Republic of Kenya

FY 2016 Ex-Post Evaluation of Technical Cooperation Project[1]

"Strengthening of Mathematics and Science Education (SMASE)"

External Evaluator: Takako Haraguchi, International Development Associates, Ltd.

0. Summary

This project was implemented to establish or strengthen (i) in-service education and training (INSET) for mathematics and science teachers in primary and secondary education in Kenya and (ii) training for the member countries of the Strengthening of Mathematics and Science Education in Western, Eastern, Central and Southern Africa (SMASE-WECSA), an intra-regional cooperation network in Africa,[2] which were both implemented by the Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA). The project was planned and implemented in two components, one for Kenya (the Kenya component) and the other for African countries (the WECSA component). The evaluation of each component is as follows.

(1) The Kenya component: The relevance of the component is high, as its objectives were consistent with Kenya's development policies and development needs as well as with Japanese aid policies with respect to strengthening teachers' capacity. Although the project's purpose of strengthening mathematics and science education in Kenya was mostly achieved, students' interests, an alternative indicator to measure the overall goal of upgrading students' capabilities in mathematics and science, missed the target slightly. The effectiveness and impact are evaluated to be high by taking into account other observed positive impacts, such as the diffusion of the project's effects to other subjects than math and science and pre-service training in the primary education level, which was the central sub-component in the Kenya component. The project's efficiency is evaluated to be high, as the project cost and the project period were both within the plan. The sustainability of the component's effects is evaluated to be fair, as there is a concern about the financial aspects of INSET in primary education in the future.

(2) The WECSA component: The relevance of the component is high, as it was consistent with Africa's intra-regional development policies and development needs as well as with Japanese aid policies with respect to strengthening teachers' capacity in member countries. The effectiveness and impact are evaluated to be fair. Although the project purpose of strengthening capacity of INSET providers to provide training in member countries was mostly achieved, the

[1] In order to objectively measure the extent of improvement in science and mathematics classes at the time of ex-post evaluation, this ex-post evaluation also carried out in depth analysis by a Japanese researcher who had wide experience of direct and indirect involvement in the science and mathematics education improvement projects implemented by JICA in Asia and African countries. Selection of the researcher was done by the external evaluator, and subsequently agreed by JICA.

[2] The member countries of SMASE-WECSA reached 27 in total by 2011 (Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Mali, Malawi, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Sudan, Swaziland, Tanzania, Uganda, Zambia, Zanzibar and Zimbabwe). *In alphabetical order; the Ministry of Education of Zanzibar was registered separately from the Ministry of Education of Tanzania as they are distinct organizations.

overall goal of improving the quality of teaching and learning of math and science in each country is judged to be partially achieved. Despite the presumption that the quality of teaching and learning is improving, it was difficult to set judgment criteria to determine the level of achievement and to estimate the level of contribution of this component to the improvement. The project cost and the project period were common between this component and the Kenya component; therefore, as mentioned above, the efficiency of the project is high. The sustainability of the component's effects is evaluated to be high, for the policy background and the organizational, technical, and financial arrangements necessary for intra-regional cooperation by CEMASTEA are ensured.

The overall evaluation of the entire project was conducted with greater emphasis on the Kenya component, to which larger inputs and activities were allocated than the WECSA component. As a result, the relevance, effectiveness/impact, and efficiency are rated as high, and the sustainability is rated as fair. In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description

Project Location

A primary school where teachers record and assess the degree of achievement of the learning objectives introduced through SMASE INSET

1.1 Background

Despite the effort made in Kenya to expand access to education by implementing the Free Primary Education policy in 2003 and the Free Day Secondary Education policy in 2008, the improvement in the quality of education was stagnating. To improve the quality of education particularly in mathematics and science, the government of Kenya was promoting INSET in secondary education in the aforementioned subject areas, with assistance from Japan, through technical cooperation projects such as the "Strengthening of Mathematics and Science in

Secondary Education Project" (1998-2003) (SMASE[3] Phase 1) and the "Strengthening of Mathematics and Science in Secondary Education Project Phase 2" (2003-2008) (SMASE Phase 2). The adopted approach for pedagogical improvement was based on a principle of classroom improvement called "Activity, Student-centered, Experiment and Improvisation/Plan, Do, See and Improvement" (ASEI-PDSI). Those INSET programs that used this approach to train mathematics and science teachers, known as SMASE INSET, spread throughout the country. Furthermore, efforts to promote mathematics and science education and institutionalize the INSET system in the member countries had intensified since 2001 when SMASE-WECSA was formed in SMASE Phase 1 (which also served as SMASE-WECSA's secretariat) with a mission to introduce SMASE INSET in other African countries.

Based on these results, the Ministry of Education, Science and Technology (MOEST) of Kenya requested the government of Japan for assistance for this project, which would become SMASE Phase 3, in order to implement SMASE INSET for primary education in Kenya as well and to further strengthen intra-regional assistance in Africa.

1.2 Project Outline

Kenya Component	Overall Goal	Capability of young Kenyans in Mathematics and Science is upgraded.
	Project Purpose	Quality of Mathematics and Science education at Primary and Secondary school levels in Kenya is strengthened through In-Service Education and Training (INSET).
	Outputs	1. A system of National INSET for Regional Trainers is established at CEMASTEA. 2. A system of Regional INSET and Regional workshop is established at Primary Teachers' Training Colleges (PTTCs). 3. Existing system of Cluster INSET is strengthened. 4. Secondary Mathematics and Science teachers' "Activity, Student Centred, Experiment, and Improvisation/Plan, Do, See, and Improve (ASEI/PDSI)" practices in classroom are enhanced. 5. Role of CEMASTEA as resource centre for mathematics and science education is strengthened.

[3] The abbreviated title for the Phase 1 and Phase 2 technical cooperation projects was SMASSE (Strengthening of Mathematics and Science in Secondary Education) since they targeted secondary education (Grade 9 to Grade 12). This project (Phase 3) was abbreviated as SMASE (Strengthening of Mathematics and Science Education), and it extended its scope to primary education (Grade 1 to Grade 8, of which this project specifically targeted Grade 6 to Grade 8). For convenience, this report uses the abbreviation "SMASE" for all phases from Phase1 to Phase 3, and refers to the entire series of technical cooperation projects as "the SMASE project" without specifying phases.

WECSA Component	Overall Goal	Quality of Teaching and Learning of Mathematics and Science in member countries is improved.
	Project Purpose	Capability of INSET providers to implement ASEI/PDSI based INSET in member countries is strengthened.
	Outputs	1. ASEI/PDSI based INSET providers from member countries are trained. 2. SMASE-WECSA network is strengthened. 3. Role of CEMASTEA is strengthened as resource centre for mathematics and science education in Africa.
Total cost (Japanese Side)		1,003 million yen
Period of Cooperation		January 2009 – December 2013
Implementing Agency		Ministry of Education, Science and Technology (MOEST) / Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA), MOEST
Other Relevant Agencies / Organizations		None
Supporting Agency/Organization in Japan		None
Related Projects		<Japanese Technical Cooperation> "Strengthening of Mathematics and Science in Secondary Education Project" (1998-2003) (SMASE Phase 1) "Strengthening of Mathematics and Science in Secondary Education Project Phase 2" (2003-2008) (SMASE Phase 2) <Japanese Grant Aid> "The Project for the Upgrading and Refurbishment of the Centre for Mathematics, Science and Technology Education in Africa" (August 2011) <Assistance by Other Development Partners> The World Bank, the United States Agency for International Development (USAID) and others, "Kenya Primary Education Development Project (PRIEDE)" (2015-2019)

Figure 1 shows the structure of this project, and Figure 2 shows the mechanism of SMASE INSET, which was the target of assistance in the Kenya component of this project. The Kenya

component consisted of subcomponents for primary education (Outputs 1 to 3), secondary education (Output 4), and both primary and secondary education (Output 5). Indicators for the project purpose and the overall goal were set for each subcomponent. While the primary education subcomponent aimed to launch SMASE INSET from the beginning, the secondary education subcomponent sought to disseminate school-based lesson study (activities such as peer observation of classes followed by meetings to discuss what was observed to improve lessons) to further enhance the effects of SMASE INSET that had been developed under the two preceding phases.

In this ex-post evaluation, the evaluator first rated each component and then rated the overall project based on the component-wise rating. The overall evaluation (rating) added a weight to the Kenya component, to which larger inputs and activities were allocated than the WECSA component. Similarly, rating of the Kenya component added a weight to the primary education level.[4]

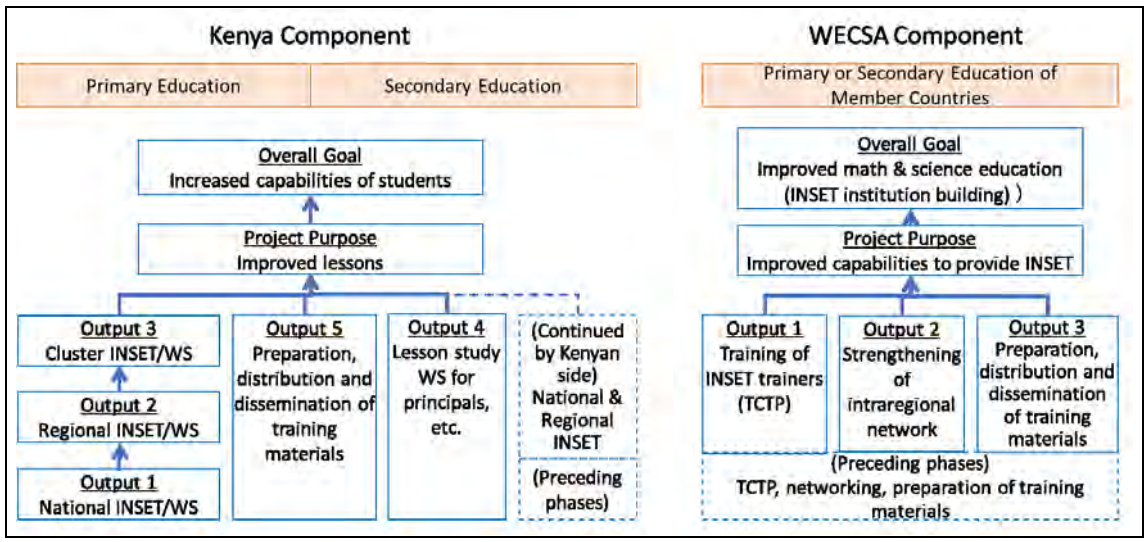

Figure 1: Logic model of this project

Source: Prepared by the evaluator.
Note: (1) "WS" stands for workshops (for disseminating SMASE INSET to education administrators conducted in parallel with training of teachers). (2) The dotted lines indicate the components that were not included in this project. (3) "Preceding phases" refers to both SMASE Phase 1 and Phase 2.

[4] Since it is difficult to disaggregate the inputs in each category (element of inputs) by component and subcomponent, weighting between the two components and within the Kenya component is based on a comprehensive analysis of the information such as the activities recorded by JICA experts in their reports, the number of deliverables produced, and interviews with former JICA experts.

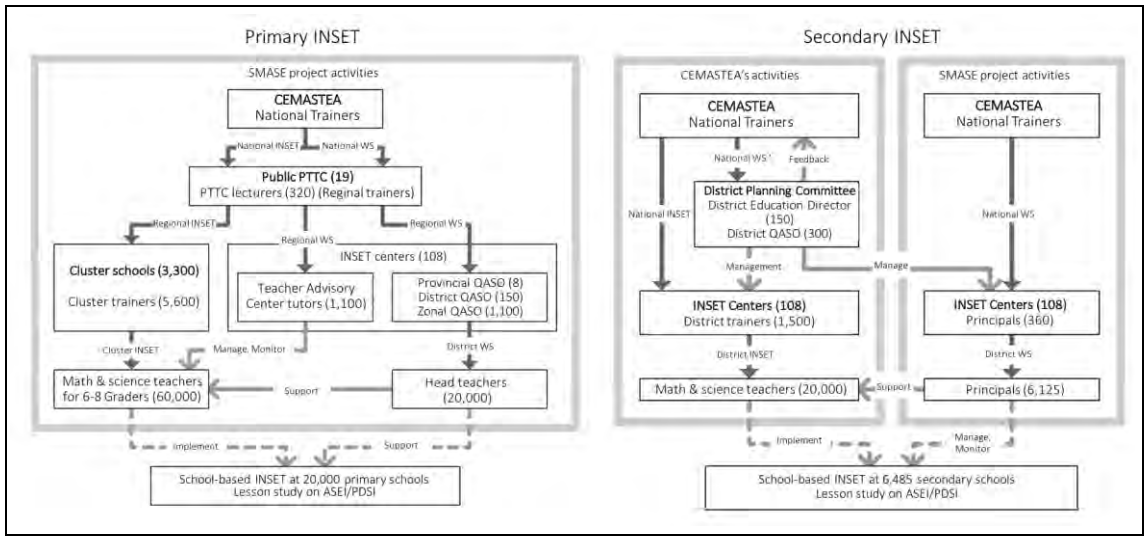

Figure 2: SMASE INSET System in Kenya

Source: Preparatory survey report for the grant aid, "The Project for the Upgrading and Refurbishment of the Centre for Mathematics, Science and Technology Education in Africa."
Note: (1) Terms and figures are those used at the time of planning. In 2013, "state" and "county" were restructured, respectively, into "county" and "sub-county," while "zone" and "cluster" (education administration district) were abolished. (2) SMASE Project: SMASE Phase 3 in particular. (3) The dotted lines indicate those activities under the INSET system that were outside the scope of SMASE project activities and CEMASTEA's activities. (4) QASO: Quality Assurance and Standards Officer.

1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

The achievement of the project purpose for the Kenya component was assessed as "likely to be achieved" in primary education and "limited" in secondary education, based on the measurements of improvement of lessons instructed by teachers who attended INSET and participation of students in the class.

Regarding the WECSA component, the project purpose was assessed as "mostly achieved" as strengthening of capabilities to provide INSET was observed among participants in the Third Country Training Program (TCTP).

1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation

For both the Kenya and the WECSA components, the assessment at the time of terminal evaluation was inconclusive for the prospect for achieving the overall goal due to inadequate pre-defined indicators and lack of statistically significant results.

On the other hand, the evaluation team highlighted the following cases as other positive impacts. In the Kenya component, schools or districts undertook their own initiatives to share and practice what they had learned from INSET. For the WECSA component, the assessment acknowledged that SMASE-WECSA was preparing to continue its activities after the completion of this project and several member countries were engaging in additional activities

resulting from the project such as conducting workshops.

1.3.3 Recommendations from the Terminal Evaluation

In order to establish sustainable, effective, and high quality INSET systems for both primary and secondary education, the terminal evaluation of the Kenya component specifically recommended to (1) continue SMASE INSET by making SMASE INSET mandatory, establishing SMASE Fund for primary education (i.e., securing the budget for implementing SMASE INSET), securing personnel, etc., and (2) enhance the effects of SMASE INSET by strengthening monitoring, identifying and supporting best practices in school, creating a new approach to support mathematics and science education based on the situation on the ground, strengthening coordination by CEMASTEA, etc.

Regarding the WECSA component, it was recommended to establish a foundation that enables SMASE-WECSA to continuously provide technical support to its member countries by strengthening SMASE-WECSA's function as an intra-regional platform for mathematics and science education in Africa, granting CEMASTEA a status to conduct intra-regional activities, providing further assistance in the TCTP, carrying out such activities as needs assessments, targeting and indicator-setting, etc.

2. Outline of the Evaluation Study

2.1 External Evaluator

Takako Haraguchi, International Development Associates, Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: August 2016 – September 2017

Duration of the Field Study: November 14-22, 2016 and January 16 – February 9, 2017

In parallel to this evaluation, the evaluator also conducted ex-post evaluation of the grant aid project, "The Project for the Upgrading and Refurbishment of the Centre for Mathematics, Science and Technology Education in Africa" (August 2011) (hereafter "the grant aid project"). Since the implementing agency and many related agencies overlapped between these two projects, the evaluator conducted the data collection for the two evaluations in an integrated manner. However, the objects of the evaluations were these two respective projects, not the overall plan in which they were encompassed.

2.3 Constraints during the Evaluation Study

The main source of information for evaluating the projects' impact is the beneficiary survey (sample survey) results as the information provided by the implementing agency alone was insufficient to grasp the achievement status of the overall goal and the degree to which the achievement level of the project purpose is being maintained (Table 1). However, the study faced several challenges due to the multiplicity of observation targets, as the impacts of this project were anticipated to materialize in Kenya and other SMASE-WECSA member countries (27 countries) in Africa.

First, the evaluator selected six counties in an attempt to include and well represent localities and schools in different geographical conditions (urban, suburban, rural, and Arid and Semi-Arid Lands [ASAL]), and selected within these six counties a total of 29 schools for site visit in varying school sizes and types (boys/girls/co-ed schools and national/county/sub-county schools), consisting of two primary teachers training colleges (PTTCs), 18 primary schools, and nine secondary schools.[5] Therefore, although the study achieved a certain level of representativeness, potential biases in the study results introduced by non-probability sampling could not be ruled out. Also, the areas that were difficult to visit due to security reasons were excluded from the study. Second, the scope and contents of the research conducted for Africa were generally more limited than in Kenya (Field research was conducted only in Kenya). Therefore, the reliability of the results of evaluation is expected to be lower than that of the Kenyan evaluation.[6]

[5] The counties and the number of schools selected are as follows: Kiambu County (two primary schools and one secondary school) and Kisumu County (three primary schools and two secondary schools) from the urban areas; Makueni County (three primary schools and one secondary school) and Siaya County (two primary schools and one secondary school) from the suburban areas; and Kajiado County (five primary schools and three secondary schools) and Homa Bay County (three primary schools and one secondary school) from ASAL.

[6] Response rate to the questionnaire for former TCTP attendees was low at approximately 10 percent. The survey results may be overrated as there may have been a selection bias favoring those attendees who are satisfied or highly utilizing what they learned.

Table 1: Outline of the beneficiary survey (sample survey) for the ex-post evaluation

	Target (population size) (Note)	Respondents	Survey method
Kenya component	Local education administrative officers (A few individuals each in 47 counties and their subordinate sub-counties, and principals)	Valid responses: 34 individuals Eight officials from education offices, etc. (six females and two males) and 26 principals or vice principals (seven females and one male)	・ Self-administered questionnaire: Delivered to all individuals who were present on the day of evaluator's site visit. ・ Key informant interviews: Conducted with all individuals who completed the questionnaire.
	Regional INSET trainers (300 individuals for primary education and 1,400 individuals for secondary education)	Valid responses: 22 individuals Primary education: Thirteen individuals (six females and seven males) Secondary education: Nine individuals (three females and six males)	・ Self-administered questionnaire: Delivered to all individuals who were present on the day of evaluator's site visit and were available to respond in relation to their lesson schedule and other conditions. ・ Key informant interviews: Conducted with a few individuals at each school. ・ Classroom analysis using video recordings (detailed analysis by an expert): Four primary school teachers and five secondary school teachers.
	Primary school teachers teaching math and science to 6th – 8th graders	Valid responses: 153 individuals Attendees of SMASE INSET: 84 individuals (40 females, 43 males, one without gender information) Non-attendees of SMASE INSET: 69 individuals (43 females, 25 males, one without gender information)	
	Secondary school math and science teachers	Valid responses: 100 individuals Attendees of SMASE INSET: 84 individuals (24 females, 59 males, one without gender information) Non-attendees of SMASE INSET: 16 individuals (six females and ten males)	
	Primary school students: 6th to 8th graders	Valid responses: 380 individuals 7th and 8th graders (171 girls and 209 boys)	Self-administered questionnaire: Distributed to randomly-sampled individuals in all classrooms that were available to respond in relation to their lesson schedule, etc.
	Secondary school students: 9th to 12th graders	Valid responses: 264 individuals 9th to 12th graders (98 girls, 164 boys, two without gender information)	
WECSA component	Attendees of the TCTP (27 countries in Africa; annual average number of attendees of 135 in 2009-2016)	Valid responses: 21 individuals (ten females and eleven males) (eleven countries)	CEMASTEA delivered the questionnaire via email to 223 individuals it randomly sampled.
	JICA overseas offices and field offices (hereafter "JICA overseas offices") in the SMASE-WECSA member countries (27 African countries)	Valid responses: 20 offices (20 countries) Addressed to officers in charge of the basic education sub-sector or JICA experts, etc.	The evaluator delivered the questionnaire via email to offices in 22 countries.

Note: The size of the population was roughly estimated by the ex-post evaluator based on documentation provided by JICA, documentation provided by the implementation agency, etc. Although the number of math and science teachers at secondary schools and the number of students in the 6th to 8th grades at primary schools were not available, Figure 3 below shows the total number of schools and teachers.

3. Results of the Evaluation of the Kenya Component (Overall Rating: A[7])

3.1 Relevance (Kenya Component) (Rating: ③[8])

3.1.1 Consistency with the Development Plan of Kenya

The long-term national development plan "Vision 2030" (2008-2030), which is active at the times of both project planning and project completion, aims to become a medium income country by 2030 and improve the quality of education and research. With respect to the sector development plan, the Kenya Education Sector Support Programme (2005-2010) implemented at the time of planning and the National Education Sector Plan (2013-2018) implemented at the times of project completion and ex-post evaluation both include INSET in primary and secondary education as their priority investment projects.

3.1.2 Consistency with the Development Needs of Kenya

In Kenya, the number of schools as well as teachers rose in both primary and secondary education (Figure 3), indicating a continuous need to strengthen teachers' capability as mentioned in "1.1 Background." CEMASTEA was occupying a significant position as the country's sole implementing body of INSET in mathematics and science.[9]

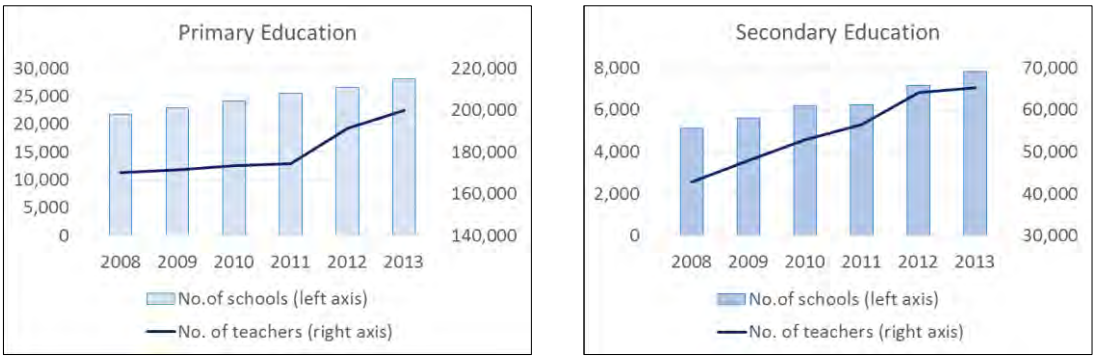

Figure 3: Numbers of primary and secondary schools and teachers in Kenya

Source: Prepared by the evaluator based on data from the Kenya National Bureau of Statistics.

3.1.3 Consistency with Japan's ODA Policy

The Country Assistance Program for Kenya (2000) states "Primary and secondary education: Improvement of quality and pedagogy of primary and secondary school teachers in mathematics and science, and improvement of facilities through such means as the construction of primary schools utilizing the grant aid for Grass-Roots Human Security" at the

[7] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[8] ③: High, ②: Fair, ①: Low
[9] Outside of CEMASTEA, INSET was implemented by the Kenya Education Management Institute, which operates training in education management, and the Kenya Institute of Special Education, which operates training in special education (this situation is the same at the time of ex-post evaluation).

beginning of the section on human resources development, one of its priority areas of assistance.

In this way, the Kenya component was highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Effectiveness and Impact[10] (Kenya Component) (Rating: ③)

3.2.1 Effectiveness

3.2.1.1 Achievement of Project Purpose

As the outputs in the primary education level, the project established the mechanism of INSET by introducing throughout the country SMASE INSET, which was designed around the three-cascade training, namely, national (Output 1), regional (Output 2) and cluster[11] (Output 3) training, and implementing training for Regional INSET Trainers (PTTC instructors), Cluster INSET trainers (selected primary school teachers) and primary school teachers (teaching mathematics and/or science to 6th to 8th graders) as well as workshops for education administrators (including school principals) according to the plan.[12] Consequently, lessons by teachers who attended SMASE INSET showed improvement during the project implementation period (Table 2). All of three indicators that measured the degree to which classroom lessons improved (i.e., Lesson Innovation Index based on self-assessment by teachers, ASEI/PDSI Lesson Observation Index based on National INSET Trainers, etc., and Student Participation Index based on assessment by students) generally achieved the respective targets. In this way, the project purpose for the primary education level was mostly achieved.

With respect to the secondary education level, the project introduced workshops mainly for school principals on lesson study and ASEI-PDSI-related instructions (Output 4), aiming to reinforce Secondary INSET that had been established through the preceding two phases. However, the number of workshops that was conducted was fewer than planned due to strikes by teachers, delays in project activities, and other reasons, and the expected effects of the workshops were not clearly demonstrated in teachers' practice in the classroom. Therefore, the project purpose for the secondary education level is judged to be partially

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[10] Sub-rating for Effectiveness is to be put with consideration of Impact.

[11] In Kenya, MOEST had once implemented cluster-level training for head teachers (principals) or core teachers. This project utilized the existing training mechanism from such training for establishing SMASE INSET.

[12] It should be noted, however, that some results such as the number of participants in some training/workshops and the submission rates of INSET implementation reports on time did not reach the level expected in the plan. For example, cluster training was not conducted in ASAL since accommodation expenses were not covered even though teachers could not commute every day to attend the training. Also, teachers did not attend the training in some regions due to opposition mainly from teachers' unions. Regarding INSET implementation reports, it is reported that most of them were submitted after the due date (e.g., within one month). Some former Japanese experts explained that the priority for punctual submission was low among teachers.

achieved[13].

Table 2 summarizes the degree to which the project purpose was achieved. Also, Table 3 shows the number of participants in Primary and Secondary INSET and related workshops to date including those during the project implementation period.

Table 2: Achievement of project purpose (Kenya component)

<table>
<tr><th>Project Purpose</th><th>Indicator (1)</th><th>Actual (2)</th></tr>
<tr><td rowspan="7">Quality of Mathematics and Science education at Primary and Secondary school levels in Kenya is strengthened through INSET.</td><td colspan="2">Primary Education Level</td></tr>
<tr><td>[1] Lesson Innovation Index attains to 3.3 on a 0-4 scale.</td><td>Mostly achieved.
<table><tr><td>Subject</td><td>2009</td><td>2011</td><td>2013</td><td>Achievement</td></tr><tr><td>Math</td><td>3.17</td><td>3.25</td><td>3.31</td><td>108%</td></tr><tr><td>Science</td><td>3.28</td><td>3.20</td><td>3.26</td><td>-</td></tr></table>Sample size (person): 111 for math and 82 for science in 2009; 78 each for math and science in 2011, 38 each for math and science in 2013.</td></tr>
<tr><td>[2] ASEI-PDSI Lesson Observation Index attains to 2.0 on a 0-4 scale.</td><td>Achieved.
<table><tr><td>Subject</td><td>2009</td><td>2011</td><td>2013</td><td>Achievement</td></tr><tr><td>Average</td><td>1.54</td><td>2.14</td><td>2.34</td><td>174%</td></tr></table>Sample size (person): 202 in 2009; 62 in 2011; 62 in 2013.</td></tr>
<tr><td>[3] Student Participation Index attains to 2.5 on a 0-4 scale.</td><td>Achieved, based on measurement on a scale of 0 to 2. (3)
<table><tr><td>Subject</td><td>2009</td><td>2011</td><td>2013</td><td>Achievement</td></tr><tr><td>Math</td><td rowspan="2">1.33</td><td>1.51</td><td>1.71</td><td>224%</td></tr><tr><td>Science</td><td>1.58</td><td>1.75</td><td>247%</td></tr></table>Sample size (person): 2,302 in 2009; 1,406 in 2011; 1,033 in 2013.</td></tr>
<tr><td colspan="2">Secondary Education Level</td></tr>
<tr><td>[4] Lesson Innovation Index attains to 3.0 on a 0-4 scale.</td><td>Partially achieved.
<table><tr><td>Subject</td><td>2009</td><td>2013</td><td>Achievement</td></tr><tr><td>Average</td><td>2.7</td><td>2.9</td><td>67%</td></tr></table>Sample size: 72 in 2009; 134 in 2013.</td></tr>
<tr><td>[5] ASEI/PDSI Lesson Observation attains to 3.0 on a 0-4 scale.</td><td>Partially achieved.
<table><tr><td>Subject</td><td>2009</td><td>2013</td><td>Achievement</td></tr><tr><td>Average</td><td>2.8</td><td>2.9</td><td>50%</td></tr></table>Sample size (person): 72 in 2009; 134 in 2013.</td></tr>
<tr><td>[6] Student Participation Index attains to 3.0 on a 0-4 scale.</td><td>Unable to evaluate (no comparable data available).</td></tr>
</table>

Source: Terminal evaluation report.

Note: (1) The indices convert the following assessments on the level of ASEI-PDSI practice into scores. Lesson Innovation Index: self-assessment by teachers using a questionnaire. ASEI-PDSI Lesson Observation Index: results of lesson observations by National INSET Trainers, etc. using a checklist. Student Participation Index: assessment of lessons by students using a questionnaire. (2) The level of achievement was calculated at the time of ex-post evaluation using the following formula: (score in 2013 – score in 2009) / (target score – score in 2009) x 100. (3) The degree of achievement of the indicator 3 for the primary education level was calculated by converting the target score to 1.5 on a 0-2 scale, as was done in the terminal evaluation.

[13] The project used the same three indices as the indicators for the project purpose in both secondary education and primary education levels. In the secondary education level, however, the project could have additionally measured the degree to which principals instructed teachers on lesson study and the degree to which teachers actually carried out lesson study, since they are likely to be intermediary steps to connect the output (i.e., implementation of workshops for principals, etc.) and the project purpose (i.e., improvements in the classroom).

From above, it is judged, by putting weight on the primary education level, that the project mostly achieved its purpose.

3.2.2 Impact

The assessment of the impact of the Kenya component focused on the degree to which the following impacts materialized: (1) Prompted by the continuous implementation of SMASE INSET (i.e., whether the outputs have sustained), (2) teachers have continuously applied the training they received in practice (i.e., whether the outcome achieved for the project purpose has sustained), resulting in, (3) enhancement of students' capability in mathematics and science (i.e., whether the overall goal has been achieved in terms of motivation, level of understanding, and academic performance of students).

3.2.2.1 Achievement of Overall Goal[14]

(1) Continuation of SMASE INSET (Whether the outputs have sustained)

After the completion of this project in 2013, SMASE INSET in the primary education level was suspended in 2014 due to unavailability of budget from MOEST. It resumed in 2015, and INSET in ASAL (the region this project had not covered) and lesson study workshops in some sub-counties in other regions have been conducted since then.[15] Although MOEST and CEMASTEA reported that the scale of SMASE INSET was reduced following the relative decrease in its budget reflecting the additional implementation of non-SMASE INSET in primary education (See "3.2.2.2 Other Positive and Negative Impacts"), related policies and planning documents (See "3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects") evince that efforts have been made to continue SMASE INSET in primary education.

Regarding the secondary education level, nation-wide SMASE INSET has been continuously implemented in a more evolved form than during the project implementation period. That is, the original system in which all teachers would receive one cycle of training each year in a total of four cycles (four years) was replaced by a new, experience-specific system starting in 2014 (in a given year, all teachers who have the target number of experience set by CEMASTEA for that year would be trained in a module designed for their amount of experience). This change made the training more targeted and responsive to the needs. Such development was possible for the secondary education level because almost all teachers had attended INSET by 2013, establishing the foundation for ASEI-PDSI. Other

[14] Since the target year for the overall goal is not mentioned in existing documents, the status of achievement was assessed at the time of this ex-post evaluation (three years after project completion).

[15] Lesson study workshops are organized by individual Curriculum Support Officers (CSOs) of Sub-County Education Offices who attended training in Japan under this project, and are administered in the respective sub-counties they are in charge of (one sub-county each in 31 counties). CEMASTEA monitors and evaluates the workshops. CSOs were called Teacher Advisory Centre (TAC) Tutors during the project implementation period.

project activities for the secondary education level such as workshops for school principals and school-based lesson studies have been continuing as well.

CEMASTEA prepares and updates necessary modules and training materials for all of the aforementioned training and workshops, and conducts monitoring and evaluation of them.

It is therefore concluded that SMASE INSET generally remains operational in both the primary and secondary education levels, while there have been changes in the implementation scale and targeting. Table 3 shows the number of participants in training and workshops in the period between project implementation and ex-post evaluation.

Table 3: Number of participants in SMASE INSET and related workshops

(Unit: person)

		2009	2010	2011	2012	2013	2014	2015	2016
Primary Education	National training	0	272	286	284	274	0	28	47
	Regional training (1)	0	59,813	51,097	47,027	39,136	0	300	3,554
	Lesson study workshop (2)	0	0	0	0	0	0	2,578	762
	Workshop for principals and education administrators	0	897	832	841	1,473	0	252	47
Secondary Education	National training	509	0	1,412	1,412	0	1,330	1,330	1,323
	Regional training	0	4,420	4,164	4,021	4,118	2,864	8,481	7,301
	School-based lesson study (3)	0	0	0	0	0	0	90	125
	Workshop for principals and education administrators	1,113	0	0	5,540	3,430	94	1,420	2,601

Source: Terminal evaluation report; responses and information provided by the implementing agency.
Note: (1) The figures of "Regional training" in primary education are the sum of the participants in regional training (second cascade) and the cluster training (third cascade). Upon facing a reduction of CEMASTEA' budget for primary education, these two cascades have merged since 2015 because the smaller budget reduced and limited the coverage of training to ASAL, which had not been covered during the project implementation period, cutting down the number of targeted teachers to a level that no longer required multiple cascades.
(2) Lesson study workshops for primary education were implemented in one sub-county per country in 31 counties. The figure for 2016 only includes participants in the eight sub-counties where CEMASTEA conducted monitoring.
(3) The figures for "School-based lesson study" in secondary education were estimated by multiplying the number of schools where CEMASTEA conducted monitoring (18 in 2015 and 25 in 2016) by five, which is an estimate, based on interview results, for the number of teachers per school that attended training (no records were available for the actual number of participants).

(2) Application of ASEI-PDSI (Whether the outcome achieved for the project purpose has sustained)

The evaluator verified that the measured values at the time of ex-post evaluation for two of the three indicators of the project purpose were mostly unchanged from the project implementation period (Table 4),[16] indicating teachers are generally applying what they had learned from the training in the class.

[16] Although most of the measured values exceeded the target values in the table, the fact that the measurement method at the time of ex-post evaluation was simpler than during the project implementation makes it difficult to interpret the increase or decrease in the values with rigor. Therefore, the measured values were only judged as "mostly unchanged" on the ground that no large fluctuations occurred.

In both the primary and secondary education levels, the values of Lesson Innovation Index (based on teachers' self-assessment) measured at the time of ex-post evaluation show no statistically significant differences by region, sex, and attendance/non-attendance, timing of attending and frequency of attending SMASE INSET.[17] High self-assessment scores among those primary school teachers who did not receive SMASE INSET might be due to a spillover of the training effects. It was observed from interviews in all schools the evaluator visited that teachers shared the contents of SMASE INSET with other teachers[18] at subject panel meetings or school-based training including lesson studies (organized as school-based INSET by each school) and that even teachers who did not receive the training had knowledge of ASEI-PDSI. Interview results also suggested that some of the teachers with SMASE INSET who were actually practicing ASEI-PDSI more frequently than teachers without SMASE INSET might have reported lower frequencies of practicing ASEI-PDSI in the survey as they might have interpreted the practice of ASEI-PDSI more strictly.[19] With respect to secondary school teachers, most of whom have completed SMASE INSET, the evaluator attempted to analyze the relationship between the frequency of ASEI-PDSI practice and the number of times teachers attended the training (i.e., whether or not they received each of Cycles 1 to 4). However, the data were insufficient for this analysis as some teachers could not correctly recall their training history. Nevertheless, it was observed that greater frequencies of supervision by the principal and implementation of school-based lesson studies tended to result in higher values in Lesson Innovation Index, possibly indicating effects of the workshops conducted for school principals.[20]

Conducted along with this ex-post evaluation was a detailed analysis by an expert, which analyzed video recordings of nine classroom lessons on mathematics or science subjects using the revised Bloom's Taxonomy of Educational Objectives[21] (expert: Hideo Ikeda, Professor emeritus, Hiroshima University). The analysis confirmed that ASEI-PDSI was being practiced in the observed lessons and the quality of teaching techniques was relatively high (See Appendix).

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[17] Mainly based on the result of linear regression analyses with a significance level of 10 percent. Also, no differences were observed in SMASE INSET attendance history between men and women.

[18] One to several teachers had received SMASE INSET in each school. Due to frequent transfers of teachers, many of them said that they had attended the training when they worked at their previous schools.

[19] Several teachers provided relatively low self-assessment in the survey questionnaire despite the results of interviews and classroom observation that revealed a high degree of ASEI-PDSI practice among those teachers. The survey questionnaire followed the design of the one used under the project and asked respondents to report their frequency of practicing activities such as "I give pupils opportunities to do activities" using response categories, "Always," "Often," "Sometimes," "Rarely," and "Never"; the views towards the choices such as "Often" and "Sometimes" were potentially less strict among teachers without SMASE INSET.

[20] However, both the regression coefficient and the determination coefficient were less than 0.1.

[21] This taxonomy classifies educational objectives to "Remember," "Understand," "Apply," "Analyze," "Evaluate," and "Create," ordered from lowest to highest. It is incorporated in SMASE INSET as educational objectives pursued by the ASEI-PDSI approach.

A science lesson in a primary school. Each student is experimenting moves of his/her lungs.

A biology lesson in a girl's secondary school. Girls' interests in mathematics and science subjects have increased with introduction of ASEI-PDSI.

Teachers pointed out a number of issues in the survey and interviews. Common responses include the followings: in the primary education level, "we will forget what we learned from the training because SMASE INSET for primary school teachers has not been provided since 2014 except in ASAL"; "because each teacher is responsible for a very large number of students (e.g., 80 students in a classroom), it makes it impossible to do any other activities other than grading students' work, and to let students conduct many experiments"; "schools lack teaching and learning materials and tools (e.g., "teachers cannot improvise test tubes")." In the period after the completion of this project, three years have passed since the nation-wide SMASE INSET for primary school teachers was suspended. There is a risk for the prevalence of ASEI-PDSI practice mentioned above to fade in the future if it remains unavailable. Regarding teaching and learning materials, publication and distribution of materials developed by CEMASTEA to the public, which did not take place during the project implementation period (Output 5), have partially realized by the time of ex-post evaluation in a form of uploaded materials on the CEMASTEA website. However, a lot of materials are still distributed only during SMASE INSET sessions. At CEMASTEA facilities, a JICA Senior Volunteer displays teaching/learning materials created by himself and teachers who attended the training. While this serves as a demonstration of "Improvisation," one of the main components of ASEI-PDSI (i.e., utilization of readily available materials in teaching), its existence does not seem to be adequately informed to teachers.

Comments from secondary school teachers tended to be divided among schools. In some schools, a typical comment was, "it is difficult to practice student-centered teaching in the class because teachers are under strong pressure to have their students perform well on the Kenya Certificate of Secondary Education (KSCE) examinations and to complete the syllabus," while some schools did not see it as a problem and were positive about practicing ASEI-PDSI. Such discrepancy does not seem to be related to the type of school (i.e., national schools or schools under local governments) or the attendance at workshops for principals. Instead, teachers' attitudes toward SMASE INSET and ASEI-PDSI seem to be affected by school principals' stance.

Table 4: Comparison of the measured values of the project purpose indicators between the times of project completion and ex-post evaluation

Indicator		Subject	Target	2013 (Project completion)	2017 (Ex-post evaluation)
Primary education	[1] Lesson Innovation Index (0.00-4.00)	Math	3.30	3.31	3.44
		Science		3.26	
	[3] Student Participation Index (0.00-2.00)	Math	1.50	1.71	1.49
		Science		1.75	1.54
Secondary education	[4] Lesson Innovation Index (0.00-4.00)	Math & Science	3.00	2.90	3.00
	[6] Student Participation Index (0.00-4.00)	Math	3.00	N/A	3.39
		Physics		N/A	3.37
		Chemistry		N/A	3.26
		Biology		N/A	3.41

Source: Terminal evaluation report for the target values and the measured values for 2013 (See Table 2 for sample size.); beneficiary survey for the measured values for 2017 (sample size: 153 primary school teachers for [1], 380 primary school students for [3], 100 secondary school teachers for [4], 264 secondary school students for [6]).
Note: The numbers in the brackets indicate the indicator numbers for the project purpose (See Table 2 for the list of all indicators.). "ASEI/PDSI Lesson Observation" is excluded from the table since the ex-post evaluation did not involve lesson observations by observers such as national INSET trainers. In 2013, all indices were measured based on the detailed survey tools (questionnaires and checklists), but the measurement in 2017 used a simplified questionnaire, which was developed by the ex-post evaluator by selecting questions that appeared representative from the original questionnaire.

(3) Enhancement of students' capability in mathematics and science (Whether the overall goal has been achieved)

Table 5 shows the status of achieving the overall goal indicators. The project had originally planned to measure the capability of students by the improvement in the scores on the Kenya Certificate of Primary Education (KCPE) (national examination) for the primary education level, and, for the secondary education level, by the results of the SMASSE Project Impact Assessment Survey (SPIAS). However, the ex-post evaluator did not use either measurement to assess the status of achieving the overall goal, as KCPE results do not always reflect changes in students' academic ability[22] and it was difficult for the present study to conduct SPIAS, which would entail an achievement test for students. Instead, the evaluator used an alternative indicator measuring "improvement in students' motivation, understanding, and grades in math and science subjects (as assessed by teachers and principals)," as well as the results of a student survey as supplementary information. Since the project did not set an expected level of improvement for students' capability, the

[22] The terminal evaluation report states that KCPE scores in a given year are not comparable with those in other years since the contents of KCPE change from year to year and the mean scores may vary according to the level of difficulty of the test in a particular year. This situation was confirmed by the results of interviews with CEMASTEA, former Japanese experts, teachers, etc., at the time of ex-post evaluation.

evaluator set a general threshold that the target would be considered as reached if 80 percent or more respondents reported that students' motivation, understanding and grades had improved.

In the survey completed by primary and secondary school teachers, approximately 70 percent to 80 percent of the responses answered "improved" for each of the three questions concerning students' "motivation," "understanding," and "grades." School principals acknowledge in the interviews that SMASE INSET contributed to such improvement. Specific comments include, "students now show less anxiety and more curiosity in math and science (reflected in such behaviors as continue working on exercises even during a break between classes, completing their homework promptly, and listening to the teacher more intently, etc.," "students' understanding and grades have improved," and "their academic performance in secondary schools they advanced to has improved (cited by primary school teachers)," and "more students take science electives (cited by secondary school teachers)," all as the result of enhanced participation of students in the class. In the student survey, most of the respondents in both primary and secondary schools reported that "I like math and science subject(s)" and cited as the reasons, "the subject is interesting," "the subject is easy," "I like the teacher (or the way the teacher teaches)," "the subject is useful in the future," and "the subject (science) deals with topics related to myself or things around me." The reasons why they do not like math and science subject(s) include, "the subject is difficult," and "the teacher (or the way the teacher teaches) is not good."

Table 5: Achievement of the overall goal (Kenya Component)

<table>
<tr><th>Overall Goal</th><th>Indicator</th><th>Actual</th></tr>
<tr><td rowspan="2">Capability of young Kenyans in Mathematics and Science is upgraded.</td><td>Primary Education Level</td><td></td></tr>
<tr><td>(1) Performance in National Examination in primary education (mean scores of KCPE) is improved.

(Alternative Indicator)
Improvement in students' motivation, understanding, and grades in mathematics and science subjects (as assessed by teachers and principals)</td><td>KCPE mean score (for reference only)
<table>
<tr><td>Subject</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td><td>2014</td></tr>
<tr><td>Mach</td><td>47.16</td><td>49.56</td><td>53.80</td><td>52.18</td><td>56.30</td><td>52.86</td><td>52.04</td></tr>
<tr><td>Science</td><td>55.24</td><td>59.92</td><td>60.86</td><td>67.48</td><td>62.76</td><td>61.82</td><td>66.00</td></tr>
</table>
Alternative Indicator: partially achieved.
・ Interviews with principals or senior teachers (18 schools): Respondents reported, "students' motivation increased by SMASE INSET" in all schools visited.
・ Questionnaire survey with teachers (153 teachers): 84% reported, "students' motivation increased," 72% reported, "students' understanding increased," and 73% reported, "students' grades improved."
・ Questionnaire survey with students (380 students): 95% reported, "I like mathematics," and 97% reported, "I like science."</td></tr>
</table>

(Table 5 continued)

Overall Goal	Indicator	Actual
	Secondary Education Level	
	(2) Results of SPIAS in the secondary level are improved compared with the results of SPIAS at the end of Phase 2. (Alternative Indicator) Improvement in students' motivation, understanding, and grades in mathematics and science subjects (as assessed by teachers and principals)	SPIAS has not been conducted since the completion of this project. Alternative Indicator: partially achieved. ・ Interviews with principals or senior teachers (9 schools): Respondents reported, "students' motivation increased by SMASE INSET in all schools visited. In response to a question whether the number of students who take science electives increased, four schools reported "increased" (among other schools, one school reported, "there are no electives," one school reported, "teachers instruct students to select electives based on their grades rather than their preferences," and the remaining three schools did not provide clear responses. ・ Questionnaire survey with teachers (100 teachers): 78% reported, "students' motivation increased," 72% reported, "students' understanding increased," and 69% reported, "students' grades improved." ・ Questionnaire survey with students (264 students): 97% reported, "I like mathematics," 96% "physics," 92% "chemistry," and 95% "biology."

Source: Information provided by the implementing agency; beneficiary survey.

It should be noted that the qualitative investigation in this evaluation could not fully verify the changes among the students, especially the degree of improvement in their academic performance. In this regard, the detailed analysis by an expert (see (2) above and Annex of this report) observed improvements in pedagogy, which was the main subject of technical transfer under this project, while the analysis points out several problems, from technical points of view, in the contents of lessons where the project's intervention was relatively minor. These results suggest that further improvement could be made in course contents in SMASE INSET in order to enhance students' academic performance.

In sum, it was found that students' attitudes have improved in all primary and secondary schools visited for the present evaluation. On the other hand, the percentage of teachers who reported that students' motivation, understanding, and grades, have improved was slightly below 80 percent. Also, the qualitative study conducted in this evaluation was not equipped to fully verify the changes among the students, especially the degree of improvement in their academic performance. Therefore, it is concluded that the project has achieved its overall goal at a limited level.

3.2.2.2 Other Positive and Negative Impacts

The following positive impacts are observed although they include outcomes/impacts of the two preceding phases of technical cooperation and the grant aid project. No negative

impacts on the natural environment have been reported. The project did not involve land acquisition and resettlement.

- Contribution of CEMASTEA as a center of SMASE INSET in Kenya: Due to the achievements it has made and the facilities developed by the grant aid project, CEMASTEA is positioned as a central organization in the ongoing reorganization of teacher training institutions at the time of ex-post evaluation (See "3.4.2 Organizational Aspects for the Sustainability of Project Effects"). CEMASTEA also assumes a role as the implementing agency of a new mathematics and science project that is being planned by MOEST.[23]
- Practice of ASEI-PDSI in other subjects: In the questionnaire survey with principals and local education administrators, 22 out of the 35 respondents reported that they adopted the ASEI-PDSI approach to teach other subjects such as language and social studies. In particular, in cases where the principal was a language or social studies teacher, the principal himself or herself practiced components of ASEI-PESI (e.g., practical activities and student-centered approach) and encouraged other teachers to practice them.
- Practice of ASEI-PDSI in pre-service teacher training: Even though PTTC instructors who attended the national training under this project did not act as INSET trainers after the completion of this project except in ASAL, according to the instructors interviewed for this ex-post evaluation, they teach PTTC students ASEI-PDSI as part of course topics such as pedagogy and classroom evaluation, and practice it in the class. Under the teacher employment situation in Kenya at the time of ex-post evaluation, it is difficult for new PTTC graduates to be immediately appointed as full-time teachers at public schools; however, according to PTTC instructors and primary school teachers, PTTC graduates practice ASEI-PDSI as part-time teachers or teachers at private schools.
- Contribution to other INSET programs for primary education: Although SMASE INSET is the only INSET in mathematics and science for secondary education, for primary education MOEST, with assistance from other organizations such as the United States Agency for International Development (USAID), implements INSET in mathematics skills development program (Early Grade Mathematics, EGMA) for early grades (1st and 2nd grades).[24] According to the implementation team of EGMA, the

[23] The project aims to increase students' interests in the fields of science, technology, engineering, and mathematics (STEM) through activities including teacher training by designating a model school in each county. CEMASTEA was conducting the feasibility study for the project as of November 2016.

[24] EGMA is organized under the Global Partnership for Education (GPE) and is part of the Kenya Primary Education Development Project (PRIEDE) supported by the World Bank, USAID, and others (2015-2018, with a plan to be extended to March 2019). EGMA, together with TUSOME (a program in Swahili and English languages; meaning

program adopts a teacher-centered approach rather than, unlike ASEI-PDSI, a student-centered approach in order to strengthen most foundational skills when students are still in early grades so that the student-centered instructions in advanced primary grades (6th to 8th grades) can be implemented effectively. Thus, a mutually reinforcing relationship exists between EGMA and SMASE INSET. CEMASTEA makes significant contribution to EGMA because the former counterpart personnel who were trained in this project and the preceding two phases play a central role in the implementation team of EGMA, and many of EGMA's master trainers (trainer education instructors) are either academic staff at CEMASTEA or regional INSET trainers who received national training at CEMASTEA.

PTTC students who just came back from teaching practice that incorporated ASEI-PDSI.


Early grade primary school pupils in math class using EGMA learning materials.

This component mostly achieved the project purpose of strengthening mathematics and science education in Kenya (judged by the level of improvement in lessons). The overall goal (i.e., upgrading students' capabilities in mathematics and science as judged by the assessments by teachers on the extent of improvement in students' motivation, understanding, and grades) was partially achieved, as the beneficiary survey results showed that the percentage of teachers who acknowledged improvement was slightly below 80 percent, and there were issues on the appropriateness of the indicators and constraints on the measurement methods. Nevertheless, this evaluation confirmed positive impacts that are likely to assist the project in achieving the project purpose and the overall goal in the primary education level, which was the central sub-component of this component; the outcomes have generally sustained since project completion at the level specified in the project purpose, and the practice of ASEI-PDSI in pre-service teacher training and contribution of the project to other INSET programs in primary education have taken place. Considering all these findings comprehensively, the effectiveness and impact of the component are high.

"Let's read" in Swahili), distributes learning materials to primary schools around the country and provides training for all primary school teachers in order to strengthen foundational learning skills for early graders in reading, writing, and calculation (in Swahili, English, and mathematics).

3.3 Efficiency (Common for Kenya Component and WECSA Component) (Rating:③)

3.3.1 Inputs

Table 6: Planned and actual inputs (Kenya component and WECSA component)

Inputs	Plan	Actual
(1) Experts	Long-term: Chief Advisor, Academic Advisor, Science Education, Mathematics Education, Coordinator Short-term: The number of experts not specified	Seven long-term experts: Chief Advisor, Deputy Chief Advisor/WECSA Advisor, Subjects Advisor (Science Education), Subjects Advisor (Mathematics Education), Project Coordinator I, Project Coordinator II/INSET Management, Academic Advisor Three short-term experts: Academic Advisor, Evaluation, Curriculum Development Dispatch of 38 Kenyan counterpart personnel to SMASE-WECSA member countries in the WECSA Component
(2) Trainees received	Training in Japan and a third country	Total of 162 counterpart personnel: 150 received training in Japan and 12 in a third country (Malaysia)
(3) Equipment	Provision of training materials and equipment necessary for training, provision of equipment related to the development of the foundation of training	Training materials and equipment
(4) Overseas activity cost	Training expenses	212 million yen (seminar expenses from the overseas activity cost and the domestic activity cost)
Japanese Side Total Project Cost	1,500 million yen	1,003 million yen
Kenyan Side Total Project Cost	1,818 million yen	999 million yen

Source: Ex-ante evaluation sheet; information provided by JICA
Note: The inputs are for both the Kenya component and the WECSA component unless otherwise mentioned. The exchange rate used for calculation of the actual cost: 1 Kenya shilling = 1.06 yen (average in 2009-2013).

3.3.1.1 Elements of Inputs

No issues are observed in the elements of inputs. It is noteworthy that (i) about the same number of Japanese experts and Kenyan counterpart personnel as in Phases 1 and 2 implemented the activities related to INSET in both primary and secondary education in Kenya and intra-regional cooperation, and produced most of the outputs except for a few outputs, while the preceding phases only covered secondary education and intra-regional cooperation, and (ii) the Kenyan side bore almost the same amount of expenses as the Japanese side to implement INSET.

Although it is difficult to verify quantitatively, the experience gained in the two preceding phases (especially the enhanced capability of the counterpart personnel) may have played a part in enabling the project to implement its wide-ranging activities. On the other hand, the grant aid project did not contribute to the achievement of the outputs of this project because

the completion of the development of CEMASTEA facilities and equipment in the grant aid project took place at around the same time as the completion of this project.

3.3.1.2 Project Cost

The project cost covering both the Kenya component and the WECSA component was lower than planned (67 percent of the plan). According to the terminal evaluation report, reasons for the decrease in the project cost included a change in the status of Academic Advisor from long-term expert to short-term expert (due to the availability of a successor), a change in the grade of personnel cost for some of the long-term experts (due to the availability of successors), and a reduction in the overseas activity cost as the result of revisions on the estimate.

3.3.1.3 Project Period

The project period was from January 2009 to December 2013 as planned (100 percent of the plan).

Both the project cost and project period were within the plan. Therefore, efficiency of both components is high.

3.4 Sustainability (Kenya Component) (Rating: ②)

With an assumption that the effect of the Kenya component that should sustain after project completion is the continuation of SMASE INSET (including the environment enabling former trainees to practice what they learned), the evaluator judged the component's sustainability based on whether the policy/institutional, organizational, technical, and financial conditions necessary for the continuation are secured and whether the latter conditions are likely to be secured in the future.

3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

Among the development policies mentioned in "3.1.1 Consistency with the Development Plan of Kenya," Vision 2030 and the National Education Sector Plan are still active at the time of ex-post evaluation. The National Education Sector Plan upholds strengthening and institutionalization of INSET in primary and secondary education and specifically states "strengthening SMASE INSET" as the Plan's goal. In addition, MOEST, CEMASTEA, and the Teachers Service Commission (an independent administrative agency that manages public school teachers including employment and capacity strengthening), with assistance from a JICA individual expert dispatched to MOEST, are preparing the Continuous Teacher Professional Development Policy at the time of ex-post evaluation. This policy, which is

expected to be approved within 2017, would make INSET (as Teacher Professional Development) mandatory in all subjects in primary and secondary education and require teachers to renew their teaching licenses every five years. Therefore, it is judged that policy and institutional arrangements necessary for the deployment of SMASE INSET are ensured.

3.4.2 Organizational Aspects for the Sustainability of Project Effects

CEMASTEA is responsible for the implementation of SMASE INSET under the supervision of MOEST, as it was at the time of planning. The supervising office in MOEST was the Field Service Department at the time of planning, but after the reorganization in February 2017, it was handed over to the Director General's Office for Field Coordination and Co-Curricular Activities. According to MOEST, the reorganization did not affect the function, staffing, and the relationship with CEMASTEA. The responsibility for local educational administration is now assumed by county education offices of MOEST following the change of local administrative divisions from provinces/districts to counties/sub-counties, but this change has not affected the continuation of SMASE INSET.

The organizational structure of CEMASTEA has not changed. Of the 107 employees in 2016, 47 were academic staff including the director and vice director, and 60 were non-academic staff. The academic staff are responsible for operation management, module development, national INSET lectures, monitoring and evaluation of regional INSET, and research in mathematics and science education; although 60 positions were originally created, with 15 positions in each of mathematics, physics, biology, and chemistry, the actual number of staff has declined because vacant positions after staff retirement have not been filled. Even though the operation is carried out by a fewer number of personnel than anticipated, CEMASTEA reported that the understaffing did not hinder activities, and new projects, development and revision of modules, and other activities continued to be undertaken.[25] Therefore, the staff size does not seem to be an issue for continuing the activities implemented in this project.

At the time of ex-post evaluation, a restructuring plan for the implementation agencies for INSET in Kenya is being planned. This plan would consolidate three existing bodies (CEMASTEA, the Kenya Education Management Institute, and the Kenya Institute of Special Education) into the Kenya School of Education, which, according to MOEST, will be formed by the end of 2017. According to CEMASTEA, the existing structure of CEMASTEA will remain intact under the changes in the plan, and it will continue to function as the specialized institution for math and science education (although a new name such as the Kenya School of Education CEMASTEA Campus is being considered). Further, a future plan is being

[25] According to CEMASTEA, training on gender and integrity is commissioned to resource persons (external experts).

considered to designate an existing teacher's college for primary education as the implementation body for non-math/science INSET and place it under the Kenya School of Education. The likelihood of CEMASTEA's continuation seems to be very high because CEMASTEA is the only organization that has experience and knowledge in INSET in individual subject areas. Therefore, it is judged that an institutional structure necessary for deploying SMASE INSET is secured.

3.4.3 Technical Aspects for the Sustainability of Project Effects

All academic staff of CEMASTEA have received technology transfer in this project, and have continued to engage in activities related to SMASE Phase 3 such as INSET in primary and secondary education (including updating of teaching materials and developing new modules), hosting of relevant conferences and workshops, training needs assessment with teachers, monitoring and evaluation of schools, and research projects (including impact assessment); they continue to upload some of the teaching materials and reports they create to the CEMASTEA website. Although some of them have retired from CEMASTEA as mentioned above, all CEMASTEA personnel receive a performance assessment and training in the organization, and share knowledge and techniques among them. Therefore, no issues were found in relation to maintaining the projects' effects that have been attained so far. On the other hand, CEMASTEA commented that further development of school-based INSET (training centered on lesson study) is important for resuming nationwide implementation of SMASE INSET in primary education with limited budget; therefore, CEMASTEA is hoping to receive Japanese assistance such as sharing of experiences in school-based activities.

With respect to the skill level of Regional INSET Trainers, those trainers for primary education in ASAL (where SMASE INSET in primary education is implemented at the time of ex-post evaluation) and those for secondary education across the country have opportunity to receive national training every year. Regional INSET monitoring reports prepared by CEMASTEA state that the performance of the monitored trainers is maintained at a certain level although improvement could be made in some areas including trainers' understanding of training contents. After the completion of this project, Regional INSET Trainers in primary education in other areas than ASAL no longer have opportunity to serve as SMASE INSET trainers, to use SMASE INSET system to maintain their skill level, and to have their performance monitored by CEMASTEA. It nevertheless seems that PTTC instructors are maintaining a certain level of skills since the incorporation of ASEI PDSI in their pre-service teacher education has created opportunity to continue practicing this particular approach as mentioned in "3.2.2.2 Other Positive and Negative Impacts."

3.4.4 Financial Aspects for the Sustainability of Project Effects

The bulk of CEMASTEA's budget is allocated by MOEST and comes from the education budget within the national budget. The education budget has grown, even though its share in the national budget has decreased since the time of planning (Table 7).

Table 8 shows CEMASTEA's budget. Although the budget is on an increasing trend, the expenses for training have fallen below the level before the project reflecting the fact that INSET in primary education is no longer administered nationally. On the other hand, the large increase in the development budget and training expenses for the Kenyan Fiscal Year (FY) 2015 reflected a change in the payment channel for the SMASE Fund in secondary education (SMASE INSET receives each year 1 percent of the capitation grant),[26] which is now paid to CEMASTEA rather than to individual schools as done in the past. According to CEMASTEA and local education offices, the change was welcoming because it directed the funds straight to SMASE INSET and eliminated the delay in payment to teachers who attended training. Although CEMASTEA has been requesting to MOEST for the creation of SMASE Fund in primary education in order to offer INSET in primary education in a national scale again, no development has taken place toward implementation. MOEST cites the availability of another INSET program in primary education other than the one provided by CEMASTEA as a factor for the lack of progress (although restricted to mathematics for early primary grades, EGMA will continue making INSET available nationally until March 2019; see Footnote 24).

Therefore, there is a concern for the prospect for sustainability as the project's effects may decline in areas other than ASAL (where SMASE IMSET is continued) if the budget for SMASE INSET in primary education does not increase.

Table 7: National budget and education budget

(Unit: million KSh)

	FY2013	FY2014	FY2015
Total expenditure	1,532,993	1,950,709	2,223,980
of which, education	253,632	301,448	319,426
% of education expenditure in total	17%	15%	14%
Breakdown of education expenditure			
Administration	171,104	181,711	193,218
Pre-primary and primary education	16,770	21,165	22,620
Secondary education	23,056	30,861	34,053
Higher education	40,436	60,471	62,255
Others	2,266	7,240	7,280

Source: Kenya National Bureau of Statistics

[26] Capitation grant = (unit amount) x (the number of enrolled students in each school)

Table 8: CEMASTEA budget (audited)

(Unit: thousand KSh)

	FY2010	FY2013	FY2014	FY2015
Revenue				
From national recurrent budget	71,433	106,935	106,432	104,824
From national development budget	200,000	97,374	155,801	586,023
Others (1)	27,969	6,638	16,779	13,391
Total	299,402	210,947	279,012	704,238
Expenditure				
Personnel	7,912	21,252	27,351	32,392
Training	259,858	117,464	134,754	530,183
Others	75,721	79,259	122,677	128,272
Total	343,491	217,975	284,782	690,847

Source: Preparatory survey report for the grant aid project (2010); documentation provided by implementing agencies.
Note: (1) Other donors including JICA; income from rent; etc. (2) O&M refers to operation and maintenance.

Overall, the sustainability of the effects of the Kenya component is fair because of the problems in the financial aspect of the component.

4. Results of the Evaluation of the WECSA Component (Overall Rating: A[27])

4.1 Relevance (WECSA Component) (Rating: ③[28])

4.1.1 Consistency with the Development Plan of the Region

At the time of planning, improvement of teacher's capability in Africa was set as one of the strategic goals in the Second Decade of Education Plan (2006-2015) promoted by the African Union (AU), and the action plan within the Plan counted on the contribution of SMASE-WECSA's intra-regional activities.

4.1.2 Consistency with the Development Needs of the Region

The needs for improving teacher's capacity are inferred from the statistics[29] for the member countries of SMASE-WECSA between 2009 and 2013, which showed an expansion of teacher population in all countries. Further, in the period between the planning and the project completion, in addition to serving continuously as the center of the TCTP in Africa, CEMASTEA was functioning as the secretariat of Math and Science Working Group within the Association for the Development of Education in Africa (ADEA)[30] (since 2004; the Working Group evolved to the Inter-Country Quality Node for Math and Science Education [ICQN-MSE] of ADEA in 2014), and the secretariat of SMASE-WECSA, which was renamed SMASE Africa in 2013. CEMASTEA, was, thus, playing a significant role as the hub for intra-regional cooperation in mathematics and science education.

[27] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[28] ③: High, ②: Fair, ①: Low
[29] UNESCO Institute of Statistics website.
[30] ADEA is a network created in 1988 to debate and exchange information on education policy in Africa. It facilitates intra-regional cooperation in education in Africa by working closely with AU.

4.1.3 Consistency with Japan's ODA Policy

The Country Assistance Program for Republic of Kenya (2000) designates "human resources development" and other four areas as the priority areas of Japan's assistance to Kenya.[31] It also states that Japan would provide assistance that would contribute to peace building and consolidation in Kenya and its neighboring regions. Also, the Yokohama Action Plan (2008), which was adopted in the Fourth Tokyo International Conference on African Development (TICAD IV), promotes a goal of "expanding teacher training in mathematics and science through SMASSE (targeting more than 100,000 teachers)".

In this way, the WECSA component has been highly relevant to development plan and development needs in Africa, as well as Japan's ODA policy. Therefore, its relevance is high.

4.2 Effectiveness and Impact[32] (WECSA Component) (Rating: ②)

4.2.1 Effectiveness

4.2.1.1 Achievement of Project Purpose

The major outputs of the WECSA component, namely, the TCTP for member countries and networking that had been continuously carried out since Phase 1, were produced mostly as planned. During the implementation period of this project, a total of 849 individuals from the 27 member countries attended TCTP courses and/or workshops at CEMASTEA. In addition, the project held five intra-regional conferences (general meetings of SMASE-WECSA) and three technical meetings (intra-regional meetings to share technical information), and provided technical support in several member countries by sending CEMASTEA staff and Japanese experts. Through these, the project aimed to strengthen capability of INSET providers as the project purpose and achieved the target level in one of the two indicators, the Capacity Building Index. Regarding the second indicator, "the extent to which the ASEI/PDSI concept is reflected in the training manual/materials in the member countries," this evaluation did not use it as a basis of evaluation because the terminal evaluation team pointed out that the validity of this indicator was low (i.e., this indicator would not necessarily represent the level of trainers' capacity development because the degree to which the ASEI-PDSI concept is reflected in manuals, etc. would be affected by the presence or absence of existing manuals and government-level decision-making in each member country). Instead, the terminal evaluation team examined self-assessment by former TCTP attendees as an alternative indicator, which showed good results.

Table 9 summarizes the degree to which the project purpose was achieved. Also, Table 10

[31] "Human resources development," "agricultural development," "development of economic infrastructure," "health and medical care," and "environmental conservation."
[32] Sub-rating for Effectiveness is to be put with consideration of Impact.

shows the number of participants in the TCTP and other related events to date including those during the project implementation period.

Table 9: Achievement of the project purpose (WECSA Component)

Project Purpose	Indicator	Actual
Capability of INSET providers (trainers and administrators) to implement ASEI/PDSI based INSET in member countries is strengthened.	(1) INSET providers obtain a mean of 2.5 on a scale of 0-4 in the overall assessment of Capacity Building Index for INSET provision.	Indicator: Achieved. ・ The average score was 3.8 in an on-line survey of 69 attendees from 17 countries conducted in November 2011. ・ The average score was 3.3 in an impact study conducted in Zambia, Uganda, South Sudan, and Gambia in March to May 2013. This study team observed INSET sessions and confirmed that the facilitation skills of the former attendees it observed had improved adequately, and that the contents of INSET were appropriate in all four countries (based on interviews with about 10 to 30 former attendees per country and observations).
	(2) The extent to which the ASEI/PDSI concept is reflected in the training manual/materials in the member countries. Alternative indicator: The percentage of former TCTP attendees who assessed that their capacities were strengthened by assistance from this project	The aforementioned impact study found that the training contents reflected ASEI-PDSI in all four countries studied (reference information). Alternative indicator: Achieved. In a questionnaire survey of former attendees conducted by the terminal evaluation team, 96 percent of 47 respondents from 15 countries reported that their capacities were strengthened by assistance from this project. Also, seven out of eight Japanese experts in member countries reported that the capacities of their counterparts were enhanced by the training in Kenya. At the same time, terminal evaluation analysis indicated that these results also reflected contribution of JICA's technical cooperation projects in math and science teacher training in individual member countries.

Source: Terminal evaluation report.

In sum, this component mostly achieved its purpose. The project would be judged "achieved" if only the performance of one of the indicators and the alternative indicator were used; however, the project purpose is judged "mostly achieved" considering that this evaluation could not consider the other indicator because its validity was low.

4.2.2 Impact[33]

The assessment of the impact of the WECSA component focused on the degree to which the following impacts materialized: (1) Prompted by the continuous implementation of intra-regional cooperation (i.e., whether the outputs have sustained), (2) former attendees of the training incorporated what they learned into math and science INSET in their home

[33] The time by which the overall goal is expected to be achieved (i.e., target year) is not clearly mentioned in existing documents. In this ex-post evaluation, therefore, the status of achievement was judged based on the status at the time of ex-post evaluation (i.e., three years after project completion).

countries (i.e., whether the outcome achieved for the project purpose has sustained), (3) contributing to the construction of a mechanism of math and science INSET in each member country (i.e., whether the overall goal has been achieved).

4.2.2.1 Achievement of Overall Goal

(1) Continuation of intra-regional cooperation (Whether the outputs have sustained)

As Table 10 shows, CEMASTEA has continuously implemented the TCTP and other activities for participants from African countries in the period between before this project and ex-post evaluation, while the number of attendees fluctuated from year to year. Although JICA has continued its assistance for the TCTP by funding part of the training expenses and dispatching a JICA individual expert ("Regional Advisor"), operation of the TCTP is undertaken by CEMASTEA on its own according to CEMASTEA and the JICA individual expert. Intra-regional conferences and technical meetings were suspended after the completion of this project, but CEMASTEA resumed them in 2016 as an intra-regional conference of SMASE Africa by managing all aspects of it including funding.

Table 10: The number of training courses and meetings held at CEMASTEA for African countries

		2009	2010	2011	2012	2013	2014	2015	2016
TCTP	Number of participating countries	18	24	11	27	23	10	8	14
	Number of training courses	6	4	1	5	3	1	2	2
	Number of attendees (person)	208	213	62	236	130	57	177	120
Number of other meetings		2	1	1	2	2	0	0	1

Source: Documentation provided by JICA; documentation provided by the implementing agency.
Note: The number of TCTP courses is the sum of the number of regular and special courses. The number of other meetings is the sum of the number of intra-regional conferences and technical meetings.

(2) Incorporation of what member countries learned from CEMASTEA into their INSET in mathematics and science (Whether the outcome achieved for the project purpose has sustained)

As mentioned in the next section, the results of the surveys of JICA offices and former TCTP attendees both showed that many former attendees incorporated what they learned in math and science INSET in their respective countries.

(3) Improvement of mathematics and science education in member countries (Whether the overall goal has been achieved)

The overall goal of the WECSA Component is described in vague terms (improvement of

math and science education in member countries), but it was determined during the project implementation that the overall goal would be measured by verifying the existence of a mechanism of mathematics and science INSET in member countries through four indicators. As summarized in Table 11, the results of the JICA office survey[34] indicate that a certain amount of progress has been made toward the institutionalization of INSET. However, targets for achievement, such as the minimum number of countries that should have such a mechanism, had not been set. If we apply a commonly used threshold of 80 percent—presuming that the target is met with 80 percent or more respondents reporting "the INSET mechanism exists"—the survey results fell slightly below the threshold to judge that the overall goal has been achieved.

Regarding the contribution of this project (the WECSA component) to such achievement, the aforementioned survey of JICA offices revealed that the offices in 16 out of the 20 countries agreed that the TCTP at CEMASTEA contributed to the establishment and implementation of a math and science INSET system in each member country. The details and mechanisms of contribution included: "after returning to their countries, attendees nurtured core personnel who would lead the promotion of math and science INSET domestically;" "incorporated what was learned when they practiced developing INSET modules and teaching/learning materials in mathematics and science;" "how to adapt what was learned to the domestic circumstances is being considered;"[35] "former attendees shared what they learned with people and organization that were involved in math and science education such as other teachers, teacher trainers, and the education ministry at home;" and "the TCTP became instrumental in promoting domestic implementation of JICA's math and science education projects."

Responses from former TCTP attendees were similar. 17 out of 19 respondents who attended TCTP courses after project completion reported, "I apply what I learned at CEMASTEA (extensively or to some extent)." The methods and instruments that they reported they use frequently included ASEI-PDSI, the revised Bloom's Taxonomy of Educational Objectives, class evaluation methods, among others.

JICA offices in five out of 20 countries that responded to the survey reported that math and science INSET is not implemented (or interrupted) in the country at the time of ex-post evaluation, due mainly to implementation budget and institutional limitations in the education ministry in respective countries, which implements INSET. Agreeing to JICA offices, the respondents in the TCTP attendee survey also mentioned lack of budget and an

[34] The terminal evaluation team collected the same information in a questionnaire survey with former attendees of the TCTP. However, the reliability of the collected information was poor, i.e., contradicting answers of respondents from the same country to items such as the presence or absence of a policy. Therefore, this ex-post evaluation took a strategy to ask JICA offices about the overview of the countries.

[35] On the other hand, some JICA offices found it problematic that former attendees only followed the form without making such adjustments.

institutional system to implement INSET as the reasons behind the difficulty in practicing what they learned from the training. Further, respondents on both sides pointed out that majority of attendees of the TCTP are INSET trainers, and not many administrators attended it. While aiming at "strengthening of capability of INSET providers" as the project purpose is consistent with the training the TCTP provided for INSET trainers, it is doubtful whether the project purpose serves as a direct means to achieve the overall goal, which was defined as "establishing INSET system."[36]

Table 11: Achievement of the overall goal (WECSA Component)

Overall Goal	Indicator	Actual
INSET systems in member countries are established/strengthened (Note by the evaluator: a literal translation of the Japanese text in project-related documents is "Mathematics and science education in the member countries of SMASE-WECSA is improved.")	(1) Existence of Policy on INSET	Partially achieved. Ten out of 20 countries (50 percent) reported that it "exists" or "is either being developed or planned to be developed" in response to the questionnaire of JICA offices conducted at the time of ex-post evaluation.
	(2) Existence of Administrative structure for INSET system	Partially achieved. Thirteen out of 20 countries (65%) reported that it "exists" in the same questionnaire.
	(3) Existence of a funding mechanism for INSET	Partially achieved. Ten out of 20 countries (50%) reported that it "exists" in the same questionnaire.
	(4) Existence of monitoring and evaluation (M&E) systems of INSET	Unknown (Not asked in the questionnaire)
	(Supplementary Information) Implementation of INSET in mathematics and science	Partially achieved. Fifteen out of 20 countries (75%) answered it is "implemented" at the time of ex-post evaluation in the same questionnaire.

Source: Beneficiary survey.
Note: Since none of the existing indicators would check whether math and science INSET is actually being implemented, the evaluator added a question asking about it as supplementary information to the survey questionnaire for JICA offices Instead, the evaluator did not include a question asking about Indicator 4 in the questionnaire in order to keep the questionnaire simple.

In this way, the beneficiary survey confirmed that the institutionalization of math and science INSET is in progress in member countries, and it is considered in majority of these countries that this project (the WECSA component) has contributed to such progress. However, claims cannot be made that the level of the progress is sufficient in 80 percent of the countries, and the relationship between the project purpose and the overall goal is indirect and partial. Therefore, it is concluded that this component has achieved its overall

[36] The original overall goal indicator that was set at the time of planning was "practice of lessons based on ASEI-PDSI," which appears logically more consistent with the project purpose in terms of means-ends relationship, although it would have been difficult to measure the level of practice. Another point to note is that cooperation efforts in other member countries such as "The Project on Strengthening of Mathematics and Science in Secondary Education in Niger" (JICA technical cooperation project, 2006-2009), which was the first SMASE INSET project in Francophone Africa, are not counted as impacts of this project even though many of these projects were implemented to meet the needs that increased through participation in SMASE-WECSA; these efforts are impacts of the preceding two phases, not of this phase.

goal at a limited level.

4.2.2.2 Other Positive and Negative Impacts

Although it is not only an impact of this project alone but also of the two preceding phases of technical cooperation projects and the grant aid project, the role of CEMASTEA as the center of SMASE INSET in Africa has been established and expanded as it continuously serves as the secretariat of ICQN-MSE and SMASE Africa (See "4.1.2 Consistency with the Development Needs of the Region").

In addition, there have been cases where CEMASTEA provided training in other African countries in cooperation with international organizations, etc., indicating a further development of CEMASTEA activities. (Note that the latter information is described here in this sub-section but not in "4.2.2.1 Achievement of Overall Goal," because Table 10 does not include this information and it is difficult to identify its relation to the overall goal.) For example, CEMASTEA developed a module and provided training at an international workshop and training for enhancing teachers' capacity held in Ethiopia in September 2016 in partnership with the United Nations Educational, Scientific and Cultural Organization (UNESCO), UNESCO International Institute for Capacity Building in Africa (UNESCO-IICBA), and International Institute for Education (IIE). CEMASTEA also provided training sessions at a training event on mathematics and science education for girls organized by Institute for Capacity Development (ICD; a Namibia-based independent international organization) in Ethiopia in December 2016.

Since this component has achieved the project purpose and overall goal to some extent, the effectiveness and impact of the project are fair. The project purpose (strengthening of capability of INSET providers) was mostly achieved by the time of project completion. After project completion, activities such as the TCTP have continued, and attendees have been utilizing what they learned from the training in activities such as math and science INSET in their home countries. The overall goal (improvement of mathematics and science education in member countries) is judged to be partially achieved because, although institutionalization of INSET is in progress in many member countries, there were limitations in the judging criteria for the achievement level and in the estimation of the degree of contribution of this component.

4.3 Efficiency (Common for Kenya Component and WECSA Component) (Rating:③)

See "3.3 Efficiency (Common for Kenya Component and WECSA Component)." Both the project cost and project period were within the plan. Therefore, efficiency of both components is high.

4.4 Sustainability (WECSA Component) (Rating: ③

The evaluator defined the WECSA component's effects that are expected to sustain after project completion as (1) the continuation of intra-regional cooperation by SMASE-WECSA and CEMASTEA for improving mathematics and science education even after the termination of JICA's assistance (continuation of the output-level effects), and (2) the existence of an environment in member countries that enables educators to practice what was learned in TCTP courses at CEMASTEA (continuation of effects at the project purpose and the overall goal levels). Then, sustainability was judged by examining whether the policy/institutional, organizational, technical, and financial conditions necessary for the continuation of these effects are secured or can be expected to be secured in Kenya and member countries. The judgment gave greater weight to the first dimension, as the second dimension was not included in the perspectives of sustainability in the terminal evaluation and there were limitations in evaluation resources.

4.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

(1) Policy and institutional aspects in Kenya related to intra-regional cooperation after termination of the TCTP

The TCTP is scheduled to continue being implemented through the Japanese fiscal year (JFY) 2017. No official documents from the Kenyan government mention whether or not it would continue intra-regional cooperation related to SMASE INSET after the termination of the TCTP. However, MOEST supports the ideas of Kenya becoming the host country of ICQN-MST and CEMASTEA assuming the role of its secretariat. In addition, the vision of CEMASTEA is to be a center of excellence in teacher capacity development in Africa, and it clearly sees intra-regional cooperation as one of its missions. CEMASTEA also states that serving as the secretariat of SMASE Africa secretariat is one of its core functions.[37]

(2) Policy and institutional aspects in member countries to support the practice of what was learned from the TCTP

While the study could not fully examine policies in individual member countries, in the questionnaire survey with JICA offices conducted at the time of ex-post evaluation, the respondents in a total of ten countries out of 20 countries confirmed the existence of an INSET policy, and the respondents from five countries reported that such a policy is either being developed or planned to be developed (Table 11). With respect to multilateral policies, revitalization of teaching profession and improvement of educational infrastructure are listed as the first and second strategic goals in the Continent Strategy for Education in Africa (2016-2025), a related policy of AU. Therefore, the policy and institutional arrangements are

[37] Documentation provided by the implementing agency and JICA; CEMASTEA website.

mostly secured.

Therefore, the policy and institutional aspects of sustainability are mostly secured in terms of both (1) and (2).

4.4.2 Organizational Aspects for the Sustainability of Project Effects

(1) Institutional arrangements for implementing intra-regional cooperation in Kenya

As mentioned in "3.4.2 Organizational Aspects for the Sustainability of Project Effects" (for the Kenya component), CEMASTEA's overall organizational structure has been adequately established. The TCTP is implemented by a TCTP Team consisting of academic staff and non-academic staff under the direction of an academic staff member who acts as Training Coordinator. The TCTP Team also has been researching training needs in Africa as recommended in the terminal evaluation. Although the organization chart does not clearly show the implementation structure related to SMASE Africa and ICQN-MSE, personnel are assigned on CEMASTEA's activity plan chart in the past and for JFY2017.

(2) Institutional arrangements for practicing SMASE INSET/ASEI-PDSI in member countries

Former TCTP attendees are likely be practicing what they learned to the extent possible as stated in "4.2.2.1 Achievement of Overall Goal." At the same time, limitations on the implementation mechanism of SMASE INSET have been pointed out. As for the intra-regional structure to sustain the project effects, CEMASTEA, serving as the secretariat of ICQN-MSE and SMASE Africa, would continue to be the center of cooperation in mathematics and science education in Africa.

The first dimension is adequately established while available information indicates some issues regarding the second dimension. Assessing these two aspects together, the organizational aspects of sustainability are considered to be mostly secured.

4.4.3 Technical Aspects for the Sustainability of Project Effects

(1) Technical level of intra-regional cooperation in Kenya (CEMASTEA)

The technical level of CEMASTEA's academic staff is high as mentioned in "3.4.3 Technical Aspects for the Sustainability of Project Effects" (for the Kenya component). Since project completion, CEMASTEA has continued activities such as the TCTP and intra-regional conferences and continuously uploaded teaching materials and reports they created to the CEMASTEA website. According to the JICA individual experts who are still dispatched to CEMASTEA, the training contents have reached a certain level of quality, and CEMASTEA's capability in operating training is high. At a SMASE Africa intra-regional conference, which

was being held when the evaluator visited CEMASTEA in November 2016, the evaluator observed that CEMASTEA was properly undertaking, without assistance, such tasks as receiving participants from eight countries, handling the plenary meeting and related programs (including technical contents such as seminars), and providing hospitality.


SMASE Africa intra-regional conference

Further, as described in "4.2.2.2 Other Positive and Negative Impacts," CEMASTEA provides technical assistance in the projects of several international organizations.

(2) Opportunity to refresh what was learned in member countries

Although adequate information was not available, multiple respondents in the TCTP attendee survey reported, "follow-up is necessary after the TCTP."

In sum, while available information on the second dimension is limited, the first dimension is adequately secured. When these two dimensions are assessed together, the technical aspect of sustainability is considered to be mostly secured.

4.4.4 Financial Aspects for the Sustainability of Project Effects[38]

(1) Financial aspects of the TCTP/intra-regional cooperation in Kenya

JICA is responsible for a portion of the training expenses for the TCTP until JFY2017. Although there has not been any indication so far to suggest that the Kenyan government will foot the cost to continue the operation, this is not an issue because it has never been planned for the national government to independently continue the training for other African countries after the termination of JICA's TCTP. Other notable expenses for intra-regional cooperation would include the expenses for having meetings, but these expenses are covered through JICA's non-TCTP financial assistance and member countries' own effort. For example, expenses for an ICQN-MSE meeting in March 2016 were partially funded by JICA. On the other hand, the SMASE Africa meeting in November 2016 collected fees from attendees, becoming the first intra-regional meeting held without financial assistance from donors.

While the results of interviews with attendees of this intra-regional conference and CEMASTEA indicate high willingness to participate among these attendees at the time of

[38] The terminal evaluation excluded the financial aspect from its judgment on the sustainability of the WECSA component based on the premise that the TCTP would be funded by JICA. This ex-post evaluation included the financial aspect while limiting it to the funding condition for intra-regional conferences and the like after the TCTP was terminated.

ex-post evaluation, whether such self-help efforts by participants will sustain in the future may depend on the utility of the output of cooperation in member countries (at the time of ex-post evaluation, output such as sharing of good practices related to student-centered teaching methods in multiple countries seems to be useful).

In addition, as presented in "4.2.2.2 Other Positive and Negative Impacts," CEMASTEA engages in training in other African countries supported by UNESCO-IICBA, IIE, and ICD, suggesting that CEMASTEA has access to sources of funding other than the financial resources of JICA, CEMASTEA itself, and member countries to continue intra-regional cooperation. According to CEMASTEA, it is planning another training course in the ICD in 2017, and a new cooperation effort with UNESCO is under consideration.

(2) Financial aspect of utilization of outputs of intra-regional cooperation in member countries

This evaluation was unable to investigate the financial conditions of individual member countries. However, according to the JICA office survey conducted at the time of ex-post evaluation, respondents representing 10 countries out of 20 countries confirmed that an INSET funding mechanism did exist (Table 11). Although the situations are likely to differ among countries, it is also inferred that countries allocate a certain amount of funds to intra-regional cooperation, as some of the participants in the aforementioned SMASE Africa intra-regional conference were sent by their education ministry using the ministry budget. At the same time, lack of funds is recognized as an issue in many countries as observed in the said JICA office survey (offices in seven countries raised this issue) and the TCTP attendee survey (ten out of 21 respondents [five out of eleven countries] raised this issue as a constraining factor for practicing INSET).

From the above, the first dimension is secured in Kenya, and the second dimension, based on limited information, is secured in certain countries while uncertain in other countries. Assessing these two dimensions together, the financial aspects of sustainability are considered to be mostly secured.

Overall, no major problems have been observed in the policy background and the policy/institutional, organizational, technical, financial aspects for the continuation of intra-regional cooperation by CEMASTEA. Therefore, sustainability of the effects of the WECSA component is high.

5. Results of the Overall Evaluation of the Project as a Whole (Overall Rating: A[39])

Taking the Kenya component and the WECSA component together, the overall evaluation of

[39] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

the entire project is as follows.

The overall relevance of the entire project is evaluated to be high as it is rated as high for both components. The effectiveness/impact is rated as high for the Kenya component and fair for the WECSA component. After adding greater weight to the Kenya component, the overall effectiveness/impact of the entire project is evaluated to be high. The efficiency is common to both components and evaluated to be high. The sustainability is rated as fair for the Kenya component and high for the WECSA component, and overall fair for the entire project by placing weight on the Kenya component.

In light of the above, the project as a whole is evaluated to be highly satisfactory.

6. Conclusion, Lessons Learned and Recommendations

6.1 Conclusion

This project was implemented to establish or strengthen (i) INSET for mathematics and science teachers in primary and secondary education in Kenya and (ii) training for the member countries of SMASE-WECSA, an intra-regional cooperation network in Africa, which were both implemented by CEMASTEA. The project was planned and implemented in two components, one for Kenya (the Kenya component) and the other for African countries (the WECSA component). The evaluation of each component is as follows.

(1) The Kenya component: The relevance of the component is high, as its objectives were consistent with Kenya's development policies and development needs as well as with Japanese aid policies with respect to strengthening teachers' capacity. Although the project's purpose of strengthening mathematics and science education in Kenya was mostly achieved, students' interests, an alternative indicator to measure the overall goal of upgrading students' capabilities in mathematics and science, missed the target slightly. The effectiveness and impact are evaluated to be high by taking into account other observed positive impacts, such as the diffusion of the project's effects to other subjects than math and science and pre-service training in the primary education level, which was the central sub-component in the Kenya component. The project's efficiency is evaluated to be high, as the project cost and the project period were both within the plan. The sustainability of the component's effects is evaluated to be fair, as there is a concern about the financial aspects of INSET in primary education in the future.

(2) The WECSA component: The relevance of the component is high, as it was consistent with Africa's intra-regional development policies and development needs as well as with Japanese aid policies with respect to strengthening teachers' capacity in member countries. The effectiveness and impact are evaluated to be fair. Although the project purpose of strengthening capacity of INSET providers to provide training in member countries was mostly achieved, the overall goal of improving the quality of teaching and learning of math and science in each country is judged to be partially achieved. Despite the presumption that the quality of teaching

and learning is improving, it was difficult to set judgment criteria to determine the level of achievement and to estimate the level of contribution of this component to the improvement. The project cost and the project period were common between this component and the Kenya component; therefore, as mentioned above, the efficiency of the project is high. The sustainability of the component's effects is evaluated to be high, for the policy background and the organizational, technical, and financial arrangements necessary for intra-regional cooperation by CEMASTEA are ensured.

The overall evaluation of the entire project was conducted with greater emphasis on the Kenya component, to which larger inputs and activities were allocated than the WECSA component. As a result, the relevance, effectiveness/impact, and efficiency are rated as high, and the sustainability is rated as fair.

In light of the above, this project is evaluated to be highly satisfactory.

6.2 Recommendations

6.2.1 Recommendations to the Implementing Agency

<Recommendations related to the Kenya component>

(1) In order to maximize the impacts of the project, it is vital for CEMASTEA to continue requesting the SMASE Fund in primary education to MOEST. MOEST, by working with the TSC and CEMASTEA, is recommended to examine at the earliest possible time the sustainability of INSET in primary education including related programs for early primary graders (EGMA and TUSOME), which are carried out with assistance from other donor agencies such as USAID at the time of ex-post evaluation. By positioning SMASE INSET in primary education in such a mix, it is recommended that MOEST seek the implementation of SMASE INSET in primary education across the country like SMASE INSET in secondary education and the continuation of the project effects. There is a mutually reinforcing relationship between EGMA/TUSOME, which aims to develop foundational skills in reading and writing in early primary grades, and SMASE INSET, which uses those skills to introduce student-centered and inquiry-based learning in advanced primary grades; it is desirable to secure funding sources for INSET in primary education that would combine these two programs as the Primary SMASE Fund.

(2) The school-based surveys for this ex-post evaluation confirmed that ASEI-PDSI is practiced in the classroom at both primary and secondary schools. However, the detailed classroom analysis by an expert, though based on a small sample size, pointed out that some problems were found in the content of the class, in which the project's intervention was smaller compared to the technical transfer in pedagogy. In both primary and secondary education, CEMASTEA is recommended to re-evaluate SMASE INSET by attaching greater

importance to the content of the class (lesson) in addition to the pedagogy when monitoring SMASE INSET and revising the modules based on monitoring results.

<Recommendations related to the WECSA component>

MOEST is recommended to clearly express in policy documents that Kenya will take the leadership in capacity development of mathematics and science teachers in Africa and provide policy support to CEMASTEA's intra-regional cooperation efforts, in which CEMASTEA assumes a central role, even after the termination of the JICA-assisted TCTP after JFY2017. MOEST is further recommended to ensure the sustainability of technical assistance from CEMASTEA to member countries by continuously allocating budget to CEMASTEA so that CEMASTEA can use it, along with the membership fees and conference registration fees it receives from member countries and meeting participants, to fund its activities such as organizing intra-regional conferences. Also considered important is that CEMASTEA continuously plan and expand useful contents for member countries such as the sharing of good practices as was done at the time of ex-post evaluation.

6.2.1 Recommendations to JICA

<Recommendations related to the Kenya component>

In order to institutionalize SMASE INSET for primary education across the country (maximization and sustaining of the impacts), it is recommended that JICA advocate to MOEST and donor agencies at such venues as education donor meetings for the expansion of SMASE INSET for primary education, which is mutually complementary to EGMA/TUSOME. In addition, CEMASTEA considers it important, given the budget constraint, to enhance school-based INSET in order to implement SMASE INSET nationally. As for JICA, it would be worth considering working with CEMASTEA to utilize its in-country training scheme to provide follow-up training for mathematics and science teachers. While doing so, JICA is recommended to examine the prospect of additionally providing technical assistance to improve the content of classes, as recommended to CEMASTEA above.

<Recommendations related to the WECSA component>

Since CEMASTEA is expected to remain as the center of intra-regional cooperation in Africa by serving as the secretariat of ICQN-MSE and SMASE Africa after the completion of JICA's TCTP in JFY2017, JICA should maintain close contact with CEMASTEA. JICA should also continue dispatching a JICA senior volunteer to CEMASTEA, and maintain cooperative relations by co-hosting conferences to exchange information and opinions on teachers' capacity development such as SMASE INSET and ASEI-PDSI.

6.3 Lessons Learned

Establishing an INSET system that can be implemented without external support

Regarding the primary education level, given the budgetary constraints that have made it impossible to implement cascade training in the entire country every year, CEMASTEA has been attempting to sustain SMASE INSET by limiting training to specific regions and introducing lesson study. As for the secondary education level, SMASE INSET's shift toward experience-specific training (i.e., each year, training is provided to teachers with certain years of teaching experience such as 0-5 years, 6-11 years, or 12 years or longer) enabled CEMASTEA to conduct training more efficiently and be more responsive to needs, contributing to high sustainability. Targeting specific training groups could also contribute to reducing the number of cascades.

These undertakings, all devised and introduced by CEMASTEA after the completion of this project in order to continue the system after the withdrawal of JICA's assistance, can become reference cases for project evolution that may be informative when considering an exit strategy of assistance projects for INSET in other countries. However, it is important that INSET rotate the target regions or target years of teaching experience so that all regions and teachers would be covered within several years, and continuously engage in teachers' capacity development by helping transferred techniques to take root and introducing new techniques, among other efforts.

Appendix: Status of production of the outputs at the time of project completion

Output (achievement)	Indicator	Achievement of Indicator
Kenya Component		
1. A system of National INSET for Regional Trainers is established at CEMASTEA. (Mostly achieved)	4 cycles of training materials and programs for the National INSET for the primary education are developed.	Achieved
	Over 250 Regional Trainers are trained at CEMASTEA every year.	Achieved
	National INSET for the primary education at CEMASTEA obtains a mean of over 3 on the scale of 0 to 4 in the Quality of INSET Assessment Index.	Achieved
	100% of implementation Reports on National INSET and Workshops are submitted by CEMASTEA staff by the agreed deadlines (in one month).	Not achieved
2. A system of Regional INSET and Regional workshop is established at Primary Teachers' Training Colleges (PTTCs). (Partly achieved)	Regional INSET for Cluster Trainers at PTTCs is carried out four times.	Achieved
	4,500 (at least 4,400) Cluster Trainers are trained every year.	Mostly achieved
	Over 1,200 TAC Tutors/Zonal QASOs, 47 County QASOs and 287 Sub-county QASOs are trained.	Partly achieved
	Regional Trainers obtain a mean of over 2.5 on the scale of 0 to 4 in the overall assessment of capacity Building Index at the Regional INSET at PTTCs.	Partly achieved
	Regional INSET at PTTCs attains to a mean of over 2.5 on the scale of 0 to 4 in the Quality of INSET Assessment Index.	Partly achieved
	100% of M&E Reports on Regional INSET and Workshops are submitted by CEMASTEA staff by the agreed deadlines (in one month).	Not achieved
	100% of Implementation Reports are submitted by PTTCs by agreed deadlines (in one month).	Not achieved
3. Existing system of Cluster INSET is strengthened. (Partly achieved)	A guideline/manual on management of M/S INSET for primary school teacher is developed.	Mostly achieved
	At least 60,000 primary school teachers who teach mathematics and/or science in grades 6, 7, and/or 8 drawn from every cluster in the country participate in Cluster INSET every year.	Mostly achieved
	100% of M&E reports on Cluster INSET are submitted by CEMASTEA staff by the agreed deadlines (in one month).	Not achieved
	100% of Implementation Reports are submitted by DEOs in three months.	Not achieved
4. Secondary Mathematics and Science teachers' "Activity, Student Centred, Experiment, and Improvisation/ Plan, Do, See, and Improve (ASEI/PDSI)" practices in classroom are enhanced. (Partly achieved)	INSET and workshop contents for introducing lesson study are developed.	Achieved
	A guidebook on Lesson Study is developed.	Achieved
	At least 90% of Secondary School Principals are trained on pedagogical leadership including Lesson Study.	Partly achieved
	47 County Directors of Education, 47 County QASOs, 287 DEOs and 287 District QASOs are trained for District Workshops for Principals.	Partly achieved
	More than 80% of the Counties (clustered Districts) conduct workshops for Secondary School Principals to share and discuss experience in Lesson Study.	Achieved
	Principal's supervision on ASEI-PDSI practice is enhanced/improved by 10% compared with the results in the Situational Analysis.	Partly achieved
	100% of M&E Reports on Principals' Workshops are submitted by CEMASTEA staff by the agreed deadlines (in one month).	Not achieved
	At least 50% of Implementation Reports are submitted by the agreed deadlines (in three months) by DPCs.	Not achieved
5. Role of CEMASTEA as resource centre for mathematics and science education is strengthened. (Partly achieved)	Primary INSET materials (write-ups) for Cycle 1&2 are revised/refined as self-explanatory materials and published for teachers.	Partly achieved
	The revised Primary INSET materials for Cycle 1&2 are digitized and made available through the CEMASTEA website.	Mostly archived
	At least one booklet on ASEI/PDSI practices is published and distributed.	Mostly achieved
	At least one exemplary lesson video is produced and distributed.	Mostly achieved
WECSA Component		
1. ASEI/PDSI based INSET providers from member countries are trained. (Achieved)	TCTP at CEMASTEA is carried out five times.	Achieved
	At least 500 participants attend the TCTP at CEMASTEA.	Achieved
	At least 15 sets of training materials are produced.	Achieved
	Lesson Innovation Index attains a mean of 2.5.	Achieved
2. SMASE-WECSA network is strengthened. (Achieved)	Regional conferences and SMASE-WECSA delegates meetings are held at least four times.	Achieved
	Increased member countries participating in SMASE-WECSA activities and implementing INSET.	Achieved
	Technical workshops organized by Kenya or in collaboration with member countries are held at least three times.	Achieved
3. Role of CEMASTEA is strengthened as resource centre for mathematics and science education in Africa. (Partly achieved)	ASEI-PDSI prototype lesson plans, developed by member countries, are compiled and disseminated.	Partly achieved
	One of the TCTP materials (write-ups) is revised/refined for publication.	Achieved
	The revised material is digitized and made available from the CEMASTEA website	Partly achieved

Source: Terminal evaluation report, JICA documents, documents provided by the implementing agency.

Appendix

Detailed analysis by an expert: "Classroom analysis through video recordings"

(Excerpts of portions related to Kenya)

Expert: Hideo Ikeda (Professor emeritus, Hiroshima University)

This detailed analysis was conducted to supplement the ex-post evaluations of this project, namely, the "Strengthening of Mathematics and Science Education (SMASE)" (technical cooperation project for Kenya, 2009-2013), as well as the Niger "The Project on Strengthening of Mathematics and Science in Secondary Education in Niger Phase 2" (technical cooperation project for Niger, 2006-2009). The following is a portion of the analysis related to the Kenyan project.

(1) Purpose of the analysis: To objectively and quantitatively evaluate the extent of improvement in science classes at the point of ex-post evaluation.

(2) Summary of the analysis:

Materials and method: Classroom video analyses were conducted. The questions posed by the teacher and the questions asked by the students during the class have been classified and analyzed, and scored according to the revised Bloom's Taxonomy of Educational Objectives[40] (based on an assumption that questions posed by teachers and asked by students can be classified into a gradient ranging from those cognitively most basic questions based on "recollection" to those most cognitively advanced questions based on "creation," higher points were assigned as the question approaches the "creation" category): 1 point for *Remember*; 2 points for *Understand*; 3 points for *Apply*; 4 points for *Analyze*; 5 points for *Evaluate*; and 6 points for *Create*. When used in such a manner, the revised Bloom's Taxonomy, which has successfully been used in prior projects in Zambia, Ghana, Bangladesh, and Japan (hereafter referred to as "international comparison data"),[41] is expected to ensure objective examinations

[40] Bloom's Taxonomy of Educational Objectives classifies target learning outcomes into six psychological and cognitive levels. The original taxonomy (Bloom, 1956) used six levels consisting of *knowledge, comprehension, application, analysis, synthesis, evaluation*, but the present analysis adopts Anderson and Krathwohl's (2001) six revised categories mentioned in the main text.

[41] Over the last 20 years, the Laboratory of Science Education, Graduate School for International Development and Cooperation, Hiroshima University, with which the author of this report had been affiliated, has directly and indirectly participated in the science education improvement projects implemented by JICA in Asia and African countries, and has conducted a series of analyses of science classes using the revised Bloom's Taxonomy in Ghana (Beccles, 2013, doctoral dissertation; Kato, doctoral dissertation data, the School of International Cooperation, Hiroshima University; Ikeda, unpublished data), Zambia (Matsubara, 2009, doctoral dissertation), and Japan (Kato, doctoral dissertation data; Ikeda, unpublished data). The author developed a rating system for the revised Bloom's Taxonomy for the present analysis to compute Bloom's Scores in order to quantitatively measure the improvement in individual classes, and applied it retrospectively to the aforementioned research. According to our results, the classes in Ghana and Zambia scored below 2.0 in Bloom's Scores, with their instructors posing questions mostly in the *Remember* and *Understand* categories, rarely in the *Evaluate* category, and none in the *Create* category. In Japan, questions in the most advanced category, *Create*, were infrequent, and were limited in situations where students

of the level of classroom instructions as the aforementioned scoring system for different cognitive activities is consistent with the idea of "making students think," which was emphasized in JICA's technical cooperation projects for basic education in African countries.[42] In the present analysis, the scores that concern us (referred to as "Blooms' Scores" in this report) are computed by multiplying the aforementioned score within each cognitive category by its frequency, then by dividing the sum of the multiplications by the total frequency. This method overcomes the challenge of analyzing classroom instructions quantitatively, and is, thus, expected to contribute to the improvement in the quality of teacher education. However, the Bloom's Score primarily measures the psychological and cognitive level of a pedagogical method, and is not concerned with the level of instructional content taught in the class. Since a quantitative classification of instructional content has not been developed, the content will be textually described in this report.

Observation target: In Kenya, observations were made on the classes instructed by a total of nine math and science teachers consisting of four in primary education (The sampled teachers were specifically in charge of 7th and 8th graders. ID: Pri1, Pri2, Pri4, and Pri5[43]) and five in secondary education (in charge of 1st to 4th graders. ID: Sec1 to Sec5). The classes were videotaped after they were chosen (purposive sampling) in the six counties visited by external evaluators during the beneficiary surveys in a manner to maintain the representativeness of different geographical (urban/rural/ASAL: Arid and semi-arid lands) and school types (boys/girls/co-ed schools and national/county/sub-county schools) in the sample. Due to the limitations in field research, only one instructor (ID: Pri4) had no prior in-service education and training (INSET) courses.[44]

Hypothesis: Those teachers who had attended INSET provide higher-quality instructions (higher Bloom's Scores) than those teachers who had not attended INSET.

(3) Results of classroom analysis in Kenya

The Bloom's Scores of the nine teachers varied widely, from the highest 2.65 to the lowest 1.29. Among these nine teachers, eight had attended INSET (regional training or school-based

considered experiment methods in those classes that focused on experiments, or when the classes were instructed by expert teachers.

[42] SMASE INSET, which was implemented in this project as well as the Third Country Training Program (TCTP) for SMASE-WECSA member countries, set the revised Bloom's Taxonomy of Educational Objectives as the target for improvement in classes that adopted the ASEI-Plan, Do, See, Action (PDSI) approach.

[43] In addition to the classes listed in the table, a primary-level math class (Pri3) was videotaped but was eliminated from the sample due to poor video and audio quality.

[44] Although only one or two primary school teachers had completed the regional training for INSET (provided by trained regional INSET instructors), most primary school science teachers had attended school-based training (transferring of knowledge and techniques from the teachers who had received regional training to their peers). Due in part to the longer history of implementing INSET in secondary education, most secondary school teachers in science had attended regional training. Non-INSET trained teachers were instructing a few classes during our school visit, but we could not obtain their consent for videotaping.

training), and only one had not attended training. When the scores for these instructors are rank-ordered from the highest to the lowest, the top four instructors had attended regional training, the fifth highest (the median score) had not attended INSET, and the remaining four had attended regional or school-based training (the 7th and 8th scores belonged to those who had attended school-based training). Based on these results, the hypothesis (higher scores for teachers with training) was not supported in Kenya. However, in a qualitative analysis, the only instructor among the subject pool who had not attended training was found to possess solid foundations on pedagogy and subject knowledge, demonstrated by such things as showing in the math class several different ways to calculate multi-digit multiplications on paper, which exceeded Kenyan math standards that required only a single method, and frequent posing of advanced questions; therefore, it would be misleading to treat this teacher as "control," i.e., without INSET.

Next, the following are the comparisons between the results from Kenya and the international comparison data.

- Compared to the teachers in other developing countries (Ghana and Zambia), the Kenyan teachers who were analyzed in the present evaluation generally posed more questions that encouraged students to think (the average Bloom's Score in Kenya was higher than those of Ghana and Zambia by 0.14 points and 0.46 points, respectively).
- The three best teachers scored 2.65, 2.22, and 2.14 respectively, scoring much higher than in Ghana or Zambia, comparing even positively to the scores of Japanese teachers. These results are considered to be reflective of the effects of the training.
- Teachers did not pose questions in the *Apply* category. Previous studies have found the same pattern in developing countries such as African countries.
- There was one case of the *Create* category in Kenya (Sec2). This was the first documented case of this type of question in the research in Africa. This type of question is not frequent in Japan, either; this result is also notable because the Kenyan teacher encouraged student to ask this type of question.
- Some teachers' scores (1.29, 1.43, 1.56, and 1.72) showed large deviations from the best scores even though they had attended training.

Further, the scores have been compared between primary and secondary schools. The teachers from these two types of schools scored similarly, with the primary school teachers averaging 1.86 and the secondary school teachers 1.84. However, the teacher of the primary school Pri5 scored extremely high, and the teacher of the secondary school Sec5 scored the lowest. The results, therefore, should not be evaluated from the scores alone. Now, the following ranking of the nine teachers, ordered from the highest score to the lowest score (the number in a circle), indicates that primary school teachers except for the top scorer did not score

very high. On the other hand, secondary school teachers except for the lowest scorer scored somewhat higher than the primary school teachers.

Primary school teachers: ① ⑤ ⑦ ⑧

Secondary school teachers: ② ③ ④ ⑥ ⑨

These results may reflect several factors. First, Kenya, JICA's assistance was initially provided for secondary education (1998), preceding the assistance for primary education (2009). Second, the two of the INSET-trained primary school teachers except for the top scorer had received school-based INSET training from their colleagues who shared knowledge and techniques, instead of receiving the training directly from INSET trainers.

Below is a list of qualitative observations, obtained from the present analysis, on the effects of SMASE INSET on teachers.

- The dimension of *Activity* in ASEI (*Activity, Student-centered, Experiment, Improvisation*) appears to have taken root solidly given that all nine classes incorporated group activities or actual measurement of specimens.
- ASEI's *Student-centered* is most strongly tied to the Bloom's Scores analyzed in the present study. Therefore, with respect to the goal of the project—stimulating students by posing questions that make them think—the three teachers who scored high as mentioned above (Pri5, Sec3, Sec2) can be considered to be stimulating students as much as, or to a greater extent than, are their Japanese counterparts.
- *Experiment and Observation* in ASEI is greatly influenced by the subject area and topic of each class. For example, it is very difficult to incorporate experiments and observations into such classes as mathematics (Pri1 and Pri4), biology (sexually transmitted diseases), and chemistry (diffusion [theory])(Sec3) due to the nature of topics handled in these classes. The analysis of five other classes (Pri5, Sec1, Sec2, Sec4, and Sec5), which showed that they adopted experiments and observations that had rarely been used prior to JICA's assistance, therefore demonstrates the effects of the project.
- *Improvisation* (simplified experiments using available materials) in ASEI is aimed at improving class instructions by encouraging teachers to innovatively use course materials, teaching aids, and experiment methods available in the textbook by adapting to diverse local and school conditions. Measurement of this dimension was impractical in the present analysis as it would require a comparison of the materials introduced in the textbook and training to those used in the class. However, we observed a few concrete examples of improvisation, such as the teacher in Sec2, who explained an improvisation on preservation by studying specimen bottles, and the teacher in Sec5 (scoring 1.29, the lowest in Kenya), who displayed available materials such as cockroaches and two plant materials.

The following are the characteristics of three classes, Sec5 that scored the lowest and Pri5 and Sec2 that scored the highest, from which may emerge concrete indications in Kenya.

- As noted in the last section, Sec5 "Taxonomy of living organisms" (scoring 1.29) can be rated positively in terms of the instructor's effort in improvisation as shown in the example of displaying actual materials as noted in the last section. In addition, questions posed by the teacher included more advanced *Analyze* and *Evaluate* questions. However, its low score is likely the result of the fact that of 102 questions posed by the teacher, 87 (85.3 percent) fell in the *Remember* category, with many of them verifying students' existing knowledge by repeating the same questions or by posing questions in a way to induce students to utter terms. Similar tendencies were observed in Pri1 (1.43) and Pri4 (1.78). These results, thus, suggest that further improvement can be expected by being more selective with questions designed for memorization and by increasing higher-level questions that encourage students to think.
- Questions in the *Remember* category were used in Pri5 (2.65) "Emunctory" to review previously studied items, but these questions were transformed into higher-level, *Evaluate* questions by asking other students to verify the answers. The teacher attempted to pose many questions in the *Analyze* and *Evaluate* categories during the development part of the lesson. These factors contributed to the highest score for the level of questions posed by the teacher in this class. Also, even though hands-on activities related to human body are difficult to practice in the class, the teacher incorporated creative activities, such as asking students to put their hands on the chest so that they could conceive breathing as it relates to internal body structure and functions. In addition to being judged intuitively and qualitatively as the "most effective class" among all 13 classes in Kenya and Niger, the analysis revealed that this class also ranked the highest when evaluated quantitatively. However, the lungs should be discussed as a respiratory organ because another important function of the lungs, absorption of oxygen, would be underemphasized if they were treated as an emunctory organ for carbon dioxide; this problem should be attributed to the science curriculum in Kenya rather than to the teacher himself/herself.
- Sec2 (2.14) "Collection of living organisms (animals)" ranked the third highest in terms of the score. Its score was pushed down because a fair number of the questions posed by the teacher were in the *Remember* category. After guiding the lesson by asking students to consider collection tools and collection methods, the teacher prompted students to ask questions, and one of them asked, "how do we collect a snake?" (a question in the *Create* category). Prompted by this question, the teacher expanded the lesson by having students to consider actual methods for collecting a snake. Accordingly, this class is considered to be the class in which students were stimulated the most.

Results of the analysis of the questions posed by teachers and asked by students

The top row (shaded cells) shows frequency (number of times); the bottom row shows the score. The number in the parenthesis indicates the number of questions asked by students.

	Re-member	Under-stand	Apply	Analyze	Evaluate	Create	Total	Bloom's Score
Pri 1Primary Math Attended school-based training	42	7	0	4	1	0	54	1.43
	42	14	0	16	5	0	77	
Pri 2 Primary Science Attended school-based training	15	8	0	2	0	0	25	1.56
	15	16	0	8	0	0	39	
Pri 4 Primary Math Not attended training	157	53	0	3	32	0	245	1.78
	157	106	0	12	160	0	435	
Pri 5 Primary Science Attended regional training	19	1	0	8	9	0	37	2.65
	19	2	0	32	45	0	98	
Sec 1 Secondary Biology Attended regional training	87 (1)	115	0	5	6 (1)	0	213 (2)	1.72
	87	230	0	20	30	0	367	
Sec 2 Secondary Biology Attended regional training	29	12	0	9	5	1 (1)	56	2.14
	29	24	0	36	25	6	120	
Sec 3 Secondary Chemistry Attended regional training	16	2	0	5	4	0	27	2.22
	32	4	0	20	20	0	60	
Sec 4 Secondary Biology Attended regional training	16	16	0	5	0	0	37	1.84
	16	32	0	20	0	0	68	
Sec 5 Secondary Biology Attended regional training	87	8	0	6	1	0	102	1.29
	87	16	0	24	5	0	132	
Average individual score								1.85
Average of all scores (N=9)	468	222	0	47	58	1	796	1.75
	468	444	0	188	290	6	1,396	

Remaining issues in Kenya: The present analysis of questions posed by teachers primarily focused on the analysis of pedagogical methods. However, in order to enhance teaching, the content of the class is as important as the pedagogy. Even though every class requires contents, this project, by emphasizing pedagogical techniques, appeared to have made very little interventions regarding course contents. This project dispatched very few experts in course contents in science, and none in in the areas of human body, health, and hygiene in biology. It

should be pointed out that the organization of the lesson materials for “sexually transmitted diseases” was highly problematic. The class made students to memorize the names and preventive methods for each sexually transmitted disease, repeated essentially the same preventive methods for other infectious diseases, offered redundant information regarding preventive methods, and let students to engage in activities (discussion) that lacked scientific bases. It is necessary, therefore, to use a more structured approach in the lesson backed by scientific evidence. The level of the lesson reflects the expert knowledge of the teacher. In this regard, the inadequate level of teachers regarding course contents remains as a major issue to be resolved, as evidenced by the various professional deficiencies exhibited not only by the teacher for Pri5 but also by eight other teachers.

JICA Evaluation Department

On Views of Experts

In this ex-post evaluation, opinion of academia was invited to capture more specialized and diverse views for the projects, in addition to the perspectives of the DAC five evaluation criteria to be conducted by the external evaluator. The external evaluator selected and enlisted the support of a leading figure in the field: Hideo Ikeda, Professor emeritus of Hiroshima University.

Prof. Ikeda, author of this report, specializes in the science and mathematics education, and lesson study. Over the last 20 years, the Laboratory of Science Education, Graduate School for International Development and Cooperation, Hiroshima University, with which the author had been affiliated, has directly and indirectly participated in the science education improvement projects implemented by JICA in Asia and African countries. For these reasons, the external evaluator asked him to conduct in depth analysis based on his expertise and experience.

Specifically, "Lesson analysis through video recordings" was conducted to supplement the ex-post evaluations of these project, namely, the "Strengthening of Mathematics and Science Education (SMASE)" (technical cooperation project for Kenya, 2009-2013), as well as the Niger "The Project on Strengthening of Mathematics and Science in Secondary Education in Niger Phase 2" (technical cooperation project for Niger, 2006-2009).

The purpose of the analysis is to objectively measure the extent of improvement in science and mathematics classes at the point of ex-post evaluation. Thereby the author tried gaining insights regarding the impact of in-service education and training (INSET) for primary and/or secondary education, which were implemented under the two projects mentioned above. Moreover, the expert shared his comments and suggestions for the further development and improvement of capacity of teachers, which are obtained through the analysis. The result of the analysis related to the Kenyan project was appended to the evaluation report as attachments.