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21. CONTEXT-BASED TEACHING AND SOCIO-SCIENTIFIC ISSUES

This chapter introduces the concept of context-based teaching and the value of teaching through socio-scientific issues in science teaching. It does this by restating the goals of science education, especially drawing attention to education aspects important for promoting scientific literacy. Related to the idea of context-based teaching is the need to establish relevance of the learning in the eyes of students. A 3-stage model is introduced as the finale of this chapter. This is intended to illustrate the operationalisation of a context-based approach, related to a socio-scientific relevant issue. It is intended to guide the teacher in enabling students to gain the conceptual science background identified from the relevant context and then this taken to meaningful lead, based on newly acquired science ideas, to the inclusion of argumentation to make a reasoned decision as a key learning attribute in science education.

When you have worked through this chapter you should be able to:

- Explain context-based teaching
- Indicate problems with science education
- Specify goals of education
- Give meaning to intrinsic relevance
- Relate relevance to context teaching
- Give meaning to STL
- Explain socio-scientific issues
- Appreciate the importance of argumentation
- Recognise the need for SSI within the context-based approach
- Illustrating a context-based, SSI approach – the 3 stage model

WHAT IS CONTEXT-BASED TEACHING ?

Context-based teaching is when the teacher introduces a topic or a lesson from a real world context and relates this to the learning of conceptual science ideas. The real world context can be included in a number of different ways, for example, a product used in society, a situation described, or an event, which is occurring or has occurred. It is an alternative to initiating the teaching from the science content, derived from a textbook chapter, the specified school or national curriculum, or relating to questions that may occur on an examination paper.

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WHAT ARE SOCIO-SCIENTIFIC ISSUES?

Socio-scientific issues (SSI) are complex, open-ended, often controversial situations, with no definitive answers. In response to socio-scientific dilemmas, valid yet opposing arguments can be constructed from multiple perspectives. Just as scientists employ informal reasoning to gain insights on the natural world, ordinary citizens rely on informal reasoning to bring clarity to the controversial decisions they face. In a democratic society, science and technology are constantly involved in socio-scientific issues, and the processes of informal reasoning allow individuals to address these issues, formulate positions, and provide supporting evidence.

TRADITIONAL FOCUS OF SCIENCE EDUCATION AND ISSUES FACED

The traditional focus for school science lessons has been the content. Science was introduced as a school subject in the 19th century, especially to cater for students entering university to read science subjects (Fensham, 2008). It provided a content background. Since then, change in school science has been traditionally slow, unlike the pace of scientific and technological development within the society, so much so that there was a danger that the changing world made the relevance of current science education and its content-led approach suspect. This was not only in terms of content and related conceptual understanding for a modern society, but also in its approach to developments, changing perceptions of relevant learning and the wider range of skills demanded of the 21st century science teacher.

Of concern is that research indicates that school science teaching with its content approach is out-of-touch with today's world (Holbrook & Rannikmae, 2014) and implications of this are that:

a. science subjects are not popular among students; less students are thinking about careers and further studies in science-related areas;
b. science as taught in schools is not relevant for students. Students do not see its usefulness for their lives and future developments;
c. science content is static in nature, overloaded with facts and theories taken from the past (Rannikmäe, 2001) bearing little relationship with everyday needs;
d. students perceive school science as dominated by content and with too little challenge;
e. science education is isolated from the values components of education. It tends to be portrayed as values free, yet at the same time, the community needs increasingly to address moral and ethical issues and related problems;
f. teaching lacks attention to higher order learning among students, limiting development of problem solving and decision –making skills among school graduates.

It seems there is a need to rethink the rationale for teaching science in schools, the context in which it is put forward and the manner in which science teaching is seen by students to be of value for their future lives. Essential to this is reflecting on an understanding of science itself, the 21st century meaning of science education and the operationalisation of science teaching to enhance its relevance for a changing world (Holbrook & Rannikmae, 2014).

UNDERSTANDING THE MEANING OF SCIENCE AND SCIENCE EDUCATION

Science can be considered as both:

a. a body of knowledge that represents current understanding of natural systems, and
b. a way of thinking associated with how the body of knowledge has been established and continues to be developed, refined, and revised.

The body of knowledge includes scientific facts leading to highly developed and well-tested theories. The theories form a basis for explaining data, predicting experimental outcomes and as a means for further subject development.

With this in mind, it is important to teach science because:

1. science is a significant part of human culture and represents an area of challenge for human thinking capacity;
2. it provides valuable experiences for developing language, logic, and problem-solving skills;
3. as democracy demands that its citizens make personal and society decisions about issues in which scientific endeavours plays a fundamental role, a knowledge of science as well as an understanding of scientific methodology, is needed;
4. for some students, it can become, or support, a lifelong vocation;
5. society is dependent on the technical and scientific abilities of its citizens for its economic competitiveness and development.

GOALS OF EDUCATION

As education in general is intended to develop individuals and lay a foundation for learning throughout life, acquiring a body of knowledge, plus a range of skills and dispositions (attitudes and values) are necessary to function in today's changing world. Education thus needs to enable students to develop attributes, such as:

- Basic Skills for functioning in today's society.
- Lifelong Learning attributes to relate to a changing technological world.
- Interrelate with others and develop a sense of responsibility.
- Acquire self-concepts and gain spiritual development.
- Ensure a positive lifestyle.
- Gain awareness of career and sifting employment patterns.
- Development of responsible citizenship.
- Able to be adaptable and focused in response to changing conditions.

GOALS OF SCIENCE EDUCATION

Although the above attributes are clearly a focus for education as a whole, science education, as a component of education, needs also to relate to these. However, in relating to the learning of science (for which the term science education is used[1]), two aspects need to be regarded as key goals for school science teaching.

- School education should assure a good foundation of scientific literacy for all.
  Looking at the world from a scientific perspective enriches the understanding and interaction with phenomena in nature and technology, enables students (and therefore future adults) to take part in societal discussions and decision-making processes, and gives them an additional element from which to form interests and attitudes. These goals do not only refer to the students' personal and individual development: a culture that is critical but open-minded for science and technology is the necessary basis for raising students' interests in scientific careers.
- Teaching and learning about and from school science must also raise an interest in scientific or science-related studies, careers and employability.
  Whereas many people regard science as important for society and cultural development, they do not regard it as important for their own daily lives or for their own career perspectives. Following this goal of raising interest in science careers, school education must provide students with an authentic view of science-related careers and a fundamental background of competences and attitudes about science that enables further learning in these areas.

Using the aforementioned criteria, we can summarise the goals for science education as the acquiring:

- scientific knowledge;
- scientific methods;
- skills to engage with and resolve social issues;
- personal developmental needs, and
- career awareness.

This integration of scientific knowledge and skills with personal development and social attributes is termed the development of enhancing scientific literacy, or in recognising the strong interaction between science and technology, as enhancing scientific and technological literacy (STL) (Holbrook & Rannikmae, 2007).

WHAT IS ENHANCING STL?

STL is put forward to mean 'developing an ability' to creatively utilise appropriate evidence-based scientific knowledge and skills, particularly with relevance for everyday life and a career, in solving personally challenging yet meaningful scientific problems as well as making, responsible socio-scientific decisions' (Holbrook & Rannikmae, 2009). This is based on acquiring intellectual, attitudinal, communicative, societal and interdisciplinary learning through studies, based on conceptual science.

RELEVANCE IN SCIENCE EDUCATION

A major factor in making science in school more popular, and which can be expected to lead to greater public awareness of science by students in the future, is the relevance of the learning in the eyes of students. Students need to see the relevance of the learning, as it applies to them personally (their own lives, their interests, their career expectations). Making the science education provision relevant to students, illustrating that the provision is helping to determine a career, and showing how it is of importance for them as a responsible member of society, can give the science component more meaning in their education.

The relevance from the students' perspective can be considered as intrinsic relevance (Holbrook, 2008), while relevance, as perceived by the teacher, related to, for example, the curriculum and examinations, can be termed extrinsic relevance. The need to strive for students' intrinsic relevance (Holbrook, 2008) of science education suggests that:

- the manner in which the teaching is approached needs careful consideration;
- the relevance of the subject is more apparent coming from familiarity within society or interests associated with aspects of society;
- the structure of the teaching, initiated from a real life concern, allows the learning of conceptual science to stem from an association with the concern and thus be seen to have a connection with reality rather than be unrelated abstract learning;
- the structure of science lessons should be less about putting forward a series of scientific and technological conceptual topics than relating to science and technology in real life.

Intrinsic relevance can be interpreted as importance, usefulness or meaningfulness to the needs of the students. A more personal interpretation of relevance defines relevance as a student perception of whether the content or instruction satisfied his/her personal needs, personal goals, and career goals. These visions suggest that relevance influences motivation and in particular intrinsic motivation to learn. Furthermore, a number of science educational literature studies have also equated relevance with students' interest (Matthews, 2004). Relevance is seen as the key to raising student interests by making it more useful in the eyes of students. This, of course, begs the question whether science education made interesting (extrinsic motivation) by the teacher can lead to intrinsic relevance. Little research seems to have occurred in this area.

RATIONALE FOR CONTEXT-BASED SCIENCE EDUCATION

The rationale for this approach is that it is more relevant for students, which can stimulate intrinsic motivation to acquire the underlying science. Furthermore, if the context is familiar to students, they can, and need to, be strongly encouraged to use their prior knowledge so the learning builds on existing scientific literacy (Holbrook & Rannikmae, 2014).

Gilbert (2006) identified five major problems in science education for which a context-based approach can be considered advantageous:

1. curriculum overload;
2. curriculum content is too fragmented;
3. student transfer of learning to new situations;
4. learning not relevant to students' lives;
5. confusion as to why learn through science subjects.

Together with Pilot and Bulte, Gilbert (2011) went further to frame the perspectives to be included for context-based approach. These were detailed as:

1. Inclusion of a specific setting – provision of a social, spatial or temporal framework.
2. Behavioural environment setting enabling actions – particularly of importance here being the enabling of student involvement in the initial discussion/
3. Use of specific communication attributes, including language, with respect to the aspects being considered.
4. Enabling linkages to prior and new knowledge.

Context-based learning can thus be identified with an appropriate behavioural environment related to real life, specific communication attributes related to this and also establishing links between the prior and new science literacy learning. While contexts can be used as an application of a concept, this approach is, basically, the reverse of the usual content-led teaching approach, where the application comes first instead of last. Its advantage is that it makes applications of the science familiar to the students from the start and in this sense provides a degree of relevance to students. Its disadvantage is that the content is quickly seen as the major focus and the educational aspects (related to personal and social competences and especially problem solving and decision making) are largely dominated by conceptual subject learning. A similar focus arises if the context is used simply to illustrate the science concepts.

Context can be the starting point from which teaching and learning can emanate in a new science education direction, where students' input from prior learning can be strongly encouraged and where the new science learning to be acquired can be indicated, to a smaller or larger extent, by the students themselves. When such a situation is developed from a context, seen as familiar and thus having personal relevance for students, context-based learning takes on a new perspective, leading to student involvement and meaningful learning. Student involvement is strengthened and the teacher is provided with a base from which to develop the new learning within the science education frame from a relevance standpoint.

Aspects such as topics, modules and themes are frequently used for establishing a relevant personal or societal context. Terms like health, environment and fuels represent broad areas shown to be interesting and relevant as areas of study (Teppo & Rannikmae, 2008). Marks and Eilks (2010), however, challenge context-based chemistry education by claiming it can be superficial, arguing contexts do not automatically motivate students, and suggesting reflection is needed for effective use of these new approaches. There is no doubt the choice of behavioural setting needs to be carefully considered. Terms such as health need to broken down further so that the relevant focus becomes clear in a real life sense.

In terms of the actual approach to teaching, four context-based teaching phases can be identified (Gilbert et al., 2011):

i. the phase of initiation, in which the relevance of the situation is identified and from this links to students' prior-knowledge in a science education sense are made (although care is needed in the direction of the teaching so that discussions do not digress heavily into social experiences or concerns);
ii. the phase of learning (the discussion/interaction) needs to allow students to recognise that their current science background is insufficient to provide an explanatory input, but arouses curiosity enabling students to have the opportunity to raise science-related questions and thereby guiding students to play their part in 'setting the scene' to acquire the curriculum-related science;
iii. the phase of development, where the students become involved in the new science learning (enhancing competences associated with science knowledge and skills), complete meaningful activities to develop their ideas, and finally
iv. the phase of deepening, where the relevance of the learning is appreciated from a science standpoint, incorporated into the science conceptual frame (concept map) and forming a platform for better appreciation of the context situation.

A SOCIO-SCIENTIFIC TEACHING APPROACH FOCUSING ON CONTEXT-BASED LEARNING

Instead of initiating the context-based approach, via a theme or area of science-related interest, a more relevant behavioural approach is proposed to relate to the context to a real life problem or issue. While both a real life problem and real life issue can relate to the learning of science knowledge and both can provide a focus for a context-based approach, only an issue forms? a basis for informal discussion, argumentation and perhaps a contentious decision. A context-based issue relates to a socio-scientific approach, in which the concern or issue has relevance, if not familiarity to the students, and involves both science and wider educational learning.

An issue differs from a problem in that there is no specific, accepted conclusion. Thus, rather than focusing on solving a problem, which may have little relevance for students, the familiar issue, if chosen well, can motivate students to want to learn more, stimulate self-determination (Ryan & Deci, 2000) and even to reflect on societal action.

AN INTRODUCTION TO SOCIO-SCIENTIFIC ISSUES (SSI)

Social issues with conceptual or technological ties to science e.g. cloning, stem cells, global warming and alternative fuels, have become common elements of the national vocabulary, as well as the currency of political debates. Because of the central roles of both social and scientific factors in these dilemmas, they have been termed socio-scientific issues. Several science educators have argued for the inclusion of socio-scientific issues in science classrooms, citing their central role in the development of a responsible citizenry capable of applying scientific knowledge and habits of mind (Driver, Newton, & Osborne, 2000). The socio-scientific issue movement's aim is to focus more specifically on empowering students, in a science education sense, to handle science-based issues that shape the current world and those which will determine the future world.

INFORMAL REASONING & ITS RELATION TO SOCIO-SCIENTIFIC ISSUES

Informal reasoning involves the generation and evaluation of positions on issues that lack clear-cut solutions leading to decision-making. Informal reasoning is thus non-structured and gives opportunities for high order thinking, especially where information is less accessible. It is needed when problems are open-ended and especially when the concern is debatable, complex and ill-structured. It is especially important when an issue is being considered when students need to build an argument to support a claim.

Informal reasoning is involved in formulating and supporting positions for socio-scientific issues. This can be affected by numerous factors. These include the needed educational skills of argumentation, the ability to evaluate information/evidence and the conceptual understanding of the material, all of which underlies the issue.

ARGUMENTATION

In everyday usage, an argument is an unpleasant situation, in which two or more people differ in their opinions and they become heated over this difference. However, in science education, the goal is to approach a consensus, in which differences are supported or refuted. The argumentation can be based, for example, on an underlying agreement of the conceptual science, but disagreement as to the degree of impact of the conceptual science in making a reasoned decision. It involves extracting as much information and understanding from the situation under discussion as possible, not only in a science sense, but in terms of the social attributes such as environmental concerns, economic concerns, ethic and moral aspects, employability and political aspects, etc. In the argumentation, alternative points of view are valued as long as they contribute to the process within the accepted norms of science and logic, but purely social positions are not. [For example, 'Should plastic bags be banned,' where the debate may well be over the health risk or cost of plastic production, or could be related to environmental concerns such as blocking drains – this is actually the case in Bangladesh!]. Because the role, mode, and acceptance of arguments, in its everyday sense, are cultural variables, it is important to teach skills and acceptable modes of scientific argumentation, and this is so for both teachers and students.

Socio-scientific argumentation involves informal reasoning because negotiation and resolution are involved. This makes participating in socio-scientific argumentation more difficult. In a common model (Toulmin, 1969), persuasive argument elements provide useful categories by which an argument may be analysed, such as:

a. A claim – a statement that you are asking the others to accept. This includes information to be accepted as true, or actions you want accepted and to be enacted.
b. Grounds – the basis of real persuasion and is made up of data and facts, plus reasoning behind the claim. It is put forward as the 'truth' on which the claim is based. Grounds may also include proof of expertise and the basic premises on which the rest of the argument is built.
c. A Warrant – this links data and other grounds to a claim, legitimising the claim by showing relevance of the grounds. The warrant may be explicit or unspoken (implicit). It answers the question '*Why* does the data given mean they claim is 'true'?'
d. Backing – this gives additional support to the warrant by answering different questions.
e. A Qualifier – indicates the strength of the link from the data to the warrant and can be an indicator of the limits for which the claim applies. Indicators include terms like 'most', 'usually', 'always' 'often'.
f. A Rebuttal – a counter argument. These counter arguments can be pre-empted during the initial presentation of the argument if the presenter is able to be persuasive.

A CONTROVERSIAL ISSUE (OR REASONABLE DISAGREEMENTS)

A controversial issue is one where there no generally agreed point of view Often this derives by discussants holding different beliefs, when the issue cannot be settled by reference to evidence. This can relate to socio-scientific issues. Decisions are inevitably influenced by feelings and emotions [or having different values] rather than relying on an objective point of view. But the teacher needs to take precautions so that:

1. the scientific evidence is appropriate and accurate;
2. students do not persuade others when there is an emotional resistance to change even when the evidence is compelling.

IMPLICATIONS FOR SCIENCE EDUCATION

Socio-scientific issues can provide a powerful vehicle for teachers to help stimulate the intellectual and social growth of their students. To develop meta-cognition as a component of scientific literacy students need opportunities to engage in informal reasoning, including the contemplation of evidence and data, and express themselves through argumentation. As cited research suggests, socio-scientific issues can provide a context for informal reasoning and argumentation (Driver, Newton, & Osborne, 2000).

It seems the promotion of argumentation skills appears to be a difficult educational goal. Argumentation and the informal reasoning that underlies it are complex processes that require time and practice to develop In fact, it is reasonable to expect that significant improvements (via classroom learning) in argumentation and informal reasoning only occurs following extended learning experiences focused specifically on this goal.

PUTTING CONTEXT-BASED TEACHING AND INCLUSION OF SOCIO-SCIENTIFIC ISSUES TOGETHER – A 3 STAGE MODEL

Figure 1 illustrates a 3-stage model (Holbrook & Rannikmae, 2010), which is based on the recognition that there is a need to initiate science education learning from a *familiar and student relevant socio-scientific issue, thus establishing intrinsic relevance*. The diagram below illustrates how relevance is intended to trigger student's self-motivation to promote self-involvement in the learning. Such motivation is sustained by student involvement but also by extrinsically relevant aspects supplied by the teacher.

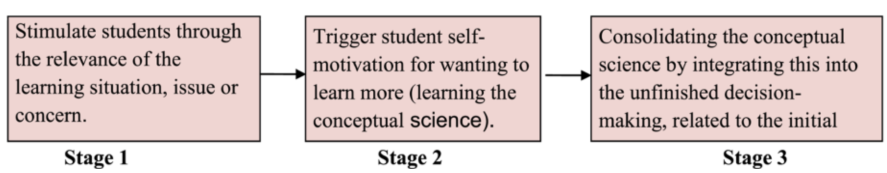

Figure 1. Stages in the 3 stage model

STAGE 1 BEGINNING WITH A STUDENT RELEVANT SITUATION (SCENARIO)

The use of a relevant context-based scenario is important. Not any situation is appropriate. Research shows that students identify with specific words, or expressions and these play an important function in determining whether the scenario chosen is appropriate. So important is the title and the depiction of the issue in a suitable manner that, if this fails to be relevant and motivational for students, the situation should not be used further and the teaching associated with this approach abandoned. This is because relevance is a very useful precursor for developing students' personal interest and a powerful stimulus for science learning. It provides students with a desire to pursue the learning further, going beyond the scenario and into the important science learning component.

The learning approach is thus 'intrinsic relevance first,' leading to science education second. This contrast with the usual suggested approach – make the science itself interesting within the context so that it will then motivate the students (but, alas, in so many cases, it doesn't!). The theoretical construct is that relevance drives students' motivation to learning and once relevance is established, the motivation for involvement can go beyond of the context-based scenario and lead into scenario-related conceptual science learning. Unfortunately, standard approaches, which assume science is inherently interesting for students, if taught well, have been shown to have little appeal to many students at the secondary level (Osborne, Simon, & Collins, 2003).

Once intrinsic relevance is established and the learning parameters defined, further learning is, in fact, the curriculum-based conceptual science ideas, which students acquire as steps towards enhancing their scientific literacy. For the learning to be meaningful, the science learning builds on a familiar, socio-scientific scenario as shown in the flowchart in Figure 2.

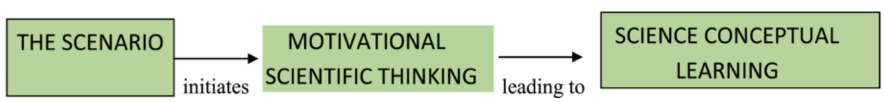

Figure 2. A flowchart showing the role of the scenario in the 3 stage model

The purpose of the scenario is to stimulate students' interest in the learning and to do this from a familiar and student relevant perspective. It is thus importance to persuade teachers to make changes to the scenario, if appropriate, to ensure such an approach. Starting from a carefully worded title (intended to be familiar and of interest to the target students), the teaching progresses, as in Figure 3 below.

EMANATING FROM THE SCENARIO

Once teachers realise the need to *initiate motivational scientific thinking in their students*, the next step is to determine students' prior science knowledge in the area related to the socio-scientific issue depicted in the scenario. In most cases, the teacher needs to expect that the students' prior knowledge is limited and students are unfamiliar with the science ideas associated with the socio-scientific issue, However,

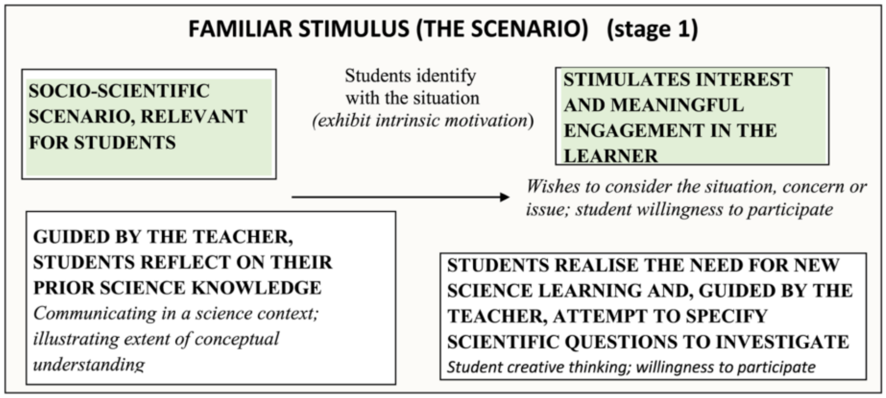

Figure 3. The role of the scenario as a stimulus for future learning

if this is not the case and students really do have a meaningful background in the underlying science, then going further to discuss the scenario *will not involve science learning*. The means the teaching needs to re-focus and the approach abandoned (why study what is already known!).

PREPARING FOR STAGE 2

While stage 1 is initially about establishing relevance for learning science, stage 2 is the important stage for gaining new conceptual science. Experience has shown that teachers need guidance on how to move from stage 1 into stage 2. The expected steps (considered within stage 1) are to:

a. enable students to recognise that they can discuss little about the scenario [OR their discussion of the scenario is limited] without acquiring the underlying science ideas, and then
b. develop the scientific question(s) (by the students if possible, otherwise by the teacher guiding the students – trying hard to not tell) to be answered in stage 2.

Moving from the scenario to developing the scientific question *is heavily dependent on the skill of the teacher*.

UNDERTAKING STAGE 2

This is likely to be the stage where most of the teaching/learning time is spent and where students gain conceptually as well as competences at the personal and social educational levels. The approach here is one of maximising student-constructed learning (with an emphasis on inquiry-based/problem-based learning) and the pace of teaching will depend heavily on the extent to which students' inquiry and process skills have been developed on prior occasions.

If students have prior experience in utilising process skills, then undertaking evidence-gathering learning (*a key element within a scientific approach*) is much facilitated. Inquiry-based learning can be expected to take far less time than in cases where students have not had prior opportunities for *student-centred approaches*. Within this stage, there is a need to stress the importance of the evidence gathering aspects, whether by experimentation, or by other means.

Inquiry-based science education (IBSE) involves, *although not usually seen as process skills:*

- *identifying* the science in a socio-scientific situation;
- *putting forward* scientific questions (questions that can be investigated scientifically);
- if necessary, breaking down questions into sub-questions that can be investigated separately.

Students can also be expected to learn to use *communication skills* to present their conclusions in suitable ways (written, oral, ICT) and, as appropriate, *discuss limitations* associated with the solutions they reach in attempting to solve the problem (that is answer the scientific question). Furthermore, inquiry learning is also very much interrelated with the development of *social skills*, especially interpersonal (student-student and student-teacher) skills and also *personal skills*, associated with aptitudes that support inquiry learning such as initiative, ingenuity, safe-working and perseverance.

Teachers can undertake inquiry learning with their students in different ways. The intended, ultimate goal is to enable students to undertake inquiry learning with no, or minimum, teacher interference (i.e. students undertake project work or 'open' inquiry). For that, teachers need to teach students to construct their thinking for the different stages of inquiry learning. And teachers must realise that *the more practice students have in IBSE,* the more easily they will undertake enquiry and the more capable they will be in undertaking high levels of student-constructed IBSE. Teachers need to recognise that progression to less (direct) teaching involved approaches given is not expected to be linear and teacher scaffolding needs to be ever-present. The type of teacher supported IBSE depends on the module being promoted and student prior experiences.

PREPARING FOR STAGE 3

The solution to the scientific question, carefully detailed and recorded, is expected to be the gateway to stage 3. But first, the conceptual science learning, emanating from the inquiry-based learning needs to be consolidated. This can for example, be enabled by student presentations on their findings and its interpretation, or through the construction of a scientific or socio-scientific concept map.

CREATING CONCEPT MAPS

Stage 2 incorporates conceptual science learning. It brings in new science. To be useful, this science needs to be put into a scientific context and, in particular, interrelated with other science knowledge. Scientific concepts can be interlinked by means of a concept map, centred on a theoretical construct (Novak & Cañas, 2006). Compiling concept maps can be a useful formative assessment exercise in which students can illustrate their learning of scientific patterns – a valuable aspect in developing the science ideas further.

UNDERTAKING STAGE 3

Stage 3 has two major components:

a. to consolidate the science ideas introduced in stage 2. This is achieved by involving students in additional tasks (above and beyond the module) related to the concepts, preferable interlinking with the students' prior concepts which were identified in stage 1. These tasks may be presented in different formats e.g. oral discussions; answering written exercises; jigsaw method, etc.
b. utilise the science ideas gained, [transferred to in the context of?] the original scenario situation, so as to enable students to discuss the scenario situation in more detail, using the newly acquired science. This is an important component of the learning and is expected to achieve two major learning targets (i) being able to transfer scientific ideas to a new, contextual situation, and (ii) participate meaningfully in a decision-making exercise to arrive at a justified decision related to the initial socio-scientific situation outlined in the title of the module.

Part (b) will involve student groups, or whole class interactions, in activities such as debates, role-playing, or discussions. Students are expected to put forward their points of view, while the teacher ensures the new science is incorporated in a meaningful and *appropriately correct* manner. Students are thus involved in aspects of *argumentation*, where the end result is a set of small group decisions, or a consensus decision made by the class as a whole. The actual decision is not, in itself, as important as the justifications put forward, but can be expected to comply with social values accepted by the local society as a whole.

SUMMARY

This chapter provides answers to two fundamental questions:

a. What is context based teaching?
b. What is a socio-scientific issue?

It also introduces STL and the role of science in science education

FURTHER READING

In the 2nd International Handbook of Research on Science Education (2012). **(**Eds.). Barry Fraser Kenneth Tobin Campbell J McRobbie. Dordrecht, Heidelberg, London New York: Springer.

- *Learning Science through Real World Context* by Donna King and Stephen M. Ritchie (pp. 69–79)
- *Argumentation Evidence Evaluation and Critical Thinking* by Maria Pilar Jimenez-Aleixandre and Blanca Puig (pp. 1001–1015).

NOTE

[1] Stimulate students through the relevance of the learning situation, issue or concern.

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