

PROFESSIONAL DEVELOPMENT OF SCIENCE AND MATHEMATICS TEACHERS THROUGH INTERNATIONAL EXCHANGES

Sudhakar C. Agarkar

Homi Bhabha Centre for Science Education, TIFR, Mumbai, India

and

Vijay V. Bedekar

Institute for Oriental Study, Thane, India

Abstract

Institute for Oriental Study (IOS), Thane, India has been organizing short term exchange visits for teachers from UK and India in collaboration with the League for the Exchange of Commonwealth Teachers (LECT) London. Over the last three years it has arranged three visits of British teachers to Mumbai (India) and two visits of Indian teachers to London and Oxfordshire (UK). Each team consisted of about 20 practising teachers teaching at primary/secondary levels of schooling. The visit programme lasting for about a week comprised classroom observations, interaction with teachers, teacher trainers, members of teachers' associations and officials of the education departments. In addition, a part of the time is utilized in organizing educational tours and cultural programmes for the benefit of the visiting teams.

The experiences of all the five visits are quite encouraging and educative. During their school visits British teachers could see for themselves how Indian teachers handle large classes and teach science and mathematics within the limited availability of material and manpower resources. On the other hand Indian teachers could see personally how British teachers use Information and Communication Technology (ICT) for teaching these subjects effectively. The dialogue between the teachers from UK and India brought out clearly the difference between school education systems in Europe and in Asia. It has been realized from both the sides that the problems of school teaching are the same and concerted efforts will have to be made to overcome them.

The personal interaction between visiting and host teachers proved to be quite useful. It has resulted into the establishment of the long term professional relationship among the teachers of both the countries so that they could continue exchanging ideas and experiences on a regular basis. More importantly, this exchange programme has resulted into the close linkages between institutions working for the improvement of science and mathematics education in both the countries. It has opened an opportunity for the exchange of material and manpower between two countries. Encouraged by the positive impact of the exchange visits IOS and LECT are now planning to strengthen the exchange programme in the future.

Introduction

The Institute for Oriental Study (IOS), Thane in collaboration with the League for the Exchange of Commonwealth Teachers (LECT) has been hosting the visit of British teachers to India since 2003. It has also initiated a visit of Indian teachers to UK under Teachers' International Professional Development Programme (TIPD) since 2004. So far three visits of British teachers and two visits of Indian teachers are organised. These visits have been found to be of great help for the teachers from both the countries. British teachers could see how science and mathematics are taught in Indian schools and plan methodology for inclusive education in their schools. On the other hand Indian teachers could observe teacher pupil interaction in British classrooms and think of improving classroom proceedings back home to make it activity based. This paper attempts to describe salient features of these exchange visits,

highlight lessons learnt by teachers from both sides and make a case of exchange visits among different countries for the benefit of practising teachers.

Visit of British Teachers to India

Visits of British teachers to Mumbai (India) were arranged in Feb. 2003, Feb. 2004 and Feb. 2005. The first team was drawn from east London, the second from Oxfordshire and the third from West Sussex in United Kingdom. Each visit lasted for about a week. The visit programme was planned to provide a glimpse of Indian education system to visiting teachers. It generally had four components: Visits to schools, Visits to research and training institutions, Interaction with members of voluntary agencies and Sight seeing/ cultural programmes (Agarkar and Bedekar 2004). A short summary of each of these activities follows.

School Visits

An attempt was made to expose the visiting team to various schools in the district of Thane in Maharashtra. One of the visits was to an Ashram school modelled on the ancient Indian *gurukul*¹ system. It caters to the hitherto neglected tribal population and provides education, food as well as accommodation free of charge to students. Despite the fact that the medium of instruction in the school was Marathi (the language of the state of Maharashtra) the visiting teachers could establish good dialogue both with the teachers and students. The teachers were also taken to a school for mentally retarded children located at a *taluka*² place. They could interact with teachers and also see some material prepared by children. This interaction enabled them to know how teachers are trying to teach simple principle of science and mathematics to the ill-fated children.

A visit was arranged to two urban schools: one teaching in Marathi medium and catering to children from poor socio-economic strata and the other teaching in English medium and catering to middle class population of the town. In the first school they could observe inclusive education as practiced in India. As a part of its annual programme the school had arranged science exhibition with the participation of students from neighbouring schools. The visiting team could see the exhibition and interact with the students who had brought their exhibits. Teachers appreciated the idea of science exhibition as it offered them an opportunity to see creativity expressed in exhibits students. They were impressed by the fact such an exhibition is arranged not only by school management but also by the education department of the state government on a regular basis. During the period of the visit there was a craft exhibition in English medium school. A variety of artefacts prepared by children were displayed systematically in the exhibition. Visiting teachers showed interest in knowing the material used and the way the exhibits were prepared. What attracted them most was the *Rangoli*³ pattern prepared using coloured powders. It was realised that this simple activity enables students to master geometrical concepts.

A visit was also arranged to an international school in the district of Thane. The school attempts to offer modern education with a focus on Indian culture and tradition. It has all the modern facilities like a laboratory, a computer room with dedicated Internet connection and good lecture rooms. Students from different states of India and also from other countries attend the school. British teachers could establish

¹ Gurukul is a unique educational system followed in ancient India, where pupils after the age of 8 used to reside in the hermitage of the teacher for a period of at least 12 years. Apart from educational curriculum importance was given to personality development and inter-human relationship.

² Taluka is a subdivision of a district.

³ Rangoli is an ancient Indian art in which geometrical figures are drawn using white or coloured powder. The powder is prepared by crushing soft stones and colours used are organic. Usually these diagrams are displayed in the temples and outside every house, especially on the auspicious occasions.

dialogue with the students in a short time. This interaction enabled them to know the topics they study, the relationship with their teachers, and nature of peer interaction among the students. The focus on spiritual and yogic education was evident.

Visits to Research and Training Institutions

Being the host institution the first visit of British teachers was arranged to the Institute for Oriental Study (IOS), Thane. IOS is a unique institution devoted to conducting studies in oriental science. Many of the British teachers were astonished to see the treasure of knowledge that existed in ancient and medieval India. Specifically the issues related to science and technology in ancient India attracted their attention. The library of the institute has a good collection of old books and manuscripts. They could look at some of the rare manuscripts from medieval period. The institute also has some old artefacts in its collection. British teachers could see some of the rare artefacts too. The library and museum of the institute is open for school students. Practising teachers are encouraged to bring their students and open the treasure of ancient knowledge to them. The facilities of the institute are also used by research workers and academicians interested in oriental learning.

Another visit was to an Institute of Educational Management and Research in a town close to Mumbai. The focus of its activities is on creative education. Hence it undertakes activities to encourage creativity among the students. In this regard, art and science exhibitions are arranged by the institution for teachers and for students periodically. The important feature of the visit was the close interaction between the visitors and the teachers of the school. Various issues concerning school education were discussed during the interaction. The professional interaction went to the extent of discussing problems related to multicultural education and inclusion in the classroom. It was a free exchange of ideas between two groups of teachers from two different educational systems.

A visit was arranged to the Homi Bhabha Centre for Science Education (HBCSE), a national centre of the Tata Institute of Fundamental Research (TIFR) for science and mathematics education. It conducts research in the areas of curriculum development, teacher training, cognition and science communication. HBCSE undertakes projects both in rural as well as in urban areas to design methods and materials to improve teaching of science and mathematics in Indian schools. Salient features of some of these projects were discussed with the teachers. This discussion enabled the visiting team to get a feel of research conducted in science and mathematics education in the country. HBCSE also has an exhibition on History of Science within its campus. It highlights various stages in the development of science and technology. The special feature of the exhibition is that it attempts to provide a balanced view of history highlighting the contribution of eastern countries like China, India, etc. in shaping modern science, technology and mathematics. The visiting team could see some of the exhibition panels. They also had an opportunity to visit science and mathematics laboratories to observe low-cost concept based experiments designed to improve teaching learning process in Indian classrooms.

A visit to College of Education was organized with the aim of familiarizing the British teachers with the method of preparing prospective teachers. They could interact with the faculty of the college and know the course content of the training programme. They were also taken to a room that displayed a variety of teaching aids prepared by student teachers. Apart from arranging regular courses for student teachers, the college also manages a centre for distance education for practising teachers. The college faculty works as resource persons during contact sessions of the distance learning programme and supervise the project work of the students. The faculty also shared their experiences of working with such students who are slightly over-aged as compared to the regular students.

Teachers were taken to Rambhau Mhalgi Prabodhini (RMP) a unique research and training academy working for the capacity building of voluntary activists and elected representatives. It attempts to spread

the idea of good governance in the society. In a formal presentation organised by the Prabodhini the visitors were acquainted with the educational activities of the institute. Some of the artefacts prepared by local tribal artisans were displayed. A seminar was arranged on *Vedic*⁴ Mathematics to familiarize the teachers with unique system of mathematics education devised in India. The speaker explained the short Sanskrit formulae in the form of shlokas and demonstrated their use in mathematical calculations. Using these formulae he could make calculations involving big numbers within a short time.

Interaction with Members of Voluntary Agencies

Interaction of visiting team was arranged with the members of selected voluntary organizations in the district of Thane. Members of Gram Mangal, an organization working for the education of disadvantaged children, discussed the problems of rural students and elaborated teaching techniques developed by them to facilitate learning. Another organization that made itself available for discussion was Vanvasi Kalyan Ashram (VKA), a voluntary agency working for the overall development of tribals. Yet another organization that made presentation was Jana Kalyan Samitee (JKS). JKS representatives presented their experiences of mobile laboratory that goes from one place to another showing science experiments to school children. A visit was also arranged to Vivekananda Ashram, a voluntary organization that provides motherly care to about 100 poor and orphan children from tribal communities.

The district of Thane has an active science teachers' association. An interaction was arranged with the members of this association. It was clear that apart from periodic meetings of their members these associations organize in-service training courses for teachers. Notable feature of the associations is the organization of special examination to identify hidden talent among the students. The visiting team was amazed to note that teachers on their own spared time for the activities of these associations without any monetary gain.

Social/Cultural Programmes

One of the important places that were chosen for sight seeing was *Gharapuri* Island, a site of magnificent Elephanta caves consisting of beautiful carvings, sculpture and a temple of Hindu God *Shiva*⁵. It is one of the world's heritage sites designated by UNESCO. The sculpture carved out of a solid basalt rock creates a representation of heavenly mountain residence of lord Shiva. A few cultural programmes were arranged as a part of the visit programme. They could witness *sarod* and *sitar* recital as well as *Bharatnatyam*⁶ and *kuchipudi*⁷ dances. The commentary in English that went with the performance explained the genesis of each dance, the clothes worn by the artists and the special features of different dances. A question answer session at the end of the dance programme was an added attraction. The interesting epilogue of the cultural programme was the visit to a cinema theatre that showed a Hindi film made in Mumbai, popularly known as Bollywood.

Observations of British Teachers

Syllabus

In India there are different syllabi recognised by Indian Council of Secondary Education (ICSE), Central

⁴ This system is conceived by a Hindu monk in the last quarter of the 19th century. The author was inspired by the *hymns* in the ancillary text of the *Atharvaveda*, one of the ancient most Indian sacred literatures.

⁵ A member of Hindu trinity. Other two are *Brahma* and *Vishnu*.

⁶ One of the traditional Hindu dance styles practiced since ancient times.

⁷ One of the traditional Hindu dance styles practiced since ancient times.

Board of Secondary Education (CBSE) and the State Board of Secondary Education. Each school has to stick to one of these curricula. It was observed by the British teachers that a great emphasis is laid on teaching science and mathematics in Indian schools. In Indian scenario candidates offering these disciplines at the higher level not only receive great respect but also stand high in their chances of getting jobs. It was noticed that the Indian curriculum is loaded in science and mathematics. At the same time it was observed that teaching of science/mathematics is devoid of activities because of the large classroom sizes and resource crunch.

Classroom Management

The number of students in most of the Indian schools is quite large ranging from 40 to 70. The visiting teachers were concerned if the large class created any problem related to misbehaviour. They were surprised to know that Indian teachers hardly face any discipline problem in their classrooms. The answer probably lies in Indian culture and values. In India there is a tradition of respecting the elders in general and teachers in particular. Guru is considered equivalent to a God. If there is any child who has a temptation to misbehave it can be rectified just by an advice without any corporal punishment.

Involvement of Voluntary Organizations

The involvement of voluntary agencies in school education was prominently noticed by British teachers. Apart from private coaching classes there are a large number of voluntary agencies arranging out-of-school activities for school students. What was striking to the British teachers was the involvement of general public in these voluntary agencies as there are voluntary groups formed by persons from different professions to support school education. On many occasions they arrange co-curricular activities like exhibitions, quiz competitions, sports meet, visit to industries, etc. Indian teachers made it clear that these out of school inputs facilitate students' school education significantly.

Students' Assessment

In India, examination is given much more importance in formal school education. Public examination held at the end of 10 years of schooling carries high degree of importance, especially to seek admission to higher classes. There is also an annual examination at the end of each academic year. The performance in the examinations decides if the child can go to next grade or not. If the performance is not satisfactory a student is asked to repeat the same grade for yet another year. Students are, therefore, under constant pressure to perform well in these examinations. To ensure success they resort to extra coaching either from a private tutor or from a coaching class.

Equity in Education

It has been noticed that gender equity is not a problem at all. In fact, the performance of girls in most of the urban schools is better than boys. However there is problem of a different kind that the Indian teachers face. Indian society has been riddled with social stratification. The community that was given menial jobs in the past has remained aloof from formal education. The children coming from these communities and from nomadic families encounter a variety of difficulties in their educational endeavour (Kulkarni and Agarkar, 1985). Indian teachers practice positive discrimination to incorporate these children into the mainstream.

Visits of Indian Teachers to UK

The first visit of Indian teachers was to East London while the second was to Oxfordshire. The programme in the both visits composed of visits to schools, educational tours and social interactions (Agarkar and Bedekar 2005). A short summary of each of these activities follows.

School visits

The school visit programme was planned to provide opportunities for close interaction between teachers from UK and India. In east London the visit were arranged to schools in Newham and Waltham Forest areas. These areas cater mainly to the immigrant population speaking different languages. For the majority of students attending schools in these areas English is not spoken at home. Teachers have a difficulty in communicating with such children. For convenience the members of the visiting team was divided into small groups of 2/3 teachers and were dropped at different schools. The programme of interaction was planned to ensure that visiting teachers had an opportunity to see school facilities, observe classroom interactions and interact with teachers.

In Oxfordshire schools both in urban as well as in rural areas were included in the programme. Here too extensive interaction was planned between visiting teachers and British teachers by dividing them in small groups. Visiting teachers were first given a tour of the school to show the facilities. They were then given an opportunity to observe classroom interaction and talk to children personally. This mode of interaction enabled the visiting team to learn the intricacies of British education system.

Educational Tours

Tours were arranged to visit educational and research institutions both in London and in Oxford. In London visits were arranged to Learning Resource Centres in Newham and Waltham Forest areas. While in London one cannot miss visiting the British Museum, which has a huge collection of artefacts brought from different parts of the world. What is notable is that these artefacts are displayed well with useful information besides them. Within each section there is a guided tour to provide glimpse of collection and its relevance in the development of mankind. One of the visits in London was arranged to the Tower of London. The place of special attraction in the tower of London is the jewel museum. It has a good collection of crowns worn by kings and queens of England. Indian teachers had special inclination to see Kohinoor diamond embedded in one of the crowns. A visit was also arranged to Greenwich observatory. It was an unforgettable experience for the teachers. Apart from visiting the museum they could stand on the Greenwich Mean Line and take their pictures at this important place.

Educational tours in Oxfordshire consisted of walking tour of Oxford, a city with the tradition of education for more than thousand years. Indian teachers could see places like Oxford University Press, Bodleian Library, Trinity College, Balliol College, Museum of History of Science, Ashmolean Museum, Christchurch College, Indian Institute, Centre for Hindu Studies, etc. The city of Oxford has a famous botanical garden with a wide variety of plant specimen. A visit to the garden was a refreshing experience for most of the participants. Tour programme in the vicinity of Oxford comprised visit to Didcot Power station and Rutherford Appleton Laboratory. The visit to Power Station offered the teachers an opportunity to see how electricity is generated using coal/ natural gas. For many of the teachers this was a first chance to see the process of generating electricity. The tour to Rutherford Laboratory was even more exciting. They learnt that the institution is engaged in spreading science among school students and carried out some of the experiments that school students usually perform when they visit the institution.

During both the visits a day long tour was arranged to show the places associated with Indian revolutionaries in London. The teachers were taken to the places associated with great souls of India like Madanlal Dhingra, Udham Singh, Vinayak Damodar Savarkar, Lokmanya Tilak, Shamji Krishna Verma, etc lived. Teachers were shown the Caxton Hall where Indian revolutionaries used to arrange their

meetings. They were also taken to Bentonville Prison where Madanlal Dhingra and Udham Singh went to gallows. Teachers, in fact, stood in silence for a minute to pay homage to both of them. It was a great experience for the teachers as it offered them a rare chance of visiting these places and revise their knowledge of history.

Social and Cultural Programmes

The visit programmes had ample scope for social and cultural interaction. Through this interaction the visiting teachers could get the idea of social life of British persons. A dinner was arranged by the teachers who had visited India earlier. It was a good opportunity for socialization among the UK and Indian teachers. During the visit to Oxfordshire arrangement was made to see a play written by Shakespeare entitled 'As You Like It'. The play was a festive comedy based on the love stories of three couples. Teachers enjoyed the play thoroughly as it was a very different experience for the visiting team members. Also, the musical evening offered yet another memorable experience. The musical evening, managed by students and their teachers made use of a variety of instruments.

Observations of Indian Teachers

School curriculum

Earlier, different education authorities in England followed different curricula. However, national curriculum movement enabled to bring uniformity in the curriculum. All the schools in east London and Oxfordshire where the visits were arranged followed the national curriculum. The special feature of the British curriculum as noticed by Indian teachers is the focus on Design and Technology. It was also noticed that the British system emphasises a more active approach to learning than Indian system. One of teachers from visiting team commented, "Indian system is information oriented while British system is skill oriented."

Discipline in the classroom

It was noticed that the number of children in British classes was limited to 20-25. Even with this small numbers, teachers face discipline related problems. They are not respected as it happens in India. On the other hand they have to earn respect by being good classroom managers with interesting strategies to deliver the curriculum. Home and social environment is such that students enjoy extra freedom. Teacher is forced to listen patiently to emotional problems of children. In case of necessity the child has to be referred to a counsellor. Corporal punishment is illegal in all schools in the UK.

Examinations

Indian teachers were informed that British school system does not follow the rigid method of annual examination. It was clarified that the emphasis is on teacher's assessment through observations and assignments over a span of the entire academic year. The tests are mainly used for diagnostic purposes to understand the strength and weakness of students or to provide the guidelines to the next teacher to understand the level of preparation of the students. Public examinations are held in UK at the age of 7, 11 and 16 years. The examination at 16 (GCSEs) is important for the students as the performance in this examination determines what career path they will follow. Based on students' performance in these examinations a league table is prepared to determine where a school stands. However, no student is detained because of the poor performance in these examinations.

Citizenship Education

The need for inculcating moral values among the students has been realised all over the world (Norton, 1994). Serious efforts are made to teach these values in the schools in England. Because of the strong family bonds in India many of the moral values like respecting the elders, behaving properly in the group, etc. are developed automatically. In England, however, inculcating social values among students receives importance in school education due to different family structure. A substantial number of students in England come from broken or single parent families. British teachers described what they do to inculcate social and moral values among the students. Schools arrange celebrations of festivals observed by people from different religions. Special camps are arranged to familiarise students with values related to good citizenship. These efforts are certainly useful. Nevertheless, as some teachers agreed, there is no substitute to strong family bonds.

Inclusive Education

Indian teachers noticed special efforts made by LEAs to provide education to students with special needs. Schools appoint Special Needs Coordinators (SENCO) to tackle the problems of these students. Sessions were arranged on inclusive education to familiarise the visiting team with the efforts made in this domain. Speakers enumerated various problems faced by teachers in dealing with students coming from homes with social problems. Officials of LEAs have been advising teachers to provide education to the students with special educational needs in normal classrooms.

Use of ICT

Information and communication technology is making headway in school education in a big way. As one enters the British classrooms one notices the presence of smart boards and LCD projectors. Teachers are quite familiar with these instruments and can use them proficiently. Seminars were arranged for the benefit of Indian teachers to acquaint them with the potential of the smart board and too explain how teachers are trained to use this modern gadget.

Summary and Implications

The interaction between British and Indian teachers enabled them to learn positive as well negative aspects of each others educational systems. British party took many ideas back to their country and were able to reflect on their own ideas and practices. They were impressed by the importance given to science and mathematics education in Indian schools. They could personally see how Indian teachers are teaching these subjects with limited resources. For Indian teachers it was a rare opportunity to talk freely to their counterparts in England in such an informal environment. They were immensely benefited from the experiences they had by visiting classrooms. Many of them could learn the use of ICT in classroom interaction.

An important outcome of the exchange visits is the establishment of the linkages between institutions in UK and in India. These institutions comprise schools, research/training institutions and local education authorities. A long term friendship is now established among the members of these institutions from both the countries. They continue to exchange their ideas and seek guidance from each other. It is hoped that this link would eventually lead to the exchange of material resources on a regular basis.

During the exchange programmes it was realised that the teaching community enjoy freedom in both the systems. They are free to organise the classroom as they wish. However, the classroom strength and material resources force them to manage classrooms differently. British teachers can resort to work in small groups, adopt more interactive method of teaching, offer opportunities for experimentation and

provide guidance for individual or group assignments. Indian teachers, on the other hand, are forced to follow traditional mode of chalk and talk with a few opportunities for lab activities at convenient times. Since examinations results are given much more importance these teachers are under constant pressure to prepare the students for formal assessment. Cooperation received from the students, their parent and the society in India is noteworthy. It is through this cooperation that the teaching community is able to deliver the goods in spite of many odds.

Through international exchanges teachers have noticed inherent differences in the educational systems of UK and India. At the same time they have noticed similarities in these systems and common problems that can be tackled together. For example, the issue of inclusion, multicultural education and motivation for learning are some of the areas that raise similar questions in both the countries. Sharing of experiences in these areas would go a long way in improving the education systems both in the east and the west.

The exchange programme discussed in this paper has brought out beyond doubt that there is lot that can be learnt by arranging interaction of teachers from different systems. Teachers International Professional Development Programme thus has a potential to build a strong collaboration between teachers from different cultures. Encouraged by the positive experience of the exchange visits IOS and LECT have decided to arrange more number of visits in the future. It is hoped that such an exchange programme is also initiated within Asian as well African countries where there is a large scope to learn from each others experiences.

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