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## Subject studies in teacher education

Barbara Jaworski

*Aga Khan University, Institute for Educational Development, Karachi*

Bernadette L. Dean

*Aga Khan University, Institute for Educational Development, Karachi*

Rana Hussain

*Aga Khan University, Institute for Educational Development, Karachi*

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## **Subject Studies in Teacher Education**

**BARBARA JAWORSKI,  
BERNADETTE L. DEAN & RANA HUSSAIN**

### **Introduction to Subject Studies at the Institute for Educational Development at the Aga Khan University (AKU-IED)**

*What is it Important to Learn and How Can Learning Be Organised?*

If we answer the question, ‘What is it important for children to learn’, it is likely that we would include a variety of concepts relating to the world around us including aspects of language, mathematics and science; environmental, social, cultural and religious issues and concerns; music and the arts; physical education, and so on. As we consider how such concepts might be addressed, the ethics and values of addressing them, and the outcomes for children’s growth and participation in society, a curriculum starts to form. Civilized societies that institutionalize learning into schools have developed curricula that relate to their particular contexts, values and political ideologies. In many countries, the resulting curriculum designated for schools has similarities, one of which, particularly in secondary education, has been its division into *subjects*. Although some schools in some parts of the world have resisted such division, it is a prevalent way of organising the curriculum. This is no less true in Pakistan and in other countries from which the AKU-IED draws its students, who are practising teachers.

Education at primary level tends to be more variable, with some places preferring a thematic division to the curriculum rather than a subject-based one. Thus, whereas subjects might include English, History, Geography, Mathematics, Science, and so on, themes would be broader and more socioculturally related: for example, buildings, fire, food, sport or trade. Study within a theme would draw on a wide range of subjects and encourage both subject-specific learning and development of values and skills for life. Thematic learning at secondary school level is seen to be more difficult to organize than at primary level since it is not obvious how certain concepts

can be developed through a thematic approach except perhaps in a very contrived way. This, of course, varies according to subject discipline.

### **Teachers' Knowledge**

#### *What Forms of Knowledge Do We Recognise?*

Learners need opportunities to address concepts in their experiential world, and the mantle of responsibility rests on teachers to interpret the given curriculum in ways that foster learning. Thus, teachers need knowledge appropriate to their interpretation of the curriculum. This includes the specialized knowledge to address concepts and issues that are subject related, the pedagogical knowledge to create learning environments and the social knowledge to address values and relationships. Scholars have written extensively about the knowledge teachers need, and the forms it might take. For example, Shulman's classification includes content knowledge and pedagogical content knowledge, both relating to subjects and approaches to teaching those subjects (for example, Shulman, 1987); while Eraut (1994) classifies knowledge into procedural knowledge, propositional knowledge; practical knowledge; tacit knowledge; and skills and know-how (p. 16). The latter may be seen collectively with respect to any one subject, or may be considered across subjects. However, it seems to make sense that in order to teach, for example, Science, whether directly as a subject or inter-thematically, teachers have to have knowledge of Science, and this has to be applicable to ways in which Science contributes to the experiential world of a student.

#### *Content and Pedagogical Content Knowledge*

Content knowledge involves the specialized knowledge that is the mainstay of each disciplinary field like Science or Social Studies. It also, to some extent that is negotiable, includes epistemological knowledge in the field. For Mathematics, for example, this might be seen as including the nature of abstraction, and how abstraction arises from particular cases, through generalization and proof. For example, the recognition that  $3 + 7 = 10$  and that  $5 + 11 = 16$  leads to a conjecture, expressed in general terms, that the sum of two odd numbers always gives an even number. We can prove this algebraically by starting with a general odd number  $2n + 1$ , where  $n$  is any whole number, and adding to it another odd number  $2m + 1$ . The sum of these is  $2n + 2m + 2$  which we can write as  $2(m + n + 1)$ . This result has a factor of 2 which means that it is an even number. Thus we have proved a result that the sum of two odd numbers always makes an even number. Such reasoning, using algebraic symbolization and processes of generalization and proof is typical of mathematical formalism, and therefore indicative of aspects of mathematical epistemology. Although we may seem to focus on aspects of Mathematics that are regarded as hard and uncompromising, we must

remember the conjecturing process, spotting patterns from trying out special cases, that leads to such results. The use of such recognition to encourage students to try out special cases, spot their own patterns and conjecture their own rules might be seen as a part of mathematical pedagogy. We shall show an example of this later in the chapter. The knowledge that teachers need in order to use such approaches to Mathematics and devise classroom activities that are conducive to students' learning is known as pedagogical content knowledge (Shulman, 1987).

In the case of Social Studies, content knowledge is sometimes viewed as knowing an enormous number of facts. For example, names of countries and capitals in Geography and dates and personalities associated with important events in History. Learners need to move beyond facts to appreciate concepts, concepts clusters and generalizations. In Geography we have concepts such as region, country, continent, longitude, latitude; concept clusters such as the climate, natural resources, population; and generalizations such as each region of a country interacts with other regions and makes economic contributions or human activities and natural forces cause changes on the earth's surface. Key concepts in History, particularly the concepts of time, continuity and change, causation, and the understanding of events and issues from the perspective of people in the past are important to enable learners to develop a sense of order of events in History and a coherent pattern of the stages that people have gone through to get to where we are today. The application of these concepts or 'tools of thought' helps to turn historical facts into historical knowledge (Sansom, 1987). Thus even when students are unable to recall specific details they still understand the significance of key events (which is an important educational outcome).

#### *How Can Teachers Be Prepared for What They have to Teach?*

In deciding how to approach the knowledge needed by teachers to provide effectively for students' learning, the IED had to consider both what is needed by teachers in their own national contexts as well as the ideals of preparing teachers for the comprehensive education of their students. The IED curriculum for teacher education in the M.Ed. programme has recognised teachers' needs for subject development, and for a more general growth of knowledge. This can be seen in relating subjects to each other and to wider aspects of students' life-worlds, and in developing understandings of educational process and development beyond specific subjects.

Within the subject studies part of the M.Ed. course, four subjects have been recognised as core areas: English, Mathematics, Science and Social Studies. These are areas in which many of the teachers recruited to the M.Ed. have a speciality, particularly those who have taught students at lower or higher secondary levels. They need to have a good understanding of their speciality subject in order to teach it effectively themselves and to help

develop teachers more widely. However, for teachers who have taught mainly at primary or lower primary levels, there may be no specific speciality but a need for knowledge that is related to a wide range of subjects. Such specialisms and needs raise questions about the most appropriate structure in the M.Ed. programme for addressing those needs.

As Chapter 3 has indicated, the M.Ed. programme is a programme in Teacher Education. Its graduates will become teacher educators in schools or in institutions of higher education. Thus, it is not only their own subject specialism on which they need to focus, but also they require knowledge of areas of need for teachers with whom they will work. This complicates issues considerably.

#### *The AKU-IED's Structure for Subject Teaching*

As part of a two-year programme, there have been four modules, each of six weeks, each attending to one of the core areas of English, Mathematics, Science and Social Studies. In the early programmes, participants engaged in all four modules. In more recent programmes, each participant has selected two modules from four: one from English or Mathematics and one from Science or Social Studies. This recognises that some teachers feel very underprepared to engage with certain subjects and thus allows them to avoid those subjects; it also provides more space for other areas of the M.Ed. curriculum. However, it limits the extent of subject knowledge of teachers emerging from the programme and their possibilities for working with teachers in a range of subject areas. In early programmes, in addition to the four subject modules, each course participant (CP) participated also in one subject specialist module of their choosing. The module in subject specialism was called the EPCK (Enhancing Pedagogical Content Knowledge) module: these modules enabled CPs to study one subject to a greater depth.

In recognition of the special needs of those who will teach primary school children and those who mentor teachers at this level – namely, work with teachers to enable their reflective development of teaching – a cross-subject primary module has been taught. As the subject modules have been reduced, the primary module has grown accordingly. Thus all CPs address subject concepts in all four areas, relating specifically to primary education, and this study addresses subject content coverage to some extent. Also, particularly in English, approaches to developing understandings for learners at primary level are very different from those of older children at secondary and higher levels. Therefore a separate module to address such approaches is important. However, for some subjects, many issues in teaching transcend the primary-secondary phase boundary, so that a primary-secondary separation is less important.

There are many issues relating to structures of subject teaching within the M.Ed. programme. We address some of these below: firstly, through

consideration of two cases (Mathematics and Social Studies) as examples, and, secondly, by extracting key issues across the four subject areas.

*Areas of Mathematics and Social Studies: theory, practice and issues*

*Mathematics.* Studies in Mathematics, from the start, have involved a partnership between the AKU-IED and the University of Oxford. This has emphasized a need for cultural rationalization between international theoretical perspectives and more local and idiosyncratic approaches to education. Those who planned and taught the module were aware of the IED's mission to develop teacher educators who are reflective practitioners and to encourage a broad conceptual understanding in learning. Such aims see the M.Ed. as fitting with a view of Mathematics as socially constructed, fallible knowledge rather than as an absolute body of knowledge outside the domain of the learner (for example, Ernest, 1991). Such a perspective has strong implications for how Mathematics is learned and taught. The learner of Mathematics is no longer seen as acquiring knowledge from outside herself, but rather as constructing knowledge within social settings. Piagetian and Vygotskian theories of human learning and development help formulate a social constructivist view of mathematical learning from which teaching approaches can be formulated (for example, Piaget, 1950; Vygotsky, 1978). Teaching becomes a process of creating environments in which learners can meet and engage with mathematical ideas and make sense of Mathematics jointly and personally (for example, Jaworski, 1994). The IED's commitment to cooperative learning and interactive teaching fits well with these perspectives of Mathematics, learning and teaching.

A major issue for some teachers in encountering such perspectives was that Mathematics has been seen, traditionally, as a subject of right or wrong answers, of procedures and rules, as hard and fixed. Changing such perspectives towards fallibility and social construction has not been easy or straightforward, and has presented a challenge for tutors.

To address this challenge, successive cohorts of M.Ed. teachers (CPs) have been invited to experience Mathematics themselves from a socially constructive perspective. They engaged in problem-solving tasks where they devised their own methods and analysed their solutions along with tutors. A simple question like, how many different numbers can you make using 4 fours, and operations +, -, x, / proved stimulating and rewarding. For example,

$$1 = \frac{(4+4)}{(4+4)} \quad 2 = \frac{(4 \times 4)}{(4+4)} \quad 3 = \frac{(4+4+4)}{4} \quad 4 = (4-4) \times 4 + 4 \dots$$

and we can proceed for other numbers such as

$$1 = \frac{(4+4-4)}{4}$$

Some numbers can be represented in more than one way, for example,

$$63 = \frac{4^4 - 4}{4}$$

Even those participants who were afraid of Mathematics, and believed they could not do it, could be successful with a problem such as this one. It challenged them; they enjoyed finding more numbers, and different ways of finding the same numbers, and in the process of working with numbers their knowledge of number relationships developed. Thus they learned Mathematics, and they also learned Mathematics pedagogy in how to challenge students and provide fruitful learning activities. When one CP who had said she was no good at Mathematics was successful in solving a problem, the tutor said, 'So you *can* do Mathematics'. The CP's response was, 'this isn't Mathematics, it's just common sense'. That Mathematics could derive from sense-making – making sense of something – was a completely new idea.[1]

So CPs were invited to engage in problems that opened up areas of Mathematics which they had found difficult previously. For example, tackling fractions, a notoriously difficult topic, from this new perspective was a complete revelation for many CPs: as a result they were now able to understand concepts in fractions. Geometry, algebra, statistics and trigonometry were all approached through investigative, problem-solving tasks involving activity and discussion. The idea was that the CPs together could construct mathematical knowledge, and that a tutor's role was to question and challenge. CPs learned to devise their own questions and set their own challenges. Solutions had to fit with the body of Mathematics socially constructed over millenia.[2] Tutors had to ensure that incomplete or incorrect solutions were challenged, discussed and corrected, with a main focus on student activity and sense-making through reflection and critique. The processes through which the CPs themselves learned were discussed and synthesized as a pedagogy for the classroom.

Simultaneously, CPs worked with students and teachers from local schools and put some of their own learning into practice. They also devised workshops for these teachers in which they offered and discussed what they themselves had learned. However, CPs recognised quickly that the approaches they were learning did not fit well with the systems used in many Pakistani schools. Although children responded extremely well to the activities they offered, teachers were less well disposed. Teachers had to follow textbooks, complete the curriculum in a limited time and prepare students for examinations. To achieve these requirements, students were expected to sit quietly, attend to the teacher, copy the teachers' methods,

answer textbook questions exactly as they were presented, learn the material exactly as they had been given it and reproduce it for the examination. If students did all of this they were 'successful', and schools and teachers were measured by their success. Teachers felt enormous pressure from schools to keep to this pattern which was declared to be 'traditional', and which fits with a traditional view of Mathematics.

For the CPs, there was a clear dichotomy: in the IED environment, investigative Mathematics, questioning and sense-making were important; in schools the traditional methods were important. As teacher educators working in schools, how could they deal with this dichotomy? The dichotomy became even more real and potent when, as graduates of the M.Ed. programme, now Professional Development Teachers (PDTs), they had to work with other teachers in their schools and contribute to programmes for teachers (Visiting Teacher (VT) Programmes) at the IED. Their task became not just a case of working with teachers as they had worked at the IED, but of finding ways to reconcile fundamental differences between the two systems. They could not change textbooks or examinations, so they had to find ways of working with these traditional systems, but at the same time introducing the new approaches – a serious challenge and an uphill learning experience (see Chapter 13 and Mohammad, 2002).

This led to important learning also for their tutors. It was not sufficient just to work with the CPs in ways that encouraged mathematical concept building and conceptual understanding. They had to take into account the school systems and requirements on teachers. Thus, school textbooks became an important part of the Mathematics module. Investigative work had to be linked clearly to what was in the textbook. Tutors had to address the dichotomy from within the IED programme.

Another very important issue that became clear during the delivery of the first Mathematics module was that of the CPs' own subject knowledge, particularly those who were specialists in Mathematics and would be required to become future leaders in the subject. Traditional forms of teaching had resulted in understandings that were largely instrumental and lacked connections to other areas of Mathematics or to problem solving more broadly. It was clear that subject knowledge for these CPs needed to be enhanced. Through three subsequent programmes, CPs who chose Mathematics as their speciality attended the EPCK module in Mathematics. Here tutors taught Mathematics, modelling the pedagogic approaches and strategies that had been introduced and implemented in the Mathematics module. Thus CPs worked conceptually on number, functions and algebra, trigonometry, and calculus. The first such module (Class of 1998) was joined by PDTs from the first M.Ed. cohort (Class of 1996) who wanted extra mathematical experience. Learning in the module was researched during its practice through recorded observations of sessions and interviews with CPs (see Jaworski & Nardi, 1998). Deep learning of concepts and development of awareness of mathematical relationships were evident for all participants.

Tutors too acknowledged that the open and inclusive pedagogical approach had enhanced their own learning in important ways. It was a pity that the EPCK module had to be abandoned in later programmes to make room for other important aspects of a Master's programme in Teacher Education.

*Social Studies.* Social Studies in the M.Ed. curriculum was included as a response to a decline and neglect of the subject's status in schools. Teaching in the Social Studies module involved a radical shift from the 'traditional' implementation of Social Studies, in which knowledge is presented as facts to be learned, towards a participative curriculum in which learners are actively engaged in attaining key concepts. Activity included the use of concept attainment strategies such as identifying attributes through looking at examples and non-examples of the concept in the different disciplines that comprise Social Studies. This new curriculum encourages learners to apply their knowledge to understand present-day issues so as to become citizens capable of participating meaningfully in decision-making situations affecting their lives or engaging in social reform.

In its attempt to introduce a totally different way of dealing with content the Social Studies module faced a challenge. One or two course participants were Social Studies teachers and another one or two had taught History or Geography as separate subjects, but most had no experience of teaching Social Studies. Most CPs' knowledge was confined to the facts in the textbooks they used for teaching. Skills like map reading and chronology were negligible. In addition, most CPs' teaching practice comprised teacher talk. Alongside classroom lectures, the Socratic method of questioning is used. A typical lesson would include reading from the text followed by a lecture to explain the text and questions for in-class review. Repetition of material through reading assignments and answering textbook questions followed to prepare students to do well in examinations.

In introducing CPs to the idea that history is interpretive and perspectival, one CP commented, 'How can I interpret History from different perspectives? For me the history is given. Also by reinterpreting history I am going against patriotism'.<sup>[3]</sup> Since participants came to the module with such experiences of Social Studies, either as a subject teacher or as a learner, it was of crucial importance to help them reflect critically on their past experiences.

The module was planned to deal with limitations in CPs' prior knowledge. An approach was selected to help the CPs to reconceptualize the teaching and learning of Social Studies by critically examining the nature and role of Social Studies in school given the aim of developing members of society capable of taking responsible actions for improving their society. The course called for the CPs to put in considerable effort to enhance their own knowledge through research and enquiry. They were introduced to enquiry as a teaching/learning strategy. They chose a topic for enquiry and were then walked through identifying a question, collecting information, synthesis and

presentation. Presentations facilitated the CPs' learning from each other. The use of enquiry and preparation of content for presentations to their colleagues, was seen as a valuable experience which helped them translate the term lifelong learning into 'I can improve in areas where and when I need it.'

The CPs also learned how to help students attain and develop concepts through the introduction to concept attainment and development strategies. Reflection, questioning and meta-cognition were important parts of the strategy. An important part of the Social Studies module was for the CPs to see themselves as 'Transformative Intellectuals' (Giroux, 1988), both in schools and in the communities in which they lived. They used enquiry to study social issues such as environmental degeneration, women's empowerment, and child labour, drawing on the various disciplines, applying skills learnt, developing attitudes and taking actions. For example, a small group studied why girls are not sent to school and possible ways to address the issue by interviewing parents and community leaders in addition to surveying the literature. They presented their findings to faculty and staff in the form of a role play following which they led a discussion on the topic. This approach to the development of subject knowledge with a focus on becoming a critical pedagogue remained a challenge for quite a few CPs as they moved from the position of 'doing as told' to 'acting after reflecting'.

Through the module the CPs began to question the content of Social Studies in the curriculum as well as the second-class status of Social Studies in most schools. This provided an opportune time to move to a key component of the Social Studies module which is CPs' work in schools. The M.Ed. programme required the CPs to translate into practice, in real classrooms, the knowledge and skills learned as theory in the seminar sessions. They engaged in unit planning, enriching the text with relevant content, instructional strategies and assessment practices. The CPs were not always able to teach as planned. For example, in their desire to include all students in the activity of the class, they kept calling on students to assess their prior knowledge, so that class time was used up before their plan was complete. The CPs found it difficult to deal with the noise during group work and to focus on one group while keeping an eye on all groups. Their self-reflections and feedback helped improve performance over time.

In order for the CPs to continue learning on their own and in collaboration with colleagues they were required to keep a reflective dialogue journal which was shared weekly with a colleague. In addition they collaborated with a partner to carry out an action research task in an area of their choice. This exercise enabled the CPs to see how, through systematic action and reflection, they could improve an area of practice.

### **Issues and Implications**

Although there are clearly subject-specific ideas and issues in each of the cases reported, and the same is true for English and Science, there are

nevertheless many subject-related issues that cross subject boundaries. The main issues, as we see them, can be listed as follows:

1. The shaking up of teachers' perceptions of subject as they meet new perspectives and formulations.
2. The traditional curriculum and traditional approaches to teaching it. The influence of textbooks and examinations.
3. Teachers' lack of subject knowledge and its implications for learning and teaching. How subject knowledge can be enhanced.
4. The theory–practice interface: interpreting theoretical perspectives such as a social constructivist view of learning and critical reflective practice in relation to the practice of subject teaching. Cultural dimensions at odds with recommended practices.
5. Pedagogic practice: the need for rationalization of methods across individual subject modules.

#### *Teachers' Perceptions of Subject*

The nature of Science, or of Mathematics, or of Social Studies, as seen by CPs, was challenged in the modules. Seeing Science as a tentative human construct rather than an abstract external truth; Mathematics as fallible and socially constructed rather than rule driven with right and wrong answers; Social Studies as being about controversial issues, rather than historical or geographical facts; was seriously challenging. Pedagogical approaches in these subject areas were premised on such alternative perspectives of subject, and only made sense if these epistemological foundations were in place. One of the problems that emerged from subsequent studies of the teaching of VTs (Visiting Teachers, taught by the PDTs: see Chapters 3 and 5) was the implementation of pedagogical approaches without the epistemological understandings that allow such approaches to make sense. The result was 'methods without meanings', and hence ineffective outcomes in terms of students' subject learning (Halai, 2001; Mohammad, 2002).

#### *The 'Traditional' Curriculum*

The way that curriculum is presented traditionally, in Pakistan and beyond, is to list topics that are to be taught and learned. Such topics are then presented by teachers to students through forms of direct instruction in which teachers tell and demonstrate what is to be learned and students internalize through repeated practice and memorization. Textbooks present the 'knowledge' to be learned in culturally acceptable forms; teachers follow textbooks closely; and examinations test what has been set out in the textbook. According to sociocultural theories, such practices are perpetuated by newcomers, new teachers and students, being enculturated into accepted ways of doing and being (for example, Lave & Wenger, 1991; Wenger, 1998). In order for such perpetuation to be modified, epistemological

positions of teachers need to change, so that alternative practices can be introduced in meaningful ways. However, this alone is not sufficient without wider systemic change. A massive challenge for the AKU-IED is to influence educators and policy makers, across the countries it serves, to look at critically, and modify, syllabuses and examinations [4], to support change.

#### *Teachers' Lack of Subject Knowledge*

In all subjects, teachers' knowledge of their subject was limited, thus constraining potential to teach well according to new beliefs and practices, and to mentor other teachers (Khamis, 2000; Halai, 2001; Mohammad, 2002). Partly, this was due to instrumental learning deriving from their own schooling; partly it was due to the limited nature of the curriculum they had followed. All subject modules addressed 'content' knowledge as part of the overall delivery of the module as can be seen from the two cases above. However, the module time was insufficient to cover all necessary content adequately. The EPCK module provided an excellent opportunity to address further content and its teaching at a range of levels. We feel it would be valuable to reinstate such provision in future programmes.

#### *The Theory–Practice Interface*

The subject modules made heavy demands on CPs in terms of new theory, philosophy, pedagogy and content. In the (relatively) luxurious surroundings of the AKU-IED, with the expertise of their tutors always on hand and resources readily available, it was possible to espouse new ideas and translate them into tentative belief systems. It was too easy to forget the constraints that faced teachers in the realities of schools and classrooms. Mohammad (2002 and in Chapter 13) points out the very seriously disjointed nature of these systems. Teachers in general, and especially those in government schools, face curriculum and examination constraints; large classes; poor buildings; inadequate furniture or resources; heat; lack of water; lack of concern for their physical and mental well-being; family concerns; needs to earn extra money to support their families, and so on. Translating AKU-IED theory into classroom practice is a greater challenge than just that of translating theoretical ideas into classroom practice, although this alone is a serious challenge. Module leaders are tackling issues of how to address the theory-practice transformation, taking into account all the above factors. For example, in Science, the need for resources has been addressed through a focus on simple, readily available or home-made materials that can support scientific enquiry. However, dealing with practical concerns while maintaining a focus on epistemological groundings of subject teaching and the associated pedagogies is still a serious challenge.

Key factors of personal preparation to teach and strategies for classroom teaching include questioning, use of interactive activity, a range of resources and modes of cooperative learning, critical reflection and action research. Use of these modes, strategies and ways of thinking has manifested itself differently in different modules, but their overall theoretical basis has been common to all modules. In addition, theoretical positions related to learning, such as a social constructivist perspective, have underpinned approaches and strategies. There is thus a case for CPs to work generically on such ideas before or after seeing their individual interpretation in subject areas.

For example, all subject area modules have incorporated some form of activity related to the assessment of the module, in which CPs have conducted some small-scale action research and analysed their findings. Such activity has been highly revealing of issues related to learning, teaching, mentoring or classroom practice. Thus, depending on which module has come first, this has involved CPs' first introduction to action research. They have then revisited action research in successive modules, from different perspectives and often using a different, subject-related discourse. Such differences have impeded a generic perspective of action research and its contribution to development in teaching and learning. Module leaders have recognised a need for collaborative cross-subject addressing of such common areas of pedagogy, so that CPs are encouraged to build a coherent sense of theoretical notions and a critical sense of how they are interpreted in practice. A clear example of this necessity can be seen in the concept of *cooperative learning*. This term has been employed in Social Studies, but pedagogical discourse in Mathematics has included terms like 'group work' and 'pair and small group discussion', and their relation to knowledge construction, without ever referring to them as cooperative learning. Thus, cooperative learning has come to be seen, erroneously, as a strategy for Social Studies, but not necessarily for other subject areas. Theories of learning form a backdrop to thinking about classroom practice in all subjects, but it is in Mathematics and Science that a *social constructivist perspective* has been addressed most overtly, with a possible consequence that it is seen as particular to these subjects.

A different kind of issue has arisen with respect to the use of enquiry or 'questioning' which is fostered in all subject modules. In Pakistani schools children are not encouraged to question teachers, or teachers their superiors in the school. The educational practice of questioning goes against accepted norms in Pakistani society. This has raised ethical as well as social issues. How are the PDTs to deal with such issues as they work with teachers in Pakistani schools as part of their M.Ed. learning and beyond?

### Concluding Remarks

It is clear to us as writers of this chapter, that each of the above sets of issues could form a chapter of a book about subject studies. Perhaps such a book might be prepared in the future. We feel that we have, here, just alerted readers to the issues we have found in addressing subject studies. Some of these are issues that will be found prevalent internationally; others are more particular to the developing world. Where our CPs are concerned, as they emerge from the M.Ed. programme to become PDTs and to mentor other teachers, they are potent issues that PDTs and their tutors are still addressing.

As PDTs ran courses for Visiting Teachers (VTs) at the AKU-IED, they were more able to recognize such issues for themselves. Although the AKU-IED's ethos and environment provided a supportive atmosphere for working with the new approaches, and the IED's walls an insulation from the realities outside, the problems were passed on to the VTs who had to contend with the dichotomy when they returned to their schools. Subsequent research has shown VTs confused by trying to reconcile their new learning and old practices in subject teaching (Halai, 2001; Mohammad, 2002). Many revert to the old practices as the only way to cope. In just a few schools, particularly where head teachers have followed the AKU-IED's head teacher programmes, schools have recognized the need for support and teachers have been encouraged to bring the new methods into general school practice (see Chapter 10).

The knowledge of issues that we see reflected briefly in the above sections forms the roots of a new epistemology of subject teaching to which the developing nature of AKU-IED practices is making a very significant contribution.

### Notes

- [1] There is a considerable literature related to mathematical development, learning and teaching from a social constructivist learning perspective which relates to the contexts addressed here: see for example, Jaworski (1994, 2001) and the literature reviews of Halai (2001) and Mohammad (2002).
- [2] For helpful pedagogic analysis relating to mathematical topics, see Prestage & Perks (2001) and Ollerton & Watson (2001).
- [3] This quotation derives from the experience of the authors.
- [4] The Aga Khan University has now been chartered to set up an examination board which would contribute to changing the systemic condition.

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