Mongolian
Ministry of Education

Mongolia

The Project Study on Improving Science Education by Utilizing Digital Learning Materials

Project Completion Report

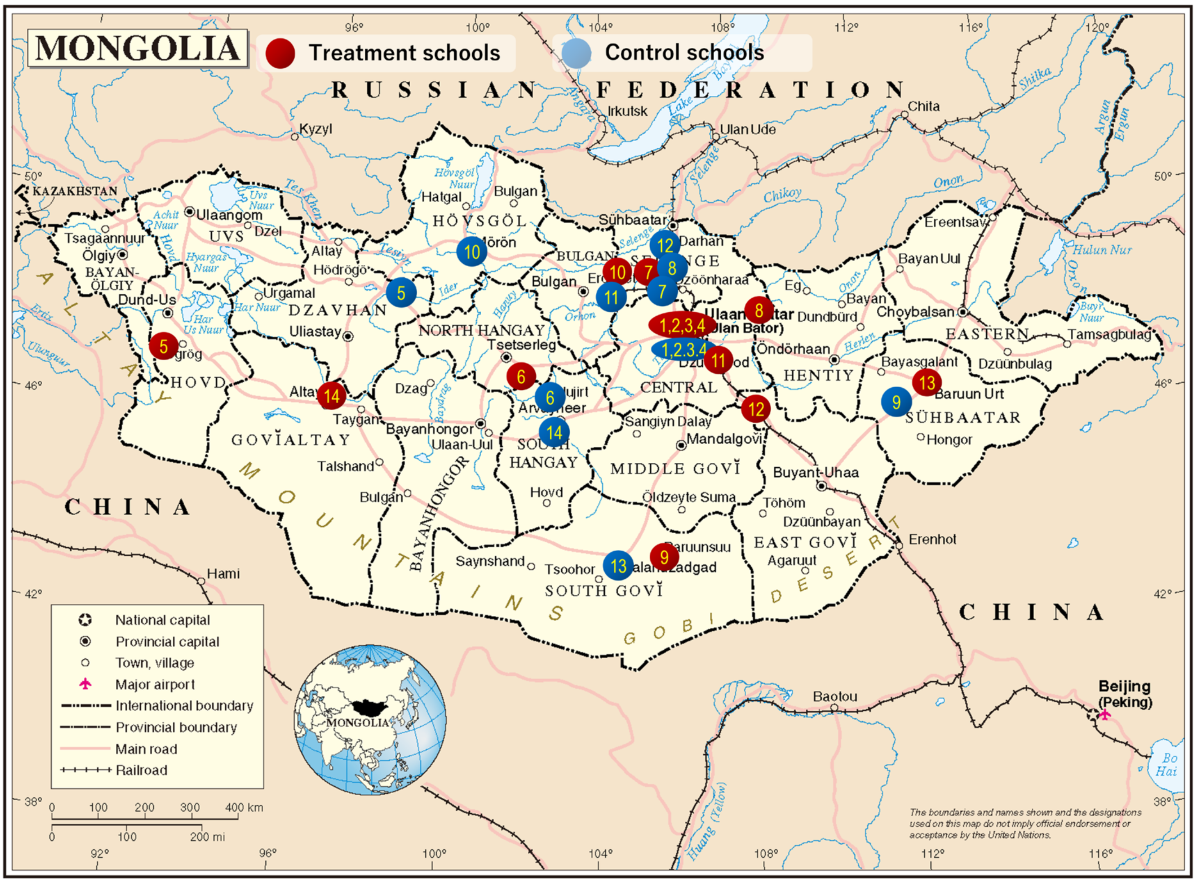
August 2025

Japan International Cooperation Agency

IC Net Limited
Gakken

HM
JR
25-068

LOCATION MAP



Map No. 3721 Rev. 3 UNITED NATIONS
January 2004

Department of Peacekeeping Operations
Cartographic Section

Ref. The Project Study Team modified the United Nations Map No. 3721 Rev. 3, January 2004

< Exchange rate as of August 2025 >

USD (United States Dollar) 1.00 = JPY (Japanese Yen) 148.599000
MNT (Mongolian Tugrik) 1.00 = JPY 0.041290

List of Abbreviations

Abbreviation	Term in Full
ADB	Asian Development Bank
C/P	Counterpart
EEC	Education Evaluation Center
EIT	IT Center of Education
ESMTDP	Education Sector Mid-Term Development Plan 2021–2030
GAE	General Authority for Education
H5P	HTML5 Package
ICT	Information and Communication Technology
ITPD	The Institute of Teachers Professional Development
JICA	Japan International Cooperation Agency
JoT	Joy of Teaching (Mongolian NGO)
LMS	Learning Management System
MC	Mongol Content LLC (Mongolian video production company)
MNIER	Mongolian National Institute for Educational Research
MNT	Mongolian Tugrik
MoE	Ministry of Education (Mongolia)
NGO	Non-governmental Organization
P/M	Person-Month(s)
TfM	Teach for Mongolia
TIMSS	Trends in International Mathematics and Science Study

Table of Contents

I. Overview of the Project Study

This section outlines the overall framework of the Project Study. Detailed descriptions of activities and related components will be provided later.

I-1. Background and Context

One of the challenges that Mongolia faces is the vulnerability of its economic structure, which is heavily dependent on mineral resource development. To establish a stable foundation for economic growth, nationwide efforts have been made to diversify its industries, requiring a consistent supply of qualified human resources in the science and technology fields.

In the education sector, the Government of Mongolia has been promoting human resource development in line with the "Education Sector Mid-Term Development Plan 2021–2030 (ESMTDP)," released in October 2020. The plan identifies persistent challenges, including students' insufficient basic literacy and numeracy skills and poor performance in science subjects. It also highlights significant regional disparities as a major concern.

Owing to the nationwide school closures from January 2020 to September 2021 in response to the COVID-19 pandemic, students continued their education remotely. However, the lack of digital learning materials and remote education infrastructure contributed to learning delays and widened achievement gaps.

Considering these challenges, this Project Study aimed to identify effective approaches to enhance students' interest in science subjects and improve their foundational academic skills by introducing digital science learning tools, with a focus on addressing regional disparities in educational outcomes.

I-2. Purposes and Overview of the Study

(1) Purpose

To examine the impact of digital learning materials on students' interest in science and their academic achievements and to propose effective approaches for improving science education using digital materials.

(2) Implementation Period

May 2024–August 2025 (1 year and 4 months)

(3) Overview of Activities

This Project Study was conducted in six phases: "Preparation," "Current Status and Issue Analysis," "Material Development," "Material Piloting," "Effectiveness Measurement," and "Project Completion Report."

The Project Study focused on the development of digital learning materials, worksheets, lesson plans, and teacher training materials for Grade 4 and Grade 5 primary science education, considering the current state of science education and the use of information and communication technology (ICT) in schools. Subsequently, the Project Study measured and reported on the effectiveness of the tools when used in actual classroom settings. The overall process is illustrated in Figure I-1.

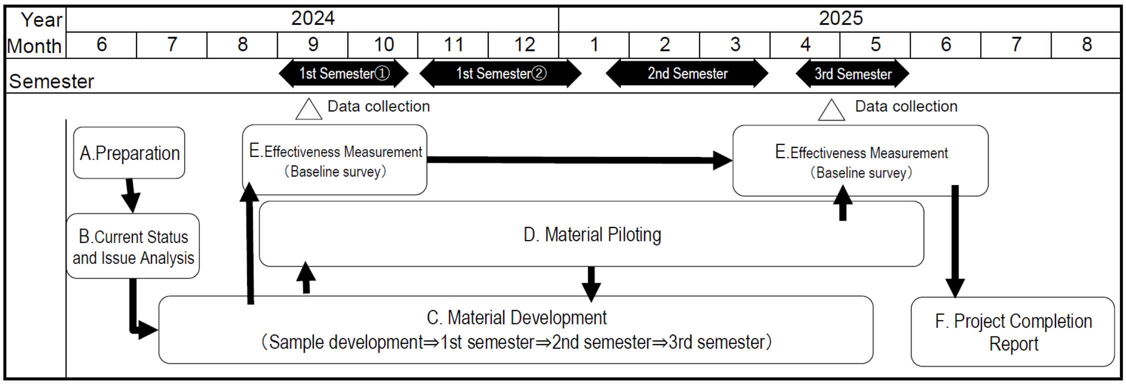


Figure I-1: Overview of Project Study Activities

(3) Implementing Organizations

The following organizations took part in the implementation of this Project Study: The Mongolian National Institute for Educational Research (MNIER) under the Ministry of Education (MoE) served as the main counterpart (C/P) institution, and the project office was established within MNIER. Teaching materials were distributed to the target schools through Google Classroom in Google Workspace for Education, a learning management system (LMS) provided by Google Mongolia. Teacher training was conducted in collaboration with Teach for Mongolia (TfM), an NGO affiliated with Google.

- Counterpart Organization: MNIER, MoE
- Related Organizations: Google Mongolia, TfM
- Implementing Agency on the Japanese Side: JICA

Overall management of the Project Study was conducted through a kickoff meeting held in June 2024, where key stakeholders from Mongolia and Japan confirmed the implementation policy and schedule. Thereafter, working group meetings were held each semester with operational-level stakeholders to report progress and make decisions. The Japanese Project Study team in collaboration with Mongol Content (MC), a video production company subcontracted for the task, was in charge of the material development. Draft materials were shared with science curriculum officers from MNIER, and revisions were made through ongoing consultations.

(4) Number of Beneficiaries

The approximate number of beneficiaries of this Project Study is as follows:

- Direct beneficiaries: 115 Grade 4 and 5 teachers and 4,095 Grade 4 and 5 students from 14 treatment group schools
- Indirect beneficiaries (if digital materials are made public and utilized nationwide): Approximately 12,000 primary school teachers and 381,000 primary school students[1]

[1] Both figures are based on 2023 statistics.
Source: World Bank (2025), https://data.worldbank.org/indicator/SE.PRM.ENRL

II. Project Study Activities

II-1. Input

II-1-1. Inputs from the Japanese Side

(1) Total Financial Input from the Japanese Side

The total financial input from the Japanese side during the project period amounted to 27.2 million yen. The breakdown of the annual expenditure for local operations is shown in the table below.

Table II-1: Expenditure on Operational Cost

Fiscal Year	Duration	Expenditure (JPY)
Year 1	May 2024–August 2025	27,239,361[2]
	Total	27,239,361

(2) Dispatch of Team Members

A total of six team members were dispatched, comprising five Japanese and one Mongolian member. While the original plan anticipated a total of 17.50 person-months (P/M), the actual input increased to 20.72 P/M owing to the strengthening of the video production management system and the additional task of producing explanatory videos for teachers. Overall, the input was largely in line with the original plan. For the details of the team dispatch schedule, refer to Appendix 1.

Table II-2: Record of Dispatched Team Members

Name	Role	Main Responsibilities	Dispatch Period (P/M)
Mr. Chiko YAMAOKA	3.42	• Overall project activity planning, operation, and management • Preparation and coordination of work plans • Status and issue analysis (ICT infrastructure and utilization, teachers, and students' ability to use ICT materials) • Development and coordination of material development plans • Overall management of baseline/end-line survey planning, tool development, implementation, analysis, and report writing • Planning and organizing the Project Study result reporting session • Overall management of the Project Completion Report preparation	3.12
Dr. Kotaro KIJIMA	5.67	• Overall project activity planning, operation, and management (acting for the team leader in his absence and sharing management responsibilities) • Overall project budget management; Support for preparation and coordination of work plans • Status and issue analysis (curriculum, textbooks, and teachers' guides) • Overall management of science material/tool development plans, supervision of subcontractors	4.18

[2] The expenditure for August 2025 is based on the projected amount.

Name	Role	Main Responsibilities	Dispatch Period (P/M)
		• Development of lesson plans (teaching guides), and preparation of teacher guidance materials • Development and analysis of science tests for baseline/end-line surveys, and drafting of relevant report sections • Support for planning and organizing the Project Study result reporting session • Drafting relevant sections of the Project Completion Report	
Mr. Tatsuya MAEHARA	1.13	• Preparation and coordination of material development plans • Development and coordination of sample materials • Support for subcontractors of digital material development • Support for digital material development • Support for development of student worksheets • Support for tool development and result analysis for baseline/end-line surveys	1.13
Mr. Nobuyuki IRISAWA	1.60	• Preparation of material development plans (technical aspects) • Development of sample materials (technical aspects)	1.60
Mr. Daisuke TANAKA	3.97	• Support for preparation and coordination of material development plans • Support for development and coordination of sample materials • Development of digital material • Development of student worksheets • Support for development of lesson plans (teaching guides) • Support for tool development for baseline/end-line surveys	3.97
Mr. Enkhbold BATJARGAL	2.50	• Support for office setup and local staff management • Supervision of subcontractors for digital material development • Quality control of Mongolian translations of science materials/tools • Conducting briefing sessions for pilot school stakeholders • Uploading, printing, and distributing developed tools • Monitoring and support for pilot schools • Support for baseline/end-line survey implementation • Support for planning and organizing the Project Study result reporting session	2.20
Mr. Issei Morita	3.58	• Office setup and local staff management • Support for overall project budget management • Uploading, printing, and distributing developed tools • Monitoring and support for pilot schools • Support for baseline/end-line survey implementation • Support for planning and organizing the Project Study result reporting session • Drafting relevant sections of the Project Completion Report	2.35
		Total	21.87

(3) Equipment

No equipment was provided under this Project Study. However, project-related items totaling JPY 209,045 were purchased and handed over to the C/P organizations after the completion of the Project Study. The list of purchased items is shown in the table below.

Table II-3: List of Project-Related Items

#	Item Name	Quantity Procured	Amount (JPY)
1	Laptop	1 Unit	119,201
2	Printer-Scanner-Copier	1 Unit	89,844
	Total		209,045

II-1-2. Inputs by the Mongolian Side

(1) Assignment of Counterparts (C/Ps)

A total of four staff members from the Mongolian National Institute for Educational Research (MNIER; the C/P organization) were assigned as counterparts (C/Ps). Moreover, a working group consisting of 11 members from MNIER, Education Evaluation Center (EEC), General Authority for Education (GAE), Information Technology Center of Education (EIT), education-related NGOs, and Mongolian National University of Education was established. The assignment status of the C/Ps is as follows.

Table II-4: Assignment Status of Counterparts (C/Ps)

Role	Number Assigned	Position/ Organization	Periods of Engagement	Remarks
Project Study Manager	1	Head of Education Policy and Planning Research Sector, MNIER	June 2024–August 2025	
Project Study Staff	2	Specialist, Curriculum, Evaluation and Teaching Material Research Sector, MNIER	June 2024–August 2025	1 Physics, 1 Chemistry
Project Study Staff	1	Specialist, Education Policy and Planning Research Sector, MNIER	June 2024–August 2025	
Working Group Members	11	Members from MNIER, EEC, GAE, EIT, Education-related NGOs, Mongolian National University of Education	September 2024–August 2025	Including 4 staff concurrently assigned from the MNIER
Total	11	(Excluding concurrent assignments)		

(2) Supplies and Equipment

Supplies and equipment were provided as originally planned. The office space was provided by the MNIER only during the travel periods of the Japanese Experts.

Table II-5: Provision of Supplies and Equipment by the Mongolian Side

Item	Planned Quantity	Provided Quantity	Remarks
Office Space	1	1	
Furniture	1	1	Desks, chairs, shelves, etc.
W-FI	1	1	

II-2. Overview of Project Study Activities

As described in "I-2. Purposes and Overview of the Study (3) Overview of Activities," the Project Study was implemented in six phases: "Preparation," "Current Status and Issue Analysis," "Material Development," "Material Piloting," "Effectiveness Measurement," and "Project Completion Report." These phases were implemented largely as scheduled. Figure II-1 provides an overview of the implementation period, content, and sequence of activities for each phase. The following sections outline the actual activities conducted under each phase, along with any changes. For detailed schedules of each activity period, refer to "Appendix 2: Detailed Activity Plan."

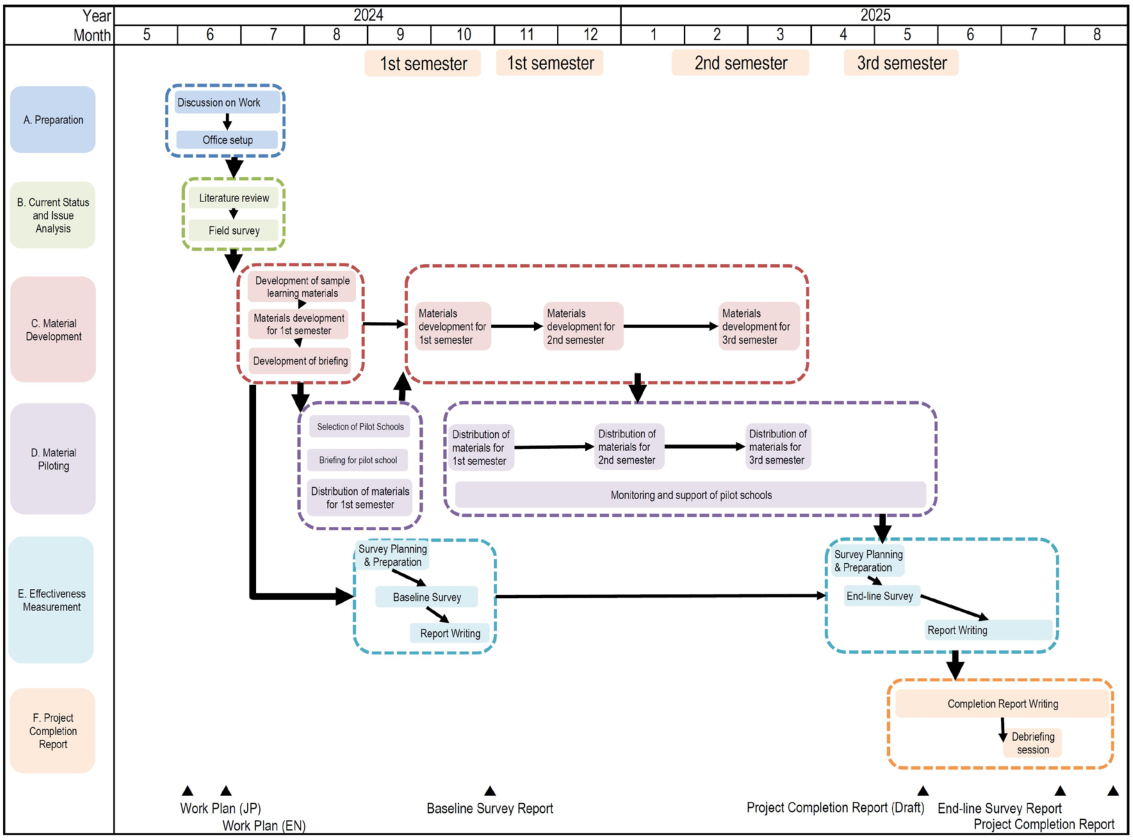


Figure II-1: Workflow Chart of the Project Study

A. Preparation (May–June 2024)

A draft version of the Work Plan was prepared in consultation with JICA. Subsequently, during the fieldwork in June 2024, a kickoff meeting was held between the Project Study Team and key stakeholders, including JICA, MoE, MNIER, Google, and TfM. During this meeting, the contents of the Work Plan were discussed and finalized upon mutual agreement.

The project office was established within the Department of Curriculum, Assessment, and Teaching Materials Research of MNIER. Necessary equipment was provided, and local staff members were hired accordingly.

B. Current Status and Issue Analysis (June–mid-July 2024)

Prior to the development of science digital materials, a review of existing literature and reports was conducted, along with site visits to schools in Ulaanbaatar (School No. 119 and School No. 33). Additionally, interviews were held with key stakeholders, including officials from the MoE departments such as the MNIER, EIT, and Medle School, as well as representatives from other donors such as the Asian Development Bank (ADB) and the educational NGO Joy of Teaching (JoT). These activities aimed to assess the status and challenges of science education in Mongolia.

Based on the findings, the Project Study team analyzed and identified countermeasures to incorporate into the digital learning materials to be developed under the Project Study. The main challenges identified and the corresponding countermeasures proposed through the Project Study are summarized in the table below.

Table II-6: Challenges in Science Education and Countermeasures in the Project Study

	Challenge	Countermeasures in the Project Study
＜Curriculum, Textbooks, Teacher Guides, and Lessons＞		
1	Teachers and existing video materials do not sufficiently encourage student questioning and thinking.	The digital materials are structured in three parts to ensure that students are provided with opportunities and time to think. The lesson plans include sample questions for students.
2	Compared to basic knowledge acquisition, higher-order learning—such as applying concepts and analyzing experimental results to form conclusions—is rarely conducted.	The digital materials include segments that promote higher-order learning, such as conceptual understanding, application, and analysis, beyond simple factual knowledge.
3	Owing to limited availability of equipment and materials, it is difficult to conduct experiments and observations in class.	The materials introduce experiments and observations that can be conducted using familiar materials. Moreover, videos are provided to demonstrate experimental procedures or to serve as substitutes when actual experimentation is not feasible.
4	Teachers feel that they lack sufficient science knowledge and confidence in teaching the subject.	Key points are explained in the video materials. Lesson plans also include the lesson flow, answer keys with explanations for worksheets, typical student misconceptions and ways to address them, and supplemental teaching knowledge to help teachers teach with confidence.
5	Although lessons include experiments and observations, students rarely make predictions, present results, or engage in reflection.	Worksheets and other materials include instructions that prompt students to record, analyze, reflect on, and present their findings. Lesson plans include guidance to encourage students to express their thoughts in their own words during prediction and reflection activities.
6	The new curriculum development began in 2024 and has been piloted in some schools, but the content is still under discussion and not yet finalized.	The materials are developed based on the current curriculum but will flexibly incorporate elements of the new curriculum as its development progresses.
＜Use of ICT in Education＞		
1	There is a lack of systematic policy on ICT	While Google Classroom, which is being

	operation and utilization in education.	introduced in schools, will be used to distribute materials, the materials will also be developed in a format compatible with Medle, the existing educational platform.
2	Many schools have PCs for teachers and smart screens in classrooms, but only about one class set of tablets for students.	The materials are designed for whole class viewing on classroom screens, rather than individual viewing by students. Printed worksheets will be distributed to all target schools. Lesson plans are intended to be viewed on teachers' PCs.
3	Urban schools are better equipped, while rural schools often lack adequate facilities or maintenance.	Only schools equipped with facilities for viewing video materials in classrooms are selected as target schools.
4	Teachers have received basic ICT training but require further capacity building for advanced educational applications.	Teachers will receive training on how to use Google Classroom to access materials and how to use the digital materials effectively in their lessons.

【C. Material Development Phase】(July 2024–June 2025)

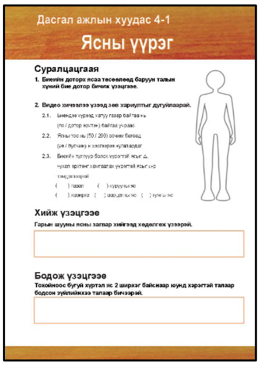
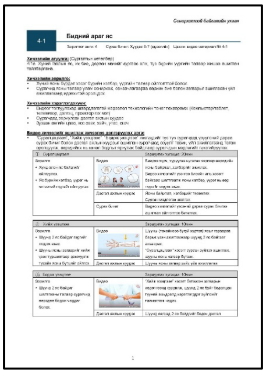
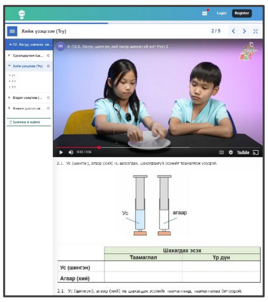
Based on the analysis of the status and issues described above, digital materials (video materials, student worksheets, and lesson plans) were developed as tools to support students' scientific inquiry-based learning activities.

(1) Alignment of the Concept and Structure of the Digital Materials

Drawing on Japan's expertise in educational material development, the Japanese side led the design of the concept and structure of the digital materials. These were subsequently presented to and discussed with the MoE and MNIER. Considering feedback from field teachers, the content of the digital materials was then finalized. The following table presents an overview of each type of material.

Table II-7: Overview of Digital Materials

Type	Overview
Video materials	The video materials consist of short video clips, approximately 10 minutes in length, incorporating footage of scientific observations and experiments as well as animations. They are designed to guide students' learning with deepening their interest and curiosity about nature and science. Each video material follows a common three-part structure: 1) "Let's learn!" – This part draws out students' sense of wonder in natural things and phenomena and then provides explanations of foundational scientific knowledge aligned with textbook content. (2) "Let's try!" – This part encourages students to make   

Type	Overview
	predictions and think critically through observation and experiment activities using familiar everyday items. (3) “Let’s think!” – This part extends and deepens their interest and understanding by prompting students to connect what they have learned with broader natural phenomena and scientific concepts.
Student worksheets	The worksheets are closely aligned with the structure and content of the video materials and are basically two pages in length. Page 1 is used during the lesson to help students record their predictions, thoughts, and observation results, corresponding to the three parts of the video. Page 2 consists of exercise questions related to the lesson content, which are used after the lesson to help consolidate students’ understanding and skills. Teachers can also use this to check students’ levels of understanding. | 
Lesson plans	The lesson plans are designed to help teachers use the video materials in their lesson. The first half includes information such as the content standard describes in the curriculum, textbook page numbers, objectives, and activities for each part of the video material, and required equipment and materials for experiment, enabling teachers to grasp the overview of the video material. The second half provides sample lesson flows using video material, including when and how to use the worksheet, sample questions to encourage student thinking. The correct answers and explanations of the worksheet tasks, as well as additional teaching tips and supplemental information for teachers to teach the content are also provided. 
Online materials (Lumi)	The online materials compile the contents of the video materials and worksheet tasks into an online content format. Accessible via the Internet, the platform allows students to watch the videos and answer worksheet questions online, with immediate feedback and explanations. For simple multiple-choice questions, correct/incorrect responses are provided instantly. The content is accessible from laptops or smartphones if Internet connection is available. 

(2) Selection of Units and Lessons for Digital Material Development

In selecting units and lessons for digital material development, priority was given to those challenging to implement in the classroom because of the need for scientific observations or experiments, as well as those where conceptual understanding could be enhanced through animation. The selection also considered balance across learning areas and instructional timing. In accordance with the original plan, a total of 40 digital learning materials were developed, 20 for Grade 4 and 20 for Grade 5. Tables II-9 and II-10 list the lessons for which digital materials were developed.

At the beginning of the Project Study, it was planned to select lesson content from the new curriculum being developed by the MoE and MNIER. However, eventually, the developed digital materials were selected from the current curriculum for the following reasons:

The pilot schools for the new curriculum were designated by the MoE; however, the selection was substantially delayed, and the number of designated schools was greatly reduced compared to the original plan. Consequently, it was not possible to align the pilot schools for the Project Study with those for the new curriculum. Thus, the Project Study pilot schools conducted lessons based on the current curriculum and existing textbooks, which necessitated re-selecting the lesson content for digital materials based on the current curriculum. In doing so, units and lessons universally taught in the respective grades were prioritized, with the aim that the developed digital materials would remain relevant and usable even after the curriculum is revised. However, by the time this decision was made, some storyboards and scripts for the video materials had already been completed. Owing to time constraints, certain video materials continued to be developed based on the new curriculum. Among the 20 video materials developed for each grade, four video materials for Grade 4 and one video material for Grade 5 correspond to the new curriculum content. It should be noted that materials aligned with the new curriculum were not distributed during the pilot implementation, as the new curriculum was not implemented in the pilot schools for the Project Study.

Table II-8: **Titles of Digital Materials for Grade 4**

Strand	ID	Digital Material Title	Remarks
Life and Environment	4-1	Our Bones	
	4-2	How Do We Move?	
	4-3	Are Animal Bones Similar to Human Bones?	
	4-17	How Do Living Things Adapt to the Environment? (Plants)	
	4-18	How Do Living Things Adapt to the Environment? (Animals)	
	4-19	Interactions of Living Things: The Food Chain	
Physical Science	4-4	Do All Objects Cast Shadows?	
	4-5	Can We Change the Width of a Light Beam?"	
	4-6	Let’s Collect Light	
	4-7	The Motion of a Pendulum	New curriculum

Strand	ID	Digital Material Title	Remarks
	4-8	The Rule of the Pendulum	New curriculum
	4-9	Let's Light a Bulb Using a Battery	
	4-10	What Conducts Electricity?	
	4-11	Earth's Gravity	New curriculum
	4-12	What Are Solids, Liquids, and Gases?	
	4-13	Why Do Solids, Liquids, and Gases Have Different States?	
	4-14	What Dissolves in Water?	
	4-15	How to Represent Particles in Water	
Earth and Space	4-16	Climate Change	New curriculum
	4-20	How Can We Reduce Waste?	

Table II-9: **Titles of Digital Materials for Grade 5**

Strand	ID	Digital Material Title	Remarks
Life and Environment	5-14	What Are the Organs of a Plant?	
	5-15	Life Cycle of Flowering Plants	
	5-16	Reproducing Plants from Vegetative Organs	
	5-17	Which One Is an Insect?	
	5-18	Life Cycles of Butterflies and Grasshoppers	
	5-19	Reproduction and Life Cycles of Living Things (Egg-Laying Animals)	
	5-20	Reproduction and Life Cycles of Living Things (Viviparous Animals)	
Physical Science	5-3	What Is Balance?	
	5-4	How Can We Lift Heavy Objects?	
	5-5	Uses of Levers	
	5-6	Air Resistance	New curriculum
	5-7	How Does Water Change?	
	5-8	What Happens to Particles During a Change of State?	
	5-9	Where Do Water Droplets Come From? (The Water Cycle)	
	5-10	What Is the Difference Between Reversible and Irreversible Changes?	
	5-11	Investigating Combustion	
Earth and Space	5-1	Let's Identify the Sun's Position by the Shadow of the Body	
	5-2	Day and Night (Earth's Rotation)	
	5-12	Observing Weather: Temperature	
	5-13	Observing Weather: Wind	

(3) Development of Sample Video Material

Before proceeding with full-scale production of the video materials, one sample was developed to ensure alignment in concept and structure among MNIER and other stakeholders. The sample video was reviewed by members of MNIER, and their feedback was collected.

Positive comments included the following: “The video made me want to try the activities myself,” “It was created from a students’ perspective, which was good,” and “The flow from learning knowledge to applying it in problem-solving and further exploration was effective.” These comments indicated general agreement on overall concept and structure of video materials. However, some concerns were raised about unclear parts of the narration. It was recognized that greater attention would be needed in future video productions, particularly in reviewing Mongolian translations and narration scripts, with the involvement of science specialists from MNIER.

(4) Selection of the Subcontractor for Material Development

For the full-scale production of video materials, a local production company was selected as a subcontractor. While the scripts of the video materials were created by the Japanese side, drawing on Japanese expertise, the filming, editing, and animation production were subcontracted to a local company.

In selecting the subcontractor, the evaluation emphasized not only video production capabilities and costs but also the presence of Japanese-speaking staff who could ensure accurate communication of intentions and facilitate detailed adjustments. A competitive bidding process was conducted by issuing a Request for Proposal to four video production companies based in Ulaanbaatar. Proposals were received from three companies and evaluated by three Japanese team members and one member from MNIER based on pre-established evaluation criteria. The company that received the highest score in technical and price evaluation was selected as the subcontractor. After reporting the selection process to the JICA office and obtaining its approval, a contract was signed with Mongol Content LLC, a major video production company in Mongolia. Following the selection, the Project Study team provided the sample materials and scripts, including storyboards and rough illustrations, to produce video materials. The Project Study team members, supported by monitoring and coordination staff, reviewed and managed the quality at each key step of the development process.

(5) Establishment of the Working Group

In August 2024, a Working Group was established for the Project Study. Eleven members were selected from MNIER, EEC, GAE, EIT, education-related NGOs, and the Mongolian National University of Education. The Working Group was tasked with monitoring the progress and issues of the Project Study, providing advice, and offering expert feedback on the digital materials. Drawing on Japanese expertise, Japanese team members developed video storylines, worksheets, and lesson plans. The Working Group provided feedback to ensure that these materials were appropriate for the Mongolian context—for example, whether the content reflected familiar local animals, plants, and scenes for students and whether the Mongolian translations were accurate and natural. Additionally, the Working Group discussed the specifications and structure of the digital materials, as well as procedures for integrating them into Medle, the existing digital platform in Mongolia. These efforts ensured that the materials would be well-suited to Mongolia's educational environment.

(6) Development of Digital Materials

The development of the video materials was conducted through the following steps:

① Creation of rough sketches by Japanese team members
② Translation of rough sketches into Mongolian
③ Review and revision of rough sketches by the Working Group
④ Creation of storyboards by the video production company based on the rough sketches
⑤ Review of the storyboards by Japanese team members
⑥ Filming and editing by the video production company based on the storyboards
⑦ Review of video drafts by Japanese team members and requests for revisions
⑧ Revision by the video production company
⑨ Finalization of the video materials

Figure II-2: Flowchart of Video Material Development

Japanese team members created the overall storylines of the video materials. As written scripts alone may not convey a clear image of the videos, rough sketches combining text with illustrations for each scene were created. Using these rough sketches in both face-to-face and remote communication with the video production company helped facilitate smooth understanding of the videos' storyline and content. The storyboards, serving as the scripts for filming, were created by the video company based on rough sketches. These included the dialogues for narrators and presenters, descriptions of each scene (whether it would be filmed, animated, or depicted using illustrations or photos), and other necessary details. The video company conducted filming and editing based on the storyboards. For scientific experiments challenging to perform, Japanese team members visited the video company to provide direct instruction or supplied footage and photos taken in Japan for inclusion in the video materials.

To ensure quality, multiple Japanese team members reviewed video drafts to check that 1) there were no scientific inaccuracies in animations or illustrations, 2) the procedures and results of observations and experiments were correct, and 3) subtitles and visual aids were easy for both teachers and students to understand. When necessary, the team requested re-filming or re-editing to finalize the video materials. To avoid misunderstandings or unnecessary rework with the video company, the team provided clear and specific instructions using rough sketches and held regular meetings to ensure mutual understanding.

Student worksheets and lesson plans corresponding to each of the 40 videos were created by Japanese team members and finalized after review of the content and Mongolian expressions by members of the Working Group.

(7) Designing the Format to Match the Digital Platform "Medle"

To ensure that the developed digital materials could be utilized nationwide after the completion of the Project Study, the materials were designed to be uploaded to Medle, the national digital platform widely used in Mongolia. Rather than simple video files, the materials needed to be formatted for web-based use in accordance with Medle's platform requirements.

In consultation with EIT, which manages and maintains the Medle platform, the materials were converted into the HTML5 package (H5P[3]) format, allowing all 40 video materials to be viewed online. H5P supports a wide range of content types, including videos, quizzes, multiple-choice questions, and open-ended tasks, enabling the integration of video materials, worksheet questions, and explanations from the lesson plans into comprehensive online content. Although H5P content can be used via web browsers or embedded in learning management systems (LMS), the tool used to create and share the H5P materials was Lumi,[4] an open-source content creation platform.

During the Project Study pilot implementation phase, access restrictions were applied to prevent control group schools from accessing the materials. Therefore, the H5P files were not uploaded to Medle during this period. Instead, links to the Lumi files were shared via Google Classroom, allowing only teachers at the treatment schools to access and use the online materials during this phase.

Through the above processes, 20 sets of video materials, student worksheets, and lesson plans were developed for each grade (Grade 4 and Grade 5) and prepared as online learning materials compatible with Medle.

D. Material Piloting (September 2024–May 2025)

To assess the impact of using the developed science digital learning materials in classroom instruction, the materials were pilot implemented in designated pilot schools from September 2024 to May 2025. An overview of each process involved in the pilot implementation is provided below.

(1) Selection of Pilot Schools

In consultation with the MNIER, a total of 28 pilot schools were selected. As noted in the section "C. Material Development," the initial plan was to select 50 schools designated by the MoE for piloting new curriculum materials (textbooks and worksheets). However, the final number of pilot schools was reduced to 28 for the following reasons: the pilot implementation of the new curriculum did not proceed as planned in the originally designated 50 schools; the number of target students exceeded initial estimates; and budgetary and time constraints made it

[3] H5P https://h5p.org/
[4] Lumi https://lumi.education/en/

impractical to include schools where the baseline and end-line surveys could not be conducted. Thus, there was no justification for including such schools in the pilot.

The selection process considered schools with strong affiliations to key partners, including Google, which provided some devices and software for distributing materials online; TfM, an NGO that conducted teacher training on the material use; and JoT, an NGO supporting science education. Schools that had received Japanese grant aid for school building construction were also considered. Based on these factors, MNIER initially selected 40 candidate schools nationwide.

From these, 30 schools that met the necessary conditions for using digital learning materials—such as availability of ICT devices for teachers—were shortlisted. These schools were then grouped by region, location (urban/rural), and school size. Within each group, half of the schools were randomly assigned to the treatment group and the other half to the control group, resulting in 15 schools per group. However, two schools were later excluded owing to their inability to participate in the teacher training on digital materials or in the baseline survey. Consequently, the final selection comprised 14 treatment group schools and 14 control group schools, as listed in the table below.

Table II-10: List of Pilot Schools

	School Name (Treatment Group)		School Name (Control Group)
1	Setgemj complex school (Ulaanbaatar)	1	84th secondary school (Ulaanbaatar)
2	21st secondary school (Ulaanbaatar)	2	14th secondary school (Ulaanbaatar)
3	Ireedui complex school (Ulaanbaatar)	3	57th secondary school (Ulaanbaatar)
4	Bolovsrol complex school (Ulaanbaatar)	4	23rd secondary school (Ulaanbaatar)
5	Munkhkhairkhan public school	5	Tosontsengel public school #1
6	Tsenkher public school	6	Khujirt public school
7	Khushaat public school	7	Zuunkharaa public school #1
8	Mungunmorit public school	8	Shariin gol public school #2
9	Tsogttsetsii public school #2	9	Uulbayan public school
10	Public school #2 (Orkhon)	10	Murun public school #1
11	Zuunmod public school #5	11	Bayan-Undur public school #4
12	Sumber public school #5	12	Public school #4 (Darkhan-Uul)
13	Baruun-Urt public school #1	13	Dalanzadgad public school #3
14	Taishir public school	14	Arvaikheer public school #4

For detailed information on the target schools, including the geographical classification, number of students, and number of teachers, please refer to “Appendix 1: School List” for reference.

(2) Orientation for Pilot School Stakeholders (Teacher Training for Treatment Group Schools)

A three-day face-to-face teacher training was conducted from August 28 to 30, 2024, for schools in the treatment group. The training goal was to ensure that participating teachers understood the objectives and activities of the Project Study and were able to effectively use the developed video-based digital learning materials in their science classes. A total of 49 teachers from the 14 treatment group schools participated. The training covered the following topics: an overview of the Project Study, the structure of the digital learning materials (video content, worksheets, and lesson plans), the use of Google Classroom, and hands-on exercises involving mock lessons using the video materials in group work. An overview of the teacher training is presented in Table II-11.

Two prototype video materials were used for training. Participants were divided into groups to conduct mock lessons based on each video. During the mock lessons, participants alternated roles between a teacher and student, simulating real classroom scenarios while using the video materials. Subsequently, each group shared good practices and solutions to any difficulties encountered, which deepened collective learning and generated positive feedback on the video materials.

As the developed video materials were to be distributed to treatment group schools via Google Classroom, all participating teachers needed to gain a basic understanding of how to use this platform. Therefore, the training program on Google Classroom was entrusted to TfM, an NGO with experience in delivering teacher training on Google Workspace for Education. With TfM's support, participants confirmed their Google Classroom accounts, received an orientation on its basic features, and practiced its use firsthand. This contributed to the smooth distribution and effective use of the video materials during the pilot implementation. TfM was also responsible for logistics arrangements related to the training.

For teachers unable to attend the training, a recording of the session was made available via Google Classroom.

Table II-11: Teacher Training for Treatment Group Schools

Date	Content	Main Facilitator
August 28, 2024 (Day 1)	• Overview of the Project Study • Explanation of the concept and structure of the digital learning materials • Introduction to ICT tools including Google Classroom and account setup	Project Study Team Project Study Team TfM
August 29, 2024 (Day 2)	• Practical exercises on using ICT tools including Google Classroom • First round of mock lessons using digital learning materials and reflection (group work)	TfM Project Study Team
August 30, 2024 (Day 3)	• Second round of mock lessons using digital learning materials and reflection (group work) • Case study: anticipated benefits and challenges in classroom use of digital learning materials • Sharing good practices from each group	Project Study Team Project Study Team, TfM Project Study Team, TfM

(3) Uploading, Printing, and Distribution of Developed Tools

The completed video materials were sequentially uploaded to Google Classroom and made accessible only to teachers from the treatment group. The digital learning materials were uploaded as unlisted videos on a project-created YouTube channel, and the links were shared via Google Classroom. This allowed teachers to play videos directly from YouTube without needing to download large files onto their PCs or other devices. Given that the network environment in Mongolia was generally stable even in rural areas, there was no need to distribute the video files via USB or other physical media.

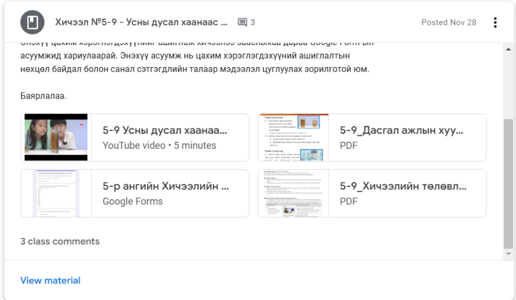


Figure II-3: Teaching and Learning Materials on Google Classroom

To ensure that students could reliably use the worksheets during lessons, electronic versions of the worksheets were uploaded to Google Classroom, whereas printed copies for all Grade 4 and Grade 5 students in the treatment group schools were produced by the project team and delivered to each school.

Lesson plans were also uploaded as electronic files to Google Classroom. Teachers accessed and used these either through ICT devices such as tablets or by printing them at their schools.

Table II-12: Distribution Methods of Video-Based Digital Learning Materials

Material	Distribution Method
Digital Learning Materials	Videos uploaded as unlisted on YouTube; links shared via Google Classroom
Student Worksheets	Electronic files uploaded to Google Classroom; printed copies mailed to all students in treatment group schools
Lesson Plans	Electronic files uploaded to Google Classroom
Online Materials (Lumi)	Web links shared via Google Classroom

(4) Monitoring and Support for Pilot Schools

After the implementation of the science digital learning materials began in treatment schools, two rounds of monitoring visits were conducted at schools in Ulaanbaatar in December 2024 and March 2025. These visits aimed to observe how the digital learning materials were being used in actual classroom settings and to gather feedback on any challenges. The findings were utilized to inform improvements in the development of subsequent materials. Table II-13 presents an overview of the pilot school monitoring.

Table II-13: Overview of Pilot School Monitoring

	First Monitoring Visit	Second Monitoring Visit
Date and Time	December 19, 2024, 9:30–13:00	March 27, 2025, 8:45–10:30
Target School	Bolovsrol complex school, Ulaanbaatar (Grade 4: 6 classes, Grade 5: 7 classes)	21st secondary school, Ulaanbaatar (Grade 4: 8 classes)
Conducted by	Mr. Tanaka, Mr. Batjargal	Mr. Tanaka, Mr. Batjargal
Purpose	• Monitor and provide guidance on the use of distributed materials. • Film the promotional video footage.	• Observe and monitor lessons using distributed materials.

Additionally, online monitoring sessions were conducted once per term—in December, February, and April—targeting the treatment group schools. These sessions aimed to provide guidance on how to effectively use digital learning materials in classrooms, collect information on the current usage status, identify challenges and questions from teachers, and discuss possible solutions collaboratively. The online monitoring sessions were recorded and uploaded to Google Classroom to ensure that teachers who could not attend were also able to access the content.

Table II-14: Overview of Online Monitoring Sessions

	First Session	Second Session	Third Session
Purpose	To gather feedback from teachers on the use of distributed materials to inform future material development and classroom application.		
Date	December 13, 2024 (approx. 2 hours)	February 18, 2025 (approx. 2 hours)	April 17, 2025 (approx. 2 hours)
Participants	Grade 4 and 5 science teachers from treatment group schools (24 participants)[5]	Grade 4 and 5 science teachers from treatment group schools (39 participants)	Grade 4 and 5 science teachers from treatment group schools (39 participants)
Facilitators	Mr. Yamaoka, Dr. Kijima, Mr. Morita, Mr. Batjargal	Same as the first session	Same as the first session
Main Topics	• How to guide student predictions using materials • Reporting and discussion on material usage • Upcoming material distribution	• How to use different components of the materials effectively • Reporting and discussion on material usage • Upcoming material distribution	• Developing science process skills using materials • End-line survey updates • Upcoming material distribution

[5] The number of accounts connected to the online meetings. The actual number of participants may have been higher because multiple teachers from the same school occasionally joined using a single device.

Monitoring confirmed that the developed digital learning materials were actively utilized in classroom lessons and generally recognized by teachers as helpful for lesson delivery and beneficial to student learning.

However, several challenges were identified, including delays in material distribution, difficulties some teachers faced logging into Google Classroom, and insufficient attention to safety during experiments. For issues that could be resolved through improvements in material development and distribution, appropriate countermeasures were implemented.

(5) Development of Instructional Video Materials for Teachers on the Use of Digital Learning Materials

To enhance the sustainability of the project after its completion, an additional activity was undertaken to develop instructional video materials for teachers, explaining how to effectively use the digital learning materials. These videos were intended for online distribution.

As described earlier, teachers from the treatment group had opportunities to learn about the use of digital materials and instructional strategies through the in-person training in August 2024 and the three rounds of online monitoring. However, teachers consistently expressed a desire for more detailed guidance. After the Project Study completion, the developed digital learning materials will be made available nationwide via the Medle platform for use in primary schools across Mongolia. To facilitate effective use at the national level, it is essential to share practical knowledge and experiences with all teachers.

Accordingly, an instructional video was developed to provide clear and concise guidance on how to use the digital learning materials, highlighting key instructional points. This video builds on the methods and tips introduced during the training sessions and monitoring meetings and includes actual good practice observed in local classrooms.

Table II-15 presents an overview of the instruction video. As it is available alongside the digital learning materials on the Medle platform, it is expected to promote effective nationwide utilization of the materials beyond the duration of the Project Study.

Table II-15: Overview of Instructional Videos on the Use of Digital Learning Materials

Purpose	Number	Content (each within 20 minutes)
Introduction to the Materials	1	Overview of the Project Study
	2	Structure and content of the digital learning materials
Effective Use of Video Materials	3	Lesson planning and implementation using the developed materials; annual planning
	4	Introduction of good practices (from end-line videos, etc.)
	5	Video materials and scientific process skills
	6	Using video materials to guide hypothesis generation in science lessons
	7	Guidance on observation and experimentation using video materials

E. Effectiveness Measurement Phase (August–October 2024, April–July 2025)

To measure the improvement in students' achievement and interest in science subjects as well as the effects on teachers, baseline and end-line surveys were conducted to determine changes in terms of Before/After and With/Without. The survey results are described separately in "II-3 Measured Outcomes."

(1) Framework for Effectiveness Measurement

A baseline survey was conducted in September 2024, prior to the start of the Material Piloting Phase, whereas an end-line survey was conducted from April to May 2025, during the latter half of the Material Piloting Phase, to compare Before and After. Furthermore, the pilot schools for this Project Study were divided into intervention schools (treatment group) and non-intervention schools (control group), with 14 schools selected for each group to enable a With (treatment group)/Without (control group) comparison.

For the 14 schools in the treatment group, the project implemented the intervention using the developed tools. In addition to distributing the tools, training was provided to teachers on how to use Google Classroom for tool distribution and on the practical use of the tools through explanations and exercises. Meanwhile, the 14 schools in the control group received only an online briefing that provided an overview of the Project Study and an explanation of the effectiveness measurement survey.

(2) Survey Targets and Sample Size

The pilot schools targeted for the survey were the 28 schools (14 treatment, 14 control) listed in "Table II-10: Pilot School List." The selection method is described in 【D. Material Piloting Phase】.

The survey participants included one Grade 4 or 5 class from each school (1,944 students in total), all Grade 4 and 5 science teachers from each school (266 teachers in total), and one principal or elementary section manager from each school (a total of 28 persons).

The same classes were selected for both the baseline and end-line surveys. Students and teachers who participated in only one of the two surveys were excluded from the Before/After analysis. As schools in the control group tended to be larger in size, the sample sizes for teachers and students were greater in this group than in the treatment group.

Moreover, classroom observations and recordings were conducted for nine classes. For the baseline survey, two classes from the control group were selected to confirm that no major differences existed between the treatment and control groups. For the end-line survey, all nine classes from the treatment group were selected to compare pre- and post-intervention results for the teachers and identify good practices.

(3) Survey Implementation Structure

The Japanese Experts team was responsible for survey management, development and analysis of the questionnaires and science test items, and the report drafting. JICA and MNIER provided advice on the content of survey tools and cooperated in lesson analysis. Short-term local enumerators were in charge of data collection at pilot schools, data entry, and tabulation of the collected data.

(4) Survey Items and Tools

The data collection tools included the following: for students, science tests and questionnaires; for teachers, science tests, questionnaires, and classroom observation sheets; and for principals/elementary section managers, questionnaires. The main contents of each survey tool are described in “Table II-16: Baseline and End-line Survey Items,” with notable points highlighted below:

For the science tests for students, 25 questions were prepared for each grade (Grade 4 and Grade 5). Questions 1–15 differed between the baseline and end-line surveys. Because the baseline survey was conducted at the beginning of the school year, 15 questions were selected from content taught in previous grades. For the end-line survey, 15 questions were selected from units covered in digital materials by the third term of each respective grade. Meanwhile, ten questions assessing understanding of everyday natural phenomena and scientific reasoning, which were outside the formal curriculum, remained the same for both the baseline and end-line surveys. Although differences in test content led to variations in average scores between baseline and end-line surveys, the changes in average scores for both the treatment and control groups were compared to quantitatively assess the effect of this project’s intervention.

For teachers, the test consisted of 20 questions based on the modified Grade 4–5 content (the same changes as for the student test) and ten non-curricular questions, also included in the baseline survey. Approximately one-third of the questions were adopted from the Trends in International Mathematics and Science Study (TIMSS) to allow comparison with international averages. All questions used a four-option multiple-choice format.

For the questionnaires, principals were asked about school attributes, whereas teachers were asked about teacher and class attributes, lesson implementation status, students’ learning environment, familiarity with the teaching materials, and teaching methods. Students were asked about their home environment, science study habits, and learning motivation. Some questions were adopted from TIMSS. In the end-line survey, principals, teachers, and students in the treatment group were additionally asked about their use of the developed science digital materials.

The classroom observation sheet used a rubric with ten items, including the presentation of questions in class, learning activities, and assessment methods, each rated on a three-point scale. MNIER staff viewed the recorded lessons and scored them. Prior to scoring, the Japanese experts and evaluators confirmed the rubric criteria and aligned their scoring standards. Moreover, records of teacher and student activities during lessons were created to enable a detailed comparison of lesson content.

Table II-16: Baseline and End-line Survey Items

Category	Survey Item	Method of Data Collection
School Attributes	Number of students, number of classes, location, etc.	Questionnaire for principals
Class Attributes	Number of students, gender ratio, attendance status, etc.	Questionnaire for teachers
Status of Lesson Delivery	Number of science lessons, class cancellations, etc.	Questionnaire for teachers
Teacher Attributes	Gender, age (years of teaching experience), academic background, qualifications, position, ICT teaching competency, training history	Questionnaire for teachers
Students' Learning Environment	Availability of ICT equipment, textbooks, and other teaching materials; utilization of developed tools in class	Questionnaire for teachers
Teachers' Knowledge of Developed Tools	Teachers' understanding of the utilization of developed tools	Questionnaire for teachers
Teachers' Academic Ability	Subject knowledge in science	Test for teachers
Teachers' Teaching Skills (Changes in Teaching Methods)	Basic teaching skills, Utilization of developed tools, Willingness to improve teaching	Classroom observation / Analysis of lesson videos, Classroom observation / Analysis of lesson videos, Questionnaire for teachers
Students' Academic Ability	Subject knowledge in science	Test for students
Students' Learning Motivation	Interest and motivation for learning; study time at home	Questionnaire for students
Students' Academic Ability	Subject knowledge in science	Test for students
Students' Learning Motivation	Interest and motivation for learning; study time at home	Questionnaire for students

(5) Baseline Survey Report Meeting

In October 2024, after the completion of the baseline survey, the survey results were compiled into the Baseline Survey Report, and an online meeting was held to present the results to JICA and the MoE of Mongolia. Based on the issues identified in the baseline survey, the following points were emphasized in developing the materials:

- ✓ Develop materials that provide students with opportunities and time to think
- ✓ Include higher-order questions that require conceptual understanding, application, and analysis
- ✓ Develop materials that support experiments and observations
- ✓ Conduct online monitoring to support teachers in using digital materials

F. Project Completion Report (May–August 2025)

Based on the activities described in Sections A through E, a draft of this Project Completion Report was prepared in June 2025 and finalized in August 2025 through close consultation with JICA and the counterpart (C/P) institutions.

In August 2025, a reporting session was held to present the outcomes of the Project Study and derived recommendations outlined in this report. Representatives from the C/P institutions under the MoE, as well as stakeholders from Google, TfM, JoT, the Asian Development Bank (ADB), and other donor organizations, attended this session.

II-3. Measured Outcomes

The results of the baseline and end-line surveys were compared and analyzed. The key differences observed are summarized below. The analysis focused on the effects of the Project Study intervention. In particular, the analysis examined changes in students' motivation and academic achievement, as well as improvements in teachers' instructional skills, attitudes, subject knowledge, and lesson quality.

(1) Changes in the Learning Environment

Throughout the baseline and end-line surveys, no major changes were observed in the basic learning environment of the target schools that could be attributed to factors outside the Project Study. However, in the treatment group schools, the frequency of teachers' meetings increased, as did the use of LMS platforms such as Google Classroom. Teachers' confidence in using ICT also improved, which appears to be an effect of the Project Study intervention.

According to questionnaire results from students, teachers, and principals or primary-level managers, digital materials, including video content, worksheets, and Lumi, were frequently and actively used in both lessons and home study in the treatment group, as illustrated in Figure II-4. These materials were reported to contribute positively to increasing students' motivation and improving the quality of teaching.

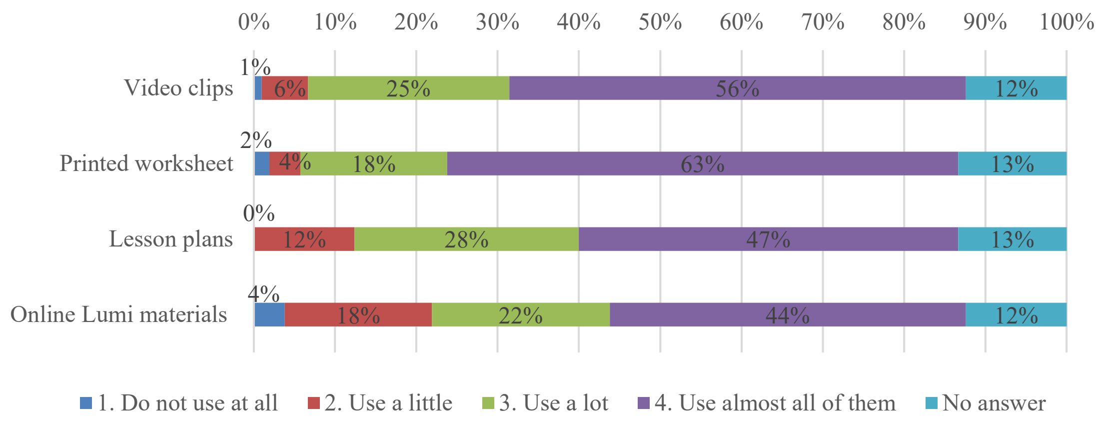


Figure II-4: Utilization of the Developed Science Digital Learning Materials

One reason for the active use of digital materials was their alignment with the existing curriculum and textbooks, which made them easy to use as supplementary tools. However, several other factors also contributed. First, the overall quality of teachers in Mongolia is relatively high compared to other developing countries, and many were willing to incorporate new materials. Teachers generally conducted classes reliably and, in some cases, held preparatory sessions to discuss how to use the materials effectively.

Additionally, all students had access to their own textbooks. As a result, valuable class time was not spent copying notes from the blackboard as a substitute for textbooks. The availability of textbooks provided a clear instructional reference, which likely facilitated the supplementary use of digital materials. Furthermore, because there were no competing sets of structured science video materials, the ones developed under this Project Study stood out and had a significant effect.

Finally, the availability of Internet access and devices, such as displays and smart screens, allowed teachers to smoothly present digital materials to students.

(2) Changes Observed in Students

Changes in students' attitudes toward science are illustrated in Figures II-5 and II-6, which show the shifts in students' levels of "liking science." Students in the treatment group showed a statistically significant improvement in how much they liked the subject by the time of the end-line survey. This improvement was particularly notable among Grade 5 students. Their interest remained high even as the curriculum content became more advanced. This resulted in a more pronounced difference compared to the control group. Feedback from teachers also indicated an increase in students asking inquiry-based questions, such as "Why?" and "How?" suggesting a deepening of student-led learning.

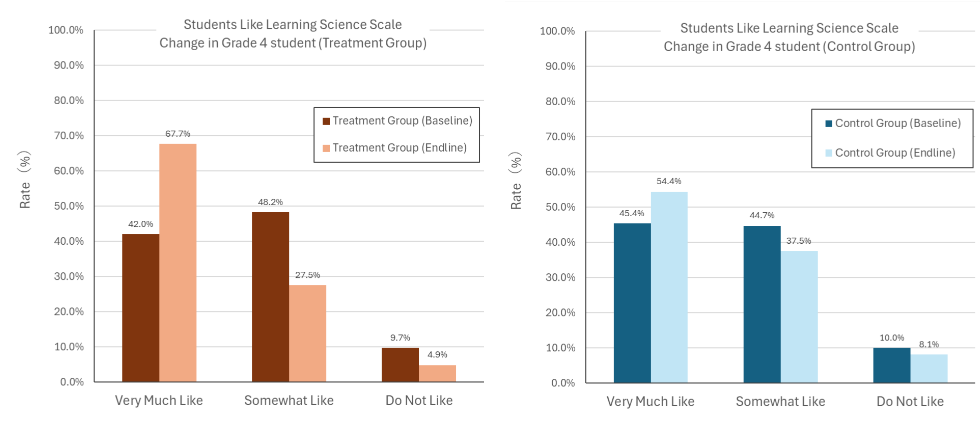


Figure II-5: Changes in "Student Like Learning Science" for Grade 4 Students

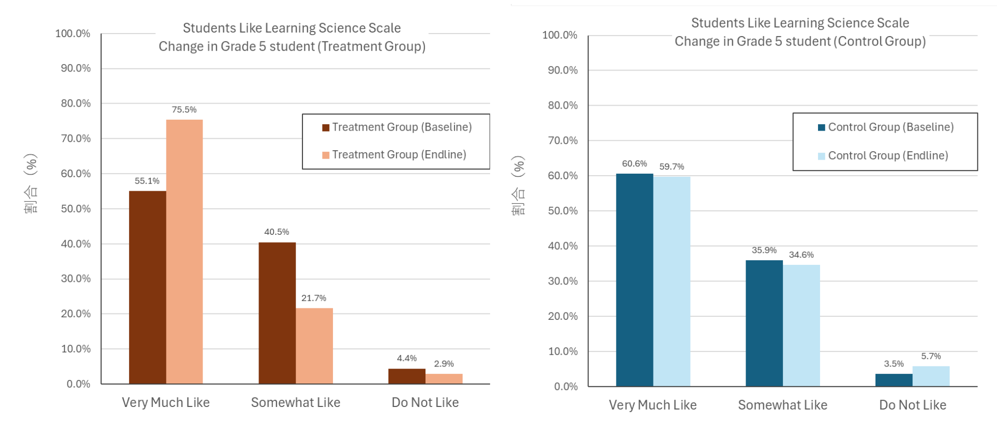


Figure II-6: Changes in "Student Like Learning Science" for Grade 5 Students

Regarding confidence in science, the changes are illustrated in Figures II-7 and II-8. Grade 5 students in the treatment group maintained a level comparable to international averages, while students in the control group showed a declining trend. This result indicates that the digital science learning materials helped maintain learners' confidence, even in higher grades where content difficulty increases.

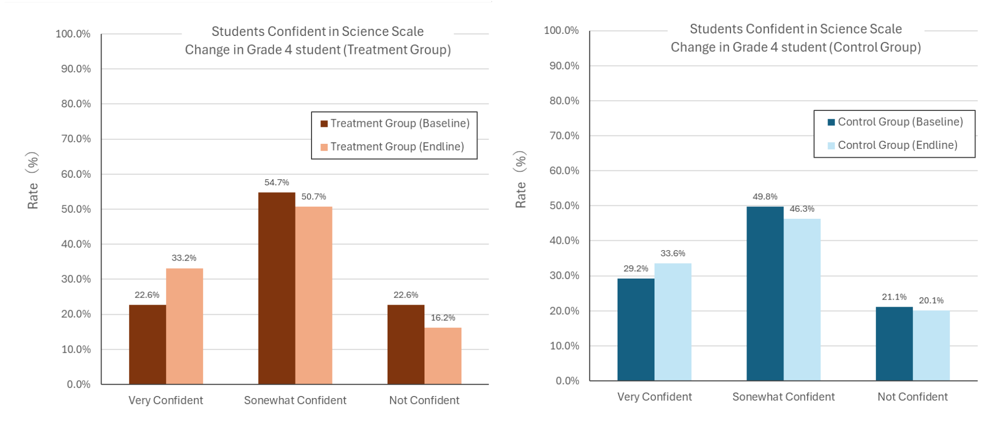


Figure II-7: Changes in "Student Confident in Science" for Grade 4 Students

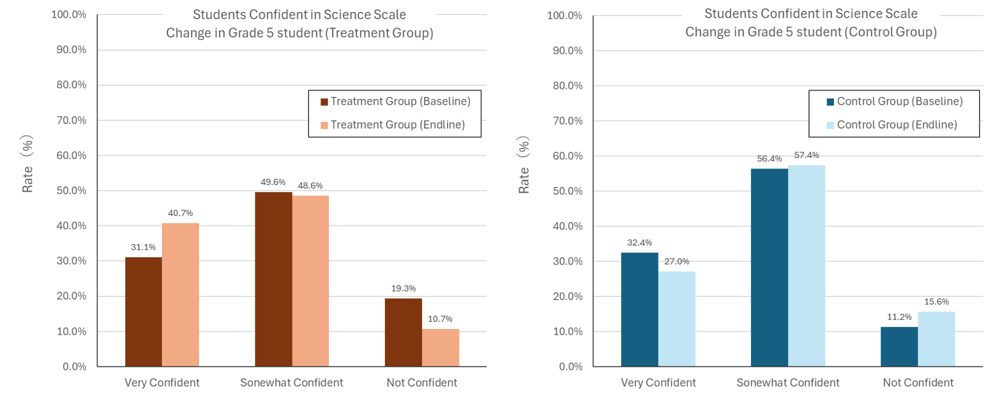


Figure II-8: Changes in "Student Confident in Science" for Grade 5 Students

Changes in students' academic achievement test results are shown in Figure II-9. At the time of the baseline survey, the treatment group had significantly lower average scores than the control group. By the end-line survey, the gap had closed. This confirms that the Project Study intervention had a statistically significant positive effect. In particular, students in the treatment group showed improved accuracy on questions related to content covered by the digital learning materials. This indicates a reduction in scientific misconceptions. For questions less related to the digital content, differences between the groups remained small. This highlights the need for continued instructional support.

Although improvements were also observed in higher-order thinking questions among treatment group students, the difference in gains compared to lower-order questions was not especially large.

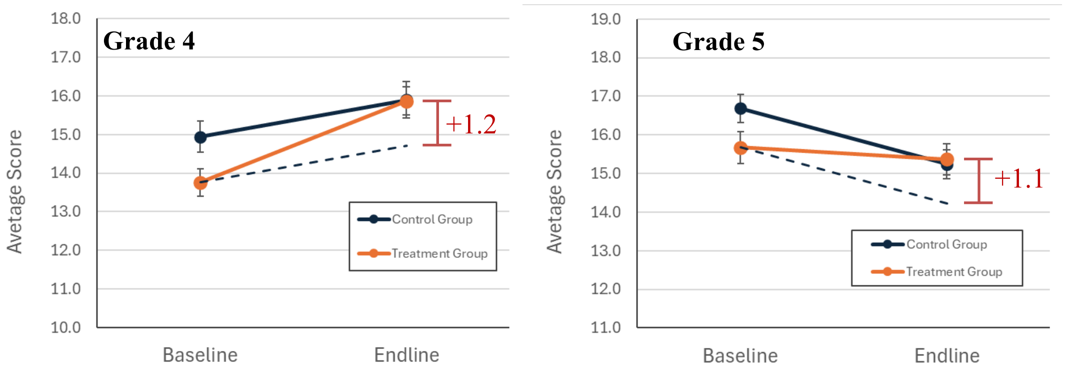


Figure II-9: Change in Average Score

(The dotted line starts from the score at the baseline of the treatment group and is a straight line with the same slope as that of the control group)

One of the primary factors underlying these observed changes is the structure and content of the materials developed through the Project Study, which were designed to engage students' interest and curiosity. The digital materials were developed to spark curiosity by presenting questions rooted in everyday life and the surrounding environment. The materials encouraged deeper learning through video viewing and by prompting students to engage in hands-on observation and experimentation using their own bodies and locally available resources.

For observations and experiments that were difficult to conduct in the classroom, the videos were designed to serve as effective alternatives. These videos allowed students to experience those activities visually. Concepts that are not easily observable or natural phenomena that are difficult to grasp were modeled through animations. The advantages of video materials were used to enhance conceptual understanding.

To further stimulate students' curiosity and promote active learning, the videos included elements such as unexpected results that differ from students' initial predictions. The videos also featured scenes with two child actors of a similar age conducting investigations and asking questions such as "Why?" and "How?" mirroring the students in the classroom. The accompanying lesson plans provided example questions to prompt student thinking and exploration.

Importantly, the difficulty level of the materials was carefully calibrated. The materials were not so easy that students would lose interest, and not so difficult that they would become discouraged. This balance contributed to sustaining engagement and increasing confidence. These thoughtful design features of the materials likely played a key role in the positive outcomes observed.

Box 1: Reflections Based on the Gakken Science Materials Experience

Philosophy Behind the Gakken Materials

The science materials developed by Gakken, which served as a reference for this Project Study, are designed based on the following three principles:

① Enhancing students' motivation by encouraging enjoyable learning experiences

② Deepening understanding by engaging hands-on and physical activities

③ Promoting comprehension through familiar and relatable topics

Moreover, the materials incorporate lesson structures that emphasize student thinking and inquiry, with the aim of fostering not only cognitive abilities but also non-cognitive skills such as concentration and curiosity.

Observed Effects and Contributing Factors

The development of non-cognitive skills such as those described above generally does not yield immediate results; improvements typically become evident over the course of several years. However, in this Project Study, the use of the materials brought about noticeable effects within a short period. The following two factors are believed to have contributed significantly to these outcomes:

- Improved student concentration: Students initially struggled with maintaining focus, but their ability to engage attentively improved using the materials.
- Enhanced teaching effectiveness: Because the materials were easy to use and provided clear lesson flows and instructional points, teachers were able to understand the learning objectives and teach with confidence, leading to improved lesson quality.

Outlook for the Future

Given these outcomes, it is anticipated that continued use of the materials will yield even more visible effects—particularly on non-cognitive abilities—over the next year or two.

(3) Changes Observed in Teachers

Similar trends were observed in the teacher academic achievement test. When the baseline survey was conducted, the average scores of teachers in the treatment group were significantly lower than those in the control group. By the end-line survey, this difference had reversed, with teachers in the treatment group scoring significantly higher. The improvement in correct answer rates was especially pronounced in questions related to the video lesson content, more so than among students. A reduction in misconceptions was also observed. These results suggest that teachers strengthened their subject knowledge by studying the video materials and lesson plans in depth during lesson preparation. Changes in teachers' academic achievement test results are shown in Figure II-10.

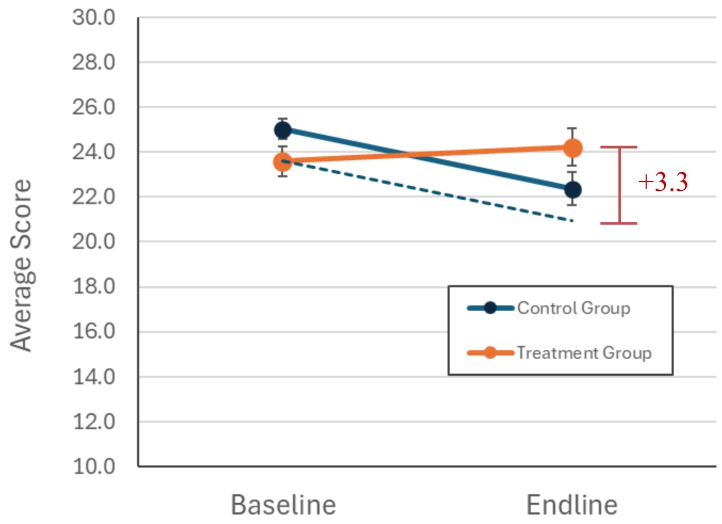


Figure II-10: Changes in Average Scores of Teachers
(The dotted line starts from the score at the baseline of the treatment group and is a straight line with the same slope as that of the control group)

Regarding teachers' instructional attitudes, there was a statistically significant increase in the proportion of teachers in the treatment group who reported feeling confident teaching science. Changes in teachers' attitudes toward teaching science are shown in Figure II-11. Moreover, teachers in the treatment group reported a significant reduction in the burden of lesson preparation. This finding indicates that the digital materials supported teachers in planning and delivering their lessons. The frequency of classroom experiments also increased significantly in the treatment group, which promoted more active learning practices. Regarding attitudes toward instructional improvement, treatment group teachers became more aware of the need to enhance not only teaching materials and equipment, but also pedagogical methods and their own instructional skills. This finding suggests that their experience using the materials effected a shift in their overall educational perspective.

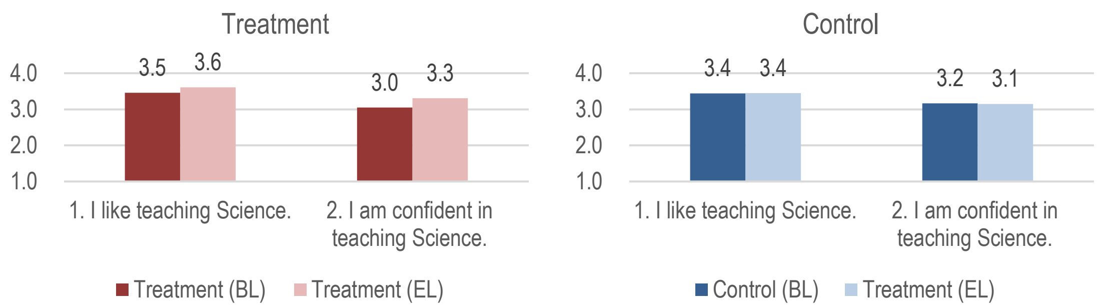


Figure II-11: Teachers' Attitudes toward Teaching Science

Several factors appear to underline these changes. In initial interviews at the start of the Project Study, some teachers expressed concerns. For example, one teacher stated, "I want to conduct experiments and observations in class, but I'm afraid I won't be able to answer students' unexpected questions." Another teacher said, "In Mongolia, science is seen as a subject for learning logic and theory, not something 'fun,' so I'm not sure if I would use entertaining video materials in class." However, the Project Study consistently positioned the digital materials as user-friendly teaching aids. These materials incorporated engaging, scientifically accurate explanations and provided practical support for conducting experiments and observations.

Both the video and worksheet materials were divided into three parts to accommodate classroom use and teacher convenience. This structure allowed teachers to use them flexibly during lessons. Many teachers reported that lesson preparation became easier and that the materials were teacher-friendly. After using the materials, fewer teachers conveyed scientifically inaccurate content. More teachers began referring to the supplementary guidance in the lesson plans to deliver instruction with greater confidence. In-person training sessions that clearly explained the purpose and use of the digital materials, as well as regular online sharing meetings among teachers, likely also contributed to increasing their confidence.

The observed improvement in teachers' academic achievement suggests that teachers who previously lacked understanding of scientific content or hands-on experiments and observations deepened their scientific knowledge and thinking skills by teaching with the digital learning materials in their classrooms.

(4) Changes Observed in Principals and Primary-Level Managers

The evaluation by principals and primary-level managers was also positive. In the treatment group, their assessments of teachers' instructional skills in science and students' interest in science improved from the baseline to the end-line survey. The digital science materials developed through the Project Study were highly valued because they supported teachers in lesson delivery and enhanced students' interest and engagement in science.

(5) Changes Observed in Lessons

Lesson observations confirmed an overall improvement in lesson quality. Notable gains appeared in the areas of “providing instructions for thinking activities,” “student participation in activities,” and “support provided to students.” Compared to the baseline survey, the following improvements were observed in the lessons:

- The use of video materials increased students’ interest and motivation, leading to more active participation in learning activities.
- Even content that was difficult to demonstrate through direct experiment or observation was effectively illustrated using video materials.
- Lesson design showed improved alignment between learning objectives, activities, and assessment, and sufficient time was allocated for students’ independent learning using worksheets.
- Teachers became more proactive in providing individual support and feedback to students.

However, the extent to which the use of digital materials led to improved lesson quality depended heavily on teachers’ ability to use them effectively. The depth of teachers’ engagement with the materials through lesson preparation appeared to affect student outcomes. In classrooms where teachers received high evaluation scores for their observed lessons, students demonstrated improved academic performance, greater enjoyment, and increased confidence in science. In contrast, in classrooms where digital videos were shown with minimal follow-up learning activities, student performance remained largely unchanged compared to the control group.

These findings suggest that future efforts should focus on strengthening teacher training to promote more effective use of digital materials and improved lesson design.

Overall, the intervention using the digital science materials developed through this Project Study had a clear and positive effect on students’ motivation and academic performance, teachers’ subject knowledge and instructional skills, and the overall quality of lesson delivery. Based on these outcomes, recommendations have been presented in “Section IV: Recommendations for Effective Approaches to Enhance Students’ Interest in Science Subjects and Improve Foundational Scientific Competencies.”

Ⅲ.Challenges, Measures, and Lessons Learned in the Implementation and Management of the Project Study

III-1. Challenges and Measures in Implementation and Management

The following outlines the challenges identified during the implementation of the Project Study, along with the preventive measures and countermeasures that were devised to address them.

(1) Delay in the Trial Introduction of the New Curriculum

Challenge

The initial plan was to develop digital learning materials in alignment with the new curriculum, which was scheduled for trial introduction beginning in 2024, and to utilize these materials in the designated trial schools. However, owing to a change in the Minister of Education and delays in the development of the new curriculum itself, the implementation was postponed, and the number of trial schools was significantly reduced.

Consequently, the structure of the new curriculum units and the draft textbooks remained unclear even after the start of the first semester, which severely affected the instructional material development schedule. For instance, certain units taught in the first semester under the current curriculum were scheduled to be taught in later semesters under the new curriculum. Some of these units were eventually removed from the new curriculum altogether, making it impossible to complete their development in time. Additionally, filming and development had already progressed for some units intended exclusively for the new curriculum, and changes could no longer be made midway.

Preventive Measures and Countermeasures

The pilot schools for the Project Study were selected independently from those designated for the trial introduction of the new curriculum. The sequence of material development was flexibly revised to follow the annual teaching plan of the existing curriculum, adjusting both the targeted grades and units, and the distribution schedule.

Initially, there was a plan to include Grade 3 as a target grade because some content from the current Grades 4 and 5 curriculum was expected to shift to Grade 3 under the new curriculum. However, in the end, the project adhered to the existing curriculum’s annual teaching plan, and Grade 3 was not included.

In consultation with MNIER, some units that were to be included only in the new curriculum were incorporated into the development plan; however, priority was given to units shared by both the new and existing curricula. For units in the new curriculum that had not yet been finalized, draft storyboard sketches for video materials were prepared based on assumptions and reviewed continuously with MNIER to confirm their content.

The development of materials for the new curriculum was scheduled as the final stage, after completing the development and distribution of materials aligned with the existing curriculum. In total, four units per grade were developed—consisting of new curriculum-only units and those from the existing curriculum that could not be completed in time—but these were not piloted in the current phase. Instead, they are planned for distribution to schools in the following academic year.

(2) Delays in the Production of Video Materials

Challenge

The subcontracted video production company experienced staff resignations and subsequent organizational restructuring, which led to the dissolution of the video production team. Additionally, owing to limitations in the availability of Japanese project study team members in the field, many of the video materials had to be developed through remote supervision between Japan and Mongolia.

During this process, misunderstandings stemming from the production staff's limited background in science occasionally resulted in inappropriate content being used in the videos, which required extensive revisions. These factors contributed to delays in the development of video materials compared to the original schedule. As a result, there were cases where the distribution of materials to pilot schools was delayed.

Preventive Measures and Countermeasures

Regarding progress management, milestones such as storyboard rough sketches, detailed scripts, video drafts, and final cuts were established in coordination with the video production company. A detailed progress management sheet specifying deadlines and responsible people for each delivery was used to enable both parties to clearly understand the status of production.

Regarding communication, a group was created on Viber, a widely used messaging app in Mongolia, to facilitate timely chat exchanges with the Japan team. Additionally, a weekly reporting system was set up with the management of the production company to detect delays early and enable prompt countermeasures.

Concerning content quality, scientific annotations were added in detail to the storyboards provided to the production company. Japanese Project Study members conducted focused guidance during experiments and filming on their visits. Prior to filming, experimental apparatus and materials were checked, and raw footage was reviewed before editing. When necessary, experimental videos, photos, and illustration materials were supplied from Japan to manage quality and prevent rework.

Regarding delays in material distribution to pilot schools, efforts were made to prevent delays in video production as described above. However, when material distribution was expected to be later than the pre-shared schedule, timely information was shared via Google Classroom, and schools were requested to adjust the timing of material usage in classes as much as possible.

(3) ICT Infrastructure and Access to Materials

Challenges

Although most schools own student PCs or tablets, the number of devices is often limited to approximately one set per class, which is insufficient in many cases. Moreover, owing to issues with accounts issued by the Ministry of Education (MoE), a certain number of teachers were unable to access Google Classroom.

Preventive Measures and Countermeasures

To ensure that students could view the digital learning materials, the default method was for teachers to display them using smart screens or similar equipment in classrooms. While students could use individual PCs or tablets to watch videos and read worksheets, these were not made essential. For this reason, printed worksheets were distributed to all students.

Regarding access to Google Classroom, the Project Study Team requested technical support from the MoE and Google. In cases where teachers could not access the platform, materials were shared among colleagues at the same school, allowing those without access to use downloaded digital learning materials and video links provided by their peers.

(4) Utilization of Digital Learning Materials by Teachers

Challenges

From the outset of the Project Study, there were concerns about whether teachers would actively use the developed digital learning materials in their lessons. Furthermore, during the baseline survey, some instances were observed in which teachers used the materials inappropriately or ineffectively. Thus, ensuring that many teachers would be able to use the materials appropriately during their lessons was considered a potential risk factor.

Preventive Measures and Countermeasures

To encourage appropriate use of digital learning materials, face-to-face teacher training was conducted for teachers from the pilot schools. Rather than simply introducing the materials, the training included mock lessons using the digital learning materials, enabling teachers to experience firsthand how to integrate the materials into actual classroom teaching.

Subsequently, online monitoring sessions were held once per term for all teachers in the treatment group schools. These sessions included information on the schedule for material distribution, practical knowledge, and methods for using the materials, and interactive activities such as real-time online polling of school-wide material usage and the sharing of good practices among teachers.

All sessions were recorded and made available via Google Classroom, allowing teachers who were unable to attend to view the content later.

(5) Monitoring of Pilot Schools

Challenges

Because of the limited duration of the Japanese Project Study members dispatch in Mongolia, opportunities for in-person school visits were restricted. Consequently, it was initially difficult to obtain a clear picture of how the digital learning materials were being utilized at the school level.

Preventive Measures and Countermeasures

To address the issues above, a hybrid approach was adopted, combining in-person monitoring visits to schools in Ulaanbaatar with online interviews targeting treatment schools nationwide. During the on-site visits, detailed examples of how the materials were being used in classrooms were observed. Meanwhile, the online monitoring sessions for all treatment group schools included online questionnaires, which provided information on overall material usage and gathered feedback on areas for improvement.

Based on the findings from these monitoring activities, the digital learning materials were revised, and additional support strategies were considered.

Furthermore, the end-line survey collected more comprehensive data through questionnaires and lesson observations, which confirmed that there were no major discrepancies from the information obtained during the monitoring phase.

(6) Nationwide Utilization of the Digital Learning Materials in Mongolia

Challenges

Following the completion of the Project Study, the developed digital learning materials are expected to be made available on the Medle platform so that they can be used in primary schools across Mongolia. However, for effective nationwide use, teachers throughout the country must understand how to utilize the materials. Unlike the teachers in the treatment group schools, conducting in-person training sessions for all teachers nationwide would be physically, logistically, and financially challenging. While video recordings of the face-to-face training sessions exist, it was considered unrealistic to expect busy teachers to watch the entire three-day training, which includes group work and discussions.

Preventive Measures and Countermeasures

To ensure broader access to the materials, the digital learning materials were formatted for online distribution: videos were uploaded to YouTube as unlisted content; worksheets and lesson plans were converted into PDFs; and interactive learning materials were created in H5P format. All these resources were made accessible via the Medle platform.

To support teacher utilization of the materials, a series of instructional videos was developed. These videos concisely explain how to effectively use the digital learning materials, incorporating key methods introduced in the face-to-face training and online monitoring sessions, along with good practices observed in actual classroom settings. By allowing teachers to view these instructional videos on the Medle platform alongside the digital materials, the nationwide adoption and effective use of the digital learning materials are expected to continue even after the Project Study ends.

III-2. Lessons Learned

Based on the findings presented in Section "II-3. Measured Outcomes" and Section "III-1. Challenges and Measures in Implementation and Management," the following key lessons were derived.

III-2-1. Lessons Related to Project Formulation

(1) Role Sharing with the C/P

Because of constraints on the duration and resource input, the Japanese side took the lead in developing the digital learning materials, while the MoE of Mongolia was mainly responsible for confirming the development policy and reviewing the materials with suggestions for improvement. Consequently, the Japanese side was able to ensure both the quality and the speed of development, thereby completing 40 high-quality digital learning materials successfully within the project period. This approach was deemed necessary to achieve tangible results within a limited period and input.

The involvement of the counterpart in actual material development was limited, which also meant limited opportunities for capacity development. Although the Mongolian side expressed a desire for training sessions to build the C/P's capacity in material development, the Project Study was unable to fully respond to these requests.

When formulating a project, it is essential to clearly define the intended goals and to align the input volume and duration accordingly, ensuring that all parties have a consensus on the project objectives and strategy.

(2) Policy Changes and Timing of Supplementary Material Development

At the start of this Project Study, delays and scaling back of the planned introduction of the new curriculum had a significant impact on the development and implementation schedule of the digital learning materials. This is because digital learning materials are designed as supplementary tools to support teaching in alignment with official resources such as the curriculum and textbooks; they cannot be developed independently of these foundational materials.

While it may be appropriate to develop textbooks and teacher's guides in parallel with the introduction of a new curriculum, the development of supplementary materials is more efficiently undertaken once the institutional changes, such as curriculum revisions, have settled and stabilized.

(3) Importance of Planning for Impact Evaluation

From the initial planning stage, this Project Study was carefully designed to include both a treatment group and a control group to objectively measure the effects of the intervention. The necessary activities and input were secured to enable this measurement. During the selection of target schools, the treatment and control groups were assigned as randomly as possible.

The results of the impact assessment clearly demonstrated that the intervention brought about by the Project Study had a positive effect on student learning; this is considered a major achievement. For future interventions, such as those involving the development of educational materials, it is essential to plan from the outset for proper impact assessment. This includes the careful selection of target groups and the appropriate allocation of necessary inputs to ensure valid and reliable evaluation results.

III-2-2. Lessons Learned in the Development of Educational Materials

(1) Science Digital Learning Materials That Deepen Learning

Students who used the digital learning materials developed through this Project Study showed notable improvements in both their attitude—such as "liking science"—and their confidence in science. Moreover, their academic performance improved. The following characteristics of the materials are considered to have contributed to these outcomes:

- ✓ Presenting familiar scientific questions or phenomena at the beginning of the lesson to spark students' interest.
- ✓ Featuring child actors of a similar age to the students in the videos, along with worksheet questions that encourage students to think critically by asking "Why?" and "How?" thereby providing time and opportunities for reflection.
- ✓ Supporting not only passive video viewing, but also active observation and experimentation using students' own bodies or locally available materials.
- ✓ Using animations to visually supplement experiments and phenomena that are difficult to observe in the classroom or are invisible to the naked eye, thereby enhancing students' conceptual understanding.
- ✓ Incorporating not only basic knowledge recall but also higher-order questions involving conceptual understanding, application, and analysis.

(2) User-Friendly Supplementary Materials for Teachers

Teachers who used the digital learning materials developed through this Project Study frequently reported that lesson preparation became easier and that the materials were helpful in teaching. Improvements were also observed in their subject knowledge and confidence in teaching science. The following features contributed to the effectiveness of the materials as user-friendly supplementary tools:

- ✓ The materials aligned with the official textbooks, enabling teachers to use them directly in regular lessons and thereby reducing their workload.
- ✓ The package included video materials, worksheets, lesson plans, and online content, allowing teachers to conduct lessons simply by using the components provided.
- ✓ The materials were structured around three key components: "Let's Learn," "Let's Try," and "Let's Think," which could be freely combined according to the flow of each lesson.
- ✓ The lesson plans included advanced scientific knowledge and sample questions, encouraging teachers to engage in further instructional planning and self-study.

(3) Consideration of Environmental Disparities in Material Usage

While most primary schools in Mongolia have some means for students to view video content, there are disparities between schools in terms of access to individual digital devices. To address this, the worksheets were made available in both online and printed formats, ensuring that even schools with limited ICT infrastructure could use the materials without difficulty.

In future digital learning material development, it is important to provide alternative formats and delivery methods to ensure that schools with less developed ICT environments can also benefit from such resources. This approach can help expand the accessibility and usability of digital learning materials nationwide.

(4) Quality Management in Remote Development of Video Materials

While it is most efficient for video material developers in Japan and Mongolia to work together in-person, there are situations in which remote development becomes necessary because of various circumstances. Based on the experience of this Project Study, the following considerations are essential to ensure proper quality management during remote development:

- ✓ Conduct regular progress reviews using concrete tools such as progress management charts.
- ✓ Establish a responsive international communication system using messaging apps.
- ✓ Prevent misunderstandings and rework by maintaining close communication to compensate for limited subject-matter knowledge among video production staff, including advance sharing of technical information and prior content reviews.

(5) Absence of Competing Materials Creates High Added Value

As there were no existing structured video-based supplementary materials aligned with Mongolia's primary science curriculum, the materials developed through the Project Study were enthusiastically adopted in schools—like water soaking into desert sand. This reinforces a simple truth: in the absence of competing materials, the development and provision of high-quality resources can directly yield significant educational impact at the school level.

III-2-3. Lessons Learned Regarding the Use of Learning Materials

(1) Learning Materials Are Most Effective When Accompanied by Training

No matter how high the quality of learning materials, their intended effects cannot be achieved if teachers are unable to use them appropriately. In the effect measurement conducted during this Project Study, student learning gains were not observed in classrooms where the materials were used improperly. When introducing new digital learning materials, it is essential not only to help teachers understand the materials' objectives, structure, and usage methods, but also to provide opportunities for them to practice lessons using the materials. Training that enables teachers to effectively use the materials is therefore critical.

(2) Providing Support Through Monitoring

In addition to in-person training, this Project Study conducted several online monitoring meetings to help improve teachers' ability to use the teaching materials by sharing concrete examples and good practices. Through on-site monitoring visits to schools and regular online monitoring sessions, the Project Study team also listened to teachers' needs and challenges in the field. When issues that hindered material usage were identified, efforts were made to resolve them. These continuous support measures through monitoring played an important role in promoting the effective use of the materials.

(3) Designing Outputs with a View Toward Sustainable Use and Expansion

This Project Study was designed to ensure that the developed materials could continue to be utilized and disseminated after the project's completion. This included selecting units aligned with the new curriculum, creating materials in formats compatible with Medle, the existing official platform for teaching materials, and producing training videos for teachers. Incorporating standardized formats and using official platforms adopted by government agencies from the early planning stages can contribute significantly to enhancing sustainability.

IV. Recommendations for Effective Approaches to Enhancing Students' Interest in Science and Strengthening Foundational Scientific Literacy

IV-1. Recommendations for Mongolia

Through this Project Study, it was confirmed that the use of digital learning materials had a significant positive impact on students' motivation and academic achievement, as well as on strengthening teachers' instructional capacity. To scale up and deepen these outcomes nationwide, the following three perspectives are proposed as an approach to improving science education.

(1) Nationwide expansion and sustainable implementation of the developed digital materials

Based on the positive outcomes observed in the pilot schools, the scope of the developed digital science materials should be expanded and implemented nationwide. Continued use of these materials is also expected to contribute to the development of non-cognitive skills over time.

To ensure effective integration, a clear schedule for material distribution and usage should be established in advance. This enables teachers to incorporate the materials systematically into their lesson planning. Providing on-demand training resources on how to use the materials will further support the development of teachers' instructional skills.

In the future, a comprehensive ICT-based system should be established to enable seamless integration of material distribution, learning record management, and student reflection. Use of the materials for home study should also be promoted, with efforts to involve parents in the learning process. Moreover, improvement of ICT infrastructure at the school level is necessary, including the provision of offline resources for schools in regions with limited connectivity.

Given the persistent demand from schools and teachers for science experiment equipment, schools should refer to the recommended list of materials provided through the Project Study when planning equipment procurement.

Approach Title: Nationwide Expansion of the Developed Digital Science Materials
Objective: To enhance students' motivation and academic achievement using the developed digital science materials Target Group: Grade 4 and Grade 5 students and teachers in primary schools across the country Implementation Strategy: ① Upload the digital science materials developed under the Project Study to platforms such as Medle to ensure accessibility for primary school teachers and students. ② Provide offline versions of the materials to schools in areas with limited Internet connection. ③ Equip schools with science experiment tools based on the recommended equipment list. ④ Disseminate the benefits and usage schedule of the developed digital science materials to primary school teachers and parents nationwide by utilizing existing promotional videos and findings from the Project Study. ⑤ Offer on-demand online training for teachers on how to use the materials effectively.

⑥ Conduct regular online monitoring and information-sharing sessions on material usage under the coordination of MNIER.

⑦ Gradually establish a system that integrates the use of H5P13F[6] content, learning record management, and student reflection.

(2) Improving Coverage of Digital Science Materials

While improvements in non-cognitive skills such as motivation, concentration, and curiosity are expected to lead to long-term gains in overall academic achievement, including in areas not directly addressed by the digital materials, content covered by the digital materials has a more immediate and measurable effect on student learning. Therefore, it is essential to continue expanding the content coverage of the materials.

Moving forward, digital materials should not remain limited to the current target grades and units. They should be gradually developed to cover additional grades and topics. This approach will improve the overall alignment of digital materials with the entire science curriculum.

To ensure comparable outcomes, it is necessary to maintain the same principles and development methods used in this Project Study. This includes sustaining the quality of materials through well-defined instructional design and consistent pedagogical goals. Outsourcing to private educational content developers and video production companies will likely be necessary. Planning must consider the production pace achieved in this project, approximately 40 units per year, when setting development schedules.

Based on the lessons learned during material development in this Project Study, the following section outlines key topics that require priority coverage, as well as important considerations for expanding the content.

<u>Lessons Involving Difficult Observations or Experiments</u>

Certain science lessons that require laboratory equipment, preparation of specific materials, or observations affected by environmental conditions such as temperature and humidity can be challenging for teachers to conduct in the classroom. In these cases, video-based materials offer a practical alternative. By clearly demonstrating experimental procedures and outcomes, these materials enhance students' understanding and help teachers learn the correct methods and expected results. This can reduce the psychological barriers teachers may face when implementing experiments, making them more likely to offer students hands-on learning experiences. Including additional guidance in lesson plans can also alleviate teachers' concerns about conducting experiments.

<u>Topics That Support Conceptual Understanding Through Modeling</u>

Video materials are particularly effective for conveying abstract or unobservable phenomena. For example, videos in the Project Study illustrated concepts such as the rotation of the Earth and

[6] A format of online learning materials, which can be used by web browser or LMS.

the resulting day–night cycle, particle-based models explaining states of matter, and muscle movements using animations. These types of explanations become more essential as grade levels advance. Continued development of digital materials to cover such content is expected to provide significant instructional support for teachers.

<u>New Units in the Revised Curriculum</u>

The new national curriculum, currently under revision by the MoE and the MNIER, emphasizes subject knowledge, logical thinking, creativity, and the practical application of knowledge. The structure of the digital materials developed in this Project Study aligns with these goals. As the curriculum evolves, teachers will be expected to adopt new instructional approaches. Video-based materials can serve as practical tools to support that transition.

<u>Tasks That Encourage Student Agency and Independent Thinking</u>

Promoting student agency requires tasks that stimulate curiosity and encourage self-directed learning. To achieve this, digital materials should present relatable, thought-provoking questions and problems grounded in Mongolia's local environment, nature, culture, and the developmental stage of primary students. Encouraging students to ask "Why?" and to explore with their senses helps increase deeper engagement in science learning.

<u>Addressing Challenges Observed in the Current Digital Materials</u>

To ensure clarity and accessibility, all materials should use simple and precise Mongolian language. Moreover, content volume should be structured to support lesson design and allow flexible implementation across multiple class periods if needed. Because some teachers may rely heavily on simply showing the videos, materials should remain engaging even when used passively. This may include incorporating humor, ensuring that child actors verbalize predictions and hypotheses, and prompting viewers to think along with the lesson.

In the future, the inclusion of universal design elements, such as subtitles, audio narration, and visual storytelling, will be important to ensure equitable access for all students. These considerations highlight the importance of allocating sufficient lead time for content development and distribution in future projects.

After the development of new digital materials, they should be integrated into the nationwide expansion framework outlined in Approach (1).

Approach Title: Expanding the Coverage of Digital Science Materials
Objective: Increase the grade levels and units covered by digital science materials Target: Primary school students (Grades 1–5) and teachers nationwide Approach Methodology: ① Designate the department and personnel within the MoE (MNIER) responsible for developing digital science materials. ② Formulate a development plan for digital science materials, including target grades and units based on the new curriculum, along with a development schedule and budget allocation. (Development should follow the phased introduction of the new curriculum.) ③ Secure the necessary budget in consultation with the MoE, donor agencies, and other relevant stakeholders. ④ Select educational content developers and video production companies. ⑤ The MNIER and content developers create initial concepts and storyboards for the digital materials. ⑥ Based on the storyboard, the video production company produces digital video materials. ⑦ The MNIER and content developers create accompanying worksheets, teacher guides, and online materials. ⑧ Upload the completed digital science materials to platforms such as Medle to ensure accessibility for teachers and students. ⑨ Conduct regular school visits and online monitoring sessions to follow up on the implementation and usage of the materials.

(3) Teacher Capacity-Building Activities

Observations revealed that the use of the digital science materials developed through the Project Study, both in lesson planning and in classroom practice, contributed to improvements in teachers' subject knowledge and their attitudes toward teaching. Therefore, these materials can be effectively used to strengthen teacher capacity. Coordination with existing training frameworks, such as the national teacher foundational training provided by the Institute of Teachers' Professional Development (ITPD), training supported by other donors such as ADB, and initiatives by education-focused NGOs such as TfM and JoT are desirable to make efficient use of resources. Presenting model science lessons that incorporate digital materials and promote their widespread adoption can further support the enhancement of teachers' instructional skills. These materials can be integrated into both ICT-related and subject-based training programs.

Furthermore, ongoing professional development opportunities are recommended, such as regular study groups held within schools, among neighboring schools, or through online platforms. These learning communities should serve as venues for sharing practical cases of using digital science materials and for facilitating peer learning to disseminate effective practices. Such collaboration can further reinforce the outcomes observed during the Project Study, such as the correction of teachers' scientific misconceptions and improved understanding of accurate science concepts. Strengthening teachers' capacity to facilitate "hypothesis generation and reflection by students," to give "explicit instructions for thinking-based activities," and to provide "support for student learning" is also expected. Additionally, teachers can exchange practical ideas on how to implement experiments and observations using locally available materials, thus promoting experiential science learning even in schools with limited facilities.

Approach Title: Teacher Capacity-Building Activities
Objective: To enhance teachers' subject knowledge and attitudes toward teaching using digital science materials. Target: Primary school science teachers nationwide Approach and Methods: ① Conduct a survey of existing teacher training programs implemented by the MoE, donors, and educational NGOs. ② Discuss the potential benefits of incorporating digital science materials into these existing teacher training programs. ③ Revise existing teacher training materials to integrate the use of digital science materials. ④ Implement training programs in accordance with the existing training plans. ⑤ Investigate existing teacher learning communities and study groups. ⑥ Regularly provide these learning communities with examples of digital science material usage and lesson studies categorized by grade and topic. ⑦ Conduct school visits and online monitoring to follow up on the implementation of teacher training and study groups.

IV-2. Recommendations for Application in Other Countries

Based on the lessons learned from this Project Study and the recommendations provided for Mongolia, the following considerations are proposed for effectively introducing similar approaches in other countries to enhance students' interest in science subjects and strengthen their foundational scientific literacy.

(1) Considerations for Developing Educational Materials

<u>Ensuring Alignment with Curriculum and Textbooks</u>

To facilitate classroom integration, supplementary materials should be aligned with the national curriculum and textbooks of each country, enabling local teachers to use them with confidence.

<u>Design and Format Considerations</u>

In addition to video content, accompanying worksheets for students and lesson plans for teachers should be developed as a set to ensure the materials can be seamlessly incorporated into lessons.

Stimulating Interest Alongside Scientific Understanding

Rather than focusing solely on knowledge acquisition and verification, materials should be structured to encourage students to think for themselves and foster scientific curiosity. A sequence such as “introduction→experiment/observation/discussion→advanced content” is recommended. Everyday questions and familiar phenomena should be incorporated to capture students’ interest and make learning enjoyable.

Complementing Experiments, Observations, and Collaborative Learning

For scientific content that is difficult to implement in real classrooms, video-based materials can be used to provide experiential learning. The materials should be designed to encourage student interaction, such as predicting outcomes before watching videos and sharing observation results afterward.

Incorporating Offline and Printable Materials

In countries with uneven ICT environments, it is essential to develop materials that can be downloaded and used offline, such as PDF worksheets that can be printed, to ensure accessibility regardless of connectivity.

(2) Teacher Training and Capacity Development

Preliminary Training to Enhance Material Utilization

Face-to-face training sessions should be conducted to share the purpose of the materials, methods of utilization, and lesson design strategies. By experiencing hands-on practice through mock lessons, teachers are more likely to effectively use the materials and improve their classroom instruction.

Promoting Peer Learning through Sharing Practices

Both online and in-person training should include case studies from other teachers. Sharing not only successful strategies but also lessons learned from failed attempts encourages grounded and practical use of materials across classrooms.

Materials That Facilitate Teacher Learning

Lesson plans should include detailed examples of class progression, suggested questions and answers, guidance on addressing common misconceptions, instructional tips, and advanced scientific knowledge. This enables teachers to understand what and how to teach effectively. Well-designed lesson plans also serve as a valuable resource for novice teachers to support their own instructional preparation.

(3) Improvement of Educational Environments

Prioritized Introduction in Schools and Regions with Capacity

Priority should be given to schools and regions that have the necessary ICT environment for classroom use, such as Internet access, display equipment, and electricity, and teachers with the capacity and attitude to effectively utilize digital tools. Demonstrating the positive impact of such materials in these environments can encourage other schools to improve their infrastructure. It should be noted that in Mongolia, the materials were not used solely for home learning, and therefore their effectiveness for that purpose remains unverified.

<u>Providing Accessible Environments for Digital Materials</u>

Digital materials should be delivered in various formats and structured so that they can be accessed through officially endorsed platforms such as the government's LMS or other designated digital distribution platforms.

<u>Strategic Introduction in Areas Lacking Comparable Digital Materials</u>

In countries or regions where no similar digital science materials currently exist, the introduction of high-quality content is likely to generate significant educational benefits. If sufficient ICT infrastructure is in place, such areas should be prioritized for strategic deployment.

As discussed above, effectively enhancing students' interest in science and improving their foundational academic abilities using digital learning materials requires more than simply providing content. It demands a comprehensive approach that considers the quality of the materials, teachers' instructional competence, students' learning engagement, and the overall learning environment. The results from Mongolia showing increased student interest, confidence, and academic performance in science, as well as improved teaching capacity and material utilization skills among teachers demonstrate that, when implemented in the right context at the right time, similar outcomes can be expected in other countries as well.

<u>Appendices</u>

Appendix 1: School List
Appendix 2: Plan of Operation
Appendix 3: Personnel Plan
Appendix 4: List of Counterpart (C/P) Members
Appendix 5: List of Digital Science Learning Materials
Appendix 6: List of Instructional Videos on Material Utilization

Appendix 1：School List

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JICA PROJECT PILOT SCHOOL LIST																													
№	Region	Province/District	School	Video shoot	Location			Affiliation				Number of students			Number of teachers		#students/clss (Average)		Baseline target							Training participants (Actual)			
					Soum (District)	Aimag (Province)	Capital	Google partnership	Japanese Grant Aid	Teach for Mongolia	Joy of Teaching	# of 4th grade classes	# of 5th grade classes	Average	# of 4th grade teachers	# of 5th grade teachers	# G4 students per class	# G5 students per class	#Teachers in G4 and G5	Grade 4			Grade 5			G4	G5	Manager	Total
																				# of G4 classes	Target G4 class	# G4 students per class	# of G5 classes	Target G5 class	# G5 students per class				
Treatment Schools																													
1	Ulaanbaatar	UB, Bayangol	Setgemj complex school				1	1	1			124	130	127	4	3	31	43	6	3	4v	42	3	5a	42	1	1	1	3
2	Ulaanbaatar	UB, Bayanzurkh	21st secondary school	✓			1				1	509	487	498	11	11	46	44	23	12	4-i	50	11	5-l	50	2	3	0	5
3	Ulaanbaatar	UB, Songinokhairkhan	Ireedui complex school	✓			1	1	1			346	326	336	8	8	43	41	17	9	4v	45	8	5a	49	3	2	1	6
4	Ulaanbaatar	UB, Baganuur	Bolovsrol complex school				1	1	1			277	319	298	7	8	40	40	13	6	4b	36	7	5g	42	2	2	1	5
5	West	Khovd	Munkhkhairkhan public school	✓	1					1		41	28	34.5	2	1	21	28	4	2	4b	16	2	5b	19	1	2	0	3
6	Khangai	Arkhangai	Tsenkher public school		1						1	79	69	74	3	2	26	35	5	2	4a	32	3	5a	28	1	1	0	2
7	Central	Selenge	Khushaat public school		1					1		29	35	32	1	1	29	35	2	1	4a	32	1	5a	29	1	1	1	3
8	Central	Tuv	Mungunmorit public school	✓	1						1	33	28	30.5	1	1	33	28	2	1	4a	32	1	5a	27	1	1	0	2
9	Gobi	Umnugovi	Tsogttsetsii public school #2	✓	1					1		187	170	178.5	5	5	37	34	10	5	4v	40	5	5b	40	1	1	1	3
10	North	Orkhon	Public school #2			1			1			46	45	45.5	2	2	23	23	4	2	4b	20	2	5b	25	1	1	1	3
11	Central	Tuv	Zuunmod public school #5			1				1	1	95	105	100	3	3	32	35	6	3	4b	32	3	5a	32	1	1	1	3
12	Gobi	Govisumber	Sumber public school #5	✓		1				1		127	162	144.5	4	4	32	41	8	4	4v	30	4	5v	31	2	2	1	5
13	East	Sukhbaatar	Baruun-Urt public school #1			1				1		233	222	227.5	7	6	33	37	14	7	4v	32	7	5a	32	2	2	1	5
14	West	Govi-Altai	Taishir public school	✓	1							17	8	12.5	1	1	17	8	2	1	4a	15	1	5a	8	1	1	1	3
	Нийт / Total			**7**	**6**	**4**	**4**	**3**	**4**	**6**	**4**	**2143**	**2134**	**2138.5**	**59**	**56**	**443**	**471**	**116**			**454**			**454**	**20**	**21**	**10**	**51**
Control Schools																										Briefing（Actual）			
1	Ulaanbaatar	UB, Bayanzurkh	84th secondary school				1	1				514	547	530.5	10	11	51	50	21	10	4-10	51	11	5-11	55			0	0
2	Ulaanbaatar	UB, Bayanzurkh	14th secondary school				1	1	1			582	627	604.5	12	12	49	52	25	13	4-4	50	12	5-8	50			1	1
3	Ulaanbaatar	UB, Chingeltei	57th secondary school				1	1				151	154	152.5	5	5	30	31	8	4	4b	27	4	5g	38			0	0
4	Ulaanbaatar	UB, Chingeltei	23rd secondary school	✓			1	1				292	304	298	6	6	49	51	12	6	4v	52	6	5b	50			0	0
5	West	Zavkhan	Tosontsengel public school #1		1					1	1	96	99	97.5	4	3	24	33	7	3	4a	32	4	5a	30			0	0
6	Khangai	Uvurkhangai	Khujirt public school		1					1		126	139	132.5	4	5	32	28	2	1	4a	29	1	5a	36			1	1
7	Central	Selenge	Zuunkharaa public school #1		1					1		109	77	93	4	3	27	26	8	4	4b	27	4	5a	27			1	1
8	Central	Darkhan-Uul	Shariin gol public school #2		1					1		126	123	124.5	4	4	32	31	8	4	4v	29	4	5v	29			1	1
9	East	Sukhbaatar	Uulbayan public school		1						1	47	56	51.5	2	2	24	28	4	2	4b	24	2	5a	24			1	1
10	North	Khuvsgul	Murun public school #1			1				1		230	259	244.5	6	6	38	43	12	6	4d	43	6	5d	43			1	1
11	North	Orkhon	Bayan-Undur public school #4			1		1				256	266	261	7	7	37	38	14	7	4b	43	7	5ye	43			0	0
12	Central	Darkhan-Uul	Public school #4			1			1			137	119	128	4	4	34	30	8	4	4a	36	4	5a	36			0	0
13	Gobi	Umnugovi	Dalanzadgad public school #3	✓		1					1	160	145	152.5	4	4	40	36	8	4	4a	45	4	5a	45			0	0
14	Khangai	Uvurkhangai	Arvaikheer public school #4			1				1	1	185	183	184	5	5	37	37	10	5	4g	34	5	5a	38			0	0
	Нийт / Total			**2**	**5**	**5**	**4**	**5**	**2**	**6**	**4**	**3011**	**3098**	**3054.5**	**77**	**77**	**503**	**512**	**147**			**522**			**544**	0	0	6	**6**

Appendix 2: Plan of Operation

Activity			Plan/Actual
A. Preparation	1)	Drafting the Work Plan in Japanese (in Japan)	Plan / Actual
	2)	Drafting the Work Plan in English (in Japan)	Plan / Actual
	3)	Discussing the Work Plan with JICA and C/P agencies	Plan / Actual
	4)	Establishing the project office (Procuring equipment and employing local staff)	Plan / Actual
B. Current Status and Issue Analysis	1)	Analysis of curriculum, textbooks, and teacher's guides (in Japan)	Plan / Actual
	2)	Analysis of ICT environment and usage (in Japan)	Plan / Actual
	3)	Analysis of the ability of teachers and students to use ICT materials (in Japan)	Plan / Actual
	4)	Observation, interview, and additional analysis related to 1) through 3)	Plan / Actual
	5)	Summarizing issues and countermeasures based on the analysis results	Plan / Actual
C. Material Development	1)	Formulation of and discussion on the material development plan (in Japan and Mongolia)	Plan / Actual
	2)	Development of and discussion on sample learning materials	Plan / Actual
	3)	Sub-contracting the development of digital learning materials	Plan / Actual
	4)	Development of digital learning materials in science for in-class use	Plan / Actual
	5)	Development of worksheets for students linked to digital learning materials (in Japan and Mongolia)	Plan / Actual
	6)	Development of a model lesson plan linked to digital learning materials and worksheets (in Japan and	Plan / Actual
	7)	Development of briefing materials for teachers	Plan / Actual
D. Material Piloting	1)	Selection of pilot schools	Plan / Actual
	2)	Briefing for pilot school teachers	Plan / Actual
	3)	Uploading, printing, and distributing the developed materials	Plan / Actual
	4)	Monitoring and support of pilot schools	Plan / Actual
E. Effectiveness Measurement	1)	Planning and consultation on the baseline and end-line surveys (in Japan and Mongolia)	Plan / Actual
	2)	Development and piloting of baseline and end-line survey tools (tests, questionnaires, classroom observation sheets)	Plan / Actual
	3)	Selection, hiring, and training of baseline surveyors	Plan / Actual
	4)	Conducting the baseline survey	Plan / Actual
	5)	Data entry and analysis of the baseline survey (in Japan and Mongolia)	Plan / Actual
	6)	Writing the Baseline Survey Report (in Japan)	Plan / Actual
	7)	Debriefing session of the baseline survey	Plan / Actual
	8)	Selection, hiring, and training of end-line surveyors	Plan / Actual
	9)	Conducting the end-line survey	Plan / Actual
	10)	Data entry and analysis of the end-line survey (in Japan and Mongolia)	Plan / Actual
	11)	Writing the End-line Survey Report (in Japan)	Plan / Actual
F. Project Completion Report	1)	Debriefing session of the project study results	Plan / Actual
	2)	Writing the Project Completion Report (in Japan and Mongolia)	Plan / Actual

Period (Year/Month): 2024: 4, 5, 6, 7, 8, 9, 10, 11, 12; 2025: 1, 2, 3, 4, 5, 6, 7, 8

Submission period of each deliverable (Indicated with △): △ Work Plan (JP); △ Work Plan (EN); △ Baseline Survey Report; △ Draft Project Completion Report; △ End-line Survey Report; △ Project Completion Report

Legend: Activity in Japan (Plan) Activity in Mongolia (Plan) Activity in Japan (Actual) Activity in Mongolia (Actual)

Annex 3: Personnel Plan

		Title	Name	Organization	2024												2025								Total	
					1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	Total Days	Total P/M
Work in Mongolia	1	Team Leader/ Educational Planning	Mr. Chiko Yamaoka	IC Net						15			11							10	2			9	47.00	1.57
	2	Deputy Team Leader/Science Education	Dr. Kotaro Kijima	IC Net						18	5	25	13	15						18				13	107.00	3.57
	3	Science Material Development 1	Mr. Tatsuya Maehara	Gakken						8	5														13.00	0.43
	5	Science Material Development 2	Mr. Nobuyuki Irisawa	Gakken						8	5	9		10											32.00	1.07
	4	Digital Material Development	Mr. Daisuke Tanaka	Gakken								25		24		25			20	8					102.00	3.40
	6	Survey Monitoring and Supervision 1	Mr. Enkhbold Batjargal	IC Net																					0.00	0.00
	7	Survey Monitoring and Supervision 2	Mr. Issei Morita	IC Net						18	3		20							15	7			13	76.00	2.53
																									377.00	**12.57**
Work in Japan	1	Team Leader/ Educational Planning	Mr. Chiko Yamaoka	IC Net					1	3	2	1		3						5	7	4	5		31.00	1.55
	2	Deputy Team Leader/Science Education	Dr. Kotaro Kijima	IC Net						4			2	3						6	6	8	7		36.00	1.80
	3	Science Material Development 1	Mr. Tatsuya Maehara	Gakken								4		2		4			4						14.00	0.70
	5	Science Material Development 2	Mr. Nobuyuki Irisawa	Gakken										0.67						5	5				10.67	0.53
	4	Digital Material Development	Mr. Daisuke Tanaka	Gakken																6.40	5				11.40	0.57
	6	Survey Monitoring and Supervision 1	Mr. Enkhbold Batjargal	IC Net					※	3	3	10	5	3	3	3	1	2	2	4	1	1	3		44.00	2.20
	7	Survey Monitoring and Supervision 2	Mr. Issei Morita	IC Net										3							2	6	5		16.00	0.80
																									163.07	**8.15**
																									540.07	**20.72**

Legend: Work in Mongolia (Plan) / Work in Mongolia (Actual) / Work in Japan (Plan) / Work in Japan (Actual)

※ The expert on Survey Monitoring and Supervision 1, who resides in Mongolia, will perform his tasks there.

Deliverables: Work Plan (JP); Work Plan; Baseline Survey Report; Draft Project Completion Report; End-line; Project Completion Report

Appendix 4: List of Counterparts (C/Ps)

Role	Name	Position/Organization	Engagement Period	Remarks
Project Study Manager	Dr. Kh. Otgonbaatar	Head of the Education Policy and Planning Research Sector, MNIER	June 2024–August 2025	Concurrent member of the Working Group
Project Study Staff	Mr. B. Altansukh	Specialist (Physics), Curriculum, Evaluation and Teaching Material Research Sector, MNIER	June 2024–August 2025	Concurrent member of the Working Group
Project Study Staff	Ms. G. Bayanchimeg	Specialist (Chemistry), Curriculum, Evaluation and Teaching Material Research Sector, MNIER	June 2024–September 2024	Took leave from September 2024
	Ms. M. Uuganzaya		September 2024–August 2025	Assigned owing to the predecessor's leave
Project Study Staff	Ms. G. Khaliun	Specialist, Education Policy and Planning Research Sector, MNIER	June 2024–August 2025	Concurrent member of the Working Group
Working Group Members	Mr. T. Barsbold	Specialist (IT), MNIER	September 2024–August 2025	
Working Group Members	Mr. S. Gendenjamts	Head, Item Bank Division, EEC	September 2024–August 2025	
Working Group Members	Ms. Davaadulam	Specialist, Item Bank Division, EEC	September 2024–August 2025	
Working Group Members	Mr. B. Gan-Erdene	Specialist, Item Bank Division, Education Evaluation Center	September 2024–August 2025	
Working Group Members	Ms. Ts. Delgermaa	Specialist (Science), Department of Curriculum Implementation, GAE	September 2024–August 2025	
Working Group Members	Ms. B. Enkhzaya	Specialist, EIT	September 2024–August 2025	
Working Group Members	Ms. E. Davaakhuu	Director, Joy of Teaching (Education-focused NGO)	September 2024–August 2025	
Working Group Members	Dr. V. Gundegmaa	Professor (Biological Sciences), Mongolian National University of Education	September 2024–August 2025	
Total	12	(Excluding those concurrently serving or with mid-term changes)		

Appendix 5: List of Digital Science Materials

List of Digital Science Materials (Grade 4)

Strand	ID	Digital Material Title
Life and Environment	4-1	Our Bones
	4-2	How Do We Move?
	4-3	Are Animal Bones Similar to Human Bones?
	4-17	How Do Living Things Adapt to the Environment? (Plants)
	4-18	How Do Living Things Adapt to the Environment? (Animals)
	4-19	Interactions of Living Things: The Food Chain
Physical Science	4-4	Do All Objects Cast Shadows?
	4-5	Can We Change the Width of a Light Beam?"
	4-6	Let’s Collect Light
	4-7	The Motion of a Pendulum
	4-8	The Rule of the Pendulum
	4-9	Let’s Light a Bulb Using a Battery
	4-10	What Conducts Electricity?
	4-11	Earth’s Gravity
	4-12	What Are Solids, Liquids, and Gases?
	4-13	Why Do Solids, Liquids, and Gases Have Different States?
	4-14	What Dissolves in Water?
	4-15	How to Represent Particles in Water
Earth and Space	4-16	Climate Change
	4-20	How Can We Reduce Waste?

Note: Each digital learning material comprises a video component, a worksheet, a lesson plan, and an online module.

List of Digital Science Materials (Grade 5)

Strand	ID	Digital Material Title
Life and Environment	5-14	What Are the Organs of a Plant?
	5-15	Life Cycle of Flowering Plants
	5-16	Reproducing Plants from Vegetative Organs
	5-17	Which One Is an Insect?
	5-18	Life Cycles of Butterflies and Grasshoppers
	5-19	Reproduction and Life Cycles of Living Things (Egg-Laying Animals)
	5-20	Reproduction and Life Cycles of Living Things (Viviparous Animals)
Physical Science	5-3	What Is Balance?
	5-4	How Can We Lift Heavy Objects?
	5-5	Uses of Levers
	5-6	Air Resistance
	5-7	How Does Water Change?
	5-8	What Happens to Particles During a Change of State?
	5-9	Where Do Water Droplets Come From? (The Water Cycle)
	5-10	What Is the Difference Between Reversible and Irreversible Changes?
	5-11	Investigating Combustion
Earth and Space	5-1	Let's Identify the Sun's Position by the Shadow of the Body
	5-2	Day and Night (Earth's Rotation)
	5-12	Observing Weather: Temperature
	5-13	Observing Weather: Wind

Note: Each digital learning material comprises a video component, a worksheet, a lesson plan, and an online module.

Appendix 6: List of Instructional Videos for Teaching Material Utilization

Objective:

To enable teachers to conduct effective science lessons using the digital learning materials by watching explanatory videos.

Purpose	Number	Content (each within 20 minutes)
Introduction to the Materials	1	Overview of the Project Study
	2	Structure and content of the digital learning materials
Effective Use of Video Materials	3	Lesson planning and implementation using the developed materials; annual planning
	4	Introduction of good practices (from end-line videos, etc.)
	5	Video materials and scientific process skills
	6	Using video materials to guide hypothesis generation in science lessons
	7	Guidance on observation and experimentation using video materials