

Contribution of IMSTEP (JICA technical cooperation) for improving Science and Mathematics Education in Indonesia

(Networking and partnership among educational institutions in Asia)

Sumar Hendayana and Harun Imansyah
FPMIPA UPI

Abstract

The Project for Development of Science and Mathematics Teaching for Primary and Secondary Education (IMSTEP), a JICA technical cooperation, has been implemented in 3 F(P)MIPAs of Indonesia University of Education (UPI), State University of Yogyakarta (UNY), and State University of Malang (UM) for 5 years. The project is intended to strengthen pre- and in-service program run by 3 participating universities in order to improve science and mathematics teacher competences as the central factor for improving the quality of science and mathematics education in secondary schools. The project has conducted various activities, such as curriculum development, teaching materials and textbook development, communication, and piloting. The project has dispatched experts from Japanese universities and sponsored counterpart training in Japan for teaching staffs of the participating universities. The project has distributed the outcomes to 9 LPTKs (former IKIPs/STKIPs) and schools. With regards to piloting, teaching staffs and schoolteachers tried out the developed science and math teaching models (teaching methods, teaching materials, and assessment) at real situation at junior and senior secondary schools. The impact of the IMSTEP has been studied at FPMIPA UPI and junior and senior secondary schools in Bandung. It was found that the quality of teaching learning process has improved at FPMIPA UPI as indicated by increasing in number of laboratory activities, more hands-on and discussion in learning activities, more seminar and workshop activities involving faculty members, students, schoolteachers, increasing in GPA, and decreasing in length of study. In addition, the junior and senior secondary school students enjoyed learning science and mathematics because they did experiment in science and math subjects, involved in group-discussion to exchange information among classmates, felt science and math learning related to daily life situation. The networking and partnership among 3 universities, Japanese universities, and schools have been strengthened as an additional impact of the project.

1. Introduction

Since October 1998 Directorate General of Higher Education (DGHE) Ministry of National Education of RI in cooperation with JICA has implemented a technical cooperation project in three participating universities, namely Indonesia University of Education (UPI), State University of Yogyakarta (UNY), and State University of

Malang (UM). The project entitled The Project for Development of Science and Mathematics Teaching for Primary and Secondary Education (IMSTEP). As complement to this technical cooperation project, JICA implemented a grant aid project that includes laboratory equipment provision for the three participating universities and building construction for Indonesia University of Education.

This IMSTEP project is intended to strengthen pre- and in-service teacher training program run by the three participating universities in order to improve science and mathematics teachers' competence as the central factor for improving the quality of science and mathematics education in primary and secondary schools. It is expected that graduates of the three participating universities improve science and mathematics education practice in schools as well as all of the outputs of the project is extended to other teacher training institutions in Indonesia.

Through this project, the networking and partnership between FPMIPA UPI and other institutions has been made. Staffs exchange has been done between FPMIPA UPI and Japanese universities. FPMIPA UPI has sent faculty members to learn many aspect of science and mathematics education at universities in Japan. Japanese universities have dispatched their faculty members as long- and short-term experts at FPMIPA UPI, FMIPA UNY, and FMIPA UM. In this project, FPMIPA UPI has conducted many activities collaboratively with FMIPA UNY and FMIPA UM. Also FPMIPA UPI has worked collaboratively with the well-known institution (Bandung Institute of Technology, ITB) and other 9 LPTKs in Indonesia. In addition, FPMIPA UPI has strengthened partnership with 4 junior and senior secondary schools in Bandung. The benefit of networking and partnership between FPMIPA UPI and other institutions will be discussed in detail bellow.

2. FPMIPA UPI-Japanese Universities

Networking with universities in Japan has been established since the beginning of project implementation. The Japanese universities involved in this project are listed bellow:

- (1) Tokyo Gakugai University
- (2) Gunma University
- (3) Hitotshubashi University
- (4) Shizuoka University
- (5) Aichi Education University
- (6) Utsunomiya University
- (7) Tottori University
- (8) Mai University

Forty-three faculty members from those Japanese universities have been dispatched as short and long term JICA Experts at FPMIPA UPI, FMIPA UNY, and FMIPA UM. They worked collaboratively with faculty members to improve the quality of science and math education in the 3 participating universities. JICA Experts along with Indonesian counterparts of faculty members have conducted several discussions,

seminars, and workshops regarding many aspects of science and mathematics teaching for both school and university levels.

Twelve faculty members of FPMIPA UPI have been sent abroad for improvement of their special skills in many aspects of science and mathematics education and research skills in science and mathematics educations in Japanese universities. For example, some of them learned how to develop digital teaching materials for science and mathematics teaching.

As a result, faculty members of FPMIPA UPI got special skills in many aspect of science and mathematics education. After returned home, they have contributed for improvement of science and mathematics teaching at FPMIPA UPI as indicated by various teaching materials and methods applied in their teaching. Other important result of the networking was scientific publication in international journals. Many faculty members of Department of Mathematics Education of FPMIPA UPI have published research results in Japanese Journals.

3. FPMIPA UPI - other Universities in Indonesia

The networking and partnership among FPMIPA UPI, FMIPA UNY, and FMIPA UM has been strengthened since FPMIPA UPI along with FMIPA UNY and FMIPA UM has implemented the JICA technical cooperation project for development of science and mathematics teaching for primary and secondary education in Indonesia since October 1999. The networking scheme among the 3 participating universities is based upon following project organization structure shown on Figure 1. At faculty level it has been established a working group (WG) for each field lead by department head so that totally each university has four WGs, those are for mathematics, biology, physics and chemistry. Each WG consists of four Task Teams (TT), namely Task Team A for curriculum, Task Team B for teaching methods, Task Team C for teaching materials, and Task Team D for evaluation and communication. 4-5 faculty members are assigned as member of each TT within a department.

The project has held Working Group Conferences twice a year to discuss the progress of activities at UPI, UNY or UM. Members of task teams and head of working groups attended the conferences for sharing experience in conducting the project activities. Head of Department of Mathematics of FMIPA UNY, head of Department of Physics Education of FPMIPA UPI, head of Department of Biology of FMIPA UM, and head of Department of Chemistry Education of FPMIPA UPI chaired the Working Group Conference for mathematics, physics, biology, and chemistry education, respectively.

Following Working Group Conference, the project has held Steering Committee Meeting twice a year at UPI. Rector of UPI chaired the meeting for formulating the annual work plan and coordinating the project activities. Members of the Steering Committee Meeting consist of deans, vice deans for academic affair, local coordinators, chairpersons of Working Group Conference, and JICA Experts. At national level, the Joint Coordinating Committee (JCC) has been established for supervising the project plan and reviewing the project progress and achievement. Director General of Higher Education chaired the JCC meeting held once a year and

the meeting was attended by Rector of UPI, Rector of UNY, Rector of UM, Director for Junior Secondary Schools, Director for Senior Secondary School, Director for LPTK, BAPPENAS, Representative of JICA Indonesia office, and JICA experts.

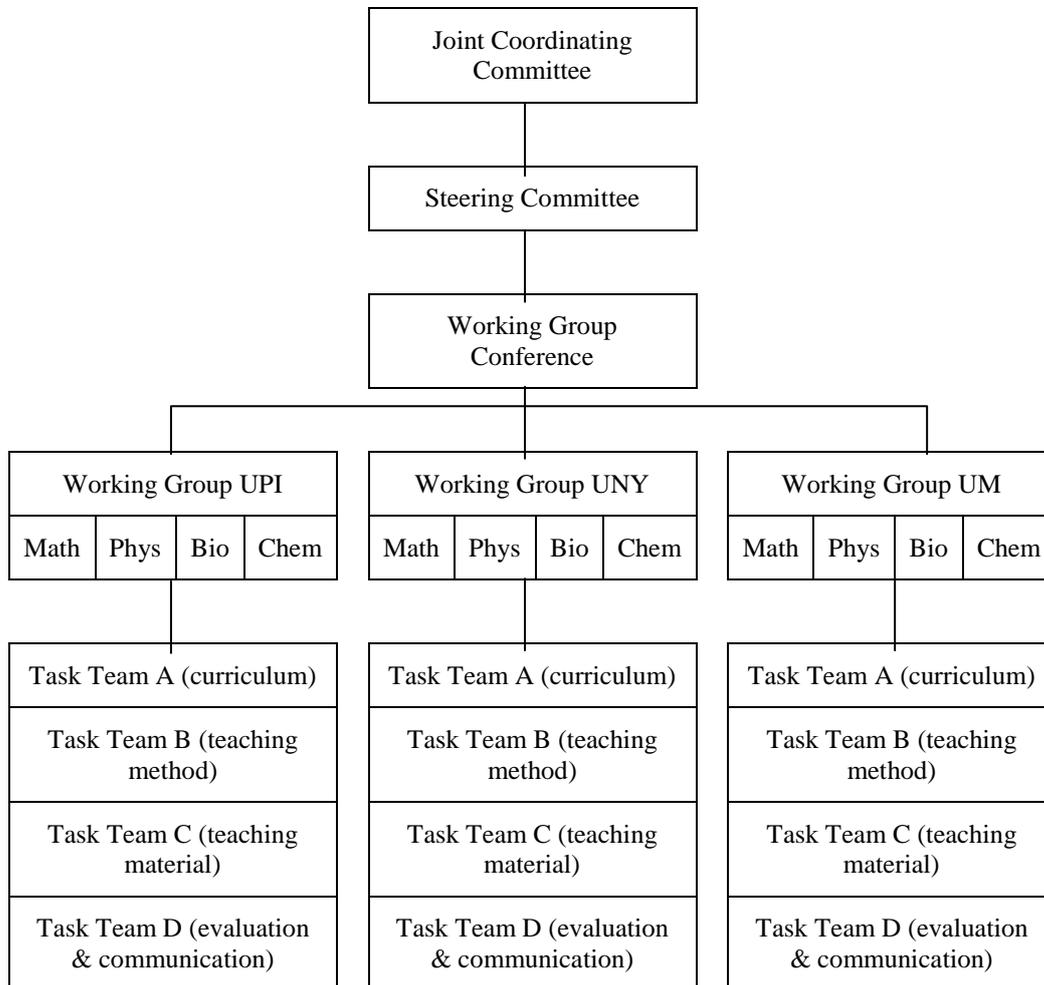


Figure 1. Project Organization Structure

To implement the JICA-IMSTEP project, the 3 participating universities (UPI, UNY, and UM) have conducted many activities. Each participating universities did some specific activities, such as curriculum review and revision, teaching materials development, laboratory development, etc. In addition, the 3 participating universities have worked collaboratively in developing common textbooks and publishing newsletters.

Faculty members of FPMIPA UPI have reviewed and revised syllabi, so that course contents are more relevance to the needs. The revised syllabi were distributed to students to guide them in learning the course contents. To support the implementation of the revised syllabi, faculty members have developed/utilized teaching materials, such as Power Point based teaching materials, web based teaching materials, computer simulation, and so on. In addition, faculty members have developed more laboratory activities for students since the project provided laboratories and their facilities. For

example, physics students enjoy observing stars and planets at night through telescope provided under this project.

Faculty members of FPMIPA UPI, FMIPA UNY, and FMIPA UM were requested to develop common textbooks of science and mathematics that accommodate at least 75% of syllabi content of each university. The common textbooks, which are written by faculty members of one of the participating universities, were reviewed internally by related faculty members from other two participating universities. For example, Physical Chemistry textbook, which is written by faculty member of FPMIPA UPI, was reviewed internally by a faculty member of FMIPA UNY and a faculty member of FMIPA UM. To improve the quality of the developed common textbooks, the project has asked faculty members of other 2 universities to review the common textbooks externally. For instance, faculty members of FMIPA of Bandung Institute of Technology (ITB) and FMIPA of State University of Jakarta (UNJ) reviewed externally the common textbooks that are developed by faculty members of FPMIPA UPI. 47 common textbooks have been developed collaboratively during the implementation of JICA-IMSTEP. The developed common textbooks are listed below, Table 1.

Table 1. List of developed common textbooks

Fiscal Year	UPI	UNY	UM
1999/2000	<ol style="list-style-type: none"> 1. Pemrograman Komputer untuk Matematika 2. Petunjuk Praktikum Fisika Dasar I 3. Teknik Laboratorium 4. Kimia Fisika I 	<ol style="list-style-type: none"> 1. Aljabar Linear dan Penerapannya 2. Konsep Dasar Fisika Modern 3. Kimia Anorganik I 4. Taksonomi Tumbuhan Tinggi 	<ol style="list-style-type: none"> 1. Metoda Statistka Praktis 2. Fisiologi Manusia 3. Kimia Analitik II 4. Fisika Dasar II
2000/2001	<ol style="list-style-type: none"> 5. Strategi Belajar Mengajar Matematika 6. Gelombang 7. Strategi Belajar Mengajar Biologi 8. Strategi Belajar Mengajar Kimia 	<ol style="list-style-type: none"> 5. Pengantar Aljabar abstrak 6. Listrik dan Magnet 7. Kimia Anorganik II 8. Biologi Vertebrata 	<ol style="list-style-type: none"> 5. Pengembangan Kurikulum dan Pembelajaran 6. Zoologi Avertebrata 7. Dasar-Dasar Kimia Analitik 8. Strategi Pembelajaran Fisika
2001/2002	<ol style="list-style-type: none"> 9. Matematika Diskrit 10. Matematika Fisika I 11. Mikrobiologi 12. Ikatan Kimia 	<ol style="list-style-type: none"> 9. Kalkulus Lanjut 10. Penilaian Pencapaian Hasil Belajar Fisika 11. Kimia Dasar I 12. Genetika 	<ol style="list-style-type: none"> 9. Persamaan Diffrensial Elementer 10. Anatomi Tumbuhan 11. Kimia Organik I 12. Fisika Dasar I
2002/2003	<ol style="list-style-type: none"> 13. Kalkulus I 14. Matematika Fisika II 15. Kimia Fisika II 	<ol style="list-style-type: none"> 13. Analisis Nyata 14. Mekanika 15. Kimia Dasar II 16. Biologi Sel dan Molekuler 	<ol style="list-style-type: none"> 13. Program Linear 14. Ekologi Hewan 15. Kimia Organik II 16. Dasar-Dasar Fisika Kuantum

Some of developed common textbooks have been used in the 3 participating universities (UPI, UNY, dan UM) for references. Also the JICA-IMSTEP project has distributed some of developed common textbooks to 9 LPTKs (UNIMED, UNP, UNJ, UNNES, UNESA, UNM, U.Manado, STKIP Gorontalo, and STKIP Singaraja) for

references. These common textbooks help students in understanding the course contents since the textbooks were written in Indonesian and each student at FPMIPA UPI, FMIPA UNY, and FMIPA UM can borrow those common textbooks for 1 semester.

Increasing in number of facilities has improved the academic atmosphere at community of FPMIPA UPI as indicated by many seminars/workshops held by involving faculty members, students, and schoolteachers, once a month in average in FY 2002/2003. With office space equipped with LAN system at FPMIPA UPI building, faculty members spent much time to work on campus for preparing teaching kit, such as syllabi, handout, textbook, teaching materials, instruction manual for experiment. Faculty members can assess scientific information globally through available Internet connection, so that they can always update the teaching material, handout, and textbook. Also they can write better research proposals for getting competitive research grant.

Pre-/in-service students got much better learning facilities, such as comfortable classrooms, laboratories, lab equipment, syllabi, textbooks, and manuals for experiment, so that they have more hands-on and discussion in learning activities. In addition, they have better opportunity to interact with faculty members for consultation on some matters regarding mini theses project and course matters. Therefore, the JICA IMSTEP project has improved productivity and efficiency of FPMIPA as indicated by number of outcomes and increasing in GPA as well as decreasing length of study though other factors have contributed. Increasing in GPA and decreasing in length of study are shown on Figure 2 and 3.

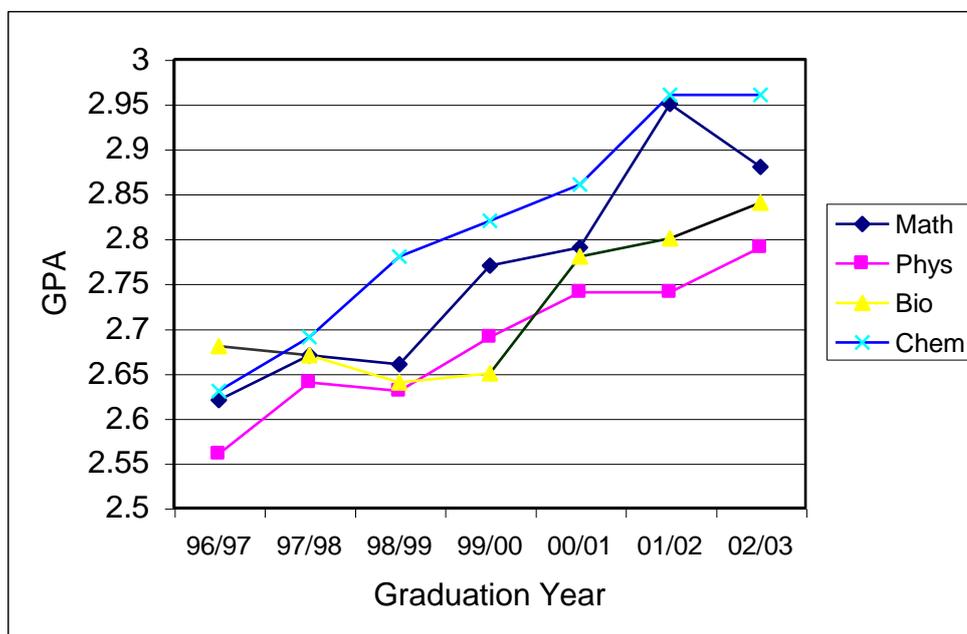


Figure 2. Increasing in GPA of FPMIPA students

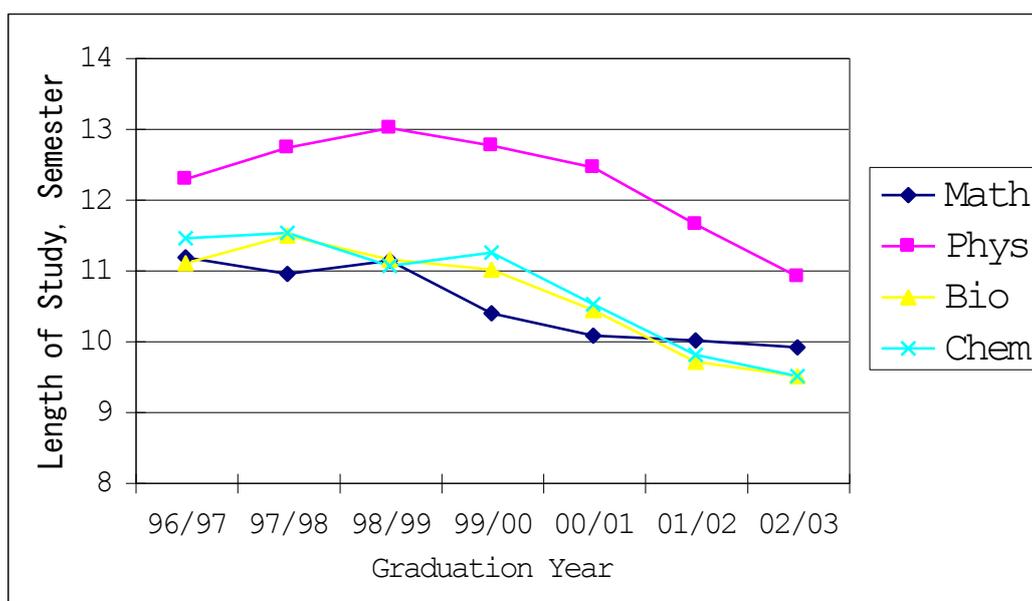


Figure 3. Decreasing in length of study

4. FPMIPA UPI-Junior and Senior Secondary Schools in Bandung

The JICA-IMSTEP project has supported the networking and partnership with schools.. FPMIPA UPI has worked collaboratively with 2 Junior Secondary (SLTPN 1 Lembang and SLTPN 12 Bandung) and 2 Senior Secondary Schools (SMUN 1 Lembang and SMUN 9 Bandung) in Bandung to conduct piloting activity. The selection of schools was based on willingness and commitment of school personnel. The objective of piloting activity is to improve science and mathematics learning in pilot schools through application of several project outcomes (teaching models, practical work activities, teaching materials, and assessment model) as well as to improve pre-/in-service programs at FPMIPA UPI.

Scope:

The 1st stage of piloting activity was done in first and second quarter in school year 2002/2003. The 2nd stage of piloting program is being conducted in second semester in school year 2002/2003. The piloted instructional models were “realistic mathematics education (RME)” for math, process skills and productive questions for biology, multidimensional approach for physics, and process skills and higher order thinking for chemistry. Those models were applied to some junior and senior secondary school curricular content of second semester.

Procedure:

Several phases i.e. pre-trial phase, trial phase, and post-trial phase, were done to conduct the piloting activities.

Pre-trial phase. In this phase, the following activities were conducted: (1) in-campus workshop to introduce the models to pilot schoolteachers and how to judge appropriateness and effectiveness of the models through piloting, (2) collecting information about base line condition of science & math teaching in new pilot

schools, (3) development of teaching plan (topics of content, approach used, teaching-learning activities, evaluation method) as well as preparation of required teaching materials and worksheets, involving teachers and faculty members collaboratively in a series of meeting.

Trial Phase. In trial phase, the following activities were conducted: (1) Teachers applied the lesson plans in teaching, while faculty members attended the class as assistant and observer (Some prospective teachers and non-pilot teachers voluntary attended and observed the teaching-learning activities), (2) post teaching discussions between teacher and faculty members (in some occasion attended by JICA experts) on experience in applying the model, as well as improvement should be done in next teaching period, (3) preparation for next lessons.

Post-trial phase. In this phase, the following activities were conducted: (1) faculty members collect information concerning appropriateness and effectiveness of the models through student questionnaire, observation notes, and informal interview to participating teachers, (2) Report writing.

As a result, the piloting activity gave benefit for school and university. Piloting activity improved students' enthusiasm, students' motivation, students' activities, and students' performance. Students enjoyed learning science and math during piloting activity due to some reasons. According to students' respond, the lesson was not so formal, the contents were easier to learn, students able to express their ideas, students got much time for discussion with their classmates, more experiment science and math. This activity improved teachers' professionalism in terms of teaching performance, variation of teaching methods/approach, and collaboration. Teachers got alternative method to let students learn and construct their own concepts. However, teachers took time to get used to develop teaching model by their own. Faculty members got to know more about the problems faced by teachers. Results of piloting activities have been disseminated to other non-pilot schoolteachers through seminars/workshops.

5. Conclusions

The conclusions of networking and partnership between FPMIPA UPI and other institutions (Japanese Universities, LPTKs, and Schools) through JICA-IMSTEP project are as follows:

- (1) The networking between FPMIPA UPI and Japanese universities has improved staffs' skills in some aspect of science and mathematics teaching, increased various teaching methods, and promoted scientific publication globally.
- (2) The networking between FPMIPA UPI with other LPTKs has provided pre-/in-service with enough learning resources in Indonesian to mastery the course contents. Then, the JICA-IMSTEP project has contributed positively for improvement of quality of pre-/in-service programs as indicated by increasing GPA and decreasing length of study.

- (3) Quality of science and mathematics teaching has increased at pilot schools through this project as indicated by shifting teaching paradigm from teacher- to student-centered.

References:

1. Project Design Matrix of JICA-IMSTEP
2. Report of Final Evaluation of JICA-IMSTEP Project