

Developing a Student Centered Inquiry Based Teaching Approach at Elementary Level Science in Pakistan-A Three Years Implementation Cycle

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Abstract

National Curriculum, 2006 is one of the significant measures to improve the quality of education in Pakistan. For General Science, grades IV-VIII, “Student-Centered and Inquiry-Based (SCIB) learning” are a key concept of it. However the system for teachers’ in-service training in the country at the Federal and the Provincial levels is pathetic and many of the teachers do not have chances to be equipped for the new ways of teaching science based on the new curriculum. To address this issue and help Pakistan in this significant task of national importance, the Japan International Cooperation Agency (JICA) undertaken the challenge of coping with the problem and help Pakistan through a technical cooperation project aiming at establishing a training model that ensures teachers to deliver SCIB science lessons.

The purpose of this paper is to describe the SCIB project design and the basic policy of a three years implementation cycle that will support in development and sustainability of science curriculum reforms efforts in Pakistan. The process and achievements of the project outlines the development of teaching plans, master trainers training, teacher training, school cluster and baseline survey of schools and organization of forums at the Federal and the Provincial levels. The paper covers an analysis of some issues related to SCIB teaching model development in the perspectives of ground reality and the lesson learned from implementing such innovative projects in past. The concept of Teaching through Easily Available Material (TEAM) and SCIB teaching approach being practiced in Pakistan may be valuable for the developing countries of the region.

Keywords: Teaching approach, Student-centered, Inquiry-based, Elementary science, Teaching plans, Master trainers training

1. Introduction

Despite the continuous efforts of the Ministry of Education (MOE) Pakistan, the quality of education remains a big challenge. The National Education Policy, 2009 (Govt. of Pakistan, 2009) states that “the quality of teachers in the public sector is unsatisfactory”. One of the significant measures to improve the quality of science education is the New National Curriculum 2006 (Govt. of Pakistan, 2006). The key concept of General Science for Grades IV – VIII is “student-centered” and “inquiry-based”. However, the system of in-service science teacher training in the country is weak and most of the teachers do not have the opportunities to equip themselves with new teaching methods in-line with the new curriculum.

Against this background, MOE requested for technical assistance from Japan, which dispatched senior volunteers to the National Institute of Science and Technical Education (NISTE). Upon the request, the Japan International Cooperation Agency (JICA) carried out a preparatory study and the record of discussion was signed by the Pakistani government and the JICA in February 2009 to initiate a three years Project for Promotion of Science Education. This project is named as “Student-Centered Inquiry Based” (SCIB).

Ministry of Education developed the new General Science Curriculum for grades IV-VIII in the year 2006. The implementation of the new curriculum is scheduled to be commenced from academic year 2011. The “Inquiry-based”, “student-centered”, and “outcome-focused” are the main foci of this curriculum. In the new curriculum document (Govt. of Pakistan, 2006), the idea of inquiry-based science lessons is explained in Table 1 for comparison with the traditional style of science education.

The JICA has implemented technical cooperation projects which promote student-centered science lessons in many countries including Sri Lanka, Bangladesh, Mongolia, Kenya, South Africa, and Honduras (JICA, 2009). JICA defines the student-centered lesson as a lesson in which students consider learning issues as their own issues and the processes of seeking answers by themselves, by using thoughts and bodies, and through discussion (Lees, 2004). In SCIB science lessons, more emphasis is given on understanding scientific concepts and developing the abilities of inquiry than obtaining scientific facts and information. Teachers are encouraged to provide their students with the opportunities to clarify, share, compare, evaluate, and modify their ideas and ask right questions (Elsgeest, 1985). It is expected that in such ways of learning, the students will enjoy science lessons more and ensure the acquisition of science literacy needed for their future lives.

2. Literature Review

There are number of studies on inquiry-based teaching (Abderson et al. 1982) and inquiry-based programs (Mechling & Oliver, 1983; Shmansky et al. 1990) which have advocated for use of inquiry approaches in science teaching. The nature, scope and importance of inquiry-based teaching are best described in the document of new National Curriculum for General Science from grades IV to VIII (Govt. of Pakistan, 2006). It is envisioned in the Curriculum 2006 that “this Curriculum presents a paradigm shift from the characteristics of traditional approaches to inquiry-based approaches”. According to the document, the curriculum is developed to provide “a set of well defined General Curriculum Outcomes (Learning Strands and Content Standards), Key Stage Curriculum Outcomes (Benchmarks), and Specific Curriculum Outcomes (Student’ Learning Outcomes – SLOs) for the students of grade IV-VIII which will provide a consistent framework for science education at primary and middle levels”.

The insignificant role of inquiry-based instruction has also been recognized and envisioned by the National Science Teacher Association (NSTA, 1998), the American Association for the Advancement of Science (AAAS, 1993), Rutherford & Ahlegren (1990) and the NRC (1996). According to Novak (1964) “inquiry is the set of behaviors involved in the struggle of human beings for reasonable explanations of phenomena about which they are curious”. Martin (2000) has elaborated the integrated curriculum as “common in inquiry-based science instruction due to the constructivist underpinnings of the pedagogy”. Inquiry approach is considered to be more useful and applicable at the elementary level in the subject of science. Research evidence show that “inquiry-related teaching is effective in fostering scientific literacy and understanding of science processes (Linderg, 1990), vocabulary knowledge and conceptual understanding (Lloyd & Conteres, 1985, 1987), critical thinking (Narode et al. 1987), positive attitudes of science (Kyle et al., 1985, Rakow, 1986), higher achievement in tests of procedural knowledge (Glasson, 1989) and construction of logical mathematical knowledge (Staver, 1986).

There have been found only a few studies on inquiry teaching approach at elementary level in Pakistan. The results of a study show that inquiry-based teaching at middle level supports in enhancing student’s performance (Nazir, 2006). It was concluded by Khan (2004) while comparing the inquiry-oriented and traditional methods of teaching science at grade-VIII that achievement level of students exposed with inquiry-orientation is significantly higher than those exposed with traditional method of teaching science. Ali (2007) found that “the science process skills best developed when students of elementary science are exposed with inquiry approach”. The ‘paradigm shift’ from knowledge to understanding as described in curriculum 2006 showed positive impact while using TEAM activities of SCIB teaching approach by Ullah (2010).

A few studies have come up with findings that inquiry-based teaching is more worthwhile for special children, underserved and underrepresented populations. A study considered by Rosebery et al. (1990) concludes that “language minority students were found to acquire more as compared to others, the scientific ways of thinking, talking and writing through inquiry-based oriented teaching. Also, “inquiry-based science teaching was shown to promote development of classification skills and oral communication skills among bilingual third grades (Rodriguez & Bethel, 1983)”. Similarly, “deaf students were found to be significantly active explored in science through inquiry-based teaching (Chira, 1990)”. Haury (1992) identified the material for inquiry-based teaching and stressed that “an emphasis on inquiry-oriented teaching does not necessarily preclude the use of textbooks or other instructional materials”. The inquiry orientation material is included in the study material of the Biological Science Curriculum Study (Hall & McCurdy, 1990, Sarther, 1991). Tamir (1985) has described a content analysis scheme for identifying the inquiry-friendly textbooks. Duschl (1986) has explained ways of using textbooks for inquiry-based science teaching which is identical to a pattern being developed for new general science curriculum of grades IV-VIII in Pakistan.

3. Project Design

Overall goal of this project is the development and implementation of an effective teacher training model ensuring teachers to deliver student-centered and inquiry-based (SCIB) science lessons at the Federal and the Provincial levels. Components of the Project include (i) development of SCIB teaching plans for grades 4-8 science; (ii) training of Master trainers equipped with skills and knowledge to deliver SCIB science lessons; (iii) identification of necessary interventions for effective teacher training through pilot activities in Islamabad Capital Territory (ICT); (iv) strengthening collaboration between NISTE and the Provincial institutions regarding science education. The duration of the project is three years starting from May 2009 to April 2012 (JICA, 2009). The project implementation structure is exhibited in Figure 1.

3.1 Basic Policy for Implementing the Project

1. For the purpose to develop the concept of 'SCIB science lesson', that will be suitable and effective for the students in Pakistan, the JICA Expert Team is working on SCIB science lessons with Pakistani Counterparts not in the ideal class environment but in the realistic situation in Pakistan such as 'classroom with no electricity'. They are also focusing on the definition of SCIB science on occasions such as teaching plan development, planning training for master trainers and ICT teachers, and so on, to promote better understanding of SCIB among the main stakeholders of the project.

2. To form system for cooperation between NISTE and both the Federal Directorate of Education (FDE) and the Provincial Departments of Education in implementing the teaching plan development, master trainer training and teacher training at ICT, JICA Expert Team is in good communication with NISTE, FDE and four Provinces. They are all studying the situation, needs and available resources of those main counterparts. Similarly, for developing teaching plans, Teaching Plan Development Teams, consisting of the members from NISTE, National Book Foundation, FDE and four Provinces is formed. Through exchanging ideas in the regular meetings of the team and with guidelines from JICA Expert Team, the teaching plans based on the new idea of SCIB are being developed.

3. For master trainer training, the master trainer team of NISTE counterparts is formed. The team is implementing the master training of the project with the support of four Provinces, FDE and JICA Expert Team. The representatives of these bodies are meeting and discussing the design of the training including 'Selection of suitable participants at the Provincial level', "Program responding the needs of the participants" and "Monitoring the participants work" in the Provinces after the training. Similarly, for teacher training in the pilot areas in ICT, the evaluation team of NISTE counterparts is formed. The team is monitoring and evaluating the effectiveness of master trainer training appeared in the quality of teacher training at pilot areas and the use of teaching plans at schools. The team is also implementing other activities to strengthen the teachers' delivery of SCIB science lessons. For the purpose to increase the efficiency of the project by strengthening the linkage among teaching plan development, master trainer training and teacher training, the plan includes three components. These are (i) 'Explanation' and 'Way of Use' of the teaching plan is incorporated in the master trainer training and the teacher training in the pilot areas; (ii) The master trainers are using the teaching plan in their Provincial teachers' training and their activities are monitored by the NISTE team in cooperation with the Provincial partners; (iii) Preparation of teaching plan is programmed in master trainer training and some of the good plans are incorporated into the final versions.

4. To increase the efficiency and the sustainability of the project by utilizing the existing organization, system and resources, NISTE has good track records of practicing master trainer training. The Provinces and the FDE also have good experiences and ability of producing educational materials. Utilizing these existing resources bring advantages not simply in experience and ability but in selecting suitable personnel for the targets of technical cooperation and avoiding the duplication of the works. It is considered that for developing teaching plans, the materials available in Pakistan or already developed by the JICA volunteers can be utilized effectively in the project activities.

4. Implementation Process and Achievements

The major activities of the project are grouped into four categories, namely, (1) Teaching Plans Development, (2) Master Trainers Training at NISTE, (3) Pilot Teacher training in ICT, AND (4) Strengthening the relationship between NISTE and the Provinces. The activities planned and its implementation methods are explained as follow:

4.1 Teaching Plans Development

4.1.1 Developing draft prototype teaching plans: The Teaching Plans Development Team with the support of JICA Experts Team develops draft prototype teaching plans. The members report their progress of works and discuss their preliminary drafts at the regular workshops being held monthly. The structure adopted to put in the teaching plans for each grade tentatively is given in Table 2.

4.1.2 Revising the draft prototype teaching plans: The draft prototype teaching plans are tried-out by teachers in ICT and the development team revises the drafts reflecting the teachers' feedback on their uses. The draft teaching plans for grades 4 and 5 are used as training materials for the Master Teacher Trainers at NISTE. The comments from the trainees on the teaching plans are examined for their revision.

4.1.3 Discussing printing and cost bearing of the teaching plans: Use, printing, delivery and cost bearing of document of teaching plan are discussed among the stakeholders of the project, JICA Pakistan office and JICA Experts Team.

4.1.4 Presenting teaching plans to Provinces/FDE: The project presents teaching plans to the teacher training departments and the Textbook Boards of the Provinces/FDE/NBF with recommendation letters of MOE (Policy/Planning Wing and Training Wing). Thereafter the Provincial/FDE partners decide how to use those teaching plans in their Provinces/ICT.

4.1.5 Supporting adjustment of the prototype to be in-line with the Provincial situation: The development team in collaboration with JICA Expert Team supports adjustment of the prototype to be in-line with the Provincial situations responding to the requests from the Provinces.

4.1.6 Achievement

Draft prototype teaching plans for grades 4, 5 and 6 have been developed through the collaborative work of Teaching Development Team. In addition, two types of baseline survey for impact analysis and for teaching plan development have been conducted. The review work on new curriculum, new textbooks and identification of other materials are in progress at the provincial level.

4.2 Master Trainer Training

4.2.1 Designing Master Trainer Training: Master Trainer Training Team (hereinafter referred to as "MTT" Team) is formed at NISTE. MTT team, based on the consultation with Provincial institutes and the FDE, designs the MTT programs reflecting needs and context of the respective Provinces and the FDE. Concept of SCIB lesson is incorporated in most of the training sessions These included: introduction of SCIB project, Introduction to the new science curriculum 2006, situation of teacher training in the provinces and the FDE, subject matter of grades 4-8, explanation of teaching plans developed by the project, making of simple materials for science experiments, science lesson study for SCIB science lessons, assessment procedures and evaluation techniques in science.

Through the consultation, MTT team discusses and asks appropriate selection of the participants and efficient use of those participants as Master Trainers of the Provincial teacher training to the Provinces and FDE.

4.2.2 Selection of participants of Master Trainer Training: Each Provincial institutions and FDE select and nominate the participants of Master Trainer Training based on the criteria agreed at PIMC meeting in the first year of the project.

4.2.3 Developing training materials for Master Trainer Training: MTT team develops the training materials with consideration of the Provincial contexts being supported by other NISTE staff. JICA Experts Team supports and gives advice on material development. Draft Teaching Plans for grade 4 and 5 have been used as a major portion of the training materials during training of MTTs.

4.2.4 Training in Japan for training management: Training for the management of teacher training was conducted in Japan for three weeks during second year of the Project. The participants were selected each from NISTE, the Provinces and the FDE based on the criteria already determined. The topics of the training program included: History of formal education development and science education policy in Japan, variety of styles and objectives of teacher training, training programs of educational Boards and schools, methods of managing teacher training, observation of SCIB science lessons, and evaluation methods of teacher training.

4.2.5 Achievement on Master Trainer Training: NISTE led by MTT team and supported by JICA Expert Team conducted four weeks Master Trainer Training in June and July, 2010 for grades 4 & 5. One hundred participants were trained at NISTE. During the training periods, JICA Expert Team provided guidelines to NISTE counterparts especially on how to transfer proceeding skills of lesson study to the Master Trainers. NISTE counterparts and JICA Expert Team jointly evaluated the MTT training through questionnaire and tests

responded by the participants. The MTTs reflected on the training, clarified the effects and identified the issues to be improved. When lesson plans of high quality are produced by the participants during MTT training, they are taken into the Teaching Plans of the project.

4.2.6 Monitoring impact of MTT: NISTE evaluation team and JICA Expert Team jointly monitored the impact of MTT in the Provinces and the ICT. The monitoring focused the training quality of the master trainers and the teaching quality of the teachers trained by the master trainers. Some other monitoring items to see the impact of MTT are also being discussed. The dates of monitoring are fixed for the training schedules of the provinces and the ICT.

4.3 Pilot Activities in ICT

4.3.1 Formulating Strategy for Teacher Training in ICT: Evaluation Team is formed at NISTE. Although the team is directly responsible for monitoring and supporting pilot activities, including teacher training in ICT, other NISTE counterparts and JICA Expert Team support the team in its activities. FDE selects five pilot areas (school clusters) in ICT in consultation with JICA Experts Team. The Evaluation Team and the JICA Expert Team support the FDE in designing the teacher training programs. The training programs and the monitoring methods are designed in second year of the project for grades 4 & 5. For the training program, almost same topics were undertaken which were included in the MTTs training among which the concept of SCIB lesson was incorporated mostly.

4.3.2 Training in Japan for Educational Evaluation: Training of educational evaluation experts was conducted in Japan for three weeks in second year of the Project period. Eight participants were selected from NISTE, Provinces and the FDE based on the criteria already determined. The topics of this training were similar to those included in the training program of management group.

4.3.3 Supporting Implementation of Teacher Training in the Pilot Areas: The FDE conducts teacher training at Teaching Resource Centers in the pilot areas in ICT. Evaluation Team of the project and JICA Expert Team visit the venue and give guidelines on implementation including facilitation of the sessions to the master trainers in charge. The training of teachers for grades 4 & 5 level was conducted for one week in October, 2010.

4.3.4 Conducting Workshops for School Supervisors and Headmasters: Evaluation Team in collaboration with the FDE and the JICA Expert Team conducted workshops for school Supervisors and Headmasters of the schools in the pilot areas in order to receive their cooperation for effective implementation of the teacher training and for effective use of the training outcomes in the context of SCIB science lessons. The workshops were conducted in May and November 2010 for grade 4 & 5 training.

4.3.5 Collaboration between NISTE and Provincial institutions are strengthened regarding science education: 'Establishing the project implementation structure' was a good example of the collaboration. Since then, Teaching Plans Development (TPD) workshop, which is a collaboration work and held once a month in average. In addition, the baseline survey for the teaching plan development was conducted in collaboration with the NISTE and the Provincial partners. Such collaborations were strengthened at PIMC and JCC as well.

4.3.6 Monitoring/Mentoring Teacher Training: The evaluation Team in cooperation with the FDE and the JICA Expert Team monitors the teacher training. The monitoring conducted based on the monitoring sheet which was provided to the member of Evaluation Team. Evaluation Team in cooperation with the FDE and the JICA Experts Team monitor the usage of SCIB Teaching Plans at selected schools in the pilot areas. This monitoring was conducted in second year of Project implementation for grades 4 & 5 teacher training. The results are reported to PIMC for reflecting other follow-up activities to the training.

4.3.7 Conducting post-training survey for SCI: The Evaluation Team in cooperation with the FDE and JICA Expert Team conducts post-training survey for SCIB lessons at selected schools. They see the quality of the lessons or the extent of actualization of SCIB science lessons as effects of teachers training and other supporting activities. This survey is conducted together with the monitoring of teaching.

4.3.8 Conducting Lesson Study: The FDE in collaboration with the Evaluation Team and the JICA Expert Team conducts lesson study at schools in pilot areas as additional training to strengthen the teachers' capacity for delivering SCIB science lessons. Lesson study is conducted as a half or one day program once in second year of project implementation for grades 4 & 5. To share chances of demonstrating lessons, three schools in a cluster other than Teaching Resource Center are selected for the venues of lesson study. In a lesson study program, a teacher demonstrates his/her SCIB science lesson and participants including teachers from other schools of the FDE, Evaluation Team and the JICA Expert Team observe the lesson. After the lesson, all the participants discuss the lesson demonstrated in context of SCIB lessons.

4.4 Strengthening Collaboration among NISTE, FDE and Provincial institutions

4.4.1 Holding National and Provincial levels forum: To strengthen coordination among NISTE, the FDE and the Provinces and to share good practice of SCIB training and lessons, NISTE and JICA Experts Team hold forums at national and Provincial levels in cooperation with the Provincial Education Departments. The problems and solutions for promotion of SCIB lessons are also discussed. One national level forum in Islamabad and one provincial level forum in Punjab are held in second year of the project period.

4.4.2 Organizing awareness raising activities on SCIB science lessons: In order to strengthen coordination among NISTE, FDE and the Provinces and to raise awareness of the SCIB lessons among teachers and educational officers in the Provinces, NISTE and JICA Expert Team organizes awareness raising activities on SCIB science lessons at national and Provincial levels in cooperation with the Provincial departments. The details of the activities are discussed among NISTE, the Provincial departments, the FDE and the JICA Expert Team for proposed open lesson study. Similarly to the forums above, one national level and one Provincial level activity are held at the end of second year of project period.

5. Mid Term Review of Project

The mid-term review is conducted in December, 2011 to evaluate the progress of the project, to identify the problems arisen and to give some recommendation for better implementation of the project. A joint review team was formed between JICA and the Pakistan side. The major components of the project were evaluated on the basis of the Project Design Matrix. The evaluation components included, achievements based on the indicators set, implementation process and analysis by the five evaluation criteria viz: relevance, effectiveness, efficiency, input and sustainability. All four major activities were evaluated by the review team. The team showed its satisfaction regarding development of teaching plans and their utilization in Master and teachers training. The review team identified verifiable indicators of each of the output of the project. The team has come up with several proposals of amendments, changes and alternate strategies for remaining project period (JICA, 2011).

In a consequence of mid term review of the project, some indicators were verified, amended and suggested to be incorporated in the over all plan of the project in remaining period. The present target of the project includes only 60 pilot schools in ICT for the further dissemination of SCIB teacher training model. As the model is piloted in the ICT and may not be perfectly fitted into the other areas. Therefore, it is recommended by the review team to include 60 more schools in this program. Since the project purpose is to establish an effective SCIB training model, therefore, it is proposed to include the documented training model as a deliverables for the verifiable indicator of project purpose. Model refers to the comprehensive training model components include (i) preparation, (ii) training delivery, (iii) training content and (iv) monitoring and evaluation. These components are compiled and endorsed by the evaluation team. However, to make clear the meaning of '70% achievement of indicators', the evaluation team recommended to redefine the indicators as '70% of teachers in pilot area in ICT' who received training is acquired with and practices at least one criteria of SCIB science lessons concept.

6. Analysis of Issues Related to the Model Development

There are some issues related to the SCIB model teaching approach of general science in Pakistani situation. The elaboration of strategies for utilization of teaching plans and MTTs training, increase awareness, communication with stakeholders, financial implications and collaboration of various components of the project are analyzed issue-wise.

6.1 Elaboration of strategies to utilize the developed Teaching Plan: The project is developing teaching plans for the general science subject of grade 4-8 in-line with the national curriculum 2006. The stakeholders who are involved in the Project have appreciated these teaching plans as very effective tools. However, the project as well as Pakistani stakeholders including the Federal and the Provincial organizations do not have any concrete plan for the dissemination of these teaching plans. The strategy for printing and distribution of teaching plans has not been cleared as yet. On the other hand, a high interest of the stakeholders of Punjab Province is shown in introducing the concept of the SCIB and the teaching plans into their own in-service teacher training programs in the Province. What really needed at this stage is to initiate the discussion on how to utilize and disseminate teaching plans developed in project and finalize the strategy before the end of the project.

6.2 Elaboration of strategies to utilize the trained Master Trainers: Under this project, one hundred Master trainers from the Federal and all four Provinces of Pakistan have been trained in grades 4 & 5 and about same numbers are yet to be trained in remaining period in grades 6-8. The Master Trainers for the five clusters at Federal level conducted the 5-day and 1-day follow-up training to the teachers in pilot schools. These trained teachers are given mandate to introduce the SCIB teaching approach into their classes. The Master Trainers and

the teachers are considered to be key resource persons of the project. However, the strategies for multiplication of trained teachers through these trained Master Trainers are not addressed in the framework of the project. It would be better if services of these Master Trainers and the trained teachers under this project are utilized for the dissemination of SCIB approach to the teachers in the field. A viable strategy needs to be identified for utilization of Master Trainers and bridging this with the strategy for the utilization of teaching plans.

6.3 Clarification of SCIB training model and its effectiveness: The project purpose – Effective SCIB training model that ensures teachers to deliver SCIB science lessons is established – refers training package including training system, method, contents, its effectiveness, challenges and lessons learned derived from the experience in the five clusters in ICT. The project will evaluate the effectiveness of the training program based on the three criteria, i.e questioning, prediction and discovery, which were also used in the baseline survey. It would be better if the qualitative and quantitative aspects of the SCIB teaching plans can be added in these criteria.

6.4 Increase awareness activities in Islamabad and other Provinces: The Federal and the Provisional levels forum and awareness sessions organized by the project may contribute to raise awareness of the SCIB teaching plans and teacher training program. It would be an ideal if the project increases the number of awareness and dissemination campaigns apart from the Federal and the Provincial forums which may be organized with the support of Master Trainers in their local areas. Besides the awareness campaign, dialogue with decision makers in each Province and local areas may further accelerate awareness of SCIB teaching plans and teacher training. Public relation tools might help this awareness campaign in the Provinces.

6.5 Communication with Federal and Provincial Stakeholders: Having the multiple stakeholders from all over the country, the project faces difficulties in communicating with all the stakeholders. Smooth communication with the right personnel including decision makers will facilitate understanding of SCIB project. It would be better for the project to keep good communication with each stakeholder.

6.6 Financial implications for dissemination of SCIB lesson approach: The project aims to establish the model of SCIB teacher training and dissemination of the model in its framework to the provinces for integration. The developed model, however, can be a model once it is made use of and disseminated. Dissemination is contingent on availability of funds for printing and delivery of teaching plans and training, which is not presently included in the project framework. The Pakistan and the JICA both stakeholders need to come up with the strategy to overcome financial requirements for dissemination during remaining period of the project.

6.7 Collaboration with other development partner's intervention: Multiple development partners are active in the area of in-service teacher training. It would be better if Pakistani side may well coordinate with the other national and international donor agencies and NGOs to get maximum results from some of these multiple development partners' assistance for continuation of SCIB activities and development process for quality of science teaching in the country.

7. Implications of SCIB Project for other Developing Countries

Pakistan is exercising various models of curriculum development since its independence in 1947. According to Tahir & Ullah (2010), "the comprehensive national curriculum reforms are underway in Pakistan in-line with three major breakthroughs; the new National Education Policy 2009, first ever National Education Census 2005 and the 18th Amendment, 2009 in the Constitution. These changes are molding the nation to a reborn process of curriculum development". The general science curriculum from grade IV to VIII has received a special attention in this reform effort due to introduction of SCIB teaching approach with collaboration of JICA. Some of the researchers (Ullah, 2010 and Nazir, 2006) consider this as a "paradigm shift" from knowledge to understanding and most importantly science "Teaching Through Easily Available Materials" (TEAM) through Source Book developed by NISTE and the JICA volunteers (NISTE, 2006). These low-cost and no-cost experimental activities given in the Source book matches with the ground reality of Pakistani schools and equally useable for the countries of the region. Pakistani stakeholders discovered the SCIB teaching approach through teaching plans and use of TEAM activities of science for elementary level science after a long exhaustive process and experience in view of typical situation on the ground. The developing countries in the region may get "spark" from Pakistani experiences and undertake initiatives in their diverse areas of population especially.

8. Conclusion

The uniqueness of SCIB teaching approach in Pakistan has made this project very enthusiastic. Although SCIB teacher training model is being highly appreciated by teachers and science educationists of the country but still there is a need to find out relevance of this approach with Pakistani textbooks and examination system. While the SCIB approach is recognized as an important approach for leading conceptual clarity of the students, passing the

examination is also important for the student's and teacher's point of view. As a matter of fact, some topics of new curriculum 2006 do not match with SCIB approach. Therefore, for this reason, SCIB approach may not be considered as the only one tool for teaching science at elementary level. The best strategy would be to "apply different methods, approaches and models of teaching science in the classrooms of various levels" (Joyce & Calhoun, 2000). The SCIB project targets working teachers through in-service, while teachers are trained in pre-service training in teacher training education institutions in Pakistan. It is desired that the SCIB teacher training model may be included in the curriculum of pre-service teacher training institutions so that all teachers are inculcated with the SCIB approach. A major concern regarding SCIB approach would be to link this with the science textbooks of grade 4 to 8 which are still to come in market and implemented in Pakistani schools from academic year commencing from 1st April 2012. The challenge for textbook writers is to identify and plan the text and activities which are inquiry-friendly (Tamir, 1985) and accommodate the SCIB approach in using teaching plans in typical environment of Pakistan. The main concern of science teachers would be therefore to get enhance the competencies and skills that how textbooks can be used to support inquiry-based science teaching? As described by Hooker (1879, p.ii) many years ago, "No text-book is rightly constructed that does not excite [the] spirit of inquiry".

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Table 1. Comparison of components of Traditional and Inquiry-based teaching

Components	Traditional	Inquiry-based
Principle Learning Theory	Behaviorism	Constructivism
Student's participation	Passive	Active
Student's Involvement in Outcomes	Decreased Responsibility	Increased Responsibility
Student's Role	Direction Follower	Problem Solver
Curriculum Goal	Output Oriented	Process Oriented
Teacher's Role	Director/Transmitter	Guide/Facilitator

Table 2. Lesson Plans structure grade-wise

Content	Grade 4,5 (each)		Grade 6,7,8 (each)	
	Pages	Details	Pages	Details
How to use the Teaching Plan	4		4	
Unit plan	40	4p x10 units	48	4p x 12 units
Basics of subject matter	20	2p x 10 units	24	2p x 12 units
Lesson plan sample	200	20p x 10 units	240	20p x 12 units
Making of materials	20	2p x 10 units	24	2p x 12 units
Ways of assessment	20	2p x 10 units	0	0p x 0 units
Total pages	304		340	

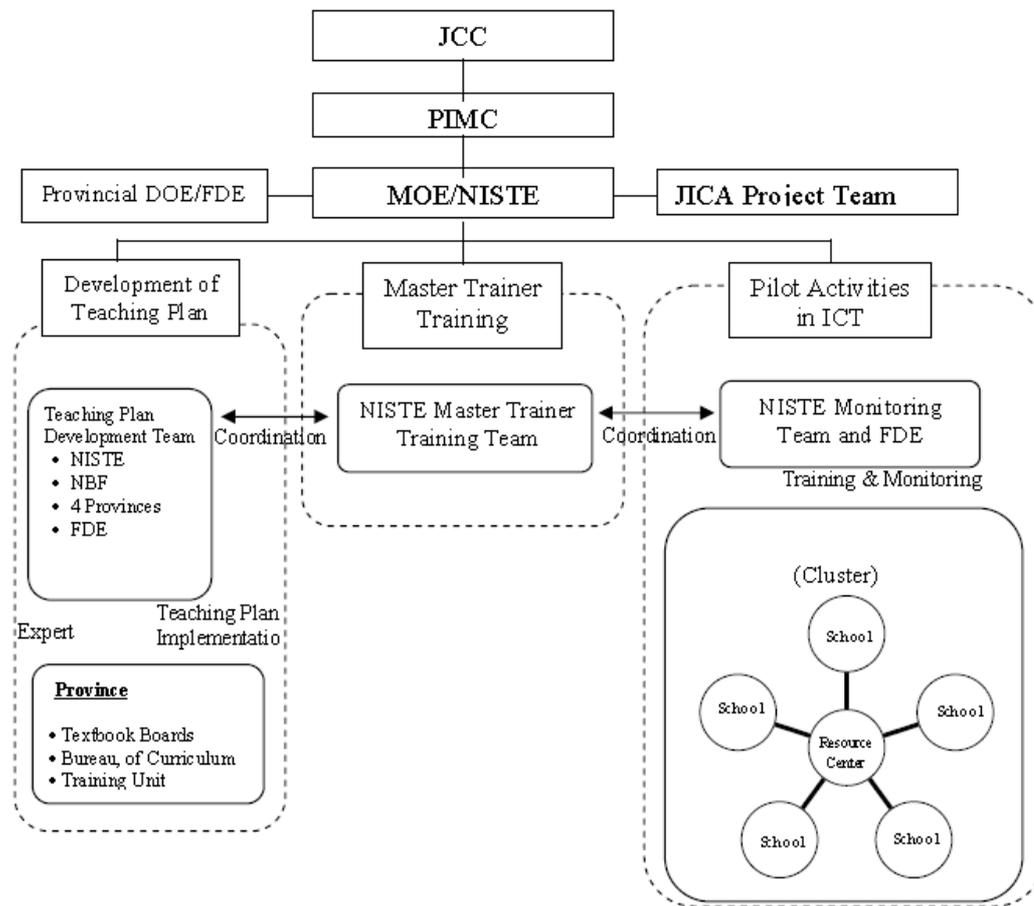


Figure1. The implementation structure of SCIB project

Legend:	
JCC:	Joint Coordination Committee
PIMC:	Project Implementation and Monitoring Committee
DOE:	Department of Education
MOE:	Ministry of Education
NISTE:	National Institute of Science and Technical Education
JICA:	Japan International Cooperation Agency
ICT:	Islamabad Capital Tertiary
NBF:	National Book Foundation
FDE:	Federal Directorate of Education