

## Learning science teaching

### 1. Professional knowledge of the science teacher : a worldwide perspective

Most teachers would agree that teaching is more than a job and many would describe it as a profession. If teaching is a profession, then teachers should be considered as professional.

According to Etzioni (1969) teaching is a 'semi-profession', compared to more established professions like medicine or law, professions like teaching were different. Means professions are highly specialized occupations. Teachers' training is shorter, their status is less legitimised, their right to privileged communication less established, there is less of a specialised body of knowledge, and they have less autonomy from supervision or societal control.

Donald Schon (1983) in his book suggests that a move from what he terms 'technical rationality' to reflection in action in the way that professionals operate.

Claxton (1997) contrasted 'knowing what to do' with 'knowing what to do when you don't know what to do'. 'Knowing what to do' is like technical rationality – a knowledge base within the profession which can be drawn upon to guide practice. Knowing what to do when you don't know what to do' is about having a repertoire of tools to construct solutions to as yet undefined problems. Reflection in action is more appropriate characteristic model for professionalism. Becoming a professional science teacher is not a case of learning a predefined set of procedures and a static body of knowledge, it is about engaging with a dynamic and exciting subject and facing the challenges of presenting to students in an accessible way.

According to Eric Hoyle there could be a distinction between 'restricted' and 'extended' professionals. Restricted professionals are not 'bad' teachers, they:

- plan and prepare their teaching conscientiously
- care for their students
- do not look beyond their classrooms
- do not have the same desire to learn for themselves, and from themselves and others, that the extended professionals do.

One of the positive aspects of a science teachers daily life comes from working with others and in departments. They recognize the value of the community of practice in which they work.

According to the idea of Lave and Wenger (1991) Knowledge is acquired through practice situations'. William Hanks (in Lave and Wenger 1991) suggests that 'learning is a way of being in the social world, not a way of coming to know about it'.

### **Knowledge bases for teaching**

Lee Shulman and his associates in the 1980s suggests – 7 categories of knowledge

"To teach is first to understand"

1. **Content knowledge** (subject matter Knowledge): knowledge of the major facts, concepts, principles with a field and relationship among them.
2. **General pedagogical knowledge**: principles and strategies of classroom management as well as its organization e.g. Understand how students learn, theories of learning, child psychology, teaching strategies,
3. **Curriculum knowledge**: particular grasp of the materials and programmes, understand the aims and objectives of the curriculum
4. **Knowledge of learners**; learners' difficulties, learners misunderstanding, learners misconceptions, needs to know students learning styles, needs of learning basic concepts
5. **Knowledge of educational contexts**; knowledge of schools, classrooms, and all setting where learning takes place
6. **Knowledge of educational ends, purposes and values**: purposes of teaching and learning , values
7. **Pedagogical content knowledge**;

Of these the greatest interest has been shown in pedagogical content knowledge and has received much attention , particularly in science education.

### **Pedagogical content knowledge (PCK)**

Shulman proposed to consider the necessary relationship between the pedagogical knowledge and content knowledge by introducing the notion of PCK.

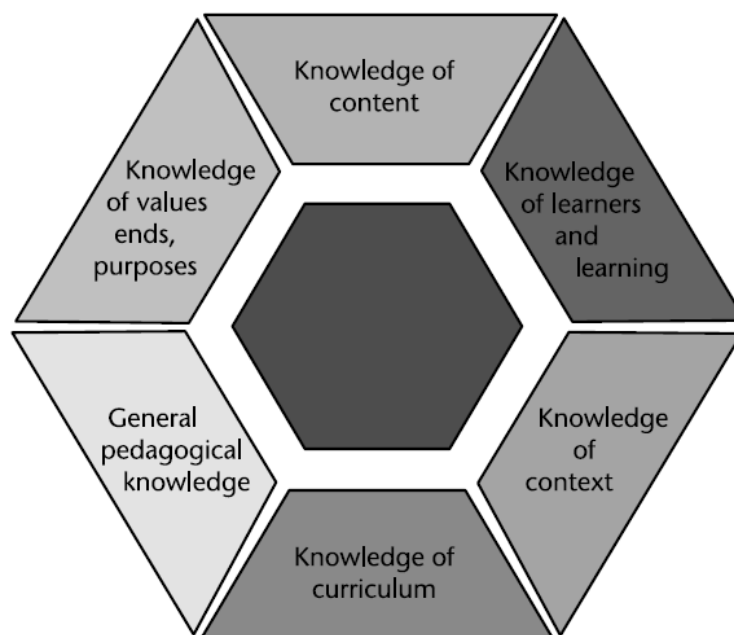
According to Shulman PCK represents the blending of content and pedagogy into an understanding of how particular aspects of subject matter are organized, adapted, and represented for instruction.

The most useful forms of representation of those ideas are the most powerful analogies, illustrations, examples, explanations, and demonstration. Teacher's deep understanding of a subject area she/he must also be able to foster understanding of subject or concepts for students

He was also clear about the context- specific nature of PCK in science would be different from PCK in other subject In science PCK has led to the association with the models, metaphors and analogies.

It would better to see PCK as - a knowledge about knowledge rather than just another component of the basic component of the basic knowledge elements of teaching.

In general, PCK is not seen as being a separate static color but rather being the dynamic colour generated in practice through the capability of the teacher to be able to combine or blend the individual knowledge bases together to spin the top . The professional knowledge of teachers proposed by Shulman is identified by using six categories indicated in figure below.



## Experts, expertise and accomplishment

According to Daved (2004): experience alone will not make a teacher an expert

According to Berliner investigation expert teachers which underpinned their teaching :

- knowledge of the cognitive abilities of their students;
- personal knowledge of their students;

- a history with their students;
- student expectations of good teaching even if it was challenging.

### **A distinction between crystallized and fluid expertise**

In the former, individual experts are able to respond in familiar situations through learning from past experience (use skills, knowledge and experience). Fluid expertise is the response to unfamiliar situations and was characteristics of the top experts -independent of acquired knowledge (includes inductive reasoning and deductive reasoning). The five stage model suggested by Berliner for the teacher development takes the teacher from novice (delidrate), through advanced begginner (insightful), competent( rational),and proficient(intuitive) but expert teachers are arational ,acting qualitatively different way to novice that means acting effortlessly and fluidly.

Sternberg and Horvath (1995), experts bear more of a family resemblance to one another than they do to non-experts. Experts features are divided into three broad areas; knowledge, efficiency and in sight. According to NBTS in USA and PS Framework in Australia expert has harder edge and suggested that teachers as highly accomplished rather than expert.

### **The Process - Content Debate**

Knowledge is insufficient in itself to result in accomplished teaching. Shulman recognized that as well as having knowledge, teachers need to be able to do something with it. The way teachers thinking is evidenced through their decision making before, during and after teaching episodes.

## Chemistry

In this part teachers teaching stream topics will be looked that involves concepts in chemistry. The topics featuring in these lessons are atomic structure and bonding, reactivity series and drugs and are the topics that happened to be ones being taught by highly accomplished science teachers.

### 1. Atomic structure and bonding

The lesson was revision phase in preparation for GCSE examinations and the students were revising their chemistry. For this lesson the teacher wanted to have some space for a kinaesthetic lesson to consolidate revision on atomic structure and bonding

At the start of the lesson the teacher had quickly stuck up large labels around the hall reading such as ionic and lattice. The lesson was very well prepared and materials were always on hand where required. The first activity in the lesson was a game called move to answer. The teacher was involved in the lesson simply by asking questions requiring them to move to the appropriate label. The teacher was going to see straightaway if they understand electronic configuration, the atomic bonding and transfer of electrons, covalent and sharing, the properties that these types of bonding create. In this activity very clear instructions were characteristics of Isabel's teaching.

In the second activity there was a recap on atomic structure as precursor to extending the activity to modeling bonding and it is modeling atomic structure and electronic configurations. The teacher taught the students needed to get into how they were working as a team and how they could involve every one rather than a core of people just doing the same thing again and again leaving people sitting on the side. The students were given a few minutes to work out the structure for their atoms. The teacher did not intervene in the group discussions, leaving the students to decide for themselves how to create their models, creating secure learning environment for them, a safe environment within which they can express not only when they do understand but also when when they do not.

The third activity was modelling bonding between atoms, in this activity the teacher decided that half of the students were going to do one of bonding and the other group to do a different thing, because she was seeing the time going and realizing that this would probably be the way of doing it.

The teacher paid attention to the lesson transition linking activity 2 with activity 3. In this activity the teacher chosen not to intervene much with the groups when they were doing the ionic bond she was more active when thinking about covalent bonding in methane and moved

b/n the groups checking they knew what they were doing. Making judgments about when to intervene and when to stand back is an important part of the skill of an accomplished teacher. The teacher uses models and simulations extensively in many topics in her teaching. She views them as being particularly important for supporting students learning about things which they cannot see.

In activity 4 the students are told that they are going to work in teams to make some molecular models and then bring to the teacher-points will be awarded for the first team. The activity was testing knowledge through a quiz about atomic structures using model kits and then drawing out chemical formulae. For the teacher it was more looking at formulae because these are terms which come in the exam. The second part of the quiz involves drawing of structural formulae.

In this activity the teacher wanted to know if the students really understood so thought of different way to get them to test out their knowledge. Reinforcement of learning plays an important part in the overall process and the highly accomplished teacher will need to think ways to present knowledge to not only recall previous learning but to try to deepen it.

The final part of the lesson was game (Quiz) with an inflatable question ball.

### ***Isabel's Professional Knowledge***

<i>Knowledge of atomic structures, electronic configurations and bonding and misconceptions</i>	<i>Knowledge of content</i>
<i>Designing teaching to respond to different learning styles, sensitivity to individual pupils ' responses to exposure in role play activities</i>	<i>Knowledge of learners and learning</i>
<i>Knowledge of students and likely responses to lesson out of normal classroom</i>	<i>Knowledge of context</i>
<i>Knowledge of examination requirements, linkage with previous work done</i>	<i>Knowledge of curriculum</i>
<i>Importance of timing preparation of materials and equipment, organization of student groups</i>	<i>General pedagogical knowledge</i>
<i>Clarity of expectations, desire for students to be well prepared for examinations</i>	<i>Knowledge of values , ends, purposes</i>

Isabel works with colleagues in department and there is some sharing of resources, she regularly attends the ASE annual meeting and collected ideas and materials from there. She also visits other schools and interacts with local authority support staff, using any opportunity arises.



## 2. Thalidamide , Stereochemistry and How Science Works

The lesson is part of a series that introduces students to the effects of drugs on the human body. The teacher's principal aim was to help the students work through some of the issues involved in testing the safety of medicinal drugs before they are advertised and sold on the open market. She was using knowledge of history of drug development to enhance student appreciation how science works

Orla aims to have the students engaged, participating and contributing and thus involved the lesson was started by showing two images of babies suffering the teratogenic effects of thalidamide .

She tried to develop a frame work for instruction in her classroom where discussion and where all students are encouraged to participate aiming that to avoid a few vocal students from feeling they could be setting themselves up to have their self-esteem or confidence under mined in full view of their peers.

She introduced the students to look at the pictures and to think about what caused this to happen to children by giving them two minutes. The students were given opportunities to contribute ideas and volunteer their idea. The teacher was praising them for their appropriateness while she was collecting their ideas. It was clearly evident that these highly accomplished science teachers find ways to give all students opportunities to contribute by giving them time to think before they are expected to answer.

She also prepared learning frame work which is important to provide her with opportunities both to monitor learning as the lesson progress and to evaluate her own teaching.

She was confident she knew the aptitudes of the students. She was appealing to the kinaesthetic learners, those learners who like to learn through a more hands on approach, physically interacting with materials.

Her belief was if students can see something in action they will understand that better and remember it better than if they had just been told. So that she was using practical approach as a kind of modeling which gets the idea into their heads much better?

She also provides opportunities for more open and relaxed discussion in the lesson. This is her broader strategy for enabling students to create a mental framework needed for the location and retention of new knowledge.

The teacher is not intending to leave the students without hard information to work from so towards the end of the lesson she distributes a facts and figures sheet.

The teacher created simple cut and stick exercise to monitor learning involving a series of factual statements.

"The best teachers engage with children" orla's belief.

### **Orla's professional knowledge**

Orla sees her professional learning occurring largely as a consequence of her commitment to reflective practice. With philosophy underpinned by a value system that centers on helping students to learn how to learn , her transformation of subject matter results in lessons designed to involve the students. Orla engaged in a process that involves her drawing on and combining aspects of these various knowledge bases.

**Her professional knowledge is summarized as shown in the table below**

<i>Broad subject knowledge in chemistry related to new knowledge developed following research into thalimide and its history</i>	<i>Knowledge of content</i>
<i>Deep knowledge of students as individuals, knowledge of learning theory</i>	<i>Knowledge of learners and learning</i>
<i>Knowledge of the nature of school</i>	<i>Knowledge of context</i>
<i>Knowledge of links to other areas of the science curriculum , preparation of students for content at much higher levels in the future</i>	<i>Knowledge of curriculum</i>
<i>Knowledge of importance of student motivation by maintaining pace through effective transitions</i>	<i>General pedagogical knowledge</i>
<i>Knowledge of history of drug development to enhance student appreciation of how science works</i>	<i>Knowledge of values , ends, purposes</i>