

En esta clase se estudia cómo resolver un sistema de ecuaciones cuyos coeficientes de una misma variable son opuestos.

Puntos esenciales:

Recordar la suma de polinomios y el concepto de números opuestos.

Aclarar que el objetivo de sumar las ecuaciones es eliminar una variable.

Señalar que para resolver un sistema con el método de reducción, lo primero es identificar la variable a eliminar.

Indicar que la suma de los lados izquierdos de dos ecuaciones, se realiza como la suma de polinomios estudiada en la primera unidad de este LT.

Destacar que se tiene que sustituir la solución de la ecuación en una variable, en la ecuación que más conviene en el sistema.

S3: Método de reducción

C1: Sistemas de dos ecuaciones con una variable que tiene coeficientes opuestos

P Resuelva el sistema $\begin{cases} 2x + y = 20 & \textcircled{1} \\ x - y = 4 & \textcircled{2} \end{cases}$

S

$$\begin{array}{r} 2x + y = 20 & \textcircled{1} \\ +) x - y = 4 & \textcircled{2} \\ \hline 3x = 24 \\ \frac{3x}{3} = \frac{24}{3} \\ x = 8 \end{array}$$

Sustituyendo $x = 8$ en $\textcircled{1}$:

$$\begin{array}{r} (2)(8) + y = 20 \\ 16 + y = 20 \\ y = 20 - 16 \\ y = 4 \end{array}$$

Resp. (8, 4)

C **Método de reducción**

- Sumar las ecuaciones lado a lado y resolver la ecuación resultante.
- Sustituir en la ecuación más conveniente el valor encontrado en 1.

E

a) $\begin{cases} 2x + y = 7 & \textcircled{1} \\ x - y = 2 & \textcircled{2} \end{cases}$

$$\begin{array}{r} 2x + y = 7 & \textcircled{1} \\ +) x - y = 2 & \textcircled{2} \\ \hline 3x = 9 \\ \frac{3x}{3} = \frac{9}{3} \\ x = 3 \end{array}$$

Sustituyendo $x = 3$ en $\textcircled{1}$:

$$\begin{array}{r} 2(3) + y = 7 \\ 6 + y = 7 \\ y = 7 - 6 \\ y = 1 \end{array}$$

Resp. (3, 1)

b) $\begin{cases} 4x + 2y = 20 & \textcircled{1} \\ 5x - 2y = 7 & \textcircled{2} \end{cases}$

$$\begin{array}{r} 4x + 2y = 20 & \textcircled{1} \\ +) 5x - 2y = 7 & \textcircled{2} \\ \hline 9x = 27 \\ \frac{9x}{9} = \frac{27}{9} \\ x = 3 \end{array}$$

Sustituyendo $x = 3$ en $\textcircled{1}$:

$$\begin{array}{r} 4(3) + 2y = 20 \\ 12 + 2y = 20 \\ 2y = 20 - 12 = 8 \\ y = 4 \end{array}$$

Resp. (3, 4)

Figure 3 Sample Page of Teachers' Guide (G8: Simultaneous First-Degree Equations, Addition/Subtraction Method)

Unidad 1: Operaciones con Polinomios

Sección 2: Multiplicación de polinomios

- ✓ En $5x^2$, 5 es coeficiente y x^2 es parte literal.
 - ✓ Para multiplicar dos monomios, se multiplican sus coeficientes y partes literales.
- Ejemplos:
 $(3x)(-4y) = (3)(-4)xy$, $(-6x)(-9x) = (-6)(-9)x \cdot x = 54x^2$
- ✓ $a(b+c) = ab+ac$, $(b+c)a = ab+ac$ (Propiedad distributiva)
 - ✓ $(x+a)(y+b) = x(y+b) + a(y+b) = xy+bx+ay+ab$
 - ✓ $(x+a)(x+b) = x^2+(a+b)x+ab$

Ejercicios

5. (P. 7) Efectúe las siguientes multiplicaciones de monomios:
- a) $(3x)(2y)$ b) $(7x)(5y)$ c) $(-2a)(9b)$
d) $(-8x)(-4y)$ e) $(5x^2)(6x)$ f) $(-7y)^2$
g) $(-8x^2)(-6x^3)$ h) $\left(\frac{3}{7}x\right)\left(-\frac{14}{3}x^2\right)$ i) $\left(-\frac{2}{5}x\right)\left(-\frac{15}{8}y\right)$
6. (P. 8) Efectúe las siguientes multiplicaciones:
- a) $3(x+2)$ b) $7(a-2)$ c) $12x(x+2)$
d) $-5y(2x-11)$ e) $(-8a-1)(-9b)$ f) $5(a+b-2)$
g) $7(4x-y-1)$ h) $\frac{1}{7}(14x+21)$ i) $-\frac{2}{5}x\left(-\frac{5}{2}x^2-\frac{5}{6}x\right)$
7. (P. 9) Efectúe las siguientes productos:
- a) $(x+2)(y+5)$ b) $(x+3)(y+2)$ c) $(x+7)(y+8)$
d) $(x-12)(y+4)$ e) $(x+9)(y-7)$ f) $(x-5)(y+6)$
g) $(x-12)(y-5)$ h) $(x-11)(y-2)$ i) $\left(x-\frac{1}{3}\right)\left(y-\frac{6}{5}\right)$
8. (P. 10) Efectúe las siguientes multiplicaciones de binomios de forma horizontal:
- a) $(x+2)(x+3)$ b) $(x+4)(x+5)$ c) $(x+5)(x+7)$
d) $(x-6)(x+2)$ e) $(x-8)(x+4)$ f) $(x-7)(x-9)$
g) $(x+1)(x-10)$ h) $\left(x-\frac{1}{2}\right)(x-2)$ i) $\left(x+\frac{4}{3}\right)\left(x+\frac{2}{3}\right)$
9. (P. 11) Efectúe las siguientes multiplicaciones de binomios de forma vertical
- a) $(x+3)(x+5)$ b) $(x+4)(x+2)$ c) $(x+11)(x+6)$
d) $(x-7)(x+6)$ e) $(x+8)(x-9)$ f) $(x-3)(x-8)$
g) $(x+10)(x-11)$ h) $(x-12)(x+3)$ i) $\left(x-\frac{3}{2}\right)\left(x+\frac{1}{2}\right)$

Figure 4 Sample Page of Students' Activity Notes (G8: Multiplication of Multi-nominal)

[1-12] To revise the Mathematics and its Didactics Guide 3 created in PROMECEM 2.

Educational materials in Primary teacher training course will need to be reviewed significantly in the near future in accordance with the revision of the mathematics textbooks in primary education that was ongoing as of June 2019. Therefore, the Project consulted with MINED. Thereafter, “Guide for the use of the Mathematics and its Didactics Guide 3 (GMD 5) using the new textbooks of NICAMATE” was developed and distributed to primary teacher training institutions to promote the use of the textbooks of NICAMATE, instead of revising the Mathematics and its Didactics Guide 3 created in PROMECEM 2.

1-3-2 Achievement and Activities for Output 2

(Output 2: The induction system for the use of materials created in the Output 1 for mathematics teacher in general course in public secondary education is strengthened.)

[2-1] To analyze the existing training programs for mathematics teachers in general course in public secondary education.

MINED currently implements in-service teacher trainings for five days in January before the beginning of school year and for three days in June or July when schools are closed for summer vacations (In 2018 only the former training in January was implemented). The training in January is normally implemented in a three-level cascade model as follows: in the first week the technical officials carry out central training for the representatives of each department (for example, 36 representatives participated in January 2017); in the second week the participants of the central training provide the same training to the representatives of the municipalities; and in the third week it is passed on to the teachers in public schools by the municipalities. Approximately 60% of the whole training time was allocated to the session of subjects teaching because the training also covers more general topics and modern themes such as Information and Communication Technology (ICTs) and peace education.

The materials of the January 2017 and 2018 training presented the participants had some mathematics problems that they needed to teach in the first semester of the year. Results of the survey conducted by the CNU and MINED in 2015 targeting 337 mathematics teachers nationwide revealed that in-service teachers have insufficient mathematics knowledge and skills at the secondary level. The training was informed by this survey and therefore intended to improve subject knowledge of the teachers.

Another training for mathematics teachers in secondary education was implemented in January 2018. The mean percentage of correct answers of the pre- and post-tests of the training were 71.1% and 83.6% respectively. Since the mathematics tests only included basic items at the secondary level, the effect of the training was not sufficient for a four-day training. In addition, because of the cascade system, the content of the training will be reduced in the second and third cascade training, and the effectiveness of the training will be further reduced.

[2-2] To design the contents of teacher training for the use of educational materials created through the Project.

Based on the review of the past training programs and the experience of the validation, the introduction training of NICAMATE materials were provided to in-service teachers as follows (See Table 13). MINED originally wanted the Project team to directly implement the training to all the teachers to avoid the quality of the training decreased in the three-level cascade model. Because the idea of MINED was difficult to implement within the limited time and human

resources of the Project members of only about 10 people, the Project suggested to carry out the training in 2-level cascade model.

Table 13 Outline of the System of the Materials Introduction Training

	Cascade Level	Training Period	Facilitator	Target	No. of Participants	Venue
1 st Week	1 st	15-17 January	Project Team	EPI ⁸ Coordinator	106	Instituto Experimental México, Managua
2 nd Week	Cascade	22-24 January			82	
3 rd Week	2 nd Cascade	2 days of 28-30 January	EPI Coordinator	Mathematics Teachers	Approx. 1,700	Schools in each municipal

Table 14 shows the purposes and activities of the introduction training. The training focused on the comparison between the new and old curriculums and the introduction of new methods such as the use of the Annual Teaching Plan, the materials of the Project and board-writing plans. The training encouraged proactive participation of the teachers using the NICAMATE textbooks.

Table 14 Outline of the Program of the Materials Introduction Training

Schedule		Activities
1 st Day	AM 8:00-12:00	<ul style="list-style-type: none"> • Pre-test of the training • Presentation of the results of the diagnostic survey and the baseline survey to inform the participants of the actual mathematics proficiency of the students • Presentation of the technical strategy of the Project • Provision of the textbooks of the Project • Workshop to compare the new and old curriculums
	PM 13:00-16:30	<ul style="list-style-type: none"> • Workshop for the development of the draft of Annual Teaching Plan • Demonstration of a model lesson by the Project team using NICAMATE textbooks • Presentation about the structure of the board-writing plan • 1st workshop of board-writing plan (development of a plan)
2 nd Day	AM 8:00-12:00	<ul style="list-style-type: none"> • Sharing of board-writing plans in pair or group • 2nd workshop of board-writing plan (transcription of the plan to the whiteboard) • 1st demonstration of a lesson by the participants

⁸ Mutual-Learning Pedagogical Meeting (Encuentros Pedagógicos de Interaprendizaje). Teachers of each subject who belong to the schools in the same clusters share their experiences with their colleagues in this meeting held on the last Friday the month. The Teacher Training Direction of the MINED supervises the meetings.

Schedule		Activities
	PM 13:00-17:00	<ul style="list-style-type: none"> • 2nd demonstration of a lesson by the participants • Reflection on the effective use of the board-writing plan and the textbooks • Presentation of the teachers' guides • Presentation of the units in which the new curriculum made significant changes in teaching methods • Sharing of experiences of the target schools for validation
3 rd Day	AM 8:00-12:00	<ul style="list-style-type: none"> • Explanations on formative assessment using the evaluation exercise in the textbooks • Presentation of the effective use of the unit tests • Sharing of the methods to review the homework of the students • Introduction of basic teaching techniques • Post-test of the training • Instructions for the trainings implemented in EPI
	PM 13:00-17:00	<ul style="list-style-type: none"> • Summary of the training • Explanations of the pre- and post-tests • Development of the training plans for the 2nd level in the cascade

[2-3] To provide the MINED with technical support for the activities of the MINED.

(1) Provide support to the materials introduction training (January 2019)

The material introduction training shown in Table 13 was implemented by MINED in January 2019. In the training for the EPI coordinators, the Project team developed and provided the training program and materials and facilitated the training. In the training of the second level of the cascade, where the EPI coordinators conducted the training to mathematics teachers, the team developed and provided the training materials and program and implemented monitoring activities. At the end of the training for the EPI coordinators, some of participants talked about the importance of individual learning, and the quality of whiteboard writing plans created by participants were high. In addition, average scores of pre- and post- tests of training content increased from 1.88 to 3.73 out of 7. For the above reasons, the participants understood the contents of the new curriculum and textbooks and how to use them to some extent. The materials provided by the Project include G7-G11 textbooks developed by the Project. Provision of the venues, communications with the participants, payment of the allowances etc. were all done by MINED.

(2) Provide support to the promotion activities targeting the pedagogical assessors and directors of private schools

The technical officials in MINED were originally planned to visit schools in their own areas after the materials introduction training in February 2019 to monitor the use of the textbooks. In reality' however, the number of schools which about ten officials can visit in a short time is limited. As a result, Ms. Melba, the general director of the Secondary Education Direction, requested to engage the pedagogical assessors (asesores pedagógicos) of each department and municipal to promote the use of the Project materials and board-writing plans in schools more efficiently. The Project team supported the promotion activities targeting the assessors of the entire country by providing presentation materials.

The Project team presented the activities and materials of NICAMATE in the meeting held by MINED in June 2019. The meeting targeted directors of all private schools in the country with the theme of “mathematics learning that is easy to understand.” In the meeting, the general director of the Secondary Education Direction announced that the materials were accessible on the MINED portal and could also be used in private schools, and that the mathematics teachers in private schools are more than welcomed as observers to the training of the Project held in each department and municipal. In addition, a mathematics teacher of a private school who participated in the meeting said, “I already use the educational materials of NICAMATE. They are wonderful educational materials. The publication of those materials is a revolutionary event for mathematics education in Nicaragua and should be used in private schools as well.”

1-3-3 Achievement and Activities for Output 3

(Output 3: The program of the Special Didactics of Mathematics for secondary teacher education in the UNAN Managua and the UNAN Leon is revised.)

[3-1] To analyze the program of Special Didactics of Mathematics of the UNAN Managua and the UNAN Leon that develop the capacities of mathematics teachers in secondary education.

Regarding the teacher training courses for secondary mathematics teachers, the Faculty of Education and languages of the UNAN Managua has two courses, “Mathematics” and “Physics and Mathematics,” and the Faculty of Education and Humanities Sciences of the UNAN Leon has only one, “Mathematics Education and Computer.” Each of these three courses has different modules and credits related to mathematic pedagogy. In consultation with the CA, the Project revised the programs of the two modules in Table 15 that are related to the didactics of mathematics.

Table 15 Modules Related to Didactics of Mathematics in the UNAN Managua and UNAN Leon

University	Modules Related to Didactics of Mathematics	Contact Hours
Faculty of Education and languages, UNAN Managua	Didactics of Mathematics I & II	60 hours each for I and II
Faculty of Education and Humanities Sciences, UNAN Leon	Special Didactics of Mathematics	60 hours

Analysis of the programs of the two modules is presented below

(1) Didactics of Mathematics I & II in the UNAN Managua (before revision)

Didactics of Mathematics I & II in the UNAN Managua included topics such as didactics of mathematics as science, research and research method of mathematics didactics, constructivism, innovative mathematics teaching methods, proof and problem solving in mathematics, evaluation methods, etc. The module did not provide many practical contents that will be useful in the actual classrooms.

(2) Special Didactics of Mathematics in the UNAN Leon (before revision)

Special Didactics of Mathematics in the UNAN Leon consists of the development of teaching

plan that adopts problem-solving skills and mathematical thinking skills, evaluation tools and the use of ICTs. The module is taken by the students in the second semester of G3, who participate in teaching practice training in schools. However, the program of the module focused on theories and did not provide many practical teaching skills that would be useful on the ground.

In summary, the modules related to the didactic of mathematics in the UNAN Managua and UNAN Leon both focused on theories and abstract topics and did not provide the students with much practical knowledge and skills that will be utilized in classrooms.

[3-2] To revise the program of Special Didactics of Mathematics of the UNAN Managua and the UNAN Leon.

The Project could hardly implement activities of Output 3, which were originally planned from June 2018, due to the socio-political instability of the country from April 2018. The revision of the program was therefore implemented in the first half of 2019. During the consultative mission in March 2019, the Project members including the CA of the UNAN Managua and the UNAN Leon discussed with Mr. Nishikata, the JICA expert of ESMATE, so that the target programs of Special Didactics of Mathematics of the UNAN Managua and the UNAN Leon for this activity were identified. The Project team agreed that the two programs to be revised would aim so that students understand the effective use of the NICAMATE textbooks before they graduate from the universities. As direction of curriculum revision, the Project team agreed that the two programs to be revised would aim that students understand the effective use of the NICAMATE textbooks before they graduate from the universities. Summary of the revised programs are as follows.

(1) Didactics of Mathematics in the UNAN Managua (after revision)

The CA of the Project, who are also the teachers of the UNAN Managua, played a major role in developing a new program of “Didactics of Mathematics” (75 hours of lectures) combining the Didactics of Mathematics I & II. The new program keeps some contents from the previous one such as didactics of mathematics as science and proof and problem solving in mathematics, but it focuses on more important contents for those who will become a new mathematics teacher such as the purposes of mathematics education. Lectures about classroom management and development of mathematic lessons were also added to the new program. In the new program, students can learn the didactic sequence of mathematics education, how to develop teaching plans and board-writing plans, how to implement learner-centered lessons, evaluation methods, etc. All these contents are related to the core methods and materials of the Project.

(2) Special Didactics of Mathematics in the UNAN Leon (after revision)

The revised program of the new “Special Didactics of Mathematics” mainly developed by the CA of the Project, who is also a teacher of the UNAN Leon. While the course originally targeted the students in the second semester of G3, the new one is for those in the first semester of G2. The new program offers practical and basic knowledge and skills that will be the foundation for the students when they join the teaching practice training in G3. Examples of the learning contents of the program are the didactic flow of secondary mathematics education, the features of NICAMATE materials, how to develop teaching plans and board-writing plans and basic teaching techniques.

[3-3] To implement diffusion activities of the revised program of Special Didactics of Mathematics for university teachers of the UNAN and other universities that develop the

capacities of mathematics teachers in secondary education.

Curriculum revision of the universities, which was not originally expected at the formulation of the Project, started following the direction of CNU in May 2019 in the four public universities: the UNAN Managua and Leon, the University of the Autonomous Regions of the Nicaraguan Caribbean Coast (URACCAN) and the Bluefield Indian and Caribbean University (BICU). The new curriculum will be introduced in each university in 2020 after harmonizing the proposed curriculums of the four universities and finalizing the new curriculum of each university. Since the programs revised by the Project will compose a part of this new university curriculum, the official approval of the revised programs by the UNAN needs to be in accordance with this schedule. The revised programs will therefore be officially shared to the university teachers of the Regional University Centers of the UNAN and other universities following this revision of the current curriculums of the four universities.

[3-4] To provide the UNAN Managua and the UNAN Leon with technical support for their activities.

Because of the initiatives of the deans of the UNAN Managua and UNAN Leon, the products of the Project were already introduced in the existing modules related to didactics of mathematics in both universities. Both universities already started implementing modules of mathematics pedagogy using the textbooks of NICAMATE (including the validation version) and proactively introduced to the students the new methods of the Project such as board-writing plans.

In addition, the core methodologies of the Project were already shared with the teachers in the Regional University Centers of the UNAN Leon. The CA of the Project, who are also the teachers of the UNAN Leon, held a workshop on 15 February 2019, to introduce NICAMATE materials to the 12 teachers in the centers. The workshop basically followed the same program of the materials introduction training in January 2019. The CA explained the results of the diagnostic survey, the characteristics and the use of NICAMATE materials and board-writing plans and implemented a model lesson in the workshop. The Japanese experts provided technical advice about the contents of the workshop. The UNAN Managua also intended to implement a similar workshop that targets the teachers of FAREM; however, this cannot be realized because the UNAN Managua was closed for a longer time than the UNAN Leon.

1-3-4 Other Achievements and Activities**(1) Joint Coordination Committee**

JCC was held four times in total during the implementation period of the Project. Table 16 shows the outline of each meeting (See Annex 8 for details).

Table 16 Outline of Each JCC

	Data and Venue	Major Agenda
1 st JCC	27 Apr. 2017 Small meeting room at Ruben Dario Hall of MINED	<ul style="list-style-type: none"> • Approval of work plan and monitoring method • Presentation of the results of the diagnostic survey • Presentation of technical strategy of the Project and textbook development • Presentation and approval of PO for the period of implementation of textbook and curriculum component (until June 2018) • Ceremony of handover of the Project vehicles

	Data and Venue	Major Agenda
2 nd JCC	23 Feb. 2018 Small meeting room at Ruben Dario Hall of MINED	<ul style="list-style-type: none"> • Report about the progress of the Project activities • Presentation about the results of the diagnostic survey and baseline survey • Presentation about the results of the pre- and post-tests of the teacher training in January 2018 • Re-confirmation of technical strategy of the Project • Report about the validation of textbook • Confirmation of the approval process of the new curriculum and materials • Comparison of mathematics teaching courses between the UNAN Managua and Leon • Modifications and approval of PO
3 rd JCC	22 Dec. 2018 Ruben Dario Hall of MINED	<ul style="list-style-type: none"> • Report about the progress of Project activities • Report about the second validation of textbook • Presentation about the results of the Endline Survey • Discussions about the budget for printing materials • Introduction of CA in 2019 • Schedules for the introduction training in January 2019 • Modifications and approval of PO
4 th JCC	31 May 2019 Small meeting room at Ruben Dario Hall of MINED	<ul style="list-style-type: none"> • Report on the status of achievement of the Project Purpose and Outputs • Report on the situation of budget for printing and distribution of the materials and request for JICA • Recommendations from the Project • Presentation about the follow-up plan

(2) Implementation of Baseline and Endline Surveys

The Baseline Survey (BLS) was carried out in November 2017 and the Endline Survey (ELS) in October 2018, to evaluate the effects of the textbooks developed by the Project (MS-Word version) that were distributed to the target schools for validation. In BLS, three schools were sampled for each of the experimental and control groups. San Benito, where the new textbooks were introduced for validation purpose, was added and analyzed in ELS. Sampling of schools were made according to the request of the MINED, that is, one school was selected for each of the experimental group and the control group from the urban, suburban, and rural areas. Model Monimbo, one of the control group schools in BLS, was omitted in ELS for security reasons in the area. The total sample sizes in BLS and ELS were 1,137 and 1,219 respectively. (See Annexes 9 and 10 for detailed sample design and results of the survey.)

The evaluation tool was mathematics tests both in BLS and ELS; however, the tests could not be identical in the two surveys since the new textbooks were developed according to the new curriculum. Thus, the test used for the experimental group in ELS was developed from the new textbooks. 60-80% of the items in the test for the experimental group in ELS were common in the tests of the control group in order to keep the relation between the two tests.

Table 17 shows the mean percentage of correct answers in common items, items newly-added in ELS and the total of the two. Differences in common items in the header of Table 17 are calculated by subtracting the mean percentage of correct answers in BLS from that of ELS. For the control group, since all items are common in the two surveys, the differences are calculated based on all the items in the test. For the experimental group, the differences are only based on the common items because the tests used in BLS and ELS were different.

Table 17 Mean Percentage of Correct Answers by School and Difference in Common Items

Group	School Name	Item	G7		G8		G9		G10		G11		Difference in common items (Point)					
			BLS	ELS	BLS	ELS	BLS	ELS	BLS	ELS	BLS	ELS	G7	G8	G9	G10	G11	
Control	Diriangén	Total	33%	22%	28%	16%	10%	14%					-11	-8	4			
	Jóse Martí	Total	21%	31%	20%	15%	10%	10%					-10	-5	0			
Experimental	Rubén Darío	Common	10%	14%	5%	9%	6%	12%					4	4	6			
		New		18%		20%		19%										
		Total		15%		13%		14%										
	Tomás Borges	Common	16%	17%	11%	14%	14%	17%	15%	21%	11%	25%	1	3	3	6	14	
		New		21%		20%		17%		30%		21%						
		Total		18%		16%		17%		24%		24%						
	La Salle	Common					15%	17%	13%	20%	18%	18%				2	7	0
		New						20%		30%		28%						
		Total						18%		24%		21%						

While in the control group, the difference between BLS and ELS was negative in the 7th and 8th grade, in the experimental groups at almost all schools and grades where the new textbooks were introduced showed a tendency to improve their mathematics academic performance, although there was a difference between schools and grades. In addition, compared with the BLS and ELS control groups, there were many students' answer sheets that left the process to answer the problems, instead of leaving them blank, although their answers were not always correct. Moreover, the number of students who persistently tried to solve problems until the end of the exam time increased.

Implications from the Interview and Lesson Observation

Comparison of test results, lesson observations and technical support during validation activities indicates that students of the teachers who are capable of leading a high-quality lesson do not necessarily achieve better results than others. In high-performing classes, teachers spent some time in each lesson on individual work so that students could work on the exercises on their own. Some of the students even spontaneously tried to solve the exercises in these lessons. This is probably because students know from experience that they could solve the problems by reading the textbooks even when the teachers' explanations were not clear. During the interviews, there was a student who told the Project team delightedly: "When I don't understand my teacher's explanations, but I can get the idea by reading the textbook. I can solve the exercises by looking at the examples on the book. This is different from the previous one."

In addition, the common problems of the lessons that needed to be improved were the lack of basic teaching techniques of teachers rather than how they used the textbooks. These techniques include how to attract students' attention, how to give them clear explanations and instructions, etc. The Project therefore addressed the importance of such techniques in the materials introduction training, the teachers' guide and the revised programs related to

(3) Public Relations and Communication

Newsletters in Spanish were published three times during the implementation period of the Project in order to introduce the Project activities for the stakeholders in Nicaragua. On 30 October 2017, one of the two most-influential newspapers, *El Nuevo Diario*, featured an interview of the Project leader, where he introduced the technical strategy and the activities of the Project and addressed the importance of time for individual work in lessons.

As for the activities of public relations in Japan, a web page was created on the website of JICA, where news of the Project was published.

2. Achievement of the Project

2-1 Status of the Achievement of the Project Output

Output 1: The students' textbook, teachers' guide and students' activity note in the area of mathematics for five (5) grades in secondary education are created.

Indicator: MINED's approval for developed students' textbooks, teachers' guides and students' activity notes.

Status of Achievement: Achieved

The students' textbook for five grades of secondary education was completed by December 2018, and the teachers' guide and students' activity notes by May 2019. MINED posted the digital version of the textbooks, teachers' guides and students' activity notes as national educational materials on the MINED portal by June 2019. MINED also began printing of the textbooks and activity notes to be distributed to all the students in the country.

In order to promote the use of the textbooks of NICAMATE, "Guide for the use of the Mathematics and its Didactics Guide 3 (GMD 5) using the new textbooks of NICAMATE" was developed.

Output 2: The induction system for the use of materials created in the Output 1 for mathematics teacher in general course in public secondary education is strengthened.

Indicator: Preparation of an induction program for the in-service teachers by the MINED.

Status of Achievement: Achieved

The program of materials introduction training was developed, which is practice-based training using the textbooks created by the Project, focusing on the introduction of the new methods such as the comparison of the old and new curriculums, the method of development of the Annual Teaching Plan, and how to use the educational materials and a board-writing plan. Then, the materials introduction trainings were held in January 2019 using the program and materials created by the Project.

Output 3: The program of the Special Didactics of Mathematics for secondary teacher education in the UNAN Managua and the UNAN Leon is revised.

Indicator: Revised program of the Special Didactics of the Mathematics for the FEI of the UNAN Managua and for the Faculty of Education and Humanities Sciences of the UNAN Leon.

Status of Achievement: Expected to achieve. The revision of the programs of the Special Didactics Mathematics was achieved. The revised programs will be officially approved by the end of 2019.

"Didáctica de la Matemática" in the Faculty of Education and languages in the UNAN Managua and "Didáctica especial de Matemática" in the Faculty of Education and Humanities Science in the UNAN Leon were revised by June 2019.

On the other hand, curriculum revision, which was not originally expected at the formulation of the Project, started following the direction of CNU in May 2019 in the four public universities including the UNAN Managua and UNAN Leon. The introduction of the programs was in accordance with the curriculum revision in the four public universities. The new curriculum is to be approved by December 2019 after harmonizing the proposed curriculums of the four universities.

2-2 Status of Achievement of the Project Purpose

Project Purpose: Educational activities in accordance with the revised mathematics curriculum are introduced in secondary education.

Status of Achievement: Partially achieved

Some parts of Project Purpose have not been achieved yet due to delays in printing and distribution of educational materials caused by the socio-political instability in Nicaragua and the curriculum revision in the universities that was not expected at the formulation of the Project. However, Project Purpose is expected to be achieved in the near future.

The status of the achievement of each indicator is as follows.

Indicator 1: Introduction of the students' textbook, teachers' guide and students' activity note developed through the Project in secondary education.

Status of Achievement: Introduction of the students' textbook was completed (The textbooks were distributed to teachers.). The teachers' guide and students' activity notes will be introduced by November 2019.

The students' textbooks created by the Project were distributed to the teachers who participated in the materials introduction training for all the public secondary mathematics teachers held in January 2019. Simultaneously, the digital data of students' textbooks was published on the MINED portal. Distribution of the textbooks and students' activity notes to the students and the teachers' guide to the teachers have not yet been completed as of the end of June 2019. However, through the national monitoring done by MINED from 18 to 22 February 2019, it was confirmed that schools in all departments in the country were implementing lessons using the students' textbooks developed by the Project⁹. Therefore, the educational activities in accordance with the new curriculum have already been conducted on the ground.

Table 18 Status of materials distribution¹⁰

Material	Distribution to mathematics teachers (nationwide)	Distribution to students (nationwide)
Students' textbook	Distribution and introduction were completed in January 2019.	Printing in process. To be distributed in September 2019.
Teachers' guide	Printed. To be distributed in September 2019.	-
Students' activity notes	Printed. To be distributed in September 2019.	Printing in process. To be distributed in November 2019.

Indicator 2: Introduction of the program of the Special Didactics of the Mathematics of the UNAN Managua and the UNAN Leon.

Status of Achievement: The programs of the Special Didactics of Mathematics were revised, and it has been introduced since 2018 based on the independent decisions of both UNAN Managua and UNAN Leon. The revised program will be officially introduced in 2021 in accordance with

⁹ According to the presentation of the pedagogical assessor of the MINED at the meeting held in Secondary Education Direction after the monitoring activities.

¹⁰ Distribution plan is based on the interview with Secondary Education Direction.

the schedule of curriculum revision in the universities.

The programs of the Special Didactics of Mathematics were revised by June 2019, although there were concerns about the procedures for development and introduction due to the closure of the university from late April 2018. However, the introduction of the programs must be in accordance with the curriculum revision in the four public universities that was not originally expected at the formulation of the Project. The new curriculum of each university will be approved by December 2019 and will be officially introduced from 2020. (In reality, however, the Special Didactics of Mathematics is a module for the students in the 2nd year. Therefore, the revised program will be introduced on the ground in 2021.)

The textbooks and the teaching methods of the Project were, however, already adopted in the modules related to didactics of mathematics in both UNAN Managua and UNAN Leon from 2018 before official approval of the revised programs.

3. PDM Modifications

3-1 PDM Modifications

No modification was made in Project Design Matrix (PDM) during the Project.

4. Others

4-1 Environmental and Social Considerations

Not applicable to the Project.

4-2 Considerations on Gender/Peace Building/Poverty Reduction

In the diagnostic survey, BLS and ELS, the results were analyzed by gender. Since no statistically-significant difference was found between genders, the Project did not conduct activities with special consideration of gender. In addition, men and women appear with approximately same frequency in pictures and questions in the textbooks.

III. Results of the Project Evaluation

1. Results by DAC Five Evaluation Criteria

Results are evaluated in five scales: high, relatively high, moderate, relatively low, and low. Five Evaluation Criteria of OECD DAC (Organization for Economic Co-operation and Development, Development Assistance Committee), that is, relevance, effectiveness, efficiency, impact and sustainability, were applied. Results of each criterion are as follows:

(1) Relevance: High

Relevance is high since the Project shows a consistency with the development policy and education policy in Nicaragua, needs of the beneficiaries, and the Official Development Assistance (ODA) policy and approach of international cooperation of the Japanese government.

Table 19 Evaluation of Relevance

Criterion	Results of Review
Needs	<ul style="list-style-type: none"> • Since the pass rate of the entrance examination of the UNAN Managua is quite low 8.66% according to the data published in January 2014, the improvement of mathematics in secondary education was an urgent issue. • Since it was pointed out that the curriculum of secondary mathematics education that existed before the project started had problems of the sequence, the curriculum revision was scheduled. Based on the previous support of JICA to the development of mathematics materials in primary education, a support was expected from the MINED to develop mathematics materials in secondary education which have coherence with those in primary education. • The previous textbooks were not utilized in schools as expected at the beginning of the development, since some explanations in the textbooks were not easy to understand, and the amount of exercises in the textbooks was not sufficient. The mathematics teachers were also not used to using textbooks in lessons. Therefore, it was expected to improve teacher education and trainings to promote effective use of the textbooks in lessons.
Priority	<ul style="list-style-type: none"> • The activities of the Project, such as the improvement of the Textbooks, teacher education and teacher training, are consistent with the national development policies in Nicaragua. In the Core National Human Development Program 2018-2021 (Ejes del Programa Nacional de Desarrollo Humano 2018-2021), which is the highest national development policy paper of the country, features education in the first chapter dedicated to social development. The education section especially emphasizes the quality of education, teacher education and training, and the improvement of curriculums including that of secondary education. • Plan of Education 2017-2021 (Plan de Educación 2017-2021) of Nicaragua states the improvement of the education quality as the first priority. The Project contributes to the improvement of the quality of the secondary education and, therefore, align with the national education policy of Nicaragua. • The Project is consistent with the ODA policy of Japan. In the Development Cooperation Chapter of Japan established in 2015, "Quality growth" and poverty eradication through such growth" is

	<p>placed as the top priority issue, and “quality education for all” is emphasized as well.</p> <ul style="list-style-type: none"> • JICA Position Paper in Education Cooperation (October 2015), the JICA guideline in education sector, also stresses JICA’s contribution to the mathematics education in Latin America, addressing the technical cooperation for development and revision of the mathematics textbooks in secondary education in four countries in Central America.
Project Approach	<ul style="list-style-type: none"> • Developing the textbooks that match the needs of the schools would be difficult to be done only by the Nicaraguan side because the country has limited human resources who have affluent experience in schools on the ground and capacity and experiences of writing quality textbooks. Thus, the approach of the Project that provided technical support to Nicaragua in cooperation with the Japanese experts was relevant. • The Project has produced the educational materials with the UNAN Managua and the UNAN Leon as well as the officials in MINED who have expertise in secondary mathematics education. This contributed to the capacity development of human resources who will be engaged in teacher education and curriculum and textbook revision in the future.

(2) Effectiveness: Relatively High

Project Purpose was only partially achieved due to delays in printing and distribution of educational materials caused by the socio-political instability in Nicaragua and the curriculum revision in the universities that was not expected at the formulation of the Project. However, the educational materials will be distributed to all the students in public secondary school from September 2019, and the revised programs of the Special Didactics of Mathematics have already been introduced to the universities on the ground and will be officially introduced in 2021. The effectiveness of the Project is therefore relatively high.

Table 20 Evaluation of Effectiveness

Criterion	Results of Review
Achievement of Project Purpose	<ul style="list-style-type: none"> • Indicator 1 of Project Purpose (“Introduction of the students’ textbook, teachers’ guide and students’ activity note developed through the Project in secondary education.”) will be achieved. The textbooks, teachers’ guides and students’ activity notes developed by the Project have already been printed or will be printed as of August 2019. Distribution of these materials will begin in September 2019. • The programs of the Special Didactics of Mathematics in the Faculty of Education and language in the UNAN Managua and the Faculty of Education and Humanities Sciences in the UNAN Leon were revised. The new programs will officially be introduced in 2021 due to the curriculum revision of the universities. However, the contents of the programs have already been introduced in the modules of the universities on the ground. Indicator 2 (“Introduction of the program of the Special Didactics of the Mathematics of the UNAN Managua and the UNAN Leon”) will therefore also be achieved.
Relation with the Project	<ul style="list-style-type: none"> • Mean percentages of correct answers for common items in BLS and ELS are compared between the experiment group that distributed textbooks and control group that did not distribute textbooks. Results show a slight improvement of mathematics performance of the schools

Activities and Achievement	<p>in the experimental group. On the other hand, the performance of the control group shows negative or no difference between the two surveys.</p> <ul style="list-style-type: none"> • One of the important assumptions in the PDM of the Project was “MINED prints and distributes the students' textbook, teachers' guide and students' activity note for five (5) grades of secondary education in the area of mathematics.” This assumption was almost broken because the EU funds became unavailable due to the instability. However, it was satisfied because of the funds that MINED acquired, etc.
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(3) Efficiency: High

The efficiency of operation was affected by the socio-political instability in the country. Nonetheless, within the limited Project period of about two and nine months, the Project achieved the three Outputs in the PDM. Namely, the Project developed 15 kinds of national mathematics materials for five grades in secondary education (Output 1), implemented the material introduction trainings for mathematics teachers (Output 2) and revised the programs of the Special Didactics of Mathematics in the UNAN Managua and Leon although not officially approved yet (Output 3). The efficiency is therefore high.

Table 21 Evaluation of Efficiency

Criterion	Results of Review
Achievement of Outputs	<ul style="list-style-type: none"> • All Outputs were achieved except for Output 3 which is in the process of approval.
Relation with the Project Activities and Achievement	<ul style="list-style-type: none"> • Activities of the Project were sufficiently implemented to achieve Outputs. • Important assumption between Project Activities and Project Outputs was “Counterparts keep working for the Project in the implementation process.” Due to the socio-political instability, the C/Ps sometimes needed to participate in the activities outside of the Project. There was a situation where it was extremely difficult to secure working hours of C/P.
Inputs	<ul style="list-style-type: none"> • JICA added 6.4 M/M of the Japanese experts within the budget of the original contract to deal with the delay of the activities due to the instability.
Cost Effectiveness	<ul style="list-style-type: none"> • Despite the socio-political instability and limited Project period (two years and nine months) and restrictive inputs of the Japanese experts, the Project developed a number of products such as the five textbooks, five teachers' guides and five activities notes and implemented teacher training for the introduction of the materials in accordance with the original plan. • The capacity for developing educational materials and teaching techniques of the C/Ps significantly improved through the activities of the Project. In support of the Japanese experts, the C/Ps developed all the mathematics materials of secondary education and the programs of material introduction trainings and revised the programs of Special Didactics of Mathematics. Especially, the C/Ps recruited by the mathematics test of the Project improved their capacity remarkably and became important human resources for the curriculum and textbook revision and teacher education in the future. • Although it was expected to develop educational materials efficiently by using references from other preceding projects in other countries, the

	period for development was not shortened much, since the educational materials need be developed in accordance with the Nicaraguan context.
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(4) Impact: Too Early to be Judged

Status of achievement for Overall Goal cannot be judged as of August 2019. It is also still too early to evaluate the impact on students (Super Goal) because the educational materials of the Project have just been introduced recently. However, the results of ELS showed slight improvement of mathematics performance and changes in attitude of the students in the schools where the Project introduced the materials (validation version) and the new teaching methods. In addition, Outputs of the Project spilled over outside of secondary education. The lesson flow of the Project, which has the four basic steps (Problem, Solution, Conclusion and Exercise), was introduced in mathematics in primary education.

Table 22 Evaluation of Impact

Criterion	Results of Review
Status of Achievement of Overall Goal and Super Goal	<ul style="list-style-type: none"> In January 2019, it was confirmed by the pedagogical assessors that the textbooks of the Project were provided to all the mathematics teachers in secondary schools in Nicaragua and were used in their lessons. However, as of August 2019, status of achievement for Overall Goal cannot be judged yet because the textbooks have been introduced just recently, and the provision of teachers' guides and students' activity notes have not yet been completed. The revised programs of Didactics of Mathematics in the UNAN are waiting for an official approval that comes in 2021 after the introduction of new curriculum of the universities. Thus, evaluation of the utilization of the new programs (Overall Goal) is still too early. Results of ELS show a slight improvement of the mathematics performance and a positive change in attitude of the students in the schools of the experimental group. The improvement of mathematics performance of the students (Super Goal (1)) could therefore be expected as long as the distribution of the textbooks are implemented as planned in September 2019, and other conditions such as the continuous use of the materials and sufficient contact hours are met. However, the expectation for the achievement of the first Super Goal is still not clear. The second Super Goal of the Project, that is, "Mutual cooperation for improving in teaching methods in mathematics is promoted at regional level," was achieved.

Spill-Over Effect	<ul style="list-style-type: none"> • The four-step lesson flow (Problem, Solution, Conclusion and Exercise) used by the Project is adopted in the primary textbooks that are revised at the moment. The flow gets a good reputation that it is simple and easy for both students and teachers. • In the UNAN Managua and Leon, the two major institutions for secondary teacher education in Nicaragua, the textbooks and core methods of the Project were introduced from 2018 not only in the module of Special Didactics of Mathematics (the target module of the Project) but also in other modules related to the didactics of mathematics. • Although the Project mainly target public schools in Nicaragua, it is reported that some teachers in private schools downloaded the digital version of all the materials available on the MINED portal and utilized them in their lessons. In the meeting held for the directors of the all private schools in the country in June 2019, MINED also recommended that the private schools use the digital version of the materials.
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(5) Sustainability: (expected to be) Relatively High

Sustainability is expected to be relatively high considering the following aspects shown in Table 23.

Table 23 Evaluation of Sustainability

Aspect	Results of Review
Policy and financial aspect	<ul style="list-style-type: none"> • Monitoring activities of the NICAMATE textbooks were conducted by the national and pedagogical assessors in 2019 in the MINED budget and the similar activities are expected to continue in 2020 and onwards. • Since MINED secured the budget for the nationwide in-service training conducted once or twice a year as of the end of the Project, the trainings are expected to be conducted onwards. • The educational materials created by the Project were uploaded on the MINED website and can be downloaded freely. • MINED already secured the budget for additional printing of the textbooks and activity notes to complement the additional needs of the materials in 2019 caused by the increase in the number of students and the loss of the materials. Besides, the EU and/or other donors' funds could be available for the next printing and distribution of the materials if the socio-political situation in Nicaragua becomes stable.

System and institutional aspect	<ul style="list-style-type: none"> • MINED and the UNAN agree that the personnel of the UNAN Managua and Leon, who have built their capacity through the Project, will be engaged in the follow-up activities of the Project continuously. • Since the 5 teachers of the UNAN who have built their capacity through the Project were employed as permanent teachers during the Project period, they are expected to contribute to the improvement of secondary mathematics education continuously in the teacher training course in the university. • The educational materials and the teaching method of the Project were already introduced in the UNAN Managua and Leon, two major institutions for secondary mathematics teacher training. Thus, new teachers graduated from these universities will start teaching after learning the features of the new curriculum and methods such as the use of board-writing plans.
Technical aspect	<ul style="list-style-type: none"> • The capacity of the C/P of MINED and the UNAN, especially the capacity for development of educational materials, lesson implementation and lesson analysis, was notably enhanced through the Project activities such as development of the materials and implementation of validation. It is possible to implement successful revision of textbooks and teachers' guides in the future as long as these C/Ps are engaged.

2. Major Factors Influencing Project Implementation and Outputs

Table 24 presents the stage of risk management by the Project, showing the risks identified at the project formulation and those that the Project faced during the implementation period.

Table 24 Risk Management of the Project

	Identified Risks	Measures
Pre conditions defined in PDM	<p><i>The MINED technical officers and professors in mathematics of the UNAN Managua and the UNAN Leon are assigned for the Project to set up the Core Group and Author Group.</i></p> <p>➔ The Nicaraguan side assigned 11 personnel in total as the CA at the launch of the Project: five from MINED, three each from the UNAN Managua and Leon.</p>	-
	<p><i>The preliminary version of revised national mathematics curriculums for secondary education is set up.</i></p> <p>➔ Revised curriculum was drafted in October 2016 with the support of ESMATE.</p>	-

Important assumptions defined in PDM (Activities to Outputs)	<p><i>C/Ps keep working for the Project in the implementation process.</i></p> <p>➔ Although the C/Ps could continuously work for the Project, there was a difference in the quality of the drafted materials since the level of mathematical knowledge was different among them. Therefore, the Project needed to spend a lot of time and effort providing technical support to the CA and improving the quality of the educational materials to a certain level. This also led to the shortage of time available for the technical support to other CA.</p>	<p>Since it turned out to be difficult to complete all the educational materials within the Project period only with the 11 CA assigned at the beginning of the Project, teachers of the UNAN were employed additionally with the Project budget. For the CA struggling to draft the textbooks, the Japanese experts assigned the tasks that match their capacity as much as possible. For example, the experts prepared the outline of the pages and asked the CA to add some information, draw some figures using GeoGebra and draft a board-writing plan.</p>
Important assumptions defined in PDM (Outputs to Project Purpose)	<p>The MINED prints and distributes the students' textbook, teachers' guide and student' activity note <i>for five (5) grades of secondary education in the area of mathematics.</i></p>	<p>Indicator 1 of Project Purpose was not achieved because the distribution of the materials of the Project could not be realized except for the textbooks provided to all the teachers in the country. However, all the materials will be introduced to the schools nationwide in September 2019 and onwards.</p>
Important assumptions defined in PDM (Project Purpose to Overall Goal)	<p><i>The national education policies are maintained.</i></p>	<p>-</p>
	<p><i>The students' textbook, teachers' guide and students' activity note are sufficiently funded.</i></p> <p>➔ Due to the socio-political instability, the EU fund, which had been considered almost certain, became unavailable for printing and distribution of the educational materials of NICAMATE.</p>	<p>The government officers in Nicaragua made every effort to achieve the new source of the fund for printing and distribution of the educational materials of NICAMATE and gained the external fund. While the fund could cover most of the expense for the nationwide distribution of the educational materials, it was not sufficient to cover all the expense. Thus, the Japanese side bore the printing costs of G10 and G11 textbooks and supported the educational materials distribution.</p>
	<p><i>The educational materials created through the Project are introduced to mathematics teachers in general course in public secondary education.</i></p>	<p>-</p>
	<p><i>The revised program of the Didactics of the Mathematics is diffused for professors.</i></p> <p>➔ The curriculums of the universities started to be revised in the middle of the Project. The programs revised by the Project will therefore be shared to the teachers following this curriculum revision.</p>	<p>Activities related to Output 3 were completed by the end of the Project. Although Indicator 2 of Project Purpose could not be achieved during the Project period, the programs revised by the Project will be introduced after 2020 following the curriculum revision of the universities.</p>

Risks faced in the first stage of the Project	<p>The instability in Nicaragua from April 2018 has had various effects on the Project activities. From May 2018, the CA of the UNAN could only work at home for safety reasons. Other Project members also sometimes were not able to commute to MINED. The CA of the UNAN resumed their work at MINED after the security situation slightly recovered in July 2018. On the other hand, the MINED personnel were sometimes required to participate in political activities outside of MINED. In addition, during the period of evacuation measures from June to September 2018, the members of the Project could not work together at the Project office. the Japanese experts could not give technical support in person. The use of internet and USB memories was also severely restricted. The low work efficiency continued until the end of the Project.</p>	<p>JICA added the inputs of the Japanese experts by 6.4 M/M. Members in Nicaragua and the Japanese experts communicated via the internet at home and worked overtime to catch up with the delay because the members in Nicaragua were unable to contact the Japanese experts from MINED due to the limitation of internet usage, and the Japanese office hour does not overlap that of Nicaragua due to the time difference.</p>
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3. Evaluation of Project Risk Management

In response to the worsening socio-political situation in Nicaragua since April 2018, the JICA Nicaragua office worked to ensure the safety of the persons concerned. The JICA Nicaragua office also instructed experts to cancel new dispatch for assignment after June 5 and encouraged early return to Japan. In addition, on 21st June 2018, JICA officially took evacuation measure “evacuation (temporary evacuation)” and continued the measure until 12th September 2018. Although there was no Japanese expert in Nicaragua from mid-June 2018 to September, the Japanese experts transferred some of the work (M/M) in Nicaragua to that of in Japan with the approval of JICA. Then the Project activities continued with remote technical assistance with the support of the JICA Nicaragua Office. In addition, because of remote technical support, etc., work efficiency was reduced, and the Project activities were delayed. In response to these circumstances, JICA approved an increase of approximately 6.4 M/M for the Japanese experts within the contract amount. The Project also responded by modifying PO in consultation with relevant parties.

In the socio-political instability in Nicaragua, under agreement of the MINED and UNAN, the professors in UNAN were allowed to be engaged in the Project activities in the environment where it is safe and they can use the Internet such as at home, from mid-May to the end of July 2018. In addition, when it was found that the funds of the EU were not available for printing and distribution nationwide of the materials of NICAMATE, which could not be expected at the beginning of the Project, executives of the MINED and executive office of the president were making every effort to acquire external funds, making it possible to distribute educational materials nationwide.

Despite the unexpected risk of socio-political instability in Nicaragua, all Outputs of the Project except for Output 3 were achieved with the rapid and appropriate effort from both the Nicaraguan and Japanese sides. Although Project Purpose was not achieved during the implementation period, educational activities in accordance with the revised mathematics curriculum will be implemented in secondary education after September 2019. The programs revised by the Project will also be introduced in the UNAN Managua and the UNAN Leon in 2021.

4. Lessons Learned

(1) Importance of securing authors with subject knowledge at a certain level

In order to develop educational materials such as textbooks within the limited period, it is necessary to secure personnel with a certain subject knowledge and teaching experiences on the ground who work intensively for the project. At the formulation of the project, it is important to confirm by an objective means that the candidates for the authors at least have subject knowledge at a certain level. Preparing a working environment so that the authors can intensively work for the project is equally important to establish a reliable implementation structure of the project. Only if these conditions were met, it would be possible to estimate the implementation period and inputs of human resources necessary for the project.

(2) Process and methods for the development of educational materials

Experience of the Project informs that it would not necessarily shorten the period for development of curriculums and textbooks even if there were references from other countries since the materials need be developed in accordance with the context of each country. In addition, the PDM plans to create the teachers' guides in parallel with the textbooks. However, it was not efficient because the Project team needed to modify the teachers' guide every time the textbooks were modified. It would be more efficient if the teachers' guide started to be developed after finalizing the textbook as the major material.

The Project team developed the textbooks for five grades in a year after the launch of the Project. On the one hand, developing the textbooks of five grades at once is advantageous because the writers can flexibly adjust the contents across the grades to have a consistency. On the other hand, the work efficiency would considerably decrease if the project could not assemble writers with the mastery of basics of mathematics for developing five textbooks at once because some parts of the textbooks would be written by the C/Ps who do not have satisfactory mathematical ability. Even if the project did not have time to develop the textbooks by one grade each year, it would still be necessary to elongate the period available for the development of textbooks and to assign C/Ps who have the mastery of basics for each grade. In that case, for example, the project could develop the textbook of only one grade in the first year and create another two grades in the second and the rest in the third year.

IV. Toward Achievement of Super and Overall Goal after Project Completion

1. Achievement of Overall Goal

Overall Goal: Educational activities in accordance with the revised mathematics curriculum are implemented in secondary education.

Status of Achievement: It is too early to evaluate the achievements of Overall Goal as of June 2019. However, there is a high possibility to achieve Overall Goal if the students' textbooks and students' activity notes are distributed nationwide.

Indicator 1: Utilization of the students' textbook, teachers' guide, and students' activity note developed through the Project in secondary education.

There is a high possibility to achieve Indicator 1 if the students' textbooks and students' activity notes are distributed nationwide by the beginning of 2020. The technical officers in MINED have confirmed that secondary mathematics teachers nationwide have already been implementing the lessons utilizing the students' textbooks distributed after the materials introduction training held in January 2019. Now MINED has already secured the funds for the printing and distribution of the students' textbook and students' activity notes to the whole country. Teachers will be able to implement lessons more efficiently with the methods recommended by the Project if these materials are distributed to students nationwide by the beginning of 2020, and the materials introduction trainings are implemented in the national in-service teacher training organized every year. Therefore, there is a high possibility that the Overall Goal will be achieved.

Indicator 2: Utilization of the revised program of the Special Didactics of the Mathematics of the UNAN Managua and the UNAN Leon.

There is a high possibility that the revised program of the Special Didactics of Mathematics will be officially introduced in 2021 if the curriculum revision in both universities is conducted as planned. The students' textbooks and the new teaching methods of the Project were already introduced in the lectures related to the Special Didactics of Mathematics in both UNAN Managua and Leon, indicating that the executives of both universities are willing to adopt the materials and methods of the Project. It is therefore highly possible that the revised program of the Special Didactics of Mathematics will be adopted from 2021 as long as the curriculum revision is conducted as scheduled.

2. Achievement of Super Goal

Super Goal (1): The academic performance in mathematics in secondary education is improved.

Indicator: Improvement of students' results in mathematics in secondary education

Status of Achievement: It is too early to evaluate the achievement of Super Goal (1) as of June 2019. However, it is possible to be achieved if the materials created by the Project are distributed to the students nationwide by the beginning of 2020, and other conditions such as the continuous use of the materials and sufficient contact hours of 140 hours per year are met.

According to the results of BLS and ELS of the Project, there is a tendency of improvement in mathematics performance as well as a positive change in attitude of the students in the schools where the materials and teaching methods of the Project were introduced. Therefore, the mathematics performance will likely be improved if the students keep learning using the materials of the Project, and other important conditions such as sufficient contact hours are met.

Although the entrance examination of national universities is specified as the means of

verification of Indicator of Super Goal (1) in PDM, there are some students who do not take the entrance examination. Therefore, the Project suggested in JCC that MINED regularly conduct academic survey similar to ELS conducted by the Project in the cooperation with UNAN. This suggestion is included in follow-up plan.


Super Goal (2): Mutual cooperation for improving in teaching methods in mathematics is promoted at regional level.

Indicator: Participation in the Regional Seminars of the Regional Project in mathematics (at least twice).

Status of Achievement: Achieved. The Project team has participated in the Regional Seminar three times mathematics: in December 2017, December 2018 and May 2019.

3. Recommendations to the Nicaraguan Side

(1) Sufficient contact hours

Since the textbooks of the Project consist of about 140 contents for each grade, it is necessary to secure the stipulated 140 contact hours (45 minutes for a lesson) in order to teach all the contents of the textbooks. In Nicaragua, while the schools count the number of days for the teachers being present at the schools, they do not record how many lessons their teachers of each subject implemented. 

In order to secure sufficient contact hours, it is important to understand how many lessons a normal teacher actually implements in a year. Since NICAMATE textbooks suggest that the teachers basically proceed by only one page in a lesson, the directors and pedagogical assessors can roughly check how many lessons the teacher has implemented by looking at the progress of the textbooks. Teachers and students in the schools in the experimental group of ELS told the Project that most of the teachers were proceeding by one page of the textbooks in a lesson as the Project suggested. It is recommended that the directors and pedagogical assessors should observe the progress of lessons of several teachers to analyze if the shortage of contact hours is due to the insufficient lesson management of the teachers, or the problem is the school management itself and therefore the teachers cannot secure the number of lessons.

According to the follow-up plan of the Project, it is suggested that teachers should bring the results of the unit tests of the textbooks to EPI held on the last Friday of the month. If the lessons are not managed well and the number of contact hours are not sufficient, the teachers cannot conduct the unit tests or bring the results to EPI. It is expected that the EPI will encourage the teachers to improve their management of the lessons and share good practices among their colleagues.

(2) Implementation of effective evaluation

In Nicaragua, some schools and/or teachers conduct evaluation of students in group, and the individual formative assessment is not always effectively done. As a result, the students could not recognize their own achievement, or the teachers cannot objectively review their implementation of the lessons. The Project attached the unit tests at the end of each unit of the textbooks as the first step to enhance the implementation of formative assessment. It is recommended that MINED should monitor the implementation of the unit tests by visiting EPI and schools and utilize the results of the unit tests to improve the learning of the students. In order to help the teachers and pedagogical assessors efficiently manage the data of the results of the unit tests, the Project

provided the MINED with spreadsheet tools for data management.

It is also recommended that MINED should implement periodic sampling assessments to objectively evaluate their own activities and achievement. Such assessments will identify the effects and problems of the revised textbooks and curriculum that will be useful for further improvement. Scale and frequency of the assessment could be within the capacity and budget of MINED. For the implementation of the assessment, the test items of ELS of the Project can be utilized to track the longitudinal changes of students' performances. The Japanese experts provided the CA a workshop about statistical analysis of test results in order to support the implementation such assessments (See Annex 13). It is expected to conduct the assessment in cooperation with these CAs, who understand very well the new curriculum and textbooks and have basics of statistical analysis, so that MINED can efficiently analyze the results and prepare for the next curriculum and textbook revision.

4. Plan of Operation and Implementation Structure of the Nicaraguan Side toward Achievement of Overall Goal and Super Goal

In the 4th JCC held on 31st May 2019, the leader of CA presented the follow-up plan shown in Figure 5. Follow-up activities include the distribution of NICAMATE materials, implementation of additional teacher trainings, provision of continuous technical support, effective use of EPI, implementation of academic performance assessment, preparation for the next material revision etc. Organizations responsible for the implementation of each activity are agreed by MINED, UNAN and JICA. The stakeholders also confirmed that the cooperation between MINED and UNAN would continue after the completion of the Project.

