



CHEVRON ENJOY SCIENCE PROJECT MIDLINE

EVALUATION EXECUTIVE SUMMARY



▶ THIRD-PARTY EVALUATION: BACKGROUND

The Chevron Enjoy Science Project is a \$30 million, five-year, public-private partnership to strengthen Thailand’s competitiveness and innovation by improving science, technology, engineering and math (STEM) education, and technical vocational education and training (TVET) across the country. The Enjoy Science project provides math and science teachers with training in highly effective pedagogical techniques to improve their teaching practices and, in turn, their classroom learning environments. The project engaged Management Systems International (MSI) to provide third-party evaluation services of project impact. The Enjoy Science evaluation team consists of evaluation and education experts from MSI and the members of the National Research Team (NRT) — over 50 education faculty members and research assistants from 16 regional universities in Thailand. Across 54 provinces, 244 schools participated in the study, reaching 20,306 students and 1,044 teachers. The midline evaluation is the second of three rounds of the Enjoy Science evaluation (baseline, midline, and endline), which specifically focuses on the three key areas of the program’s implementation: STEM (grades 7-9), STEM for TVET (grades 10-12), and Technical TVET (grades 13-14). The research questions guiding the midline evaluation are the following:

STEM COMPONENT

- 1 Does professional development and mentoring of math and science teachers in the areas of project- based and inquiry-based learning strengthen teacher engagement and instructional practice?
- 2 Do strengthened curriculum materials and improved teacher engagement and instructional practice lead to increased student interest and engagement in math and science subjects?
- 3 Does improved teacher engagement and instructional practice lead to increased student achievement on national math and science metrics?
- 4 Does increased student achievement in math and science lead to increased selection of STEM/TVET academic tracks?

TVET COMPONENT — STEM FOR TVET ACTIVITY

- 1 Does professional development and mentoring of science teachers in the areas of project-based and inquiry-based learning strengthen teacher competency and practice?
- 2 Do strengthened curriculum materials lead to increased relevance of the curriculum and improved teacher competency and practice?
- 3 Does increased curriculum relevance and improved teacher practice improve student learning of applied science and math?

TVET COMPONENT — TECHNICAL TVET ACTIVITY

- 1 Does professional development and curriculum enhancement improve teacher competency?
- 2 Does curriculum enhancement make the curriculum more relevant to industry?
- 3 Do improved teacher competency, industry-relevant curriculum, short courses and work placement improve the skills, abilities and experience of students?



METHODOLOGY

The midline evaluation used a mixed-methods approach relying on both primary and secondary data analysis to establish midline measurements on The Enjoy Science Project's key indicators. The direction and magnitude of change in the indicators from midline to baseline was evaluated. Both quantitative and qualitative data were collected in *intervention schools* that participated in the Enjoy Science project, and a matching set of *comparison schools* that were not involved in the Enjoy Science project. Quantitative analyses used a difference-in-differences (DID) technique intervention and comparison groups with two points-in-time comparisons (baseline and midline). Qualitative analyses included coding and categorization of themes emerging from structured focus group discussions with students and teachers.

DATA SOURCE AND INSTRUMENTS

STEM COMPONENT

Primary data was collected for all of the components in both intervention and comparison schools. Surveys to students, teachers, and principals were the tool used to collect quantitative data. The surveys documented perceptions of students and math/science teachers on a diverse range of topics, such as students' perceived competence in STEM, teachers' practices in the classroom, and students' and teachers' perception on the relevance of STEM studies. Further, a classroom observation tool—the UTeach Observation Protocol (UTOP)—was used to assess math/science classes in intervention and comparison schools. The UTOP is a unique observation tool, combining both quantitative and qualitative methods, to understand the primary objective of the Enjoy Science project: whether students' classroom experiences and engagement with their teachers and peers improves as a result of changes in their teachers' pedagogical practices after participating in Enjoy Science. Qualitative instruments included student focus group discussions and teacher interviews for the schools in the STEM and STEM for TVET components.

SECONDARY DATA AND STUDENT ASSESSMENT IN THAILAND

Secondary data included the Ordinary National Educational Test (O-NET) and the Vocational National Educational Test (V-NET) assessment data. All scores were provided directly by the National Institute of Educational Testing Service (NIETS) for analysis of items with content related with the Enjoy Science program. The midline evaluation focused specifically on O-NET scores for M3 (equivalent to grade 9) and V-NET scores for V3 (equivalent to grade 12). O-NET and V-NET data were analysed to complement primary data gathered by the evaluation team.



Student Surveys



Student Focus Group Discussions



Teacher Surveys



Classroom Observations



Teacher Interviews



School Director Surveys

O-NET

V-NET

DATA ANALYSIS

The midline analysis includes (a) baseline-to-midline comparisons for Enjoy Science activities that began prior to baseline data collection, and (b) baseline reporting for activities that began prior to midline data collection or were modified in some substantial way. Principal Component Analysis (PCA) was used to create indicators from student and teacher survey data. The PCA technique helps identify the underlying components that explain variance in data, as well as the amount of variance explained by each component (i.e. the strength of each component). In this case, PCA helped the evaluation team identify patterns in teacher and student outcomes and their similarities and differences, and the components that explained why these patterns are occurring. UTOP data was analyzed item-by-item as each item measures a different aspect of classroom instructional quality and offered critical information for the implementation and evaluation teams. Qualitative data were coded, categorized, and summarized across instruments; key themes that emerged were triangulated against quantitative data.

▶ ETHICAL REVIEW AND IRB APPROVAL

MSI and Kenan Foundation Asia (the lead implementing and coordinating agency for the Enjoy Science Project) received approval to conduct evaluation activities from Khon Kaen University's Institutional Review Board (IRB), a committee that ensures the ethical compliance of research design and data collection, management, analysis and reporting procedures. Further, TVET activities and evaluation tools were also reviewed and approved by King Mongkut's University of Technology Thonburi's (KMUTT's) IRB committee. MSI also received overall IRB approval (exempt status) from Advarra IRB (formerly Chesapeake IRB), a leading Association for the Accreditation of Human Research Protection Programs (AAHRPP)-accredited North American review board that has extensive experience regulating and examining the ethical implications of research designs and processes in the United States and other countries.

▶ SAMPLING AND SCHOOL SELECTION

Before baseline data collection, MSI ran a matching analysis to select a set of comparison schools similar to the intervention schools in the following set of characteristics: urban/rural locality, size of school, the administrative oversight authority, and pre-intervention school-level results on national test scores (O-NET, V-NET).

	STEM	STEM FOR TVET	TECHNICAL TVET
 SCHOOLS	144	100	40
 TEACHER	272	283	345
 STUDENT	6,238	9,541	4,527
 SCHOOL DIRECTOR		49	

▶ KEY FINDINGS

STEM RESULTS

UTOP Results: Intervention classrooms were higher performing than comparison classrooms in key areas related to teachers' pedagogical approaches, students' engagement with science and math materials, and quality and frequency of teacher-student interactions. Students whose teachers participated in the Enjoy Science project were more often observed to spend time on task, receive math and science lessons that were well structured and organized by their teachers, and discuss content that is developmentally appropriate. Students were frequently observed to be very engaged with the material in classrooms and understood its relevance and importance. UTOP results further suggested that teachers in intervention schools relied on investigative problem solving and inquiry-based approaches espoused by the Enjoy Science project, and these teachers interacted with all students regardless of gender or ability. Positive Difference in Differences and statistically significant findings included:

CLASSROOM ENVIRONMENT

- ✓ Teachers focused attention to issues of access, equity and diversity for students

LESSON STRUCTURE

- ✓ Included opportunities for the instructors to gauge students' understanding
- ✓ Allowed students to engage with or explore important concepts
- ✓ Included an investigative or problem-based approach to important concepts

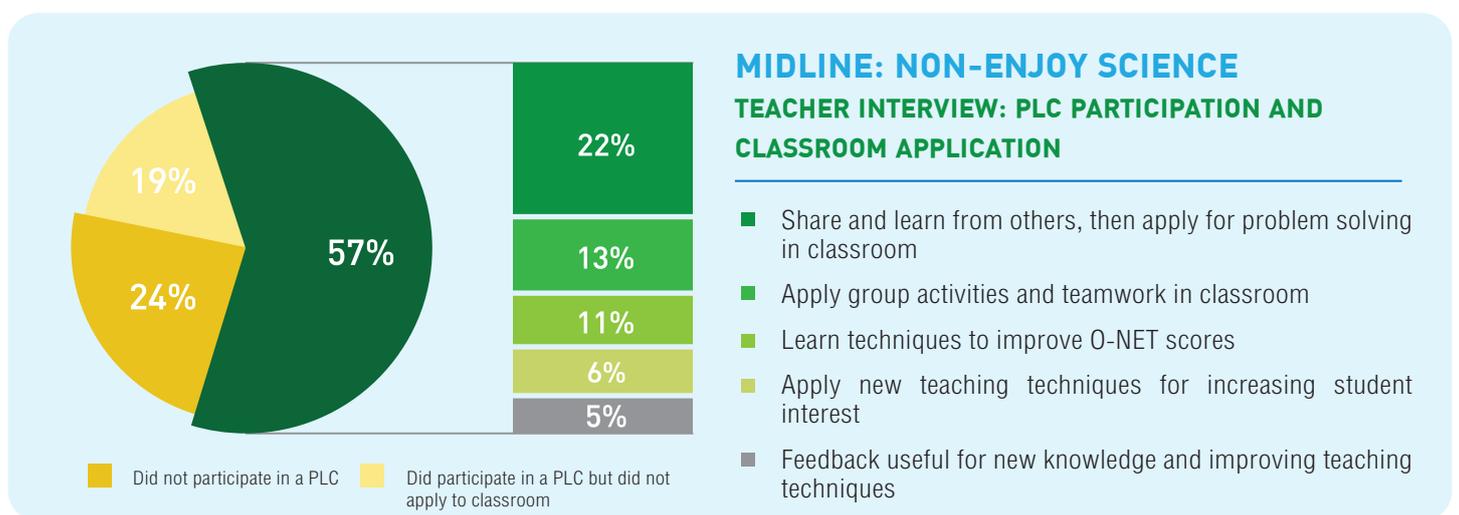
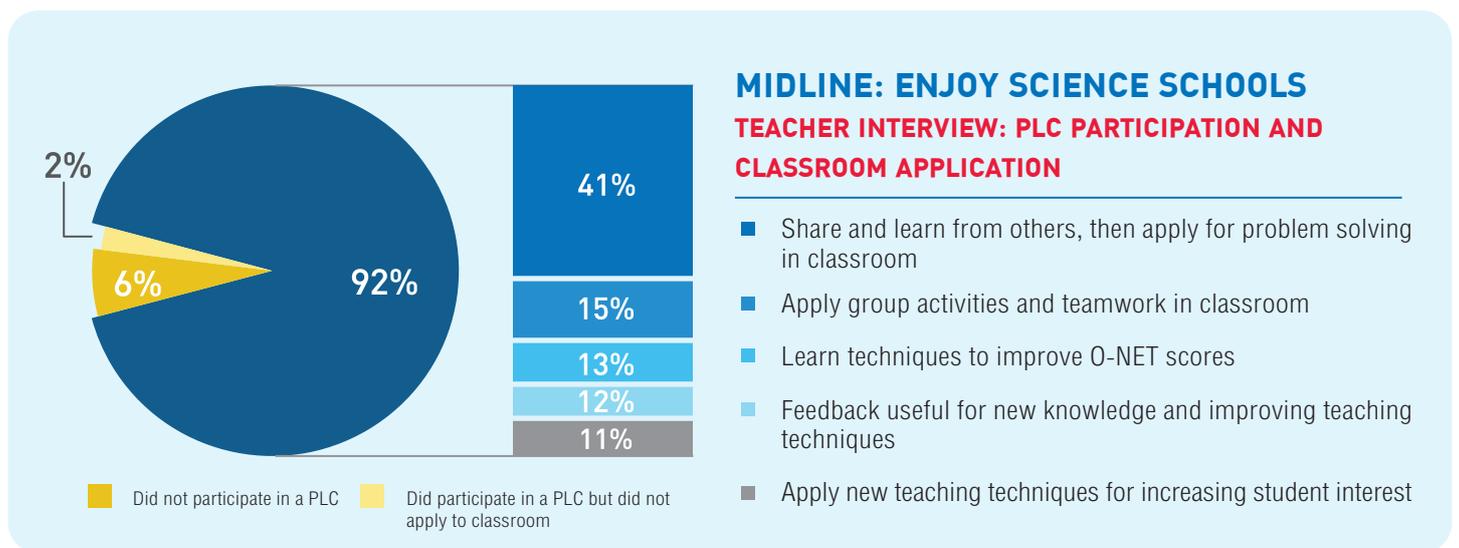
IMPLEMENTATION OF MATH AND SCIENCE CONCEPT

- ✓ Teachers used formative assessment effectively to be aware of the progress of all students and modified the lesson appropriately

Teacher Indicators Results: The DID analysis of the STEM teacher survey indicators compared teachers in the comparison group to teachers in the intervention group at both baseline and midline. The evaluation team found strong and statistically significant evidence that intervention teachers reported emphasizing the learning activities and areas on which Enjoy Science training focused. Though not statistically significant, the evaluators observed that intervention teachers reported lower levels of professional confidence than the comparison teachers did at midline. This is an important finding with implications of programmatic significance as it demonstrates, through triangulation with qualitative results, that intervention teachers are more aware of their limitations in trying new pedagogical techniques and using Enjoy Science materials and understand where they need to improve. In fact, almost all intervention teachers reported plans to update or improve their teaching, whereas only a few comparison teachers reported the same.

Student Indicators Results: At midline, intervention students outperformed comparison students consistently across all indicators. A particularly strong and statistically significant difference between the groups emerged for students' perceptions of their teachers' in-class activities, suggesting that not only have the teachers' activities effectively changed as supported by UTOP indicators and teacher survey indicators, but students' perceptions align with the new in-class activities. Intervention students also display stronger tendencies to select STEM/TVET academic tracks and place greater importance on math and science subjects than comparison students.

Qualitative data complement these survey findings, with minimal differences found between math and science teachers. Ninety-four percent of teachers from intervention schools attended professional learning communities (PLCs)—groups of teachers that meet regularly to share expertise and work collaboratively to improve teaching skills and the academic performance of students. Of this group of teachers, 98% were more likely to use the information learned in Enjoy Science PLCs in preparation for their classes.



UTOP Results: UTeach Observation Protocol (UTOP) analyses were positive and statistically significant in favor of the intervention group. Specifically, teachers participating in Enjoy Science professional development offerings were more likely to have on-task students, structure and organize lessons, use 7E and project-based learning approaches to ensure student understanding, and encourage all students to be involved in class discussions and activities. Statistically significant findings included:

7-E LEARNING CYCLE:	CLASSROOM ENVIRONMENT	LESSON STRUCTURE	IMPLEMENTATION OF MATH AND SCIENCE CONCEPT
Phase 1: Engage	The majority of students were on task throughout the class	Included opportunities for the instructor to gauge student understanding	Teacher involved all students in the lesson (calling on non-Volunteers, checking in with hesitant learners, etc.)
Phase 2: Elicit			
Phase 3: Explore	Teacher focused attention to issues of access, equity, and diversity for students	Allowed students to engage with or explore important concepts	Teacher used formative assessment effectively to be aware of the progress of all students and modified the lesson appropriately
Phase 4: Explain			
Phase 5: Elaborate		Included an investigative or problem-based approach to important concepts	
Phase 6: Extend			
Phase 7: Evaluate			

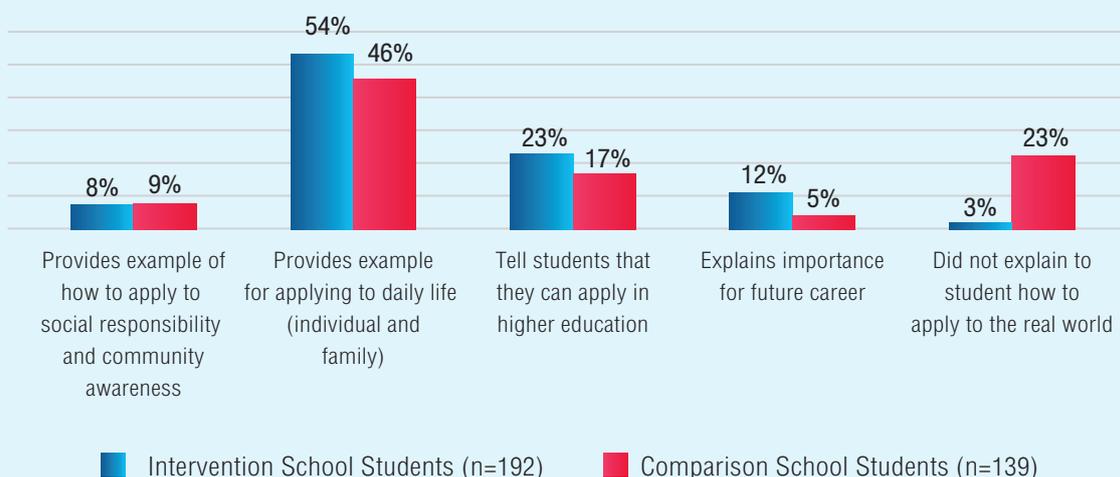
Teacher Indicators Results: Overall, based on midline teacher survey data, the evaluation team found that compared with teachers in the comparison group, intervention teachers:

- ▶ Use the 7E and project-based learning approach pedagogical techniques with greater frequency;
- ▶ Participate in more professional development activities;
- ▶ Engage with students more often and encourage their application of critical thinking skills;
- ▶ Believe the Enjoy Science curriculum is relevant for their students and recognize the connection between science and workplace activities.

Student Indicators Results: Positive (though not statistically significant) differences in favor of the intervention group were found in the following areas: students’ perceptions of teaching practices, frequency of activities in class, perceptions of their own abilities in math and science, and the relevance of science content toward future employment opportunities. For three indicators (student perceptions of teacher practices, student-teacher practices, in-class activities), the intervention students still outperform comparison students at midline.

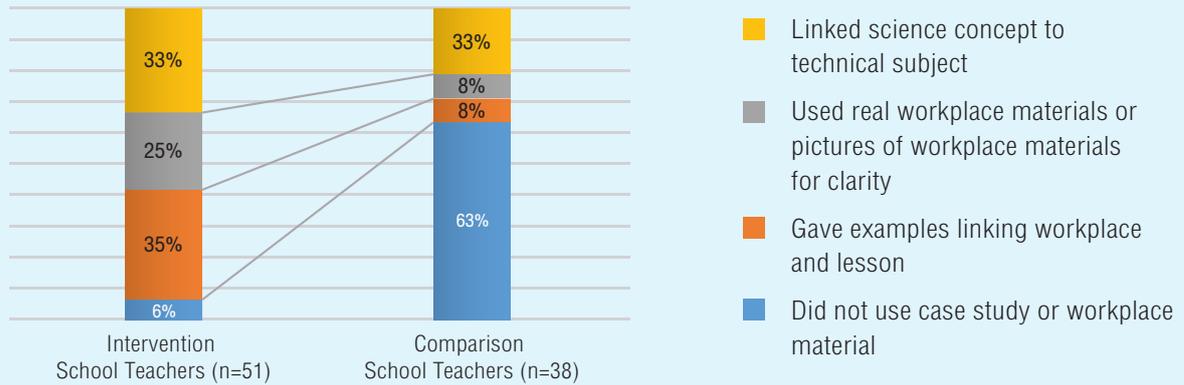
MIDLINE: STEM FOR TVET, STUDENT FOCUS GROUP DISCUSSION

DOES YOUR TEACHER PROVIDE EXAMPLES OF HOW SCIENCE CONCEPTS APPLY TO THE WORLD OF WORK AND/OR EVERYDAY LIFE?



MIDLINE: STEM FOR TVET, TEACHER INTERVIEW

DID THE TEACHERS USE WORKPLACE CASE STUDIES OR WORKPLACE MATERIALS TO DEMONSTRATE OR REINFORCE SCIENCE CONCEPT? IF SO, WHAT DID THE TEACHERS USE AND WHY?



Qualitative analysis of STEM for TVET schools suggest that teachers in intervention schools are more likely to prepare for classes with the Enjoy Science material. Both teachers and students in intervention schools came to recognize the relevance of the lessons' content to daily life. Also, teachers in intervention schools are more likely to use a teaching approach emphasizing problem solving. The student survey confirms that students believe they learn best from this type of approach. Teachers in intervention schools are also more likely to critically assess their own teaching.

STEM FOR TVET RESULTS – MATH

STEM for TVET (Math) data provided a baseline assessment of teachers and students on key indicators in 2018. The data collection was conducted before the delivery of math professional development activities to intervention teachers, and the provision of Enjoy Science learning materials to teachers and students. Mostly, no statistically significant differences emerged between intervention and comparison schools. The absence of differences is expected, given that data collection activities for math activities occurred prior to implementation of activities, and will serve as a balanced baseline for future analyses.

TECHNICAL TVET RESULTS

Implementation of the Industrial Robotics activity had not yet begun at the beginning of the study, offering the chance to obtain a “true baseline” for students and teachers midline. Data collected during the endline (June 2019) will serve as a second time point. Analysis suggests that the Technical TVET intervention and comparison groups were balanced at baseline and further exploration will help to identify results from the intervention.

O-NET AND V-NET RESULTS

National Institute of Educational Testing Service (NIETS) provided O-NET and V-NET scores by indicators deemed relevant to the objectives and activities of the Enjoy Science project to the evaluation team. For all the years (2012-2017), the sample of grade 9 intervention students with available Math and Science O-NET data scored slightly more correct responses than comparison students, though the magnitude of this difference is smaller in recent years. For the 2016 and 2017 years, the sample of vocational grade 12 intervention students with available science V-NET data scored slightly more correct responses than comparison students. None of the differences are statistically significant and suggest interpreting results with caution due to limitations of the data.

SUMMARY

The midline evaluation results show that Enjoy Science schools are making marked progress in improving the quality of teaching and learning. It is hoped that the findings may help to guide the work and decisions of policy makers and educators as they seek to establish effective instructional interventions in an effort to ensure equitable access to quality education.

Further evaluation activities are underway and the project will disseminate endline evaluation results in March 2020. A full copy of the midline report can be found at <http://www.enjoy-science.org/me/>

