

IMPROVING THE QUALITY OF MATHEMATICS AND SCIENCE TEACHING FOR PRIMARY AND SECONDARY EDUCATION IN INDONESIA*

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1. Introduction

Problems of mathematics and science teaching in Indonesia include the following aspects: (1) The process of teaching and learning is more teacher-center, (2) Lack of using hands on and practical work activities, (3) Lack of resources for teachers or prospective teachers, and (4) Students performance and interest toward mathematics and science are relatively low. In order to overcome these problems, the Project for Development of Mathematics and Science Teaching for Primary and Secondary Education so called IMSTEP had been implemented since October 1998 until September 2003 under supporting the government of Japan. The two-year follow-up program of IMSTEP has been implemented since October 2003 for preparing the dissemination of the project outcomes. Also, to run the follow-up program, counterparts in the F(P)MIPAs of three universities (UPI, UNY and UM) have worked together with assistance of JICA experts in accomplishing all project agenda. The guidelines of the Follow-up program are mentioned in the minutes of the meeting between JICA and the Government of Republic of Indonesia. This report will describe part of IMSTEP Follow-up program implementation.

2. Plan of Operation

2.1. Goal and Purpose

According to the minutes of the meeting between Japan International Cooperation Agency (JICA) and Authorities Concerned of the Government of Republic of Indonesia, the overall goal and purpose of the follow-up program are as follows. The overall goal is to improve students' scientific thinking and experimental skills as well as their understanding of science and mathematics in lower secondary education in Indonesia through institutionalizing and disseminating outputs of the Project. The purposes: (1) The quality of in-service training in science and mathematics education will be improved by the institutionalized participation of university. (2) Education to prospective teachers in science and mathematics at the three universities (UPI, UNY, and UM) will be improved.

2.2. Activities

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To achieve those purposes, seven activities were set up to accomplish the follow-up program, as follows. (1) To develop a framework and mechanism for in-service teacher training program in collaboration with the three universities, educational offices of local governments and MONE. (2) To improve piloting guidelines (such as concept, planning, and implementation procedures) as well as qualitative evaluation indicators for its outputs (such as lesson plans). (3) To implement piloting activities with wider types of schools regarding academic level and material condition. (4) To continue revision of common textbooks and other teaching materials for pre-service training. (5) To try out the common textbooks by related faculty members in science and mathematics of three universities and reflect the results in revising the textbooks. (6) To organize joint activities (workshops) with in-service teacher training institutions (such as MGMP, LPMP, and PPPG). (7) To organize the national seminar on current issues and mathematics educations.

2.3. Output

The expected outputs of the follow-up program are as follows. (1) The strengthened linkage and coordination between existing in-service teacher training institutions and universities. (2) The standardized strategies and methodologies of ongoing and future piloting activities, (3) The greater applicability of lesson plans produced through piloting activities for a wider range of schools with different academic level and material condition. (4) The complete editorial works regarding the manuscripts of common textbooks. (5) The improved quality of common textbooks based on try-out results at universities. (6) Expanded opportunities for secondary school teachers other than pilot school teachers to utilize the results of the Project output (such as lesson plans) through joint activities between faculty members and MGMP/LPMP/PPPG. (7) Enhanced understanding of personnel concerned in science and mathematics education in three universities and related organization on current issues in this area.

2.4. Approach

Approach of the IMSTEP Follow-up program is illustrated in figure 1.

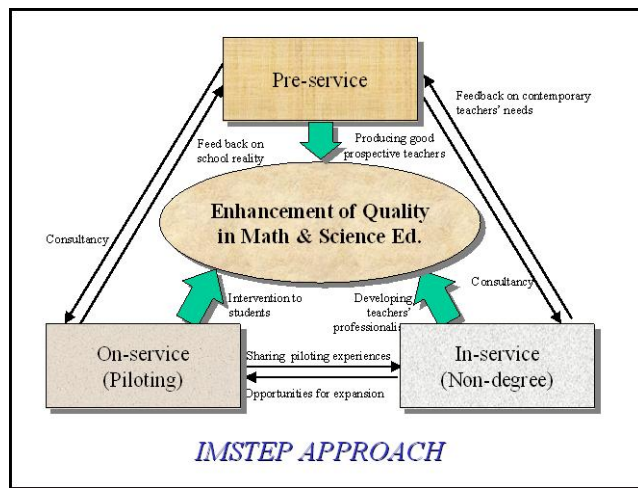
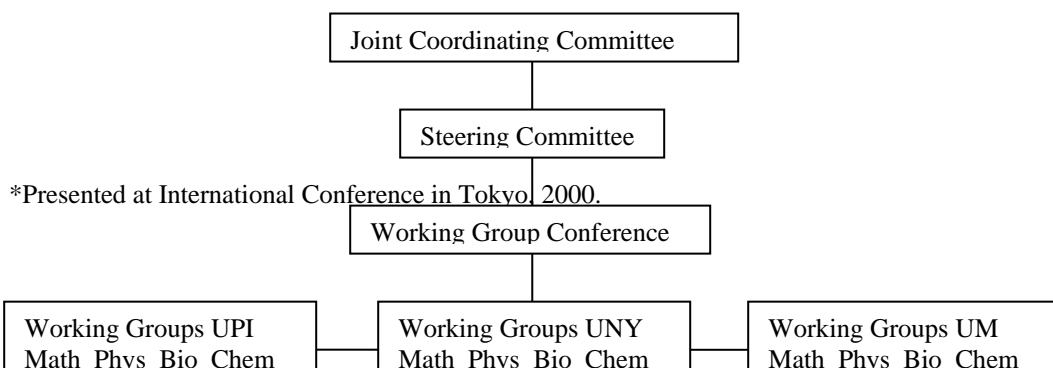


Figure 1. Approach of the IMSTEP Follow-up program.
Source: Saitos' presentation

Three components of teacher training programs (pre-service, on-service, and in-service) will contribute to the enhancement of quality in mathematics and science education. Among teacher training programs should be inter-connected for couple of reasons. Faculty members at pre-service teacher training program needs feed back on school reality and contemporary teachers' needs to produce good prospective teachers. On the other hand, both piloting teachers (on-service teacher training) and MGMP teachers (in-service teacher training) need consultancy to intervene students and to develop teachers' professionalism. Piloting teachers may share piloting experiences with MGMP teachers and it's opportunity to disseminate the piloting outcomes. By collaboration among those teachers training program, it is believed that quality of science and mathematics education will be improved.

2.5. Project Organization

Similarly to IMSTEP organization, each participating university has four working groups (Mathematics, Physics, Biology, and Chemistry Working Groups) and head of department acts as head of working group. Three task teams were established to run the follow-up program at each working group. Task team A deals with piloting, task team B deals with common textbook, and task team C deals with dissemination. In addition, Eva task force was set up in each working group to conduct study regarding the impact of piloting activity. The IMSTEP project organization is shown in the following flow chart.



Task Team A (piloting)	Task Team A (piloting)
Task Team B (textbooks)	Task Team B (textbooks)
Task Team C (dissemination)	Task Team C (dissemination)
Eva task force	Eva task force

Figure 2. Flow chart of Follow-up organization

A task team leader coordinates task team activities among three universities. For example, leader of Task Team A of biology FPMIPA UPI is in charge to coordinate activities in 3 universities. Coordinator for Task Team B is from UM, Task Team C and Eva Task Force are from UNY. Working Group Conference was held annually to plan and evaluate the progress of the Follow-up program implementation. Progress activities of the IMSTEP Follow-up program will be describe bellow.

The Steering Committee meeting that is chaired by Rector of UPI was held to formulate annual work plan and to coordinate project activities and achievements of project outcomes. Also, Director General for High Education chaired annual Joint Coordinating Committee meeting to supervise annual work plan and review overall progress of the project

3. Activities

3.1 Piloting Activities

Piloting activity has been implemented in three universities (UPI, UNY, and UM) since 2001. The objective of piloting is to improve science and mathematics learning in pilot schools and to get feed back for improving quality of pre-service training program at the three universities. We apply several principles into piloting activity, namely, school empowerment, support school policy, hands-on activity, daily life, and local materials. We utilize optimally available science and math facilities at schools. In case, school does not have any science and math facilities, teacher educators and teachers develop collaboratively hand made teaching materials by utilizing local materials. We follow the applied curriculum at schools. Teacher educators and science and math schoolteachers develop collaboratively teaching

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model (teaching plan, practical work activities, teaching materials, and assessment model) and apply it at real class. To improve student active learning in science and mathematics, we develop the hands-on and daily life based teaching model. We also enhance the quality of piloting activity in the IMSTEP Follow-up program implementation through improving in post-class discussion, video and printed documentation, as well as evaluation of the impact. Post-class discussion is an important part of the piloting activities by which the observers and the teacher in charge could share their findings and understanding of the lesson observed. The impact of the piloting activity and several factors influence students' motivation in learning science and math has been studied through survey to students, parents, teachers at pilot and control schools.

Six principles have been applied in implementing piloting activities, namely collaboration, school empowerment, support school policy, hands on and minds on activities, daily life, and local materials. Procedures of piloting activities include a cyclical scheme of plan, do, and see.

Plan. Piloting teachers and teacher educators conducted several workshops:

- ❑ to identify teaching and learning problems at piloting schools
- ❑ to design and develop teaching models (lesson plan, student worksheet, teaching materials, and evaluation method)
- ❑ to try out developed teaching materials

Do. A piloting teacher conducted a lesson by applying the developed teaching model at a class. While teacher educators, other teachers and prospective teachers observed the lesson. Some time, JICA experts attended the lesson. The focus of the observation was student activities, such as interaction of student-student, student-teaching materials, and student-teacher. Observers may take pictures for further analysis.

See. Right after the lesson, the teacher and observers got together for post-class discussion to reflect the lesson. Observers gave comments and suggestion regarding student activities to improve the next lesson.

3.2. Tryout of Common Textbooks

IMSTEP has developed 47 common textbooks, which are written by faculty members of 3 universities (UPI, UNY, and UM) to provide prospective teachers with more references in Indonesian. The common textbooks have similar course content and are used at three universities (UPU, UNY, UM). There are several stages to develop common textbooks. Each department of three universities (UPI, UNY, UM) invite faculty members to write textbooks by submitting textbook outline to be evaluated by a task team C. Task team C was in charged in

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coordinating development of common textbooks in 1st phase of IMSTEP. For follow-up program, task team B is in charged trying out the common textbooks. Joint task team meeting decides author and textbook title to be developed and each department is requested to develop a common textbook. Each department assigns 2 faculty members to review related common textbooks from other two universities. A meeting is held to exchange information between reviewers and authors concerning content and writing style. Based on reviewers' suggestion, authors revise the manuscript and authors submit the revised manuscript to the project for printing. In addition to internal review by faculty members of participating universities (UPI, UNY, and UM), the project requested other universities to participate in reviewing common textbooks. Faculty members of FMIPA ITB and UNJ reviewed the common textbooks developed by UPI. Faculty members of FMIPA from UNES and UGM reviewed the common textbooks developed by UNY. Faculty members of FMIPA from UNNESA and UNIBRAW the common textbooks developed by UM. The project distributes the common textbooks to three participating universities (UPI, UNY, and UM) and 9 LPTKs (UNIMA, UNM, UNIMED, UNP, UNJ, UNNES, UNESA, IKIP Singaraja, and IKIP Gorontalo) for try-out and getting feedback from students. Students may borrow the textbooks for one semester.

To improve quality of common textbooks, the IMSTEP Follow-up program facilitates try out of common textbooks in three universities (UPI, UNY, UM) in three semester: event semester of FY 2003/2004, odd semester of FY 2004/2005, and event semester of 2004/2005. Try out common textbooks includes readability by students and contents by related faculty members in UPI, UNY, and UM.

3.3 Dissemination of Project Outcomes

Three universities (UPI, UNY, UM) and local schools for piloting activities have developed good practices of school culture through collegiality. As a result, a number of outputs have been produced, such as lesson plan, student worksheet, teaching materials, and assessment kits. Those IMSTEP outputs and how to change school culture need to be disseminated to MGMPs and other LPTKs. The IMSTEP Follow-up program has tried out dissemination procedures, such as seminars, workshops, and training.

Seminar

Number of seminar has been held at three participating university (UPI, UNY, and UM) to disseminate the good practices of piloting activities by inviting science and math schoolteachers, faculty members of other PLTKs, LPMP staffs, PPPG staffs, and policy makers. For example, UPI held National Seminar on 10th July 2004 with 200 participants, regarding Dissemination of Results of School-University Collaboration to improve Readiness in Implementing Curriculum-2004. Experiences of piloting activities were shared by piloting team (teachers and teacher educators). On 2nd and 3rd August 2004, UNY held National Seminar on Research, Education,

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and Application in Science and Mathematics for 300 participants. On 5th and 6th September 2005, UM held National Seminar on Mathematics and Science education as well as exchange experience on good practices of the follow-up program including the implementation of lesson study. Participants were eager to learn results of activities from the three areas of project implementation.

Workshop with MGMP teachers

Workshop with MGMP teacher is first step of collaboration with MGMP to disseminate the IMSTEP outcomes, particularly results of school-university partnership. With regards to collaboration with MGMP, counterparts of the follow-up program in three universities designed program activities, include a series of workshops and lesson study for mathematics and science. According to teachers' needs, contents of workshop include refreshment of science and math subject, especially chemistry for junior secondary school since limited number of junior secondary schoolteachers with chemistry major. Other workshop content was development of teaching models (lesson plan, teaching materials, and authentic assessment) to support implementation of Competency Based Curriculum at schools. Three universities (UPI, UNY, and UM) held workshops with MGMP teachers, particularly for junior secondary schoolteachers to share results of piloting activity to improve quality of secondary school science and mathematics. Following the workshops with MGMP teachers, it has been planed to conduct lesson study. In this activity, a teacher applied lesson plan and other teachers and teacher educators observed the lesson. Next step of the lesson is post class discussion, observers are welcomed to give comment and suggestions regarding the effectiveness of lesson plan to improve next lesson. We learned that MGMP teachers were enthusiast and motivated to adopt the good practices of piloting activity. Also local Local Educational officers (DINAS) support school-university partnership but some districts were still difficult to support financially.

Implementation of Lesson Study by MGMP teachers

Each F(P)MIPA from the three universities and MGMP for math and science of junior secondary school collaborated to hold workshops for the following objectives: (1) to share results of piloting, (2) to develop and try out teaching models of junior secondary school science and math in 2004, (3) to introduce lesson study as an alternative strategy for improving learning quality of junior secondary school science and math through improvement of teachers' professionalism.

In 2005, F(P)MIPAs from the three universities and MGMP for math and science of junior secondary school have conducted lesson study activities at several SMPs in Bandung, Yogyakarta, and Malang. School teachers and teacher educators designed and developed collaboratively teaching models. A school teacher conducted a lesson while other teachers, teacher educators, school principals, supervisors, Local

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Educational authorities for SLTP, and JICA experts observed the lesson. Following the lesson, the teacher and observers had post-class discussion to reflect and share the lesson. School principal chaired the post-class discussion.

In general, the implementation of lesson study covers the following activities: identifying problems by group of teachers; developing lesson plan by groups of teachers (if necessary, faculty members could give consultation or comments); implementing the lesson plan; observing the teaching and learning processes by MGMP members, faculty members from F(P)MIPAs, School Principals, JICA experts and prospective teachers from F(P)MIPAs; and evaluating the lesson as well as reflecting on its effect by the teacher in charge and the observers. Based on the observations and reflections, teachers in the lesson-study group revise the lesson. They might change the materials, the activities, the problems posed, the questions asked, or all this things.

Based on the lesson study implemented, it seems that the activities could effectively change the schools culture as indicate in the following aspects:

- 1) Through discussion of reflection session, teachers became accustom to accepting inputs and recommendations from others, expressing the weakness and the strength of their lessons, sharing ideas for developing better classroom practices, and pointing out the essentials or the important points of classroom activities observed.
- 2) Although many observers came inside the classrooms while implementation of the lessons, the activities are running well as if the observers are not there.
- 3) As an effect of implementation of the lesson, students tend to actively involve in classroom activities such as discussing problems within small group and classroom activities, asking and answering questions, proposing argumentations, and explaining results of group discussion.

Since the effect of the lesson study to the schools cultures, it is important that the good practices of the activities need to be disseminated and expanded to other schools within the province or outside the province.

Training for LPTK staff

FPMIPA UPI held training for LPTK staffs to disseminate results of piloting activity on October 2004 in Bandung. Twenty faculty members of LPTKs (public and private FKIPs) from Lampung, Java, Bali, and Mataram participated in the 3-day training. The training content included impact of piloting activity, lesson study, and classroom action research. Training methods consists of workshop to analysis video of teaching and develop teaching models and visit of piloting schools. Facilitators for the training were JICA experts, Dean, Vice dean, Local coordinator, piloting team. Directorate General of Higher Education supported the training.

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Exchange of experience

In collaboration with MGMP for junior secondary math and science, FPMIPA UPI held exchange of experience on lesson study to share results of lesson study. School teachers of junior secondary science and math presented the results of lesson study. One hundred participants of teacher educators, school teachers, representative of UNY and UM, observers from Gorontalo and Papua, JICA experts, JICA mission team, kasubdin Dikdas West Java Province.

Exchange experiences also held in the term of annual national seminar. In 2004 and 2005, the seminars were held in Yogyakarta and Malang respectively. Participants of the seminars were school teachers; faculty members from UPI, UNY, UM, and other universities; JICA experts; and staff members from Regional Dinas Pendidikan. In those seminars, the presenters not only come from universities, but also from school teachers. Some teachers presented their experiences in attempting to improve the quality of math and science teaching by applying lesson study activities.

4. The Impact of IMSTEP Follow-Up Program

The follow-up program has a good impact to both university and school improvement. In dealing with university improvement the program has touched upon the following aspects: GPA, length of study, academic atmosphere, and relationship improvement with others including school communities.

Since the implementation of IMSTEP and its Follow-up Program, academic atmosphere among faculty members of F(P)MIPAs of the three universities tended to improve. The improvement include the positive changing of teaching paradigm such as changing focus from teaching to learning, and the use ICT in teaching and learning processes. Also, a number of national seminars held by each university, indicate that academic activities among faculty members significantly increased.

Activities implemented during the follow-up program provide opportunities for school communities such as math and science teachers, principals, MGMP members, and school supervisors to actively involve in such activities as piloting, workshop, seminar, and lesson study. By these activities, interaction among school communities and faculty members has been formed fruitfully so that the relationship has grown to be a learning community. As a result of these activities, especially the implementation of lesson study, there is a significant improvement regarding school academic culture as follows.

- Teachers have better motivation to develop innovation on mathematics and science teaching.
- Teachers self-confident tend to improve as indicate by the possibility to open their lesson to be observed and to discuss the lesson soon after the observation.

Some teachers also try to disseminate their experiences on applying lesson study in academic forum such as national seminar.

- ❑ Through the activities of lesson study, teachers, school principals, MGMP members, and supervisors may learn from each other so that the community became a *learning community* that will be useful for developing teachers' professionalism.
- ❑ Lesson study conducted by mathematics and science teachers has motivated other teachers to learn and implement the activities. In Bandung case, for example, some schools such as SMPN 1 Lembang and SMPN 12 Bandung try to promote lesson study for other subjects by their own initiative.
- ❑ The success of lesson study implementation in pilot areas has attracted other school communities from other district. For example, some district such as Kabupaten Tasikmalaya and Kabupaten Garut in West Java and Kabupaten Bantul in Yogyakarta have invited faculty members of F(P)MIPAs and MGMP to conduct workshop regarding lesson study.

5. Future Plan

The outcomes of IMSTEP Follow-up Program include the following aspects: good practices of mathematics teaching and leaning science at Junior and Senior Secondary School, a model of empowering in-service teacher training through lesson study, a model of developing partnership between universities and schools, and common textbooks for prospective teachers. In order to sustain the results of the IMSTEP follow-up program, the following recommendation need to be considered.

- ❑ The three universities (UPI, UNY, and UM) should be the center for empowering other LPTKs.
- ❑ In order to share experiences among LPTKs members, annual seminar need to be sustained.
- ❑ Results of IMSTEP follow-up program, especially lesson study, should be disseminated to other LPTKs in other provinces so that the development of teacher professionalism could be maintained.
- ❑ All of the common textbooks need to be disseminated to other LPTKs in Indonesia.