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## *Editorial*

### **Indian Educational Researcher**

Indian educational researcher is still under the grip of the positivist tether that he subjected himself to rather willingly initially hoping to get parity of esteem with the physical science researcher. But the positivist paradigm works well with the reactive subjects in the physical science researcher where description, explanation, prediction and control over the subjects is the main objective.

Educational researcher's main objective is not to have an absolute objective description or explanation of his not only reactive but proactive interactive and transactive subjects but to understand and interpret the subjects' behaviour, not from his perspective but from their perspective. And for this the physicist positivist paradigm is not of much help to him as his research experiences under this paradigm prove.

The main philosophy of positivist paradigm is 'scienticism' with its deductive logic using which the researcher verifies: his highly probabilistic preconceived notions about the variables in the phenomenon, in the 'thing' being studied on the basis of empirical evidences of Quantitative data collected through objective tools. In this 'thing' research (research on things) the reactive subjects are brought under control and changed to serve the researcher best.

Educational researcher's main concern is 'why' rather than 'what' or how of human actions. It is understanding and interpretation of the leaning the 'subjects' the people, with whom (not on whom) have about their actions. His research process derives its sustenance from an interpretive, hermeneutic philosophy and inductive and abductive logics. In human researches the benefit is more to the researched (people with whom the research is undertaken) than to the researcher It is not to his advantage alone but to their advantage Mainly Educational research is not for initiating change from above by an authoritarian external agency but for empowering the people to have the 'authority' to bring about change ridding of their misunderstanding and myth about their current behaviour.

whither are you heading to, oh the educational researcher, to follow or to deviate, follow to pursue 'thing' research or derate to do human research! !

***Dr. P.S. Balasubramanian,***

Retd Prof and Head, Dept. of Education, University of Madras, Chennai

## Conceptual Article

## Collaboration in Teaching about Science Teaching

Dr. Stephen Keast and Dr. Rebecca Cooper Monash University

Australia

### Abstract

Collaboration in teaching about science teaching plays a vital role in enhancing both teacher professional development and student learning outcomes. Collaborative practices encourage educators to share knowledge, teaching strategies, and reflective insights that promote innovative approaches to science instruction. Through teamwork, co-planning, peer observation, and joint problem-solving, teachers create a supportive environment that fosters creativity, critical thinking, and deeper understanding of scientific concepts. This process not only strengthens pedagogical skills but also builds a sense of community and shared responsibility among educators. Furthermore, collaboration enables the integration of interdisciplinary perspectives, the effective use of technology, and the design of engaging, inquiry-based learning experiences. Ultimately, collaborative teaching contributes to developing students' curiosity, scientific literacy, and problem-solving abilities, while ensuring continuous improvement in teaching practices.

**Keywords:** *Collaboration, Science Teaching, Teacher Professional Development, Co-Teaching, Inquiry-Based Learning, Reflective Practice, Interdisciplinary Approach, Student Engagement.*

### Background

When the authors decided to teach their General Science curriculum units together they also decided to research their teaching of methods for science through a critical self-study model .

The General Science curriculum units they were to teach together formed part of the final year of study for Bachelor of Education students as well as for the one year Post Graduate Diploma of Education students at Monash University in Clayton, Australia.

Rebecca was new to teacher education (working part time at the university and teaching at high school) while Stephen had to years' experience in teacher education (having spent 13 years teaching in secondary schools). Hence they shared a some natural synergies in their learning of science teaching that could be beneficial to their practice

There were a number of reasons they had for sharing and researching their practice. First of all in articulating his practice to Rebecca, Stephen thought it would help Rebecca understand both the thinking behind his practice and the difference between the pedagogy of teaching and the pedagogy of teacher education . As outlined in the literature, teacher education is often conducted by ex-teachers without formal training in teacher education and it seems to be expected that good teachers will make good teacher educators because the 'teaching' in teacher education is the same as the teaching in schools. Korthagen, Loughran and Lunenberg noted that ' ... the complex interplay of skills, knowledge, and attitudes that comprise the expertise of teaching about teaching... [Offers insights into and] foreshadows the issues, questions and concerns that are important in the research agenda for teacher educators and teacher education...' (p.110). Cochran-Smith contends that it is valuable for teacher educators to make public the important issues they grapple with in their teaching, and by doing, they can assist other teacher educators to reflect on their own practice in new ways. These views clearly influenced their approach to and thinking about their teaching of methods for science.

Second of all by articulating his practice and his thinking about his practice, Stephen considered that researching that aspect of practice might help him to better understand what he did and why he did it and therefore further develop his knowledge of his pedagogy of teacher education. Through this process, Stephen would then have multiple opportunities to 'unpack' that which is often tacit knowledge and articulate it in forms that influenced his practice as a teacher educator. By sharing in the planning of classes and debriefing after each class, this would also offer opportunities for Rebecca to question Stephen's teacher education classroom practice and further elucidate the pedagogical reasoning underpinning his teaching of teachers. In so doing, Rebecca would be able to question what she saw as critical incidents and inquire into the how and why of the pedagogic actions as they appeared to her 'in the moment'. Kosnik

identified such critical incidents as 'events that [she] considered [helped to] raise broad, sustained issues' (p. 69). Loughran and Berry summed up well the type of thinking behind about the value of sharing their practice:

*... we believe that the ability to be explicit about what one is doing and why, is enhanced through systematically inquiring into learning through experience (self-study) so that the relationship between knowing and doing might be more accessible. Importantly though, learning from the experience of "being explicit" requires a sensitivity to the ongoing tensions associated with balancing pre-service teachers' perceived needs and concerns and their teacher educator's beliefs about what they need to know and be able to do. (p.194)*

Third of all through the process of sharing discussing and debriefing the classroom events, Stephen would be introducing Rebecca (as a beginning teacher educator) to the ideas underpinning a pedagogy of teacher education in a supportive and reflective way rather than the more 'sink or swim' approach that so often happens in teacher education programs . This mentoring and support through team teaching should not be underestimated for as Rosean and Wilson observed, as teachers become teacher educators they often struggle to maintain a teacher education focus. Teachers new to teacher education typically are comfortable in articulating their problems in the school classroom and reflecting on their practices there, but when they move into teacher education they do not ponder about teaching in the same way. Therefore, this project based around collaboration and research in their teaching of science education together offered powerful ways of assisting in the transition from teacher to teacher educator.

The intention of this research paper then is to add to the professional wisdom of teacher educators more generally in ways commensurate with Cochran-Smith's expectations for scholarship in teacher education.

### **Theoretical Perspective**

In their initial discussions about teaching together the authors shared their views about that which they valued in building a pedagogy of teacher education in an attempt to understand how they would each teach. They held similar views to those which Hoban identified four conceptions of teaching; craft knowledge, labour knowledge, professional knowledge and art knowledge but modified these to three views of teacher knowledge ( craft knowledge, science

(professional) knowledge and art knowledge) for working with their pre-service teachers. Craft knowledge of teaching included the skills accrued over time while labour knowledge included the lesson plans that teachers implemented. In modifying Hoban's conceptions, they combined these two views of craft and labour knowledge and called this craft knowledge. Such craft knowledge is often the focus of the teaching practicum where pre-service teachers are 'apprenticed' for several weeks to learn the craft from an experienced teacher. Hoban contends that such a view of teaching is a 'behaviourist view of teaching'.

The art knowledge of teaching includes the personal input by the teacher as an artist might do. Teachers have a talent and their personal judgements about how and when strategies are used are to be valued. The science view of teacher knowledge implies that teaching can be influenced and improved by the research (or scientific knowledge) conducted of and by teachers. The authors agreed that while their pre-service teachers' immediate needs might often be focused on the craft knowledge of teaching, as teacher educators they should offer opportunities for their pre-service teachers to investigate and reflect on the science and art knowledge of teaching. One way they chose to do this was to implement the practice of 'being explicit' when teaching. That is they decided to share explicitly why they were teaching the way they were teaching and what their thinking was behind the approaches they used. In this way they would be modelling the decision making processes that teachers make when considering their content, the class and the context by which they taught. As teacher educators, they wanted to teach in a way that modelled teaching practices for their pre-service teachers based on reflection. Kosnik contended in her study that teacher educators should participate in the same reflective practices that they asked their pre-service teachers to participate in.

That does not however mean that such an approach is simple or easy to do, for as Berry noted, "Even though I have identified that articulating my thinking about teaching during the act of teaching is an important goal of my teaching, I have also found that this is not an easy goal' to 'live' as a teacher educator. I am not always consciously aware of my actions, in action, nor am I able to readily articulate my pedagogical reasoning on the spot. Usually, there is a multitude of thoughts running through my head as I teach. How do I know which of these is useful at any particular time to select to highlight for my students." (p. 2). Recognizing and responding to the problem in teaching would certainly be a demanding activity and one way of ensuring that their pedagogical reasoning could be available to their pre-service teachers was

to ensure that they made their model (adapted from Hoban, 2004) explicit to the pre-service teachers in their classes.

### **Linking to cases: Research and practice come together**

In the first week after the pre-service teachers complete their teaching practicum in schools, a normal program feature is for Science Method lecturers to interview their pre-service teachers about their practicum experience. The purpose of this is two-fold, first of all to see what they have done in preparing for classes, making lesson plans, recording their observations of classes and making reflections about their own teaching. Second of all to support their introduction to teaching, to listen to their stories about their successes, to be understanding of their concerns and to offer advice and assistance where needed. In a meeting with a group of their pre-service teachers for a focus group interview about the practicum debrief one pre-service teacher commented that the students were not as enthusiastic as she had expected with an activity she had planned. She said that she expected that rather than doing book work, she thought the opportunity to go out outside of the classroom would be a motivation for her students. When this was not the case, she was surprised and asked the group at the interview why they thought the students were not excited by doing something different.

Considering this situation and following their reflections on their learning from the interviews the authors decided that pre-service teachers should read and discuss several of the cases from *Looking into Practice*. They considered the cases to be a way for the pre-service teachers to relate their practicum work to the writings about practice done by other teachers. In this way they might then make the connection that reading other teachers' cases could offer one way of gaining knowledge about teaching.

These cases were written by teachers involved in a teacher research project in which they investigated and reported on one aspect of their science teaching. One particular case documented how a teacher taught a class on electricity using a role play. Her students were not enthused by the idea of the role play, which was unexpected for the teacher. However, they become highly motivated when the teacher mentioned that the role play included lollies/sweets. Some days later when the teacher questioned the students about the activity, few could remember what the role play was about except that they had eaten lollies/ sweets. The case raised many issues about teaching and learning including:

- ♦ Students are not always enthused by 'doing activities beyond' the normal classroom convention;
- ♦ Lollies/sweets are a great motivator for younger students;
- ♦ Students do not remember what you expect them to remember; and,
- ♦ The need to build strong episodic links between the rewards (lollies/ sweets) and the content being explored.

Over the next week the authors examined the cases in more detail and chose several cases each that they would use with their pre-service teachers. The purpose being to use cases in such a way that the pre-service teachers could make links between craft knowledge (the focus of their practicum) and the science knowledge (the main focus of their university study). It was hoped that the teaching and learning issues identified would emerge from the pre-service teachers' small group discussions and they would then more easily connect these issues to similar experiences they had had while on practicum.

### **Methodology of Critical Reflection**

As the above makes clear, this study is based on a model of collaborative inquiry. Deppeler notes that "Inquiry that is systematic, self-reflective and informed by evidence can be an effective tool for critically examining issues and influencing teachers' beliefs and learning about their practices" (p. 73). The authors felt that critical inquiry into their practice would give them the opportunity to systematically identify the issues that arose in their classes. As Berry observed., without having each other in the room, there is so much that has happened that would have been missed and therefore never examined. Deppeler also cites (Bray et al., 2000, p. 6) which states that "collaborative inquiry is a process consisting of repeated episodes of reflection and action through which a group of peers strives to answer a question of importance to them." The authors decided to share their planning of classes, though not necessarily teach the same content. An example of this was the choice of content for the first lesson. The purpose of the lesson was to show that new teachers needed to deconstruct their formal science knowledge and to then reconstruct that knowledge in Hays that might be more suitable for secondary students in schools. Stephen chose states of matter for his class to discuss and work with, while Rebecca chose cells. Part of Rebecca's reason for doing this was to ensure that she did not just rely on Stephen's ideas or responses for her teaching, but to make sure that her lessons were authentic and reflective of her beliefs about teaching and learning. So while the

classes had the same purpose, the content and context were flexible, each chose the content based on the background of the pre-service teachers, the confidence the pre-service teachers they had with the material and decisions made by each of the authors about the make-up of their own classes.

Of great importance was their pre-service teachers' learning and the way these students of teaching might make the transition from students to teachers. As teacher educators, the authors were conscious that their pre service teachers would be watching the way they taught in an attempt to identify what they were doing in order to keep the class flowing smoothly. It soon became apparent to that this needed to be far more explicit to the pre-service teachers as they were rarely able to "put themselves in the shoes" of the teacher whilst still being students. This led the authors to become very conscious of the way they modelled their teaching and tried to make explicit what they were doing and why.

Putman and Borke (1997) suggest that 'student teachers may have preconceptions that differ significantly from the views of learning and teaching that teacher educators wish to develop.' (p.1227) They go on to say that this could affect the new concepts of teaching and learning that the teacher educators are trying to describe as pre-service teachers will try to fit these new concepts around their current views. Having said that, Lunenberg (2007) also notes that such affects are usually "diluted" by the initial confrontation with actual teaching practice.

Lunenberg (2007) used a definition of modelling from Gallimore and Tharp (1982) which stated that modelling by teacher educators is the practice of intentionally displaying certain teaching behaviours with the aim of promoting pre-service teachers' professional learning. Both methodologically and practically, the authors have approached this study in ways that attempt to model what they believe is good teaching practice combined with explicitly explaining their pedagogical reasoning as a way of capturing and portraying the data that would comprise both their teaching of teaching and their students learning about teaching:

### *Collecting Data*

Researching practice is more systematic than just reflecting on one's practice. The authors set out to record, analyse and critique their practice an attempt to better understand each other's teaching and their developing pedagogy of teacher education. To do so required each to keep a professional Journal of their teaching in which they would each write field notes when

observing the other teach and during their debriefing sessions. The data collected from such field based observation therefore formed the basis of the data sets for this paper.

## **Results**

The data from this study (based on the field notes/journal entries) is analysed and presented in a systematic manner based on a presentation of the use of the cases and the reactions and responses to that work with the pre-service teachers. Presentation therefore follows in a chronological manner offering the Teaching and Learning perspectives followed by the learning through the subsequent debrief of each.

### ***Teaching using Cases 1***

In my class pre-service teachers worked in table groups of 4 reading the case and 'unpacking' the teaching issues they saw in it. I was surprised that the pre-service teachers could see the teaching and learning issues and could discuss them in quite sophisticated ways. Would they use lollies? They discussed both alternatives and the class was split over whether the lollies were useful or a distraction. But only one student made a link to her practice. She had used the role play and took the class through how it worked. I asked the class what 'model of electricity' was the teacher from the case using? The discussion was useful I thought and we concluded that the model was simplistic but useful and practical for the age group of the students. (Keast, journal - week 5: K class review)

### ***View of using cases 1***

In my journal the first thing I have written after watching Stephen teach his class is, "Why can't they link it? They have just spent 5 weeks in schools and have been given what I thought was a great stimulus for discussion about their experiences on teaching rounds and yet they do not seem to link this teacher's story to their own experiences out on rounds." I could see that the case had many identifiable moments that I thought would send the pre-service teachers into a flurry of "that happened to me on rounds," or "I saw that happen in this class that I observed." And yet, all they came up with was whether or not they would use this activity in their teaching and if they think it was a good idea or not. There was no mention of what the teacher from the case may have thought or felt and no relationship made to what they did or saw on their teaching rounds. (Cooper, journal - week 5: K class observation)

Stephen did not explicitly ask the pre-service teachers to link their comments to their teaching but he did put two questions on the board. One was about the science being taught

and the other was about using the teaching procedure. The pre-service teachers gave very superficial answers that indicated that they felt they didn't have any knowledge of any value to offer to the discussion. When Stephen asked the pre-service teachers to "tell me more" most of the time they couldn't articulate any further than they already had and just repeated themselves. They couldn't see where Stephen was going with this, but really wanted to have a go anyway. The discussion was never stilted and the pre-service teachers seemed quite satisfied with the lesson but it left me thinking; "Did they not have the language or experience to discuss teaching at this level? They just didn't see what I thought they would see in the case." (Cooper, journal - week 5: K class observation)

Stephen's class spent a lot of time talking about risk taking. His pre-service teachers quickly identified that when a class was going badly that the teacher needed to make an 'in the moment' decision to either keep going or make a change. The pre-service teachers could see that in many situations there was a great need for change but that making that change involved a great amount of risk and therefore, most of the pre-service teachers said that they would not deviate from their plan even if they could see that a change was required. They viewed risk taking as necessary but something you did not easily do as a beginning teacher and certainly not as a pre-service teacher. Some of this seemed to be born out of a fear of losing control of the class and some of it seemed to be the influence of the supervisors they had had on their practicum. (Cooper, journal - week 5: K class observation)

Two great comments that were made by pre-service teachers from Stephen's class were: "Teacher's really meant it when they said they were disappointed in you." And "I wasn't expecting to have Year 12's who weren't interested." As soon as I heard these comments I immediately thought that they would make great starting points for cases themselves. Stephen and I are very keen to get the pre-service teachers to write cases themselves, but at this stage I'm not sure that they understand the point of them. I also don't believe that they value the opportunity to talk about their teaching this way. Maybe this is something that you only start to value once you have been teaching for a while and you realise that this opportunity is so rare. (Cooper, journal - week 5: K class observation)

### *Debrief 1*

I went to lunch for our usual debrief quite dejected. The class had not gone at all how I had planned it. The case did not invite the pre-service teachers to talk about their own practice. It was as though the teaching of another teacher was too isolated from them for them to engage with it. They could see the issues, they could make decisions about whether they would do it exactly the same or not use lollies. They identified how they might make stronger links to the electricity concepts during the role play itself. But all this was in isolation to the links to their own practice. I questioned Rebecca. "Was it obvious to you what I was trying to do?" She agreed, it was plain for her and she expected them to make the link. "How can I make their teaching more explicit in terms of shared practice?" I felt the class was not as effective as it could have been and I grappled with Rebecca's help to understand how I could have made it better. But a larger question started to loom over me, "what would I do next week?" (Keast, journal - week 5: Lunch debrief)

This episode was not what we expected and the discussion at the debriefing was energetic and engaging as we grappled with what had happened.

### *Debrief 1*

During our debrief Stephen commented that he was trying to create an "ah-ha moment" for his pre-service teachers with respect to the link between the work we do with them at university and the experiences on their teaching round. I wondered if there was a midpoint somewhere between without spelling it out for them as the "ah-ha moment" but have since decided that this would be an almost impossible judgement to make as it could be different for every student in the room. When Stephen told me what he had planned I thought it was perfectly clear to me and that he did not need to do any more than just introduce the cases and let it all unfold. We talked about many possibilities for why the pre-service teachers had not jumped at this opportunity to explore their teaching which included; not understanding the task, us not making the task explicit and the pre-service teachers not being able to view themselves as teachers whilst being in a class as students. (Cooper, journal - week 5: Lunch debrief)

In planning this lesson, Stephen shared with Rebecca not only his plans for the lesson but his pedagogical reasoning. By doing this, he hoped it would help Rebecca understand the difference between teaching in school and teaching in a teacher education program, addressing the concerns identified by Korthagen, Loughran and Lunenberg that expert teachers are called

into be teacher educators. During their debrief reflection, the discussion focused on the pedagogical reasoning of the teacher educator as much as what occurred. In this lesson, Stephen expected his preservice teachers to make connections between their own classroom teaching experience and the issues that unfolded in discussions of the cases. While the students readily identified the issues, they made no connection back to their own teaching experiences. After the lesson Stephen grappled with why the preservice teachers could not 'see' that reviewing another teacher's teaching practice clearly related to their own teaching experience.

Rebecca, like Stephen, could not understand why the preservice teachers did not make the expected links. The authors considered several reasons for this, including Lunnenberg et al, (1997) idea that the teaching round (craft knowledge) can diminish the impact of ideas discussed at university (science knowledge). This teaching experience was meant to address this by providing an experience of science knowledge through discussion of craft knowledge and encourage preservice teachers to note that discussions of practice were useful in better understanding their own practice. Of course this all relied on preservice teachers identifying issues raised in the case discussion with their own practice.

In searching for reasons the preservice teachers did not make links, Rebecca thought this may have to do with the students' lack of language or did not yet have the classroom experience to articulate their thinking. Observing a teacher educator in practice gave Rebecca opportunities to reflect on his practice and through this understand better the pedagogy of teacher education. As an experienced teacher Rebecca had developed her own pedagogy of teaching but as a new teacher educator she was still coming to understand the pedagogy of teacher education.

In the discussion about the teaching episode, it became clear that Stephen's intention not to make this explicit but rather expected it to be an 'ah-ha' moment revealed his pedagogical reasoning. Only by being in the room and later sharing the discussion of what took place, was it possible for Rebecca to see what Stephen valued in his teaching. She too valued students making 'ah-ha' type connections in their work, but wondered if she could encourage this by making a small change to the teaching. In this way she was reflecting on her teaching of teachers and changing her teaching based on that reflection. In this way she was coming to understand and implement her own pedagogy of teaching teachers. One aspect of teacher education pedagogy different from the pedagogy of teaching is looking at ways to engage the

preservice teachers in understanding teaching. While observing the class, Rebecca looks ahead at the possibility of having preservice teachers write and discuss cases written by preservice teachers rather than cases written by teachers. She wonders whether cases written by preservice teachers would be more engaging for preservice teachers than cases written by teachers. Following the debrief, Rebecca taught her class the same unit of work. The following illustrates how that unfolded.

### ***Teaching Using Cases 2***

After our debrief over lunch I decided that I would try to balance precariously on the continuum of telling them exactly what we wanted and achieving the "ah- ha moment." I decided to add an extra question to my list of focus questions which was, "how does this link to your experience?" I thought this was a way of saying what did you see on your teaching rounds that links to this case, without really saying it. The pre-service teachers very quickly made links to using concepts maps and computers in their teaching. I was concerned that the pre-service teachers would focus on the teaching and miss the science and this is exactly what happened. The science content was a minor aspect in the case, but I did feel that the teaching strategies and the issues raised in this case would allow the pre-service teachers a way in. The discussion was lively and many pre-service teachers had stories about how they had used computers successfully, or not, as the case may be. (Cooper, journal - week 5: R class review)

### ***View of using Cases 2***

So we went off to Rebecca's class that afternoon with mixed feelings of expectation. While we plan together, we do not always teach the same. Teaching is very personal and we share plans but often the content or context will vary. Rebecca for example chose a different case to start with, Planning for Semantic Maps .

In my field notes I wrote, "Would Rebecca make this explicit (the link between craft knowledge and science knowledge), given our conversation over lunch about my class?" Clearly Rebecca saw the purpose of using Cases and the links I was trying to make for the pre-service teachers even though they could not. Yes, Rebecca included the question "how does this link to your experience?" as the last question in her list of questions she put up on the board to guide their unpacking of the case. I wondered at the time if they would make a link to this given it was the last point in a list of questions. As the pre-service teachers began discussing

the case they linked straight away to their practicum teaching experience. Why was this so obvious to her class and not mine?

During Rebecca's teaching I had an "ah-ha" moment where I realised that pre-service teachers were able to engage in her class because the content and context had provided a way in for them to discuss what they had done both in the university classroom and their teaching at schools. The difference between the two classes was Rebecca's way into the discussion. I realised it related to both the context and content of the Case. The pre-service teachers related to the content of this case - cell chemistry (her first development task in class at the beginning of semester was on cells) and the context - both concepts maps (semantic maps) and using the computer room. Compared to my content - electricity, and my context - role plays. Only one student in my class had taught electricity while out in schools and she had also used something similar to the role play. With an unfamiliar content my pre-service teachers found it difficult to relate to their own teaching experience. Few had tried role plays in their science teaching. Similarly with unfamiliar teaching context the pre-service teachers found it difficult to relate their teaching experience to the problematic nature of role plays. It was clear that having a case where the pre-service teachers were familiar with the content or context allowed them to connect and engage in the discussion about the case that included their own experience of teaching.

As Rebecca's pre-service teachers read their second case I asked Rebecca to join me in the preparation room. I said I had an insight and related to her the idea of content and context. She agreed that this could have been the key that we had been searching for over lunch and we agreed to discuss it after the class during our debrief. When we returned to the classroom the pre-service teachers seemed a little subdued but: Rebecca pushed on and I continued to take notes. Later I left the room for several minutes. (Keast, journal - week 5: R class observation)

### ***Further teaching using Cases 2***

The class was going along quite nicely and I had just set the pre-service teachers another case to read when Stephen motioned to me to join him in the prep room which is behind the classroom. We disappeared for a moment to discuss what Stephen had observed during the first half of my class and returned to a very quiet group of pre-service teachers. A few moments later, Stephen had to leave the room. The second the door closed the questions started.

"Are you alright?"

"Are you in trouble? Did you do something wrong?"

"Are we in trouble, did we say something we shouldn't have?" "The lessons been going really well, why would she be in trouble?"

They thought I had been pulled aside and disciplined for my poor teaching!

I reassured them that everything was fine and reminded them that Stephen and I were working together on a research project and that he and I were just discussing the differences between the way he and I had approached something. I made it very dear that he was there to watch me and the way I fought. They laughed, slightly relieved but still slightly unsure. Upon Stephen's return there was still some awkwardness about so I decided to turn their attention back to the task at hand and we ploughed on.

My pre-service teachers clearly hold the view that it doesn't matter what you do during the lesson you must complete every lesson by having your students write down what they've done in class so that they don't forget. We have spent a great deal of time discussing the power of episodes in learning and we are all in agreement that this is a great way to learn. But, in the eyes of my pre-service teachers it will only work if they make notes about it as well. What I find so fascinating about this view is that I haven't asked them to take notes once during our classes this year. Many of the pre-service teachers do it anyway, but I think this is more an indication of the teaching they have been exposed to at university, rather than anything else. I think this will be a constant debate between us. (Cooper, journal - week 5: class review)

## **Debrief 2**

The authors began their debrief by considering, "What were our expectations and were they reasonable?" Rebecca's class had made the link between craft knowledge and science knowledge rather well and on their own that Stephen had wanted for his class. It seemed to work better for Rebecca than Stephen, because she used a different case that included a content and context the pre-service teachers more readily identified with and she gave a question on the board to direct them to make such link. "Did the Case make a difference?" The case Rebecca chose first was more about the how of teaching than the science taught. Rebecca was concerned that teaching was easier to discuss and that the pre-service teachers were engaged but not to the depth she thought they would be. Their discussion was clearly focused on the use of the concept maps and computers rather than what the teacher was doing or thinking. They were engaged by the content but did not see the task as other teachers' stories of teaching that could

guide their reflection on their own teaching and what they might do in a similar situation. Rather they talked about using concept maps and other issues that occurred in their teaching from this, or about computers or about teaching cells. A significant question for Stephen and Rebecca from all of this was, "What are they expecting from us?" So while the preservice teachers in Rebecca's class did relate issues from the case to what they experienced on teaching rounds, they did not discuss this from pedagogy perspective as hoped. Other questions emerged, "How are their needs and concerns different from what we want them to learn about?" and "how can we bridge these differences effectively?" and "can cases be a vehicle for this?"

The pre-service teachers appeared to view the case lessons and the issues they brought up much more superficially than Stephen and Rebecca expected. In one case they saw it as one teacher making an error, talking with a colleague who they all viewed as a superior and fixing it up for next time - rather than viewing this as an example of teacher growth and a teacher using a familiar strategy at the beginning of a unit rather than at the end and in so doing realising that using it at the beginning meant her pre-service teachers needed more support. An interesting issue here was that the pre-service teachers viewed teacher talk as always from expert to novice. That the teacher had made a mistake and the discussion with an 'expert' had fixed it up. Rather than, we saw the case as a teacher trying something new, it did not work as planned. She discussed it with a colleague and together they talked their way to a better understanding of using such a technique. Each had learnt something about using this strategy in their teaching and in this way their pedagogical understanding had improved.

Another purpose for using cases was for the pre-service teachers to see why teachers would write and read cases. That it was an opportunity to share ones practice, share the complex natures of teaching, and to build professional wisdom and tacit knowledge. But we had little feedback that this was the case. What we found was that our pre-service teachers could not move beyond the science knowledge (the model used), the content (talking about cells) and note taking as the method of learning by students. Rebecca spent a great deal of time Trying to move her pre-service teachers to see that there were other ways of knowing and learning. But her pre-service teachers kept coming back to, "yes but then I would get them to take notes". It was like note taking was the ultimate way for all students to learn. Several of my pre-service teachers had worked in difficult schools and little note taking was done by the

students as they had quite poor literacy standards. They offered several different ways to help students learn. But in Rebecca's class the dominant view strongly held by most was that they learnt best by note taking and it gave you something to refer to.. Therefore students must have the same view. In a way this paralleled the views that Rebecca and Stephen were trying to teach, but they did not see at the time. Teacher educators need to realise that learning happens over time and strongly entrenched views of what learning is are not be changed easily. Conceptual change in science with pupils takes time, effort and seeing a reason for change, so conceptual change in our pre-service teachers will be the same. To change their conceptions about what is good science teaching will \_not happen in one discussion but needs to be revisited many times over each semester before it is to occur, if at all.

But the issue that shocked us more was the way the pre-service teachers viewed our roles as teacher educators. When they went to the preparation room, the class viewed this as Stephen, older expert disciplining Rebecca in a role of student 'teacher educator'. It was clearly what they had experienced and related to from their teaching round! Rather than two educators collaborating on an issue, the preservice teachers observed Stephen supervising Rebecca on what she had done wrong! The pre-service teachers clearly had the perception that there were and are 'right ways' to teach. Even though Stephen and Rebecca questioned this in each lesson and have told them several times that they are partners in a research project they still view their roles as supervisor and student. (Field notes - week 5: recording of post class discussion)

But an issue for both classes was the problem of the pre-service teachers engaging with the issues that teachers raised in their cases. I wrote during the class that pre-service teachers were focusing on the trees not the forest. In Rebecca's class, like mine, they viewed the teaching in simplistic terms, as the teacher doing the right thing or wrong thing, not that teaching itself is problematic. That teachers make 'in the moment' decisions that can lead them down different paths, often away from what they had planned but in response their student's needs. Such divergence often led to activities that were untried and required significant risk by the teacher but was seen as necessary. The student teachers did not see this in the same way. Several made comment that they would not have the confidence to take such a risk in their own teaching to change direction. Rebecca had the opportunity after observing Stephen's class to change her teaching to address the concerns of linking craft knowledge to science knowledge. While the preservice teachers did make such links, new issues emerged for Rebecca as she came to learn

about the pedagogy of teacher education. She expected her preservice teachers to engage in discussion about the pedagogy of teaching rather than the mechanics of teaching. This was significantly different from her teaching in school, in that Rebecca was trying to make her preservice teachers come to understand the pedagogy of teaching, and in so doing she was learning about the pedagogy of teacher education. As Cochran-Smith (2005) observed, by sharing the issues the authors each grappled with in their teaching of teachers, helped the other to better to understand their own teaching.

### **Post Briefings**

After the briefings Stephen and Rebecca both wrote their journals and shared them with each other. They were puzzled by what they should do next. They considered conducting an interview about Stephen's teaching of in the last lesson. It was their intention to share their purposes for the class with the pre-service teachers. To make the links between craft knowledge and science knowledge explicit and to clarify the broader issues in the cases ask them for their comments. But also it would demonstrate that experienced teachers (and teacher educators) plan lessons with purpose and good intentions only to find that do not work as they had planned. Many of the pre-service teachers had experienced this during their teaching rounds and this would give them an insight into both Stephen and Rebecca's planning and delivery. Stephen and Rebecca also wanted to show that they too grappled with the best way for their learners to learn and gave much thought to how they planned their teaching and why they did it the way they did. Another purpose was to make their reflection on their practice explicit as a form of modelling the practice. To demonstrate that they were willing to change what they had planned to teach and how it could be taught to meet the needs of the pre-service teachers. The plan was that pre-service teachers would then discuss what makes a good case and they would start planning to write a case of their own teaching experience from the last teaching practicum. This would be quite risky for them as they would be telling their pre-service teachers that they felt that their lesson with them was not as effective as they had hoped. That Stephen thought he had not taught well. Sharing both his failures and his successes, they both knew was valuable, but to talk explicitly about a failure seemed to be placing his professional reputation on the line. As Loughran noted in a similar situation he thought that sharing his thinking aloud could be viewed by his pre-service teachers as indecisive. Stephen had Rebecca had observed what Loughran had in his study, that pre-service teachers had a strong belief that there was one

'correct' way of teaching in each situation and experienced teachers like Stephen knew how to do it correctly. Revealing to them that you had a failure could risk their faith in your ability as a teacher.

### *Teaching about Teaching Cases*

So the lesson began, I gave a run-down of what we would be doing and set up two chairs at the front of the room for an interview. Rebecca asked what my purpose for last week's class was. I gave my purpose, focusing on the linking between practice and research. The reading was supposed to help them see that they could learn about teaching and improve their thinking about their teaching by reading and analysing another teachers practice. Well, the pre-service teachers readily expressed that they had done that in their in groups. The only problem was they thought that talking about their own experience was like talking off topic. So they ensured . not to bring this into the larger group discussion but kept it to their small groups. They were trying hard to meet what they thought my expectations were. They asked why did I not make it more explicit? Why did I not just tell them to make the link? I explained that I was hoping for them to have an 'ah-ha moment'. That I thought something they discovered would have a stronger episode than something I told them. Rebecca said that in her teaching if she told students she thought that had an impact value of 2 out\_ of ten, but if they qiscovered it, it had an impact value of 8-9. out of ten. So we had both deliberately chosen in my class to avoid felling them. (Keast, journal - week 6: K class review)

During this lesson we decided to share our teaching experience as a case with Stephen's class. Basically, we sat in front of Stephen's class and told them that the lesson last week didn't really go to plan and that their responses were not what we had expected. The pre-service teachers in our classes appear to hold a view that there is a right way and wrong way to teach things and there is some expectation that Stephen and I have got it right. Well, we decided to take a big risk, more of risk for Stephen than for me, and tell the pre-service teachers that on this occasion it had not gone to plan.

I asked Stephen what his purpose had been for his lesson and he explained it to the class a.long with what he saw as the teaching and learning issues in the lure of the lolly case. We explained that we wanted the pre-service teachers to have an "a-ha moment" and make a connection between what they had done on practicum and what we do with them at university.

We then asked the pre-service teachers why they hadn't discussed any of their teaching rounds experience. They said a couple of things:

- ♦ They were talked out and had been discussing their rounds all week so they were over it.
- ♦ They thought that talking about their rounds would be considered off topic!
- ♦ They wanted to know why Stephen hadn't made it explicit to them that he had wanted them to make links to their teaching rounds. He explained the idea of an "a-ha moment", but I'm not convinced that they really understood what he meant nor did they grasp power of it as a teaching tool.

Stephen set his class to work on planning to write their own case and I moved around the room assisting students. One of them asked me to come over to their table. She said that she felt she knew why last week hadn't gone so well. She felt that Stephen had set up the girl who demonstrated the role play to fail, to prove that the science model in the case was no good and that our interview today was self-serving and in no way could it be viewed as Stephen taking a risk or opening up his practice to scrutiny. I asked another student what she thought about this and she said that she could see the first student's point. I went to another table and asked what they thought and they said they too could see the point. I was stunned! Clearly they didn't know Stephen and they had no idea what he was about or what he believed about teaching. I just couldn't believe that they thought this way. The pre-service teachers expressly asked me not to tell Stephen about this. But in a way one of the pre-service teachers made it very obvious by sitting with her back to us, which I noted earlier but decided not to mention whilst the interview was happening.

My lesson was in the afternoon and I started by talking about what had happened in our class last week and what had happened in Stephen's class and then about what Stephen and I had done that morning. News had travelled fast! The pre-service teachers had heard already, so we discussed the differences between the discussions that had taken place in each class when the cases had been introduced. My pre-service teachers were interested in what had happened but were not particularly taken with it so I moved on with the rest of my class. What this showed me is that they haven't yet understood how personal teaching is and how scary it can be to open up your classroom for other people (let alone the students themselves) to comment on.

We talked about super engaging lessons where you planned things like role play and how often you used them and once again we debated the value of these types of lessons vs notes! When I told them that my Year 11 Physics class had only written notes twice for the entire semester I think they thought I was lying.

We discussed what made a good case and teased out some of their ideas for cases. We talked about why teachers read and wrote cases but I still feel that their thoughts on this are a little superficial. Perhaps they haven't taught enough to appreciate the value of monitoring your own learning about teaching and tracking the experiences you have and thus monitoring your own growth as a teacher. (Cooper, journal - week 6: class observation)

### ***Debrief after Teaching about Teaching Cases - Rebecca***

Rebecca made the decision to tell Stephen what the preservice teachers had told her during the class. Stephen's immediate response was "Why didn't you tell me during the class and we could have unpacked it?"

I knew that was true, but I also knew how nervous some of the pre-service teachers were about having said this, so we decided just to let it go. My feeling is that the pre-service teachers who spoke to me, spoke because they wanted Stephen to know what they thought without making it public knowledge. Stephen of course was shocked, just as I would have been, and he decided that he would speak privately to the pre-service teacher, who had demonstrated the role play and see how she felt.

What this showed me, is that something that was so obvious to me, like Stephen's beliefs about teaching and learning, were not obvious at all to the preservice teachers and that it is also important for the preservice teachers to understand who you are as a person in order to understand how you react in the classroom. I thought that Stephen had done a great job on several occasions of articulating his beliefs about good teaching and good learning. He has talked about how he came to these understandings and about why he believes it is important for teachers to have an understanding of their beliefs. Maybe all of this is useless in isolation from an understanding of the person who thinks it. Having only met with the preservice teachers a handful of times, and not having had the opportunity to visit any of his preservice teachers while they were on their practicum, Stephen has had very little opportunity to build a relationship with this class. They couldn't identify with any clarity his intention in his actions

and therefore did not take full advantage of the great opportunity presented to them when Stephen openly discussed his planning and teaching. (Cooper, journal - week 6: Lunch debrief)

Even though both Stephen and Rebecca made their intentions and purposes explicit to their students, the preservice teachers heard and interpreted what was said in a very different way to what was intended. Stephen was trying to make explicit to his preservice teachers his pedagogical reasoning so that they may reason about their teaching in similar ways. It was important for Stephen to model the practice he expected of his preservice teachers.

While Stephen thought he was taking a big risk revealing his 'failure' to his preservice teachers, they did not see it as a risk or a failure. They could not understand why they were not told to make the links. Stephen and Rebecca reflected that in many ways early in the year, the preservice teachers were still seeing teaching as telling. The other surprise for the authors, was that preservice teachers wanted to meet the teachers' expectation, 'doing the right thing', was high on their learning agenda. While it was the authors' intention to engage the preservice teachers in discussions and understanding of pedagogy of teaching secondary students, the preservice teachers expected more craft knowledge.

What was revealing for Stephen, was the idea that the preservice teachers had thought that he had singled out a preservice teacher to repeat the activity in the case so that she would be seen as a failure. Stephen would never have that intention for his preservice teachers, and he articulated his beliefs, but maybe the preservice teachers were not ready to hear them.

The two most important things to come out of this study for the authors, were understanding their own beliefs and their pedagogical purposes for working the way they did, and coming to better understand the pedagogy of teacher education. Reflecting with Rebecca over these critical incidents, and articulating his intentions both verbally to Rebecca and written in a journal made Stephen more aware of the beliefs and values he had of teaching and learning. He came to understand why he wanted the preservice teachers to make 'ah-ha' moments, but he also realised that at times he needs to assist them to make the links. As a beginning teacher educator, Rebecca gained valuable insights to the pedagogical reasoning of an established teacher educator and learnt rapidly about the difference between teaching school students and teaching preservice teachers.

### **Conclusion**

The authors learnt several things about their pre-service teachers;

1. They have set beliefs they bring to the course about what constitutes good teaching and learning,
2. They see all roles that involve two teachers as one with expert knowledge and one as the novice - learning,
3. They have expectations about what we do, what the course ,has to offer and what they are getting out of it,
4. Their reluctance to move beyond their comfort zone rn their teaching practice.

We begin by discussing these in detail.

The pre-service teachers came to the unit with their own beliefs about teaching science and what constitutes good teaching and learning in science. This agreed with Putnam and Borko who suggested that pre-service teachers have different views of teaching .than teacher educators. Stephen and Rebecca believe as teacher educators, part of their role is to encourage pre-service teachers to question their beliefs and consider other beliefs about teaching and learning. One example of this has been the pre-service teachers beliefs that for their students to learn in the classroom they must write something down into their workbooks. Rebecca had discussed this with her class several times, but her pre-service teachers cannot remove themselves from they are used to doing during their recent studies or in the work place. Even though she had not asked her pre-service teachers to take notes during her classes, and they can observe that she is modelling good teaching practice they still want their students to take notes as the main method of learning. Fo1 Stephen, his pre-service teachers' discussions about the role plays focused on a lack by the teacher. to have the pupils write down what they had observed. The pre-service teachers had not conceived that the activities they conduct in classrooms could be stand-alone learning, experiences for their pupils. Lunenberg et al. contend that process of learning is more important than the content of the message taught to pre-service teachers. What is apparent is that conceptual change such as the one Rebecca and Stephen encourage in their pre-service teachers, takes time, effort and a reason for change. One off episodes no matter how powerful or linked to their experience is not enough. Such issues need to be visited again and again. This is one issue that Stephen and Rebecca wanted to continue to discuss and explore over the course of the year.

Introducing collaborative roles rather than the expert-novice role has been another conception the pre-service teachers have struggled with. In schools they are treated for the

most part as novice learners needing expert guidance. Supervising teachers have the role of expert, but more importantly they are expected to know all the correct answers. Two episodes emerged that reinforced this for Stephen and Rebecca. The first was in the discussion of the first case discussed Rebecca's class, where the pre-service teachers inferred that the discussion between two teachers was led by an expert. Stephen and Rebecca saw this exchange as a collaborative discussion, where one teacher was exploring her practice with the support of another. It was the critical questioning of the second that prompted the teacher to reconsider her teaching and her expectations. She was able to work through the poor experience and rethink how she would have to use that strategy next time with more support because it was being done at the beginning of the unit rather than the end. The pre-service teachers viewed this as an expert outsider giving advice and wisdom to a novice struggling with her practice. Their roles in school were superimposed on to the roles within the cases that were discussed. Rather than seeing the 'science knowledge of teaching' in the form of cases informing their practice they were viewing the cases as examples of 'craft knowledge' where they could learn techniques from an expert. This was made clear to Rebecca and Stephen when they discussed Stephen's 'ah-ha' moment in Rebecca's class. Rather than the pre-service teachers observing Stephen and Rebecca sharing their practice, they observed a novice being reprimanded by an expert!

The pre-service teachers had expectations of what the course would offer. Fullan identified these expectations and Stephen and Rebecca conferred with them for their students. Though Stephen and Rebecca, were explicit in letting pre-service teachers know their purposes within each individual class and the course as a whole, the pre-service teachers could not yet 'hear' what they were being told. When Stephen and Rebecca shared Stephen's perceptions of his poor class they were quick to say that they had all learnt something from the class and had not seen it as poor learning experience for them. They were quick to let Stephen and Rebecca know that they had met their expectations. They were expecting more 'tips and tricks' that they could use in the classroom rather than discussions and investigations of different types of learning that can occur in a science classroom. They were focused on the craft knowledge as Fullan had suggested and were not seeing the science knowledge as being capable of informing their practice. They were focused on the 'craft knowledge' of how to do it, rather than explore the 'science knowledge' of why it might be done differently for different classes and different

student groups. Even if teacher educators create strong episodes of learning, pre-service teachers' conceptions of good science teaching and learning are hard to change. This reinforces the difficulty of conceptual change.

The pre-service teachers could recognise in the cases that it was important for experienced teachers to take risks at times based on 'in the moment' decisions and change their lesson plans to suit the needs of their students. However, they thought that it was too risky for them to try. A well planned lesson plan needed to be followed and the risks for them of following tangents could end in disaster. The disaster they feared appeared to be two fold, classroom management and to content details they would not know. Classroom management in the first semester is a biggest issue that the pre-service teachers raise: Before the first practicum round, it is the one issue most often in tutorials consistently across the course. How will they be able to handle issues associated with misbehaving teenagers? It is not surprising then that this is a concern for them in terms of changing from their lesson plan. However, Stephen and Rebecca believe that this is the only time when they will have an extra person in the room, where if something did go horribly wrong they would be able to seek assistance. For this reason alone it is a better time to try something risky than next year when they are alone in the classroom. The issue of content raises different concerns. Pre-service teachers are concerned that students may ask them questions they cannot answer and as a result they will lose respect in the eyes of the students. Stephen and Rebecca have reiterated that there are 1times when students ask experienced teachers questions that are difficult or they call } not answer. Learning to cope with this situation is another part of becoming a teacher.

Stephen and Rebecca learnt several things about their own practice as teacher educator. As noted by Cochran-Smith (2005) focusing on critical incidents where the authors grappled with their practice as teacher educator proved rewarding in articulating for each their understanding of the pedagogy of teacher education. Both authors valued the opportunity to critically reflect on each other's practice and recognised the value of teaching together as recognised by Rosean and Wilson. The experience so far for Stephen has been extremely enlightening. Articulating his practice to Rebecca has made him more focused on what he is teaching and why. It also that revealed that the style of lessons that Rebecca and he taught could often be confronting for their pre-service teachers. Such confrontation, when made explicit was useful for the pre-service teachers to reconsider their beliefs about good science

teaching and learning. This only worked when there were high levels of trust and respect between lecturer and learner. Missing practicum visits during the year had lessened the opportunity for Stephen to build the relationship he normally did with his students and had it made it more difficult to critically question the pre-service teachers about their beliefs without it appearing personal.

We have been reframing our teaching to encourage our students to engage in issues of teaching and learning rather than meeting what they see as our expectations. We would not have seen such an insight if we had not had a critical friend in the class, had not had the debrief and had we not been prepared to change our teaching in response to our students' learning needs. Seeing teaching teachers as problematic allows us to recognise the difficult nature of such teaching and investigate issues that not only illuminate the complexity of the task but offer new insights into the ways we frame that teaching.

Rosaen and Wilson had identified the struggle that teachers had moving from teaching students to teaching teachers. In their study, teachers were used to being reflective and problematising their practice with student classrooms but struggled to transfer this to teacher education. By sharing her practice with Stephen, and listening to him explain his teaching of teachers, Rebecca more quickly recognised the difference between the pedagogy of teaching and pedagogy of teaching teachers. While she continues to learn about teaching teachers, as Stephen does, she is asking questions about her pre-service teachers learning. Rebecca believes that this had come about because of the conversations she had with Stephen about his teaching approach and why. It is their plan to investigate the differences Rebecca sees between teaching students 4 days a week and teaching teachers the other day.

Loughran suggested that pre-service teachers need to have a teaching experience that goes beyond classroom control before they can appreciate the value of reflective practice. The same could be said about the use of cases. Most of the pre-service teachers here had no more than 5 weeks experience in a classroom and therefore, may not have experienced a class where classroom management was not the main focus for them during the lesson. The cases that we offered as stimulus for discussion all dealt with issues beyond classroom control. While it was possible for our pre-service teachers to think about what this would be like, they may not have experienced it first hand, making it difficult for them to connect with beyond a superficial level. By offering these cases, Stephen and Rebecca were attempting to give them a context that is

common and therefore a way of discussing possible problems that may arise in the classroom, but as they did not know how it felt to be in that situation they could not comment in a profound way. Rebecca and Stephen now recognise that their pre-service teachers were still judging the teaching presented in the cases as 'good' or 'bad' rather than 'problematic'. They have realised that pre-service teachers have considerable tension between adopting the view that teaching is problematic and needing to pass practicum and doing a 'good job' in school to pass the course! As teacher educators, Rebecca and Stephen learned that recognising these issues and managing the tensions between practice (craft knowledge) and theory (science knowledge) are integral elements of understanding the pedagogy of teacher education.

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## Conceptual Article

**Nature of Science' in B.El.Ed. Course****Ms Manisha Wadhwa Nee Dabas**

Sr. Lecturer in Education, Aditi Mahavidyalaya, University of Delhi, Delhi 110039 Email:

manisha.edu@gmail.com , [wadhwamanisha@yahoo.co.in](mailto:wadhwamanisha@yahoo.co.in)**Abstract**

The degree course B.El.Ed. (Bachelor of Elementary Education) is a four year undergraduate programme in elementary teacher education. It is offered in nine constituents' colleges of University of Delhi. The programme is one of its kind in India and is listed as one of the innovative programmes in Position Paper 2.4, National Focus Group on Teacher Education for Curriculum Renewal, NCERT, 2005. The course structure of B.El.Ed. has two compulsory and one optional paper on pedagogy of science. The compulsory courses are titled 'Core Natural Science' and 'Pedagogy of Environment Studies'. The syllabi of 'Core Natural Science' just mentions 'Classification, Property, Concept, Relation, Law'. Is it sufficient for pre service teachers to understand what nature of science is? How is scientific knowledge created? Is science objective or subjective? How do scientists work? Is there something called 'A Scientific Method'? We asked B.El.Ed. students to explain in their own words 'What is Science?' An analysis of their definitions shows that they do not understand science and its nature. They have no recognition of the tentative nature of some scientific knowledge and hold outdated positivist or empiricist views of the NOS. In such a scenario how can they translate it to students? What should be done in pre service programmes, so that teachers develop the conception of nature of science? This paper attempts to answer such questions.

**Keywords:** *Bachelor of Elementary Education (B.El.Ed.); Nature of Science (NOS); Pre-service teacher education; Science pedagogy; Scientific knowledge; Teacher conceptions; Curriculum renewal; NCERT; Scientific method.*

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Science teachers' knowledge about the nature of science was researched by Gallagher (1991). It was found from observation of science classes that teachers try to "cover" the content contained in the text; a strong emphasis on memorization of content and the vocabulary of science, with little emphasis on understanding of knowledge that is presented and application of scientific knowledge to students' experiences. Teachers have had no formal education in history, philosophy or sociology of science, nor has their scientific training provided them with much understanding of the processes by which scientific knowledge is formulated. Most of the teachers stressed the "steps of the scientific method" and the objectivity of scientific knowledge. For these teachers objectivity was an important distinction between science and other subjects like social studies, language. Science was portrayed as objective knowledge because it was grounded in observation and experiment, whereas the other school subjects were more subjective because they did not have benefits of experiment, and personal judgements. However, this belief about science was never put into practice. As the 'body of scientific knowledge' was the major focus of science study. The textbooks used by them in their classes tend to reinforce the role 'teacher as presenter of the factual content of science'.

He concluded that teachers placed most of their emphasis on the body of knowledge of science. Teachers had limited understanding about how knowledge of science is formulated or validated. It was also found that both prospective and practicing secondary science teachers have a limited knowledge of the history and philosophy of science, because they have had very little opportunity to study these fields. There was overemphasis of the factual base of science in classrooms and failure to characterize scientific knowledge as tentative and scientific work as creative.

This research was conducted almost twenty years back. Science classrooms today are still the same!! Now, I come to teacher preparation course.

The degree course B.El.Ed. (Bachelor of Elementary Education) is a four year undergraduate programme in elementary teacher education. It is offered in nine constituents' colleges of University of Delhi. The programme is one of its kind in India and is listed as one of the innovative programmes in Position Paper 2.4, National Focus Group on Teacher Education for Curriculum Renewal, NCERT, 2005. The course structure of B.El.Ed. has two compulsory and one optional paper on pedagogy of science. The compulsory courses are titled

'Core Natural Science' and 'Pedagogy of Environment Studies'. The syllabi of 'Core Natural Science' just mentions 'Classification, Property, Concept, Relation, Law'. Is it sufficient for pre service teachers to understand what nature of science is; How is scientific knowledge created? Is science objective or subjective? How do scientists work? Is there something called 'A Scientific Method'?

### **Pre Service Teachers' at Elementary Level: Understanding Of Science**

We asked around 120 B.El.Ed students to explain in their own words 'What is Science?' and also asked them to imagine how would a scientist look like and to draw a scientist.

First, let us see the analysis of their explanations of science. Their explanations have the following key words about science:

Science as Knowledge: Knowing about Truth and Facts, Study of phenomenon, Theories : Principles and Laws, and Field of study.

#### **Science involves:**

- ◆ Inquiry, Exploration, Logical reasoning, Problem solving, Explanation, Divergent thinking, Understanding
- ◆ Discovery, Inventions, Verification/ proof, investigation.
- ◆ Experimentation for Finding answers which has steps for collection of data, Hypothesis. formation, Interpretations, and Generalizations.
- ◆ It is 'A method / the Scientific Method'. Science is Objective.

Students' explanations have comments like 'science is experimentation', 'Scientists do experiments to find answer', 'science involves scientific method', 'Science is objective', 'Science has theories and laws to explain the world around', 'Science is the study of phenomena', 'Science involves logical reasoning and problem solving'.

There was not a single case which conveyed the fluid nature of scientific inquiry and the diversity of methods employed by practicing scientists. Approximately 65% of respondents explained science as a study of the world.

#### **Perception of Scientists:**

The drawings of scientists have the following characteristics:

Only 37% have drawn female scientists, in spite of explicit discussion on female scientists like Kalpna Chawla, Madam Currie, and Rosalind Franklin. Their drawings showed

scientists wearing laboratory coat (44%), spectacles (78%) and having beard (44%) in case of male scientists. Scientists were shown working with materials like test tubes, beakers, tables, and books (70%). Scientists were working indoors in laboratory (70%) and in isolation (100%), doing some kind of manipulative procedures (70%). Only 4% of scientists were shown as if they were thinking. These pictures are similar to the pictures of scientists drawn by children of all ages and across nations which portrayed scientists as bespectacled, rigid man in white laboratory coat, working alone with test tubes in completely haphazard laboratories. There was not a single case which conveyed the fluid nature of scientific inquiry and the diversity of methods employed by practicing scientists. This indicates a limited student engagement with science to daily realistic field work, promoting instead the well-regulated laboratory activity.

However, scientists, both men and women, are as human as rest of us. And they come from all races with and without spectacles. Their size, appearance, and hairstyle vary. As a group, because their methodology focuses so specifically on fallibility and critical thinking, they are probable even more aware than rest of us of how easy it is to be going wrong. There appears to be a limited understanding of scientists working creatively, in collaboration and with imagination to generate explanations of the world in which we live.

These results are consistent with the researches done on students and pre service teachers across different cultures. Some of the researches are- Newton and Newton (1992 and 1998), Haidar (1999), Abell and Smith 1994), Solomon et al. (1996), Song and Kim (1999), Ryder, Leach and Driver, 1999), Moss et al. (2001), Rubin et al. (2003), Abd-El -Khallick et al. (2004), and Kang and Lin (2005).

Pre service teachers do not understand science and its nature, then how can they translate it to school students? It is obvious that teachers cannot possibly teach that they do not understand. To be able to convey to their students adequate nature of science conceptions, teachers should themselves possess informed conceptions of the scientific enterprise. Many science teachers themselves are the products of an education system which has largely ignored the epistemic base and nature of its own disciplines. Thus teachers have no recognition of the tentative nature of some scientific knowledge and hold outdated positivist or empiricist views of the NOS. What should be done in pre service programmes, so that teachers develop the conception of nature of science?

### **How 'NOS' should be addressed in Pre- Service Teacher Programmes?**

The international reforms in Science Education - National Science Education Standards (NRC, 1996) and Benchmarks for Scientific Literacy (American Association for Advancement of Science, 1993) and National Reforms- National Curriculum Framework and Position Paper on Science Education emphasize that teacher of all grade levels are being required to teach their students to develop appropriate views of 'Nature of Science'.

An understanding of the nature of science is taught and learnt implicitly. The first step is to improve pre service teachers' conceptions of NOS (Content) and second, they should be able to translate those conceptions into forms that are accessible to all students (Pedagogy). Akerson and Abd-El-Khalick (2003) found that pre service teachers needed support in their endeavors to translate their new views to students. Pedagogical content knowledge (PCK) is a special kind of knowledge of content that allows teachers to represent the content in ways that are attainable by their students. Thus, science teacher educations need to find ways to help elementary teachers develop informed views of NOS, motivation and intention to teach NOS, and translate their views into classroom practice.

Two general approaches are used to improve science teachers' conceptions of NOS - Implicit and Explicit approach. The implicit approach suggests that an understanding of nature of science is a learning outcome that can be facilitated through science process skills instruction, science content course work and doing science; Researches who adopted this implicit approach used science process skills instruction and / or scientific inquiry activities (Barufaldi, Bethel and Lamb, (1977), Riley, (1979). The second approach is explicit in which elements from history and philosophy of science were used in instruction which geared toward the various aspects of nature of science to improve science teachers' conceptions.

It cannot be over emphasized that the above distinction should not be taken to mean that implicit and explicit approaches differ in terms of "kind". That is, not every science process-skills instructional sequence or scientific inquiry activity is an implicit attempt to enhance learners' conceptions of nature of science, nor is every instructional sequence in history of science an explicit attempt to achieve that end. The basic difference between implicit and explicit approaches lies in the extent to which learners are helped to come to grips with the concept - NOS, which would enable them to think about and reflect on the activities in which they are engaged.

Recent studies (Abd-El-Khalick, 2001; Akerson et al., 2000) indicated that using an explicit reflective approach to help elementary teachers achieve informed NOS views might be even more effective, especially if such an approach was undertaken from within a conceptual change framework. Explicit instruction refers to drawing the learner's attention to key aspects of NOS through discussion and written work following activities in which they are engaged. Reflective instruction requires learners to think about how their work illustrates NOS, and how their inquiries are similar to or different from the work of scientists. Teachers can periodically ask their students to take "time out" to "step back" and analyse the knowledge which they have been asked to learn. Such classroom discussions may prove to be invaluable with respect to the development of students' conceptions of the nature of scientific knowledge.

In the research by Khishfe and Lederman (2006) two sections of ninth grade students were randomly assigned to the two treatments: integrated and non-integrated NOS instruction. In the integrated approach, NOS was taught in relation to the regular science content about global warming. Explicit reflective discussions about NOS aspects followed and were related to the science lessons about global warming. Thus, NOS was embedded within the science content. In the non-integrated group, the teaching of the science content and NOS was separate. NOS was taught by engaging students in several generic, non-content embedded activities. NOS instruction was followed by instruction about global warming. However, the overall results do not provide any conclusive evidence to favour one approach over the other. The results merely highlight the relative effectiveness of both approaches in enhancing NOS understanding. There do not exist clearly evidence of one approach better than the other. Thus, the teacher education programme should prepare teachers to make a choice of an approach according to her own classroom context.

Pre-service teachers also should be required to teach during their internship (Practice teaching) target aspects of NOS in the context of elementary, classroom to: (a) provide an experience to allow pre-service teachers on which to reflect about teaching NOS to children; and (b) solidify their own understandings of the target NOS aspects in the context in which they will be applying these notions.

The crucial translation of pre service teachers' conceptions of the NOS into classroom practice needs to be reinforced by the culture of teacher preparation. Pre service teachers should be given much more extensive experience in teaching and assessing the NOS. They need

support in their field experiences. Extensive efforts should be made to help pre service teachers avoid the apparent tendency to think that the NOS can be taught implicitly through student participation in classroom activities. Pre service teachers need knowledge of the nature of science, but they also need to engage in an articulation and exploration of their developing beliefs about teaching itself. Teacher education programmes must strive to ensure that pre service teachers are given the opportunity to reflect in context on how and why they teach in certain ways and where they experience tensions in their overall development. Encouraging this kind of reflection at the formative stage of pre service teachers' beliefs is more likely to ensure that a productive accord between beliefs and the pedagogical implications of ideas about the nature of science is established.

Once teachers have internalized the importance of the nature of science and their intentions to address the topic are firmly in place, both beginning and experienced teachers will need to develop the instructional skills and abilities necessary to transform their knowledge into classroom practice. However, beginning teachers first, need support for developing a wide variety of instructional routines and schemes for classroom management and organization. As classroom management has been a perennial concern of beginning teachers. And later, the focus should be on specific instructional approach that can be used to influence student's conceptions of science.

It is likely that in schools the 'coverage of content', will need to be reconsidered to allow ample time to integrate this complex activity into ones teaching throughout the year and across grade levels. This work ideally would begin in teacher preparation programmes. Our aim is to integrate nature of science activities throughout our pre service programme. In doing so, we hope it would then become an integral facet of science instruction for all new teachers.

Therefore, a major test for elementary science teacher educators is to improve elementary teachers understanding of NOS so that they can help their own students develop appropriate ideas. Science teacher educators must redouble their efforts to help future teachers first to help them understand the nature of science and then equip them of the ways to translate their understanding in the classroom context. Our teacher education programme should focus on questions such as-

How can we adequately prepare classroom teachers with an understanding of the nature of science that they can use to design effective classroom activities? How can we encourage

teachers to view teaching the nature of science as important in their own classrooms? How can we enhance their self-efficacy in this area?

There is a need for supporting pre service teachers who have appropriate NOS conceptions and intentions to teach NOS to their students, by helping them:

- Recognize opportunities to teach NOS explicitly in a variety of content areas
- Contextualize in teaching practice - planning to teach NOS explicitly.
- Sharing case studies of explicit NOS instruction (via video or text or modelled-lessons).

A strong grounding for teachers and students in the science curriculum is required. The idea is that individual's intentions and beliefs play an important role in the translation of knowledge into observable behaviours. Thus, more assessment weightage should be allocated for the nature of science in pedagogy courses and school based internship practicum, which itself reinforce focus on 'Nature of Science'.

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## Research Article

## A Study on Prevalence of Conflict among Higher Secondary Teachers

**Dr. V. Thamodharan**

Principal, V.O.C College of Education, Thoothukkudi

### Abstract

Conflict is an inevitable part of human interaction and often manifests in educational institutions where teachers play a central role in shaping the learning environment. This study investigates the prevalence of conflict among higher secondary school teachers, focusing on the sources, types, and frequency of conflicts experienced. Using a descriptive survey method, data were collected from a representative sample of teachers across selected higher secondary schools. The findings reveal that conflicts primarily arise from workload distribution, administrative decisions, interpersonal relationships, and differing pedagogical approaches. Gender, teaching experience, and school management type were found to influence the degree of conflict perceived by teachers. The study emphasizes the need for effective conflict management strategies, open communication channels, and supportive school leadership to minimize negative consequences and promote a harmonious working climate. Recommendations for policy and practice are provided to strengthen teacher collaboration and overall institutional effectiveness.

**Keywords:** *Conflict, Higher Secondary Teachers, Interpersonal Relations, Workload, School Climate, Conflict Management, Teacher Effectiveness*

### INTRODUCTION

"The aim of education should be teach us rather how to think, than what to think rather to improve our minds, so as to enable us to think for ourselves, than to load the memory with the thoughts of other men" –

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Bill Beattie. Education is the dynamic side of man's life. It deals with the ever-growing life of man who strives to adjust himself to the ever growing and ever changing society. 'Education' means - the act of teaching or training. 'Educare' means - to educate', 'to bring up', 'to raise'. 'Educare' means - out to deco means 'to lead' "I mean by educational that training which is given by suitable habits to the first instigates of virtue in children" - Plato.

### **CONFLICT:**

A conflict exists when two people wish to carry out acts, which are mutually inconsistent. They may both want to do the same thing, such as eat the same apple, or they may want to do different things where the different things are mutually incompatible, such as when they both want to stay together but one wants to go to the cinema and the other to stay at home. A conflict is resolved when some mutually compatible set of actions is worked out. (M.Nicholson: Rationality and the Analysis of International Conflict. 199 2: 11) The meaning of conflict is agony, collision, confrontation, difference, disagreement friction or hostility. Thus conflict represents the discontentment, which exists among Schoolteachers in various forms on grounds.

Conflict may stem from a variety of causes, and understanding them is the first step in dealing with it effectively. Below are a few of the most common reasons.

1. There is a perceived breach of faith and trust between individuals
2. There is unresolved disagreement that has escalated to an emotional level
3. There is miscommunication leading to unclear expectations
4. There are personality clashes
5. There are differences in acquired values
6. There is underlying stress and tension
  
7. There are ego problems
8. There are combinations of the above

This may give some emotional venting or relief but rarely solves the problem, especially when our friends agree with our view and reinforce our necessarily one-sided perspective. If

we perceive the conflict as truly serious, we may contract with lawyers to deal with our problems.

### **SIGNIFICANCE OF THE STUDY**

Education is the backbone of the progress and the teachers is e nucleolus of the transmission of culture, intellectual traditions and technical skill, from generation to generation. The Kothari Commission report (1964 - 66) says "The destiny of India is now being shaped in the class rooms; this we believe is no more rhetoric. In a world based science and technology, it is education that determines the level of prosperity, welfare a:ri.d security of the people".

There is a strong undercurrent of discontent in the teaching profession. Hence, the management of educational crisis needs action on various dimensions Most of the major problems of staff are caused by tension, dissatisfaction of job, job security, stress and lack of recognition. Consequently, higher education faces a serious and multi-faced crisis results from conflicts. Conflict is undesirable and harmful at the same time; it brings to surface hidden problems, which can be attended to so that we can search for better ways of doing things in the right way. This study. is chosen by the investigator, with an idea to focus on the significance of conflict, among the teachers working in State Board Schools in Thoothukudi Educational District.

### **STATEMENT OF THE PROBLEM**

The problem chosen by the investigator is "A Study on Prevalence of Conflict among Higher Secondary Teachers in Thoothukkudi Educational District."

### **OBJECTIVES OF THE STUDY**

The investigator has formulated the objectives for the study to find out the significant difference between the prevalence of conflict and its dimensions among teacher working in State Board Schools in Thoothukudi Educational District with reference to Sex, Age, Native place of the teachers, Subject, Orientation programme and Refresher courses attended.

### **HYPOTHESES**

There is no significant difference in prevalence of conflict and its dimensions among teachers working in State Board Schools with reference to sex, place of teacher, Orientation programme attended, refresher courses attended and subject.

## **METHOD ADOPTED IN THE PRESENT STUDY**

Survey can be defined as, "a method of analysis in scientific and orderly form for defined purpose of given situation of problem or population." keeping the guidelines in mind, the investigator adopts survey method, to study prevalence of conflict among teachers working in State Board Schools.

## **POPULATION AND SAMPLE**

The population of the present study consists of teachers working in State Board Schools. From this population the investigator has selected the sample comprises 227 teachers working in 60 schools in Thoothukkudi Educational District.

## **CONSTRUCTION OF TOOL:**

In order to investigate, and analyse prevalence of conflict among teachers working in State Board Schools, the investigator has prepared a well-structured questionnaire, to tap all the possible information relevant to the study. The chosen research tool has three dimensions namely (i) individual conflict (Question 1 to 20), (ii) Interpersonal conflict (Question 21 to 59), (iii) Inter Group conflict (Question 60 to 65). By Individual Conflict, the investigator wants to reason out, the cause for the conflict in a person. Several psychological and managerial factors are considered to be the cause for conflict in a person. By Interpersonal Conflict, the investigator wants to highlight the reasons why and how conflict arises between individuals. Most of the reasons stems from managerial and psychological factor. By Inter - Group Conflict, the investigator wants to find out the cause for Inter-Group conflict between groups of individuals.

Likert's summated scale was used, to discriminate between persons whose total score is high and those whose score is low. The scale consists of a number of statements, which express either a favourable or unfavourable attitude towards the object of study. The questionnaire is designed with the consultation of the guide and other experts in the field and irrelevant factors are deleted. The respondent is asked to respond to each statement in terms of five degrees of agreements, on a five-point scale: Strongly Agree (SA), Agree (AG), Indifferent (IN), Disagree (DA) and Strongly Disagree (SD). The scale value ranges from 5 to 1 scores. Each person's response value is summed up, in the summed scale.

## ESTABLISHING VALIDITY AND RELIABILITY

The content validity is the extent to which a measuring instrument provides adequate coverage of the topic under study. The prepared tool to measure the prevalence of conflict among college teachers was given to the experts in the field, Professors and Reader of college and schools. Based on the opinions of the experts, modifications were carried out. Hence the content validity is established.

The test of reliability is a measuring instrument, provides consistent results and hence it does contribute to reliability. The investigator has administered the tool, to a sample of 50 respondents; the responses are carefully examined and scored. After an interval of a week, the same tool is administered to the same set of respondents and the responses are carefully examined and scored. The product movement correlation formula is used to calculate the correlation coefficient and it is found correlation coefficient is 0.689 and hence it is reliable.

## SCORING PROCEDURE

The investigator has allotted five statements on a five-point scale. The scale values for different degrees of agreement ranges from 5 to 1 score such as

Strongly Agree (SA)	--	5
Agree {A G}	--	4
Indifferent (IN)	--	3
Disagree (D A)	--	2
Strongly Disagree {SD}	--	1

The structure of the questionnaire was divided into 3 categories; Individual conflict, Inter-personal conflict and Inter - Group conflict. The investigator has distributed out of the 65 questions, 20 questions to measure the individual conflict, 39 questions to assess Inter - Personal conflict and 6 questions to find out Inter-Group conflict.

## ADMINISTRATION AND COLLECTION OF DATA

The investigator visited the school, with the permission of the authorities concerned. The investigator as planned has collected relevant information with the co-operation of the Headmaster of the respective school and from different categories of teachers from different localities, in tune with the objectives of the study and to highlight prevalence of conflict among teachers working in State Board schools.

## STATISTICAL TECHNIQUES USED

't' test was used the collected data for the present-study.

## DATA - ANALYSIS

### Null Hypothesis - 1

There is no significant difference in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to sex.

*Difference between male and female teachers working in State Board Schools  
with reference to conflict*

Dimensions	Male (N =98)		Female (N=129)		Calculated t' value	Remarks at 5%
	Mean	S.D	Mean	S.D		
Individual Conflict	73.24	6.66	73.06	7.1	0.10	NS
Inter Personal Conflict	127.46	13.18	128.17	11.65	0.42	NS
Inter-Group Conflict	21.69	3.93	22.18	4.45	0.87	NS
Conflict	218.64	21.51	219.1	22.56	0.16	NS

(Table T value at 5% level of significance is 1.96)

### Null Hypothesis - 2

There is no significant difference in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to place of teacher.

*Difference between rural and urban teachers working in State Board Schools with  
reference to conflict*

Dimensions	Rural (N =98)		Urban (N=129)		Calculated t' value	Remarks at 5%
	Mean	S.D	Mean	S.D		
Individual Conflict	73.81	7.03	72.64	6.76	1.27	NS
Inter Personal Conflict	129.77	12.38	126.13	12.04	2.24	S
Inter-Group Conflict	22.26	4.07	21.71	4.37	0.99	NS

Conflict	222.59	21.86	215.55	21.81	2.43	S
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(Table 't' value at 5% level of significance is 1.96)

### Null Hypothesis - 3

There is no significant difference in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to Orientation programme attended.

#### **Difference between orientation programme attended and not attended orientation programme teachers working in State Board Schools with reference to conflict**

Dimensions	Attended Orientation (N = 125)		Not Attended Orientation (N=102)		Calculated t' value	Remarks at 5%
	Mean	S.D	Mean	S.D		
Individual Conflict	73.02	6.85	73.41	6.99	0.43	NS
Inter Personal Conflict	126.91	12.19	129.03	12.41	1.29	NS
Inter-Group Conflict	21.47	4.36	22.58	4	1.99	S
Conflict	217.1	22.11	221.11	21.92	1.36	NS

(Table 't' value at 5% level of significance is 1.96)

### Null Hypothesis - 4

There is no significant difference in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to refresher courses attended.

#### ***Difference between refresher course attended and not attended refresher course teachers working in State Board Schools with reference to conflict***

Dimensions	Attended Refresher (N = 148)		Not Attended Refresher (N=79)		Calculated t' value	Remarks at 5%
	Mean	S.D	Mean	S.D		
Individual Conflict	72.14	6.82	74.05	7.01	1.36	NS

Inter Personal Conflict	126.19	12.13	131	12.11	2.85	S
Inter-Group Conflict	21.36	4.36	23.1	3.75	3.14	S
Conflict	216.05	21.9	224.24 I	21.51	2.71	S

(Table 't' value at 5% level of significance is 1.96)

### Null Hypothesis - 5

There is no significant difference in prevalence of conflicts and its dimensions among teachers working in State Board schools with reference to subject.

Difference between science and arts teachers working in State Board Schools with reference to conflict

Dimensions	Science (N = 196)		Arts (N=31)		Calculated t' value	Remarks at 5%
	Mean	S.D	Mean	S.D		
Individual Conflict	72.91	6.93	74.97	6.53	1.61	NS
Inter Personal Conflict	127.68	12.07	129.00	13.90	0.50	NS
Inter-Group Conflict	21.87	4.30	22.58	3.73	0.96	NS
Conflict	218.49	21.52	221.48	25.48	0.62	NS

(Table 't' value at 5% level of significance is 1.96)

### FINDINGS

1. No significant difference in prevalence of conflict and its dimensions such as Individual conflict, Interpersonal conflict and Inter Group conflict is observed among teachers working in State Board schools with reference to sex.
2. Significant difference is observed in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to place to teachers. As far as dimensions are concerned. Significant difference is observed in Interpersonal conflict

and no significant difference is observed in the dimensions such as Individual conflict and Inter Group conflict.

3. No significant difference is observed in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to orientation programme attended. As far as dimensions are concerned significant difference is observed in Inter Group conflict and no significant difference is observed in the dimensions such as individual conflict and Interpersonal conflict.
4. Significant difference is observed in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to Refresher courses attended. As far as the dimensions are concerned significant difference is observed in the dimensions such as interpersonal conflict, Inter Group conflict and no significant difference is observed in Individual conflict.
5. No significant difference in prevalence of conflict and its dimensions such as a) Individual conflict, b) Interpersonal conflict and c) Inter-Group conflict is observed among teachers working in State Board schools with reference to subject.

## INTERPRETATIONS

It is revealed from the analysis no significant difference is observed in prevalence of conflict among teachers working in State Board schools and its dimensions (Conflict and also in Interpersonal conflicts) with reference to locality of teachers. Rural teachers {222.59} are having more conflict than urban teachers {215.55}. This may be due to the culture and behaviour of the teachers of rural area, where as in the urban locality the teachers are having interaction with other members.

It is observed that no significant difference in prevalence of conflict and its dimensions among teachers working in State Board schools with reference to orientation programme attended and not attended. It seems both teachers attending orientation programme and not attending orientation programme are having same level of conflict whereas, significant difference is observed in Interpersonal conflict among teachers attended and not attended orientation programme.

As far as teachers attending Refresher courses significant difference is observed in prevalence of conflict and its dimensions among teachers working in State Board schools. The teachers who do not attend refresher course are having more conflict than teachers who have

attended the Refresher course. This: may be due to teachers who do not attend the Refresher course may not have proper communication and interaction.

It is observed that no significant difference is observed in prevalence of conflict among teachers working in State Board schools and its dimensions with reference to teachers handling Science and Arts subjects.

Significant difference is observed among teachers handling different subjects in State Board schools with reference to prevalence of conflict and its dimensions (Conflict and Individual conflict). This may be due to teacher's have different subjects; who mean it is depending upon the depthless and importance of subject and one may have relaxation, if different persons teach different subjects. Therefore handling different subjects may be helpful in minimizing the conflict.

### **RECOMMENTATIONS**

1. Since the level of conflict among teachers working in State Board school is moderate. Seminars or workshop may be organised by the constituent schools, University or U.G.C at regular intervals so that the conflict may be minimized among teachers.
2. Changes may be provided to the teachers working in State Board School who do not undergo Orientation programme and Refresher courses under Faculty Improvement Programme.
3. Effective (counselling Programmes and Communication Programmes can be organized among teachers in the District itself.

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## Research Article

## Relationship between Educational Values of Co-curricular Activities and Academic Achievement of Higher Secondary Students

Dr. G. N. Sunith Kumar<sup>1</sup> & Dr. S. Arockiasamy<sup>2</sup>

<sup>1</sup> Lecturer, Kerala University College of Teacher Education, Thiruvananthapuram, Kerala

<sup>2</sup> Principal, Gnanamani College of Education, A.K. Samudram, Namakkal District, Tamil Nadu

### Abstract

Co-curricular activities form a vital link in the pattern of blended educational experiences for all boys and girls in the modern Indian schools. They cater to the development of a child's entire personality. Since these activities ensure an all-round development of the personality of students, it is essential that these activities should be accommodated in the timetable during regular school hours. This will enable all students to take part in these activities .as participation in such activities can help them in developing various skills which could help in their academics and in the life as a whole. The study establishes that the perception of educational values of co-curricular activities have direct bearing on the academic achievement of the higher secondary students.

**Keywords:** *Co-curricular Activities, All-round Development, Personality Development, Educational Values, Academic Achievement, Skill Development, Secondary Education, Student Participation*

### Introduction

The aim of education is not only intellectual development of students but also their emotional, social, physical, moral and motor development. This could not be achieved by confining the educational process. There are numerous dimensions of individual's personality and thus the activities outside the classroom play an integral part in shaping the overall development of a child and promote his/her holistic growth.

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The educational possibilities of such activities are clear from the practical knowledge that it imparts. The various activities of educational potential conducted in schools like debates and discussion, projects, elocution, recitation, dramatization etc. cater to the educational needs of the students \_and thus could improve the academic achievement of such students. Also, the essential qualities such as co-operation, team spirit, self-discipline, creativity and so on are provided by participation in these activities.

According to Jaekel (1985), "the involvement in co-curricular activities is a factor that can predict success in life beyond school." The students are given an opportunity to explore and discover their hidden talents by participation in co-curricular activities. In addition, they develop skills for effective oral and written communication by their active involvement. This experience could be highlighted in the academics also thus reflecting in their overall success. Co-curricular and regular classroom activities are the means of achieving common ends. If properly organized and conducted, they reinforce each other. Both are designed to contribute to the all-round growth and development of all the boys and girls enrolled in the secondary schools. The objectives of secondary education with the examples of the various ways in which co-curricular activities contribute to them suggest that the co-curriculum may provide a mighty implement for learning efficiency and for fulfilling the needs of youth. The present study is an attempt to realize the role played by the co-curricular activities with educational potential in the academic achievement of the higher secondary students.

### **Statement of the Problem:**

"Relationship between Educational Values of Co-Curricular Activities and Academic Achievement of Higher Secondary Students"

Objectives of the study

1. To find out the level of educational values of co-curricular activities by the higher secondary students with reference to their background variables
2. To find the difference in the educational values of co-curricular activities as perceived by higher secondary students with regard to their background variables
3. To find the relationship between educational values of co-curricular activities as perceived by higher secondary students and their academic achievement with reference to their background variables.

### **Hypotheses of the study**

The following hypotheses were formulated for the study:

1. The level of educational values of co-curricular activities by the higher secondary students with reference to their background variables is high
2. There is no significant difference in the educational values of co-curricular activities as perceived by higher secondary students with regard to their background variables
3. There is no significant relationship between educational values of co-curricular activities as perceived by higher secondary students and their academic achievement with reference to their background variables.

### **Methodology**

The method adopted in the present study is Descriptive Research or Survey method. According to Dodge Fernland (2004), "survey is an investigation of the ideas, attitudes and other responses of a large number of people".

#### **Sampling Procedure**

Higher secondary students of various schools of Kanyakumari district form the population of the present study. A sample of 1000 students was drawn through Stratified sampling technique.

#### **Instrumentation:**

- Co-curricular Activities Educational Value Perception Questionnaire structured and validated by the investigator.
- For academic achievement, the marks scored by the higher secondary students of standard XI in April 2005 Annual Examinations were taken.

#### **Data collection:**

The Personal Data Sheet prepared by the investigator was used to collect information regarding the background characteristics. Before administering the tool, permission was sought, from the District Educational Officers and the concerned school headmasters. The tool along with the personal data form was administered to the higher secondary students.

#### **Statistical Treatment of the Data:**

Statistical techniques such as mean, standard deviation, 't' test and product moment correlation were employed.

**Data analysis****Hypothesis I**

1. The level of Educational Values of Co-curricular Activities by the higher secondary students with reference to their background variables is high.

Table 1.

Educational Values of Co-curricular Activities as perceived by Higher Secondary Students with regard to their Background Variables

Background Variables		Level			
		Low		High	
		Count	%	Count	%
Gender	Male	215	43	285	57
	Female	198	39.6	302	60.4
Medium of Instruction	English	123	35.14	227	64.86
	Tamil	360	55.38	303	46.62
Nativity	Village	256	41.63	359	58.37
	Town	157	40.78	228	59.22
Type of School	Govt.	161	46	159	54
	Private	252	38.77	398	61.23
Family Nature	Nuclear	383	41.14	548	58.86
	Joint	30	43.48	39	56.52

It is observed from the table that high level value perception of the educational values of co-curricular activities is shown by the female students. The reason for female dominance in the educational value may be due to their studious nature, enthusiasm, competitive spirit and interest in participation in these activities.

Again, the high level perception is shown by the students studying in English medium, private school, those hailing from town area and those belong to nuclear family. English

medium and private school students usually hail from economically sound families and hence they are more motivated in home and by teachers when compared to the Tamil medium students. Students of the nuclear family lead in their perception of educational values of co-curricular activities. The reason for this may be that the parents of such students pay much attention to their wards and encourage them to participate in co-curricular activities. Moreover, such students indulge themselves in some hobbies which can help them in developing their potential.

### Hypothesis II

1. There are no significant differences in the educational values of co-curricular activities as perceived by higher secondary students with regard to their back- ground variables.

**Table 2.**

Differences in Educational Values of Co-curricular Activities as perceived by Higher Secondary Students with regard to their Background Variables

Variable	Categories	Count	Mean	SD	't' value	Table value at 5% level	Result
Gender	Male	500	28.53	4.98	1.05	1.96	NS
	Female	500	28.86	4.73			
Medium of Instruction	English	350	29.12	4.65	2.06	1.96	S
	Tamil	650	28.47	4.95			
Nativity	Village	615	28.79	4.91	0.79	1.96	NS
	Town	385	28.54	4.77			
Type of School	Govt.	350	28.26	5.03	2.06	1.96	S
	Private	650	28.93	4.75			
Family Nature	Nuclear	931	28.70	4.86	0.15	1.96	NS
	Joint	69	28.61	4.87			

Significant differences are found in educational values of Co-curricular Activities with regard to school category and medium of instruction. The students studying in Government schools as well as those studying in Tamil medium lag behind in the perception of the educational values of co-curricular activities. This is attributed to the fact that these students

are poorly motivated as both the students and teachers are not very serious about the organization of such activities in schools. Thus these students do not seem to understand the values of these activities much.

There are no significant differences in educational values of Co-curricular Activities with regard to school locality, sex, native place and family nature. Hence, the null hypothesis is accepted except with regard to school category and medium of study.

1. There is no significant relationship between educational values as perceived by the higher Secondary students and their academic achievement with regard to background variables - sex, native place and medium of instruction.

**Table 3.**

Relationship between Educational Values as perceived by the Higher Secondary Students and their Academic Achievement with regard to Background Variables  
- Sex, Native Place and Medium of Instruction

Variables	Category	Correlation Coefficient	Table Value at 55 Level	Result
Gender	Male	0.02	0.062	NS
	Female	0.07	0.062	S
Medium of Instruction	English	0.00	0.062	NS
	Tamil	0.04	0.062	NS
Nativity	Village	0.07	0.062	S
	Town	0.02	0.062	NS
Type of School	Govt.	0.00	0.062	NS
	Private	0.06	0.062	NS
Family Nature	Nuclear	0.05	0.062	NS
	Joint	-0.09	0.062	NS

Significant relationship is observed between educational values as perceived by higher secondary students of village area and female sex and their academic achievement.

It is clear that the female students possess high perception of the educational values of co-curricular activities and this relates to their academic achievement shown by them. This feature is also shown by the students from village area though the perception is not high for them: However, in case of other variables, this is reversed. It can be estimated that for them, the educational values does not seem to have any direct bearing on their academic achievement.

The circumstances in the home, their study habits, grasping power, memory etc might have attributed to the variation in the academic achievement for such students.

### **Findings**

1. The level of educational values of co-curricular activities in the case of female students is high. Again, high level perception is shown by English medium, private school students and students hailing from town areas and those who belong to nuclear families.
2. Significant differences are found in educational values of Co-curricular Activities with regard to school category and medium. There are no significant differences in educational values of Co-curricular Activities with regard to school locality, sex, native place and family nature.
3. Significant relationship is observed between educational values as perceived by higher secondary students of village area and female sex and their academic achievement.

### **Conclusion**

The findings of the present study show that the value perception of co-curricular activities in the light of educational values seems to be high. This clearly indicates the role played by the co-curricular activities in shaping an individual by satisfying the educational potential. It is clear from the finding that the educational values of co-curricular activities exert a little influence on the academic achievement of the higher secondary students. It is essential that steps should be taken to improve the academic achievement since the higher secondary students are at the crucial stage of their studies. Also, proper planning of the various co-curricular activities is needed in the schools as a part of creation of an individual having dynamic potential.

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## Research Article

## Effectiveness of Inquiry Training Model on Achievement in Science of Secondary School Students

Ms. V.P. Smitha,

Principal Calicut University Teacher Education Centre, Puthupanam Vadakara, Kozhikode  
District, Kerala

### Abstract

This study examined the effectiveness of Inquiry Training Model on achievement in science of secondary school students. A purposive sample, consisting of eighty four eighth standard students of a government secondary school in Kozhikode district of Kerala State was adopted and a pre-test -post-test quasi-experimental design with a 2 x 2 factorial matrix was applied for the study. A regular class consisting of forty two students was taken as the control group and they were taught through conventional teaching approach during the experiment. Another division of eighth standard was taken as the experimental group and they were administered Inquiry Training Model by the investigator. The experimental intervention was carried out for a period of five months. Three hypotheses were tested. Results of the ANCOVA analysis revealed that teaching science through Inquiry Training Model was more effective as compared to the conventional teaching. The analysis also revealed that gender has no effect on achievement in science and that there was no group gender interaction effect due to the intervention through Inquiry Training Model.

**Keywords:** *Inquiry Training Model, Science Achievement, Secondary School Students, Quasi-Experimental Design, Teaching Effectiveness, Gender Differences, Kerala Education.*

### Introduction

Inquiry Training Model, developed by Richard Suchman (1964), is intended to engage students in causal reasoning, teach them to become precise in asking questions, to investigate, to build hypothesis and to test them.

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For science education to be effective, teaching methods that place emphasis in; developing higher order thinking skills need to be promoted.

Inquiry Training Model. that stresses on students constructing knowledge in the classroom through inquiry, with teacher intervention is expected to be effective in science teaching.

In an Inquiry Training Model classroom, the teacher first presents the students with a puzzling event that motivates the students to solve the problem. After this, the teacher prompts to ask relevant questions that may lead them to reach solutions. The teacher does not answer the questions directly. She just says 'yes' or 'no' to each question that students ask. The students are required to ask only such questions that contain an idea or guess which the teacher either confirms or rejects: Whenever a question cannot be answered by a 'yes' or 'no', the students are asked to re-phrase the question. Thus, after a number of questions and answers the students would have collected sufficient data relevant to solve the problem and would have established some meaningful relationships among the variables by eliminating irrelevant variables. Next, the teacher asks students 'to organise the data and formulate an explanation for the puzzle.

Joyce and Weil (1992) present five phases of Inquiry Training Model as described below:

Phase I: Confrontation with the problem; explain inquiry procedures; present the problem

Phase II: Data gathering, verification; Verify the nature of objects and conditions; Verify the occurrence of the problem situation

Phase III: Data gathering, experimentation; Isolate relevant variables; Hypothesis and test casual relationships (Students organise the information obtained so that they can derive an explanation for the puzzling event)

Phase IV: Formulating and explaining- formulate rules or explanation

Phase V: Analysis of the inquiry process-analyse inquiry strategy and develop more effective ones. The students are asked to analyse the problem-solving strategies they used. This operation helps students to establish a focus in their inquiry and to facilitate discussion of the problem situation.

According to Passi, et.al. (1987), Inquiry Training Model helps in developing in students, process skills in observing, collecting, and organising data, identifying and

controlling variables, formulating, and testing hypothesis, explanation and inferring among students. Moreover, strategies for creative inquiry and autonomy in learning are also improved.

Review of related literature revealed that few studies have been conducted to test the effectiveness of Inquiry Training Model on science achievement of secondary school students. Also, the existing studies give inconsistent results. This study, therefore, is important since the findings of this study will help improve science teaching in secondary schools by throwing light into the effectiveness of Inquiry Training Model in science teaching.

### **Hypotheses formulated for the Study:-**

#### **Hypotheses**

The following three null hypotheses were tested:

H01 There is no significant difference between the mean scores of science achievement of the experimental group and the control group.

H02 There is no significant effect of gender on science achievement of students in the experimental group.

H03 There is no significant interaction effect of treatment and gender on science achievement of students.

## **METHODOLOGY**

### **Design and Sample**

A pre-test-post-test quasi-experimental design with a 2 x 2 factorial matrix was adopted for this study. Purposive sampling technique was used, wherein the sample was drawn from two intact divisions of Standard VIII of the Govt. Vocational Higher Secondary School, Meppayur. The students belonged to the age group of 13-14 years. Overall, eighty four secondary school students, boys (N=44) and girls (N=40), took part in this study. The sample sizes of both experimental and control groups were forty two.

### **Instrumentation**

The main instrument used for this study was an Achievement Test in Science, constructed by the investigator. In addition to this, the Standard Progressive Matrices Test - SPMT (Raven, 1958) was used for measuring intelligence of the participants to partial out the effect of intelligence on the experiment.

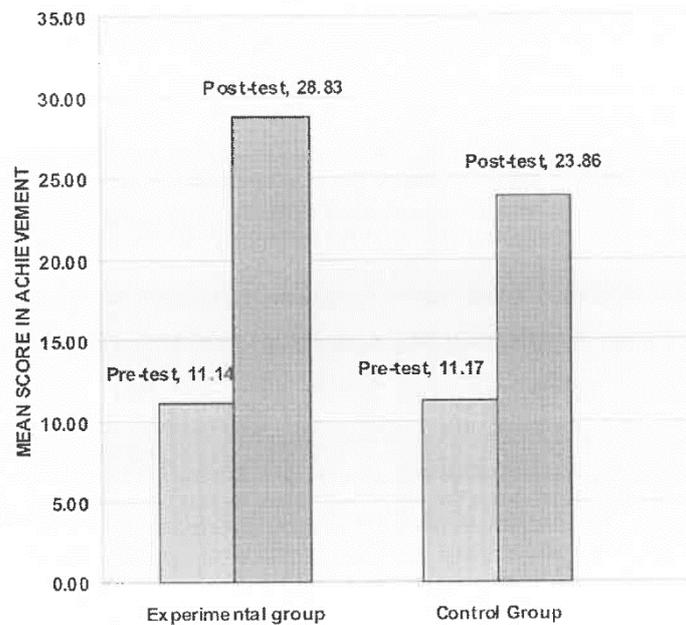
## Procedure

At the start of the experimental treatment; an intelligence test was administered to both the experimental and the control group as preliminary test to partial out the effect of intelligence on the treatment results. After this, a pretest was administered to both groups to measure achievement in science before the commencement of experimental intervention. This was followed by the experimental treatment for a period of five months, during which the experimental group was taught through Inquiry Training Model and the control group was taught through conventional teaching. At the end of the treatment period, a post-test to measure achievement in science was administered to both groups.

Fifty school periods, each with 40-45 minutes duration, were used for the study. The topics for the experimental treatment were selected from the science textbook prescribed for eighth standard pupils of Kerala State for the academic year 2005- 2006. Out of the seven units in Chemistry and eight units in Physics given in the textbook, three units in chemistry (Water, Solutions and Acids and bases) and four units in Physics (Sound, Static electricity, Electric current, Heat) were selected for teaching. The same units were taught in both the experimental group and the control group.

## ANALYSIS AND INTERPRETATION

The scores obtained from the intelligence test, the pre-test and the post-test were subjected to statistical analysis to find the effect of experimental treatment on achievement in science. A univariate analysis of covariance (2x2 ANCOVA) was done on the post-test scores of the achievement test. The post-test scores in achievement in science was taken as dependent variable and the covariates taken were the pre-test scores and intelligence test scores.



Graph-1 : Pre-test and post-test mean scores in science achievement of the experimental and control groups

Graph-1 reveals that the post test scores of the experimental group increased from the pre-test mean score of 11.14 to 28.83 for the post-test. In the control group, mean score increased from pre-test to post-test (11.17 to 23.86). To test the statistical significance of the difference in the mean scores, 2x2 ANCOVA analysis was performed on the post test scores of science achievement, the details of which are given in the Table I.

Table I: Analysis of covariance associated with science achievement of experimental group and the control group: Test of between Subjects Effects

<i>Dependent variable: Science Achievement</i>					
<i>Source</i>	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Intelligence</i>	0.146	1	0.146	0.044	0.834
<i>Pre-science achievement</i>	276.869	1	276.869	84.407	0
<i>Group</i>	458.737	1	458.737	<b>139.852</b>	<b>0</b>
<i>Gender</i>	0.739	1	0.739	0.225	0.636
<i>Group* Gender</i>	0.507	1	0.507	0.155	0.695
<i>Error</i>	255.852	78	3.28		

<i>Total</i>	59383	84			
<i>Corrected Total</i>	1080.988	83			

The ANCOVA analysis revealed that there is statistically significant difference in the mean scores of the experimental and the control groups in science achievement, as indicated by the F value,  $F=139.852$ ,  $p<0.001$ . Hence the null hypothesis H01, stating that there is no significant difference between the mean scores of science achievement of the experimental group and the control group, is rejected.

The ANCOVA analysis also revealed that gender has no effect on achievement in science as indicated by the F value,  $F= 0.225$ ,  $p>0.01$ . Hence the null hypothesis H02, stating that there is no significant effect of gender on science achievement of students in the experimental group is accepted. Analysis of covariance also revealed there is no statistically significant interaction between group and gender on science achievement, as indicated by the F value,  $F=0.155$ ,  $p>0.01$ . Hence, the null hypothesis (H03) stating that there is no significant interaction effect of treatment and gender on science achievement of students is accepted.

### **FINDINGS OF THE STUDY**

The study revealed that Inquiry Training Model is superior to conventional teaching in improving science achievement of secondary school students. These results are concomitant with the results of the studies conducted by Sivakumar and Prema (1997), Scott and Sigel (1965), Pandey (1986), Al-Khayyat and Abdul Kareem (1981) and Sushma (1987), all of which agree that Inquiry Training Model is more effective than the conventional method in improving student achievement and is contradictory to the study conducted by Alia (2005) who found that Inquiry Training Model of teaching and traditional method of teaching are equally effective in raising achievement of students in science.

It was also found that boys and girls were equally benefited from Inquiry Training Model and gender did not play a significant role in developing science achievement. This result is in contrary to the findings of Gautam (1991) who found that Inquiry Training Model is more effective in the case of girl students. Analysis also revealed that there was no significant interaction of treatment and gender on science achievement.

## DISCUSSION

There could be many reasons for the superior performance of the experimental group as compared to the control group. In the experimental group taught through the Inquiry Training Model, the students were actively engaged in constructing knowledge through inquiry with the guidance of the teacher. This confirms Bruner (1966) who said students learn better when knowledge is constructed.

## CONCLUSION

It was found that Inquiry Training Model is superior to conventional teaching in improving achievement in science of secondary school students. The study revealed that, facilitating students to construct knowledge by themselves significantly improves the quality of science learning.

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## Musings Scintillating Science

Ms. K. Tanuja, Sir Sivaswarni Kalalaya Senior Secondary School, Mylapore, Chennai - 4.

The word "Science" comes from the Latin word "scientia", meaning knowledge. It is a continuing effort to discover and increase our knowledge and understanding through research by experimentation.

To me, Science is a subject full of facts, laws, formulae, specific terminologies and lastly applications.

At the school level, let us first divide Science into its three distinct branches - Physics, Chemistry and Biology. Biology has further two distinct branches - Botany and Zoology.

When we start imparting Science Education at the primary level it is considered as an integrated subject with no distinction between its specific branches. The child is taught the subject as a whole.

For example, we teach them the chapter "Plants". We teach parts of a plant such as root, stem, leaves, flowers, buds, fruits etc. These terms seem quite familiar as they learn it from class three or four. But if we teach deeper into the parts of a seed like seed coat, cotyledons, embryo etc, the terms seem a little tougher to children and they find it difficult to comprehend. This is because only oral explanation is given to the students. The teacher may give the best possible explanation but the child will not be able to perceive it as it cannot imagine or visualize its actual structure.

Thus the best way to make the students understand is to either show the actual parts of a seed in class or use a CD show wherein colourful, realistic replicas of a seed are accompanied with suitable explanations.

In totality either hands-on experience from a very early start should be provided or a visual teaching tool should be used in order to take every child into the world of the new concept. This would stimulate the child's thinking and trigger his inventive thoughts to go deeper into the topic.

Let's take another classic example of a chapter called "The Moon" taught by a science teacher. The teacher teaches the characteristics of the moon such as -

- i) it is a natural satellite of the Earth,
- ii) it takes 28 days to revolve around the Earth,
- iii) it reflects the light from the Sun and thus shines etc.

The child grasps as much as possible and tries to memorize it depending on his/her caliber. The teacher then discusses eclipses and phases of the Moon.

Since this is school teaching, the Science class will be followed or preceded by classes of different subjects. Imagine if the social teacher also taught the class about the solar system, the planets and their satellites, followed by the eclipses - lunar and solar.

If the explanation given by the Social teacher lacks or has extra points, the trouble has then really started. For example, if he or she teaches that the lunar eclipse occurs on a full moon a point that the Science teacher may have forgotten to highlight in the class, then children are caught in, a dichotomy of thoughts. They will either be unable to link the material taught in the two classes or will be confused as to what to write for which subject.

Essentially there has to be integration of the content to be transacted at a particular level and a thorough discussion between different faculty members before it reaches the students. This will prevent confusion in students' minds.

Let us now move to the middle school level.

A science teacher is teaching about "Fuels". He/She highlights the characteristics of a good fuel, the calorific value of them etc. Later the discussion extends to fossil fuels - coal and petroleum where she teaches that it is called "black gold". He/She does not emphasize which fossil fuel, is specifically called so. Finally winds up the class placing emphasis on conservation of fuels and natural resources. Asks the students to conserve energy by adopting usage of alternate sources of energy so that future generations would not run short of these valuable resources.

The teacher feels everything has been communicated well and feels a sense of accomplishment.

A week later the chapter on "Minerals and Power Resources of India" is taught by the Social Science teacher. In the course of the discussion, the teacher mentions petroleum as "liquid gold". The students immediately raise their eyebrows and get into a state of confusion. What is right? - Petroleum as "liquid gold" or "black gold" as they lack maturity.

Frustrated, the students start losing interest in the content and withdraw their focus from theory parts of the subject.

Certain dry and boring topics have contents that do not lend to hands-on experience in class room teaching scenario. The teacher finds it difficult to keep the attention of all pupils on

the topic. At such moments, the teacher can deviate a little and move to a lighter way of transacting the content by incorporating those terms into a word puzzle or a cross word puzzle. The teacher may give simple or cryptic clues depending on the level he/she is handling.

This interactive method will enthuse children with energy suddenly and will break the monotony of the talk and chalk method. Also the students are no longer passive listeners to the lecture. They are now in an interactive session with the teacher pouring out their knowledge and at the same time clearing their doubts.

A small exercise such as this has two main advantages:-

1. Children are cleared of many misconceptions which they may have felt shy to ask in front of their classmates.
2. They open up and shed all their fears and inhibitions to express their ideas and thoughts freely.

By this method we are developing their language skills in addition to their understanding. Isn't that wonderful? Try it out! It really works.

Let me now move to the secondary level - (IX & X)

Here the foundation is assumed to have been laid. But this is not so in reality.

Let us understand this by a small example - Pose an open ended question in the class - "What is change?" Children start looking at each other and the teacher strangely. This is because defining change is very difficult. Yes indeed it is. Children may have understood the idea but find it difficult to express it in words.

As a Science teacher, change can be explained in the context of chemistry as a chemical change separately, as growth in the context of Biology, as an energy change in the context of Physics. Also it can be explained as an integrated concept of Science. The students look bewildered. The simple reason is that the basics are not taught right for the child. But yet it is not too late to repair the damage. Here at this level as the children are a little more mature, we can thrust them with little more extra things to learn. We can encourage the students to put on their thinking caps and come up with answers that are not in their text books. The answers should be evaluated on the basis of their correctness technically.

But in most cases - for that matter even in boards, this does not happen. So by this faulty way of evaluation, we are curtailing the child's thinking. Probably somewhere we the teachers

and the system are hampering their growth in totality putting a full stop to their quest of inquiry and the fire within them is put off even before being kindled.

At the middle school and senior level, I started a practice by making my students wish me with different terms and formulae occurring in sequence in the chapter. They wish me these terms mechanically for a week or so, instead of a "good morning"- or a "good afternoon". (Obviously after teaching these terms). This method by default makes them feel the tough words very familiar and easy. The next week, they wish me with a different set of words and formulae. Believe me, it works like a miracle! Every child of the class knows them at their fingertips. It is first like reciting slokas every day. The children are then so familiar with the terms, that they slowly get inclined to the subject. Later they start developing interest in learning the subject deeper.

In our school, at the primary and the middle school level, I have performed small demo experiments in the class rooms using things that are readily available there.

**Let me cite a few examples:-**

1. Pick a white coloured (transparent) water bottle with smooth sides and fill it with water and close it lightly. Then keep its sides very near a book over a page with small letters. You can see enlarged image of the letters. I explained it by saying that it behaves as a convex lens and that the letters of the page act as object between pole and focus of the lens. Thereby, we get an enlarged, virtual and erect image. I took this experiment further and demonstrated in the lab using a magnifying glass and explained the same principle.
2. Take a broad lid of a water bottle fill it with water up to the brim. Put a piece of stiff cardboard over the lid and place your hand over the cardboard. Then quickly turn the cup upside down. On removing the hand water does not flow out. Looks like magic for the children. But I explained that the cardboard was kept in its place without falling due to air exerting pressure from below. Really simple, isn't it? I am sure all of us know these things but very few of us try it out due to lack of time or lack of zeal to assemble these things and show it to children. These small little things can make children really learn the concept well as it as a visual impact and is stored in their grey matter permanently. This also in turn has a continuous effect. Children may try few innovative things by themselves and show it in the class. By this, the teachers too can got novel ideas to experiment differently in the class next time. Also events like school projects,

Science Day Celebration, Book Week etc., can be made successful by these young budding talents and their innovative ideas.

3. Take a ruler place it on your index finger and try to balance it. At primary and middle school level you can teach them about "fulcrum" effort and "load". I have taught them the concept of levers especially first class levers using the above example.

At the senior level, you can teach them about the "Principle of moments" - i.e.

$\text{Load} \times \text{Load arm} = \text{Effort} \times \text{Effort arm}$ ; using the same example. Brilliantly the concept seeps into their heads.

4. Dissect a flower and show them the different parts in the class. Not only do they learn the topic well but it also has an added advantage. They will start observing everything around them with finer details.
5. Take a small cup of water. Add one teaspoon of salt or sugar in it. Stir it with a spoon. The salt or sugar disappears. I explained its disappearance by attributing to the existence of intermolecular space in water molecules. Extend it further by adding more of salt or sugar into it. A stage is reached when no more solute dissolves in the given solvent. Hence it becomes a saturated solution. You can extend this to any extent. From saturated solution to super saturated solution... then to ways to dissolve a solute etc. You can slowly become more and more creative and let your imagination explore. This enhances the thinking and understanding of both the teacher and the taught. These are just a few sample experiments performed regularly at our school. The list goes on.....

#### **Simple suggestions for the class room:**

In light of the above discussions, we suggest few strategies & ideas to be incorporated in Science teaching at both primary and middle school level to make learning enjoyable and a memorable experience.

1. **Introduce the Topic based on the knowledge acquired in previous classes.**

Doing so interests the students and increases their comfort level to accept a new topic.

2. **Try giving both oral & visual explanations.**

Visual imprints in our mind last longer for better understanding. Keep doing it regularly either by CD shows or by viewing exhibitions in the city, or encouraging children to see programmes on the TV like "Backyard Science" or FAQ (Frequently asked Questions) in their favourite channel Disney & Pogo. Learning really becomes fun.

3. **Plan demo activities for topics that lend to it**

Do it in the class or ask children to explain it by giving them chances turn wise to do it.  
Encourages learning by doing automatically.

4. **Regular use of Laboratories**

Frequently take them to labs. It increases their curiosity to know things

5. **Incorporate word or cross word puzzles**

Enriches student's vocabulary along with in depth understanding of the content.

6. **Encourage peer group interactions**

Conduct seminars in class for a given topic. Let students teach some portions in groups. Content reaches everyone as same age group reaches out to them. We thereby increase their communication skills and also preparing them for future for GD's (Group discussions) in interview etc. ,

7. **Try making participation of students in Science Olympiads, IAPT, NSTSE exams mandatory.**

This enhances their outlook of the subject

8. **Make them practice regularly**

Increases their speed of writing and also mental mapping while writing their examinations. Slowly time management and its importance are taught.

9. **Recapitulate in every class before starting a new topic**

Gives them a link and holds their attention or else they will be lost.

10. **Finally and most important thing share a loving bond with the students because**

Their liking of the teacher can increase their interest in the subject. Be a good role model for them in all aspects.

These are just a few tips pointed out. There could be many more... Try them out.

At the end of the day, give yourself a thought i.e., introspect your day's work. Find out the shortcomings and try to, fill in these Lacunae by evolving new methods. Keep trying and trying...Everyday will be a new experience to cherish in your memories.

One last question -

"What is the purpose of learning Science?"

Perhaps the most important purpose of Science is to produce useful models of reality.

Let me conclude by saying this - Learning the intricacies of the subject and then teaching by novel methods is in itself an art. It has to be experienced by the self-first-hand and then later incorporated into one's teaching.

Thus learning the nuances of teaching science is just one such endeavour that goes behind "Complete Science Teaching".

Happy Science Teaching!!!