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## **Reconceptualising the professional development of in-service science teachers in Pakistan**

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### **Abstract**

Pakistan is a society in transition in more ways than one: politically it is still trying to find its place in the democratic nations of the world; economically it is taking steps to move closer to a market-based economy; and socially it is nurturing a more liberal and just society by reining in the religious extremists. In the aftermath of 9/11 stress has been on educational reform in a number of areas including – updating curriculum, improving access to schooling and developing teacher education. Teacher as the agent of reform is slowly gaining currency in Pakistan. The Institute for Educational Development (IED), which started working under the aegis of the Aga Khan University in 1993, is well placed to be in the vanguard of this educational change and reconstruction. IED offers a two-year Masters programme in Teacher Education and shorter in-service programmes which include, among many others, an eight-week Certificate in Education programme in curricular subjects such as science and mathematics. This book chapter discusses how this in-service programme<sup>1</sup> serves to reconstruct teachers' ideas about science from “a collection of facts” to an inquiry-based subject. The conception of science

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<sup>1</sup> Though this chapter has been written from my perspective as a faculty member engaged in teaching and coordinating at least three of these programmes, I would like to acknowledge the input of all science faculty and

as evolving, tentative and not as “truth” for all time, has implications for the society at large which generally considers knowledge to be fixed and “true”. The in-service programme is also very innovative in the ways in which it endeavors to bridge the theory-practice gap. Some research studies conducted on the efficacy of this reform initiative will also be discussed.

## **Background**

Pakistan emerged as an independent country after the British left the Indian subcontinent in August 1947. Mohammed Ali Jinnah is revered as the founder of Pakistan which at that time consisted of two wings, East and West Pakistan, separated by more than 1000 miles of Indian territory. In 1971, after a bloody “civil war,” East Pakistan separated into the independent country of Bangladesh, dealing a severe blow to the two-nation theory that was used as a basis for separation of the Muslim majority regions of the subcontinent into a separate independent country. In 1951 Pakistan was declared the Islamic Republic of Pakistan and since then there has been a public debate whether Pakistan should be governed solely by Shariah laws or not. This debate forms a part of the reason that the crisis of identity facing Pakistan has not been resolved even after more than fifty years as a sovereign nation. The present government is trying its best to transform Pakistan.

Typical of societies in transition is “seeking to ‘transform’ its economy, political system and educational system into a more just, and more racially equal system” (Mebrahtu, Crossley & Johnson, 2000, p.45). The features that link all these societies is the rapidity of change, the weakening of state controls and the messiness that comes with replacement of one system with another. They are also characterised by growing social and economic inequalities; the growth in corruption and environmental degradation (White paper on International Development, UK, 1997).

Pakistan is also showing at least some of the signs in common with the societies described above. It is a society in transition in more ways than one; politically it is still trying to find its place in the democratic nations of the world; economically it is taking steps to move closer to a market-based economy and socially it is nurturing a more liberal and just society by reining in religious extremism. Further, the process of assimilating the semi-independent tribal

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professional development teachers who have engaged with me in this programme, especially Dr Harcharan Pardhan,

societies in the North of Pakistan is a process which has just started. It is a society trying to grapple with rapid social change.

To compound the problems facing Pakistan, the role that education could have played in bringing together a multi-ethnic society in transition has largely been untapped. Education has consistently received low priority and low level of funding from the government. The UNDP Human Development Report 2004 gives expenditure of public spending on education as 1.4% of GDP which has actually fallen from the previous reported spending of 2.6% (UNDP, 2004). Government indifference has allowed the market forces to develop a system tantamount to *educational apartheid* (Najam, 1998) with one system for the rich and the privileged and another system for the poor. This is seen as abdication of responsibility by some and others see it as an opportunity to refurbish and revive the education sector which was starved of funds and new ideas. However, in the aftermath of 9/11 stress has been on educational reform in a number of areas including – updating curriculum, improving access to schooling and developing teacher education. Teacher as the agent of reform is slowly gaining currency in Pakistan not only in the private sector but the government sector as well.

The education system in Pakistan suffers from a systemic problem – the belief that knowledge is not a human construct but revealed and hence must be accepted as such (Hasanain, & Nayyar, 1999). Therefore there is a tendency to demand and expect “one answer” or “one truth” and discount plurality of ideas. This also puts the teacher in a formidable position where her/his word is the truth. Teacher’s authority is final and unquestionable. Often the mere act of raising a question in class is frowned upon, not to even mention critical thinking and challenging the teacher. In this climate the textbook that is used by the teacher also acquires a very high status in the minds of the pupils. Hence, education instead of educating ends up indoctrinating the pupils to a particular way of thinking.

There are elements in society that are interested in maintaining the status quo and do not want any kind of curriculum reform that would encourage critical thinking among the masses. Hence the uproar caused by the Nayyar-Salim report (Nayyar & Salim, 2003; Kamran, 2004) made the government retract even on the timid reforms that it was considering. Ahmad (1998, p. 1), “A major challenge of designing a learning environment in countries like Pakistan is to locate

the points of convergences and reinforcements between traditional and modern knowledge, a task which has been entirely ignored by our educational planners.” Nayyar and Salim (2003) report that, “most significant problems in current curriculum and textbooks (among others) are, (a) omission of concepts, events and material that could encourage critical self-awareness among students, (b) outdated and incoherent pedagogical practices that hinder the development of interest and insight among students (p. 17). Thus the role that the public education system could play in shaping the values of truthfulness, honesty and critical thinking are lost to generations of pupils.

But there is no doubt that education in Pakistan needs restructuring and reconceptualisation. It is not so much the physical infrastructure which needs rebuilding but the concept of education that needs reconstruction and rebuilding. This inbuilt systemic fault, where knowledge is seen as “truth” need to be addressed. I have no doubt that this will need a multi-faceted approach but good teacher education will give the greatest dividends. By good teacher education I mean education that develops the teacher as a critical thinker and a reflective practitioner. The limited resources of a country like Pakistan have to be spent on the right kind of teacher education. Dr. Bacchus the founding director of IED, strongly advocated the centrality of the teacher in school reform:

Changes in structural features of schools and classrooms do not necessarily lead to changes in the instructional strategies used by teachers which will result in enhanced teaching and improved students’ learning and performance. All these structural changes are mediated, as we should expect, by teachers’ classroom behaviours and if we want improved quality of teaching and students’ learning outcomes, we must place the teacher in the centre stage of our efforts. (Bacchus, 1997, p. 3)

The Institute for Educational Development started working under the aegis of the Aga Khan University in 1993 with the aim of: “Become a leader in educational reform and improvement, especially in the developing world, with the aim of increasing the efficiency and effectiveness of schools and other educational institutions” (AKU-IED, 1998, p. 1). AKU-IED’s philosophy is guided by three principles, teacher education should aim: (a) to be field based i.e. take place within classrooms, (b) to make teachers ‘reflective practitioners’, engaged in continual self-inquiry and (c) to include training in classroom-based research (IED, 1994). IED offers a two-year Masters programme in teacher education and shorter in-service programmes which

include, among many others, an eight-week Certificate in Education<sup>2</sup> programme in curricular subjects such as science, mathematics, English and social studies. This chapter focuses on CEP – Science, discussing how this in-service programme serves to reconstruct teachers’ ideas about science from a “collection of facts” to an inquiry-based subject.

### **Need for a new model of professional development**

In Pakistan the need for a new model for the professional development of in-service for teachers is crucial, as the vast majority of teachers employed in the private sector have no exposure to teacher education. Teacher certification is not required in most private sector schools nor in some government schools as well. The prevalent model of in-service education follows the general trend of providing a single workshop or at best a series of workshops or lectures that describe techniques and methods to deliver the prescribed curriculum (Aubusson & Watson, 1999; Hill & Tanweer, 1990; Khalid, 1996). Research has shown that this model has had very little impact on teachers’ practice (Fullan & Hargreaves, 1991; Hoodbhoy, 1998). Realising the need for more practical in-service education for all teachers AKU-IED has developed a hands-on field-based in-service programme. The Certificate in Education Programme acknowledges and builds on the previous experiences of the teachers but makes every effort to encourage them to re-examine their current practice in light of recent teacher education theory and practice.

### **Description of the Certificate in Education Programme**

The Certificate in Education is an eight-week full time in-service programme offered in five curriculum areas - science, mathematics, English, social studies and primary education. The 30-35 teachers who participate in each CEP are from the *Cooperating Schools* – this term is used to define a school that has established a formal partnership with AKU-IED. The schools are from three systems: the Government schools, the private schools and the schools that belong to the Aga Khan Education Services (both in and outside Pakistan).

The aim of the CE is to focus on three key areas (AKU-IED, 1998, p. 2):

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<sup>2</sup> This programme prior to June 2002 was called the Visiting Teacher Programme, and the teachers admitted to the programme were often referred to as VTs.

1. To enrich the subject knowledge and enhance the knowledge and practice of teaching methodology in the area of study.
2. To enhance personal teacher development in terms of teachers' understanding of their own and their student's role in teaching and learning.
3. To collaborate with colleagues to bring about school improvement

The language of instruction is English, though effort is made to translate class instructions and discussions into Urdu. At times, this has been difficult and has created problems for those teachers who are not very fluent in English.

The Heads of the Cooperating Schools nominate teachers to take part in the CEP, based on selection criteria provided by AKU-IED and includes teachers who:

1. Have an education at the BA/B.Sc. level. Preference is given to those teachers who have taken some courses in the relevant subject (science in this case) at the undergraduate level.
2. Have teaching experience of at least 3-5 years.
3. Are actively teaching at least one class in the relevant subject area (science in this case) in the school.
4. Can attend the full eight-week programme.

The teaching in the CEP is carried out by teams of 3-4 instructors, one of them being IED faculty to provide quality assurance and coordinate the programme. The rest of the team constitutes of graduates of IED's own M.Ed. programme called Professional Development Teachers (PDTs). In this chapter the group of teachers who teach in CEP will be referred to as the Teaching Team.

### **Theoretical Framework Underpinning the CEP**

## **Constructivist approach and the conception of the nature of science**

Instruction in the CEP is based on constructivist approaches to teaching and learning, and every attempt is made to encourage active learning in groups. Strategies are planned to help teachers to construct or reconstruct their knowledge of science concepts and how to teach them. The assumption underlying this practice is the oft repeated, but nonetheless powerful statement that knowledge is not transmitted directly from one knower to another, but is actively built up by the learner (Driver, et al. 1994). The concept of knowledge as something constructed by the knower and not something residing outside the knower to be learnt and regurgitated for examination is a new and novel concept. The teachers who attend the programme have some difficulty in grappling with this idea and that is to be expected, particularly in science. The prevailing understanding has been that science is truth and privileged knowledge that is discovered by dedicated scientists working alone in laboratories. The programme initiates a process of change – a change in the conception of science as a subject and discipline of study. Slowly teachers start to see science as a tentative but reliable form of knowledge that is dynamic. This is basically a change in the ideas about the construction of science knowledge generally. This is a big shift in the way teachers think about science and knowledge which has larger societal implications which will be discussed later in the chapter.

The Teaching Team takes a broad eclectic view of constructivism to encompass both the personal construction of knowledge and the role of social interaction in its creation. Knowledge is seen to be bound to specific contexts and is embedded within a group or community. It focuses on social interaction among and between people as a primary source of knowledge that cannot be gained in isolation from other people. Hence, special attention is paid to the provision of a non-threatening and enabling environment. The learning environment created and the relationships built between the Teaching Team and the teachers, and between teachers themselves, are important components of the learning process. The Teaching Team invests time and effort to see that these relationships are built and nurtured. One of the most important aspects of the CEP that the participants have noticed and commented upon is the collegial atmosphere created for teaching and learning. A community of practice is forged (Wenger, 1998); where everybody takes pride in their collective and individual successes. The focus is to

build a community of teachers that are not wedded to a dogma, but understand teaching and are committed to teaching for understanding.

### **Trying to bridge the theory-practice gap**

This programme is different from any other in-service programme offered in Pakistan in that about 33 - 40% of a teacher's time is spent in teaching in the real classroom (or related activities like lesson planning, inquiry project, etc.). This is very different from other in-service programmes where the opportunity to teach students in the classrooms is very limited if not absent. Typically, in almost all teacher education programmes that are delivered in Pakistan, there is a big gap between theory and practice (Davies & Iqbal, 1997; Hayes, 1987). The teachers are lectured about using a specific method of teaching and are expected to go back to their schools after a day, or a week, or a fortnight to put it into practice. The teachers have little idea of how to use that technique in the classroom. Whereas, in the CEP, the teachers are taught to use a method of teaching by using the method of teaching itself. The teachers also have the opportunity to see the theory in practice by engaging in practice teaching in a school classroom during the in-service. The underlying belief is that unless the teachers can practice and modify the ideas presented in a real classroom the likelihood of them trying out the ideas in their own classrooms is very remote.

### **Content-Method interrelationship: The weaving metaphor**

The initial needs assessment made it abundantly clear that science content knowledge of science teachers needed support and strengthening. Literature has also documented that science teachers, particularly primary science teachers do not feel comfortable with the science concepts they have to teach. Halai (1998) found that of the twenty science teachers (mostly secondary science teachers) with a first degree in science, only two could explain the phenomena of diffusion adequately. Studies conducted in other parts of the world have shown that primary and even secondary science teachers need to develop their understanding of the "big ideas" of science (Summers & Kruger, 1992; Harlen & Holroyd, 1997; and Harlen, 1997).

A metaphor of weaving is used to envision the integration of methods and science content. The methods constitute the woof and science content composes the warp for the fabric of science education. Science teachers are exposed to "new" methods of teaching science by

teaching relevant content taken from the school curriculum. For example, “circus workshop” is demonstrated by engaging the teachers in activities that represent the properties of matter. In this way the teachers not only learn about the properties of matter but also learn the process of engaging in a circus workshop. I found that this mode of teaching science content and methods had several advantages – the teachers had some “experts” model a method for them teaching a science concept that teachers often find difficult. This not only satisfied their need for someone to “show them how to do it”, but also strengthened their content knowledge.

The teachers are encouraged to conceive and teach science as connected frameworks, rather than discrete and fragmented pieces of information. For, example instead of teaching heat, light and sound separately the topics are tackled under the meta-topic of energy, so that connections can be made to the different forms of energy. This reduces the complexity of science teaching and shows the elegance of scientific theories. For the first time a lot of science concepts start making sense to teachers, and even Master’s prepared science teachers have commented, “Now, I *really* understand.”

### **How Does This Model Work?**

In the first week teachers are oriented to the schools where they practice-teach. Usually these are selected from the Cooperating Schools and include one government school with medium of instruction Urdu and one private school that use English as language of instruction. This is organised to accommodate the different needs of the teachers - they can elect to teach in either one of the schools depending on the language they want to use for instruction.

The first week and a half is used for revisiting basic teaching skills, such as lesson planning, setting up of routines and developing materials for teaching science. It is only when the basics have been covered, and the teachers have acclimatised to the new environment of AKU-IED, that some new and innovative strategies for teaching science are introduced such as: Learning Cycle (Lawson, Abraham & Renner, 1989), Discrepant Event (Liem, 1989), Process Skills Approach (Ramig, Bailer & Ramsey, 1995) and Concept Mapping (Briscoe & LaMaster, 1991). The rationale for including these and not other strategies are three-fold. First and foremost, these are the strategies that reflect the interest and preferences of the Teaching Team. Secondly these are some strategies that have been used in classrooms in the UK, USA, Australia,

New Zealand and Canada and there is a fair amount of research literature available on them. (Markham, Mintzes & Jones; 1994; Preece & Brotherton; 1997). And last, the selection also depends on the availability of resources in the form of print and non-print materials in the AKU-IED Library and Media Centre. So both research and pragmatic/practical concerns govern the selection of these particular strategies for the teaching of science.

Each Teaching Team plans its own programme taking into account the successes and challenges faced by the previous teams. Most CEP includes some aspect of the following steps:

1. **Modeling:** The Teaching Team model a method of teaching. In the process the teachers also get needed content knowledge. A discussion and debriefing session encourages the teachers to look at the strengths and weaknesses of the strategy; they are encouraged to critique what was modeled and not take it as “THE” mode of teaching.
2. **Planning in small groups:** The teachers are then invited to plan to teach a lesson, in pairs or trios, to students in a real classroom setting.
3. **Microteaching:** After the planning is completed, the teachers present in pairs (or trios) their ideas to the group as a whole. The microteaching session is limited to 10-15 minutes, during which teachers are expected to practice the most crucial aspect of their lesson. Most teachers choose to practice the activities that they have planned. The rest of the teachers and the Teaching Team have the opportunity to offer suggestions to improve the lesson.
4. **Teach in class:** The teachers then teach the lesson in a real classroom. As they are working in pairs (or trios) at least one of them is the observer. One member of the Teaching Team also observes the class.
5. **Modify lesson:** This is a very important part of the learning process. The teachers give each other helpful suggestions, the member of the Teaching Team who observed the lesson also give their comments but tend not to “run the show”. The lesson is modified based on this feedback. Sometimes there is opportunity to teach the same

lesson again, but in most cases the teachers plan the next lesson keeping in view the lessons learnt in this one.

6. **Reflect:** The teachers reflect about their experience in small groups and large groups. They also write about their experience in their reflective journals.

A criterion referenced assessment system is used rather than the more common norm referencing. Each teacher is individually assessed on her/his own performance and growth. Hence, a qualitative diagnostic “one-pager” is given to each teacher at the end of the course that lists their strengths and their weaknesses. This is strength of the CEP as that has helped to remove competition for grades and enhanced cooperation among the teachers. This has also provided incentive to teachers, particularly government teachers, to participate in the CEP as according to them there are “no exams” at the end of the course.

### **Teachers’ learning: Some successes and challenges**

#### **Concept of the nature of science**

As mentioned in the section above, there are a number of conceptions of the nature of science as related to school science, that are marked for reconstruction. However, the CEP is most successful in bringing about a change in the idea that science is tentative yet a reliable form of knowledge. The teachers become aware that science is a form of knowledge that is characterised by change. It is not a form of knowledge that will stay unchanged and static. I hasten to add that eight weeks of coaching does not bring about a very sophisticated understanding of this concept. The teachers still continue to think of science as a subject that makes possible one right answer. However, looking at the *development* of science they are aware that the evolution of science knowledge has rendered many an established tenet of science to be false by later theorising and investigation. They very rarely reach the point where they can accept multiple interpretations of the same phenomena easily. This, to a point is understandable, as science teachers almost always deal with “finished” science rarely with science in the “making”. Almost all the science that finds its way in the textbooks has remained as established “facts” for hundreds of years. They have very little contact with science in the making. However, this is the beginning of the process of change. In my experience some teachers do evolve in their thinking and move a bit away from the “science as a body of knowledge” concept

to “science as a way of knowing”. However, a larger number need considerable support, either through more advanced programmes offered at IED or through working with PDTs in their schools. There are still quite a few who do not manage to make this change. However, the CEP in service and other subjects manages to bring to the fore the epistemological aspects of subject knowledge, which has raised awareness among participating teachers to this aspect of their subject area.

The transformation that is taking place in society in Pakistan has facilitated the development of an “elite” class of students mostly studying in private schools. These private schools often use the British “O” and “A” level curriculum, or materials obtained from other countries such as Singapore or Malaysia. These curriculum materials are likely to reflect more the current ways of looking at knowledge and its construction. In particular the concept of the nature of science is a part of both the Pakistani and British curriculum, but it is reflected much more in the curriculum and textbooks of the British curriculum, or in books other than the Pakistani textbooks. Hence, one sees that IED trained teachers who go back into private schools have greater opportunity to engage with these ideas. This change is particularly noticeable in schools in Karachi and Northern areas of Pakistan where IED graduates have worked more intensively with teachers.

### **Peer coaching**

The purpose of encouraging the teachers to plan and deliver lessons in pairs and in groups of three is to pull down the walls of isolation surrounding the teachers and enable them to learn from each other. Teachers, generally, tend to work alone in their classrooms and have little opportunity to collaborate with their peers and share ideas with each other (Ahlstrand, 1994). Hence, peer coaching has been made an integral part of the CEP.

In the beginning the teachers are skeptical of the power of peer coaching, but during the course of the programme it becomes evident to them that they have a lot to learn from each other. Professional development experts, AKU-IED faculty and PDTs will not always be available to help them, but they could seek help and guidance from a large untapped resource in every school - other teachers. The best part of this strategy is that teachers learn even those strategies and skills that are not a part of the planned curriculum. For instance, in one

programme, the teachers learnt how to teach with the help of “song and movement” from a teachers from East Africa who was gifted in this way of teaching. When such dynamics appeared to be happening, we tried to get out of the way and let learning happen.

### **Evolution of a community of teachers**

This programme has built a community of teachers, spread in at least seven countries and different parts of Pakistan. They, to an extent, share a common language to dialogue between themselves and interact with the PDTs in the Cooperating Schools. This developing community has already started to interact across schools and systems to learn from each other (Senge & Scharmer, 2001). AKU-IED hopes to educate a critical mass of teachers in each Cooperating School, so that the process of change can become self-sustaining.

A teacher from Kenya who attended this programme wrote, “We’ve really bonded with each other and because of the success we’ve experienced working and learning together cooperatively, we feel we will be able to effectively develop cooperative learning in our classrooms” (Lakhani, 1996, p. 7).

### **Learning in small groups**

Teaching and learning in small groups is a very new experience for both students in the classroom and teachers at AKU-IED. Most students from government and private schools have their first exposure to learning in small groups during practice-teaching conducted by teachers. The students are delighted that they are expected to talk and do rather than sit and listen. However, at times the noise level and disorganisation in the classrooms has been unacceptably high.

The teachers from the government sector where classes of 80-100 students are quite common find it extremely challenging even to entertain the idea of teaching in small groups. They know the reality of the situation that they face and often said, “do it for us in the real world of our classrooms”. The situation set-up in AKU-IED is a bit irregular, as practice-teaching is conducted by a pair of teachers or a group of three teachers. Hence, the teachers could and did manage to teach in small groups even in classrooms with a large number of students. But the reality is, barring special arrangements, the teachers are alone in their classrooms.

## **Becoming Reflective Practitioners**

Reflection in the CEP is seen as self-inquiry and thinking about one's practice and considered to be an important part of the programme. Thus emphasis is not on behaviors and technique, but on teacher thinking and teacher knowledge. The CEP hopes to inculcate this "thoughtfulness" and "enquiry" by encouraging students to maintain a teaching practice journal and to analyse their own and others' teaching practice. The teachers are encouraged to reflect on the "teachers' thoughts and the act of teaching." It is hoped that through inspection, introspection and analysis teaching can be enhanced.

As mentioned above teachers are encouraged to keep reflective journals, which they then share with a member of the Teaching Team. However, the majority of teachers maintain journals as diaries or logs to note down the events of the day (Holly, 1984). Though some do reflect and engage in discussion with themselves. To encourage teachers to go deeper into themselves and their practice has been an uphill battle. This has not been a problem of the Science teachers alone; the coordinators of the CEP in all other curriculum areas have faced very similar difficulties. The conception of reflection is very central to the AKU-IED's vision of a professional teacher. Hence, I am sure that even though "perfect solutions" are hard to come by but attempts to encourage teachers to become reflective practitioners will continue and should continue (Cole, 1997).

## **Impact of the Certificate in Education Programme on Teachers' Practice**

Despite the strong overt signs of success – strong demand for the programme, excellent evaluations by the teachers themselves, readiness of schools to pay for their teachers to attend the CEP, some big questions remain to be answered. What is the impact of the CEP on the practice of the teachers? How are the schools benefiting from the teachers? Has the practice of the teachers changed as a result of the programme? What are the indicators of the success of the CEP? Have student outcomes improved due to the CEP? A number of studies on the impact (or lack of) of the CEP on teachers' practice have been conducted at AKU-IED (Ahmed, 2000; Ghulam Muhammad, 1998; Halai, 2004; Khamis, 2000; Khoso, 2004, Lakha, 1999; Mankeia, 1999; Vazir, 1998). If success is defined as bringing about change in the perceptions and beliefs of teachers, then the CEP is successful because these studies show that the CEP does bring about

a change in them. How the teachers start thinking about their subjects, about their own teaching and about student learning undergoes a change.

Ahmed (2000) studied the influence of the CEP secondary science on teachers' beliefs about science teaching and found that the participating teachers' beliefs about learning and teaching science were significantly influenced. However, Khoso (2004) studied the impact of CEP – Science on the teaching practice of one science teacher teaching in a government school in Karachi. He found that the programme did affect the teaching practice of the teacher. The teacher used a variety of strategies for teaching and used questioning very skillfully to elicit students' previous knowledge. These skills the teacher himself directly attributed to the CEP – Science. However, other studies conducted in other subject areas find that the change in practice is considerably less than what one would expect from a group of teachers showing a remarkable shift in their thinking about teaching.

A number of reasons have been cited for the limited change in teachers' practice in the classroom, such as, the external system of examination, lack of sufficient support by headteachers in the school, heavy workload of teachers and lack of time in the timetable. Factors, directly attributed to the CEP were that despite spending a third of the time in the classrooms implementing the new skills learnt, even then teachers needed support to use the skills in their own classrooms. This support was often not available in their schools.

To address some of these issues, since 1998, the CEP has evolved and metamorphosed into at least three different forms other than the one described above. The three different models are: (a) the Whole School Improvement model (WSIP) model, (b) the system-based model and (c) the school-based mode (AKU-IED Academic Review Committee documents, 2002). The first one is spread over a year with seminars and teaching sessions interspersed. The second model is for school systems that have enough PDTs to run their own CEP, using the summer and winter break for teaching and offering support during the school time. The third model is similar to the one described in this paper – that is, it is AKU-IED based but uses the summer and winter breaks for teaching. These changes have come about in response to two major concerns: (a) the limited change observed in the classroom practice of teachers despite a perceptible change in their attitudes and (b) the difficulty schools had in releasing a teacher for eight weeks.

## **Societal Implications**

The CEP is a dynamic model and a new initiative to provide in-service education to teachers for the purpose of reconceptualisation of teaching practice initiated by AKU-IED. This programme does not focus on a particular method or technique of teaching; rather it encourages the teachers to embrace a whole new way of thinking about teaching. The issue and dilemmas raised above do not take away from the bold and imaginative nature of the programme. Every innovation, every solution brings with it new questions and new problems. What is needed is to stay the course and work through the problems.

This is a small scale innovation however it has the potential to leverage significant changes in the way students and teachers think about knowing and knowledge that could influence the direction in which the transition of Pakistani society takes place. The concept that teachers bring with them about a subject does influence the way it is taught, this connection is not simple and straightforward, but researchers have identified a complex interrelationship (Brickhouse, 1990). Hence, if the teachers think that science knowledge is tentative there is, I hope, less readiness to see textbooks as infallible. This may lead to an enhancement of the capacity for multiple interpretations and an acceptance of plurality in school science as well as daily life.

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