Proceedings of

One day Teachers' Conference on

"Encouraging and supporting students' thinking in the learning of science"

Saturday, 6th February 2016

Gujarat Bhavan, Vashi, Navi Mumbai - 400703

Organised Jointly by

Navi Mumbai Science Foundation, Vashi

In Association with

Shree Gujarati Samaj, Vashi

&

Maharashtra Academy Of Sciences (MC)

Science Utsav 2016

Late Professor Chitra Natarajan (1954-2015)
An Humble Tribute to an Humble Soul

Navi Mumbai Science Foundation (NMSF) considers itself honoured while acknowledging the support it received from her during short interactions it has had while conducting one-day event "Teachers' Conference" during the years 2013, 2014 & 2015. The seeds of teachers' Conference", which is part of NMSF's bigger two-day event "Science Utsav", were sown in the year 2012, under the guidance of Prof. Jayashree Ramadas (present centre director, HBCSE). Next year onwards, due to limited availability of Prof. Ramadas, the responsibility of nurturing the year old sapling was taken up by Professor Chitra Natarajan, despite her deep involvement in several other events & projects.

It was during these interactions, that we came to know about her and her personal qualities. No amount of words can describe all the facets of her charming personality and life as experienced by us at NMSF. She always had something more to contribute and enlighten us further in any area of our scientific endeavour related to the field of "EDUCATION", and specially those related to school students.

In her passing away, we at NMSF have lost a dear friend and a vibrant guide. However, we are sure that her soul will always be around us in the hour of need and guide us intuitively. At our end we will continue to ensure that the 4-year old plant of "Teachers' Conference" prospers in leaps & bounds and adds stature to the image of the departed soul. Already the signs of this happening are visible. We now find teachers coming from places outside Navi Mumbai (like Thane, Santacruz, Ghatkopar, Bhiwandi & Pune, to mention a few) & taking advantage of the proceedings of the Conference.

(Members of NMSF)

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Navi Mumbai Science Foundation: Science Utsav 2016
One Day Teachers' Conference (TC-16)
on
Encouraging and supporting students' thinking in the learning of science

There is wide recognition across countries that education needs to prepare students for a changing society. National policy documents stress the need to move beyond rote learning and prepare students to be creative thinkers and doers. Many teachers are ready to take up the challenge and encourage creativity and thinking in their classrooms. This conference, organized by Navi Mumbai Science Foundation (NMSF}, is aimed at sharing experiences and ideas of how students' thinking can support science learning.

Description of the sub-themes:

1. Students' questions - a pathway to learning

Young children are full of questions that they are always throwing at adults. As children become older they stop asking questions, especially in school. This does not mean that they don't have questions. When teachers encourage them, students begin to think and reason. In trying to answer their questions or address their misconceptions and common doubts, through observation, experiment and discussion, students in the classroom learn as a group. Often teachers also learn something valuable. Are there such experiences that you can share from your own classroom? How did they lead to meaningful science learning?

2. Using students' out of school experience in science learning

Students from different backgrounds bring diverse experiences to the classroom. Some have experience of farming, some of small workshops, some of buying and selling, some have visited places, etc. Sharing these experiences and connecting them with science in the curriculum becomes a wonderful learning opportunity. Let us know of examples of connecting out-of-school knowledge and school learning from your teaching experience.

3. Encouraging "non-participating" students to participate in thinking

It is always a challenge to involve students in the back benches and to get them interested in participating in the classroom. Sometimes their non-participation is because their interests and questions are different. Their identity may be centred around activities that are different from classroom work, perhaps sports or art or craft. Connecting science learning with such interests can lead to their participation. Sometimes, encouraging them to contribute to on going discussion may lead to their participation. What experiences from your teaching related to this subtheme would you like to share?

4. Benefits of multi-lingual approach in science learning

Most students have multi-lingual capabilities - they can speak and understand two or more languages. Educationists are now nrlvocating the use of more than one language in the classroom to support learning, rather than restricting classroom interaction to a single language that the students may not be entirely comfortable with. Teachers in multi-lingual contexts have started using two or more languages in the classroom to encourage both the learning of science and the learning of scientific language. Have you found that such use allows students to develop better understanding and attitude to learning? We would like you to share such experiences.

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One day Teachers' Conference 2016

Program of the conference on 6th February 2016

9:00 - 9:30	Registration & Assembly
Plenary Session: 9:30 - 10:40 (70 min.)	Welcome Address & Introductory Remarks Dr. A. M. Bhagwat
	Observations/ Remarks by Dr. Aniket Sule & Dr. Sybil Thomas
	Preliminary Remarks on "Chitra Natarajan Memorial Lecture" Dr. R. Rajgopal Keynote Address (Chitra Natarajan Memorial Lecture) Prof. K. Subramaniam
	Vote of Thanks: Shri D A R Babu
10:40 to 10:55	Tea Break
Session 1 10:55 to 12:50 (115 min.)	Session 1: Chairperson: Dr. S. Kailas Part 1, Sub-theme (1): "Students' questions – a pathway to learning science" Presentations by invited speaker Dr. N. D. Deshmukh & Participating Teachers
	Part 2, Sub-theme (2): "Using students' out of school mathematics experience" Presentation by invited speaker Mrs. Leena Kulkarni & Participating Teachers
12:50 to 13:30	Lunch
13:30 to 15.00 (90 min.)	Session 2: Chairperson: Prof. Nagarjuna Part 1: Sub-theme (3): "Encouraging involvement of non-participating students" Presentation by invited speaker Mrs. Norina Fernandes (Mrs. Preethi Kumar) & Participating Teachers
	Part 2: Sub-theme (4): "Impact of language barrier on science learning" Presentation by invited speaker Ms. Meena Kharatmal & Participating Teachers
15:00 to 15:15	Tea break
15:15 to 15:55 (40 min.)	Session 3: Chairperson: Prof. K. Subramaniam Feedback Session: Inputs from the Floor Concluding Remarks by Dr. N. D. Deshmukh

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Contents

Encouraging and Supporting Students' Thinking in the Learning of Science

Keynote Address
by
Prof. K. Subramaniam
Homi Bhabha Centre for Science Education, TIFR

Engaging in a discussion with friends, looking at something from different points of view, raising questions and trying to answer them are inherently pleasurable for human beings. It follows that learning in the classroom is pleasurable when students engage with the lesson in an active and inquiring manner. Then, why is difficult to get students to be active, engaging and thinking in the classroom?

I will, argue that in fact, it is not difficult to get students to be active and thinking in the classroom. Once an initial barrier is overcome, once the teacher communicates that ideas, opinions and arguments are welcome, students are likely to start airing their views and thoughts. Many teachers may think that this is risky; it is like opening the floodgates to chaos in the classroom. In fact, this may be the underlying worry that stops many teachers from encouraging students to think and express their thoughts in the classroom.

This is a genuine worry, because teaching is a difficult and complex task. The teacher has the responsibility to ensure that as many students in the class learn as much of the curriculum and syllabus as possible. Distractions and side discussions can be costly in terms of time lost, and the teacher may find it impossible to cover the syllabus if too much time is lost.
So the question really is of how to productively manage students' thinking and expression in the classroom. How do we manage classroom discussion where students are expressing many views and opinions so that it does not become a distraction and merely time lost? How do we channel students' thinking so that it becomes an opportunity for everyone in the class to learn, and produces effective and powerful learning?

Three key factors are needed, in my view, to make this an actual feature of classroom learning in our schools. The first is a belief that students' ways of thinking are important for learning, even if their thoughts or methods are different from what is accepted in science or mathematics. This belief alone can open up the way for a different classroom culture to develop – one based on reasoning and discussion. The second key factor is the teachers' knowledge and confidence in subtle aspects of science and mathematics, which will allow her to manage the discussion even when it is going in different directions. The teacher needs to think flexibly and on her feet to manage the diverse thoughts that students have and push the lesson in the direction of the learning goals. It is very much possible for teachers to develop such knowledge and expertise. The recent literature on pedagogical content knowledge points to how this can be achieved. Finally, there is a need to build learning resources that teachers can use in the classroom to promote thinking and discussion. These could be in the form of tasks, lesson plans, questions for discussion, anticipations of student questions, responses, misconceptions, etc. I will provide some examples of how these have been managed in the teachers' professional community in India and elsewhere.

Handling of "Students' common errors & related doubts"

Invited Talk
by
Dr. Narendra Deshmukh
Homi Bhabha Centre for Science Education, TIFR

Introduction

The primary aim of science and mathematics education is to make students construct stable and meaningful organization of concepts in their frameworks. However, it should be stressed that students' prior knowledge is very important while constructing and organizing concepts. The researches of students' conceptions have become the mainstream after David Ausubel (1968) brought up the idea of 'how the preconception influences the learning of scientific knowledge'. According to Novak (1988), "the role of conceptions in constructing human knowledge has been enhanced in science education." From the time of Piaget, educationalists have been intensely involved in how students view the concepts of science, mathematics, and, programming. Since four decades, a significant body of research has focused on students' understandings of scientific phenomena (Duit, 2006).

Concepts are the most fundamental constructs in theories of mind. Concepts, as abstract units of meaning, play a key role in the development and testing of theories. Concepts help to integrate apparently unrelated observations and phenomena into viable hypotheses and theories, the basic ingredients of science. According to classical theory, most concepts are structured mental representations that encode a set of necessary and sufficient condition for their application, if possible, in sensory or perceptual terms (Laurence & Margolis, 2000).

Common errors or misconceptions

In science, the word "error" means the "uncertainty" which accompanies every measurement. No measurement of any sort is complete without a consideration of this inherent error. Errors explored in physics experiments are of two types. First type of error is random errors caused by unknown and unpredictable changes and second type of error is systematic errors which are caused by measuring instruments being used incorrectly or problem with the instrument itself. Various researches in education revealed that many students make common errors or hold many misconceptions or alternative conceptions during learning many concepts. According to Solomon (1983), most student ideas are fragmented and not logically integrated. However, if students have a lack of articulation of their alternative conceptions, it might mean that either the conceptions are rather weak, or that the conceptions are there, but students are not yet fully aware and do not yet have the terminology to express them.

Misconceptions are very different from the mistakes students make. Mistakes are not consciously made. Misconceptions are. Mistakes are made by a few, misconceptions are made by many and, repeatedly. Students can figure out their mistakes by themselves because mistakes are usually due to carelessness. They cannot do the same for misconceptions. Misconceptions are committed because students think they are correct.

The dictionary meaning of 'error' is the state or condition of being wrong in conduct or judgement. Error also means belief or mental state that does not conform to objective reality; where what is correct is actually incorrect and is actually correct. A simple definition of error is, doing the wrong thing when meaning to do the right thing. The synonyms for error are: mistake, fallacy, misconception, inaccuracy, blunder, fault, oversight, flaw wrongly, erratum, literal, etc. In the technical area the meaning of error is a measure of the estimated difference between the observed or calculated value of a quantity and its true value. Barrass (1984), wrote of 'mistakes' or errors, 'misconceptions' or misleading ideas, and 'misunderstandings, or misinterpretations of facts. Misconceptions, defined as 'incorrect interpretations or misunderstandings of an idea, concept, or process, are often a large part of students' prior knowledge and experience. Misconceptions are obstacles in meaningful learning of concepts. Misconceptions are not only observed in today's children or students – even scientists and philosophers developed and lived with many misconceptions in the past (Barke et al, 2009). Misconceptions are a bi-product of children developing their own connections as they experience science or mathematics in school and in the world around them (Hansen, 2005).

Most of the researchers use term 'misconception' for 'common error'; in this article also author is using 'misconception' for students' common errors and their doubt. As Driver and Easley (1978), point out, "the term misconception has been generally used in studies where students are exposed to formal theories and have assimilated them wrongly. It's very clear that misconceptions are faulty ideas that are based on incorrect or incomplete information, limited experience, incorrect generalizations or misinterpretations and are consistent with the student's intuitive understanding." Rosalind Driver and her colleagues in 1980 initiated studies on student misconceptions and have produced literature that is helpful to teachers and policy makers. Duit (2009) has recorded some 8400 studies across all areas of scientific learning.

According to the nature of learning problems, students misconceptions can be categorised as: i) informal ideas formed from everyday experiences which children bring into the classroom; ii) erroneous ideas developed during teaching due to lack of understanding; iii) wrong concepts propagated by teachers and textbooks. The Committee on Undergraduate Science Education (1997) categorized the students misconceptions as:

- Preconceived notions: forming an opinion prior to actual knowledge or experience.
- Non-scientific beliefs: from religious or mythical teachings.
- Conceptual misunderstandings: incomplete or over-simplified knowledge from previous science courses.
- Vernacular misconceptions: uncertainty about differences between the popular vs. the scientific use of words like work or theory.
- Factual misconceptions: falsities learned at an earlier time and retained.

School students come to the classroom with numerous misconceptions, that is, interpretation of various phenomenons, which differ, often radically from those accepted by the scientific community (Driver, 1989). Educators agree that prevalence of misconceptions among students not only presents a serious obstacle to learning in science and mathematics but also interfere with further learning (Novak, 1970). To promote effective and meaningful

learning, there is a need to identify the causes of such students' common errors or misconceptions and find ways to rectify them or prevent them from occurring.

Identification of students' common errors or misconceptions

In order to correct the students' common errors or misconceptions, these common errors or misconceptions need to first be identified so that the students can replace them with new information. Several studies have shown that it can be difficult to convince a student to give up a long held misconception unless the new concepts are more valid, more powerful, more useful, or in some other way preferable to their existing concepts. One way to identify and correct misconceptions is to assess the students' prior knowledge, keeping in mind that giving the student the 'correct' information will not necessarily cause them to abandon their misconceptions and adopt this new information.

There are a range of methods available for the assessment of prior concepts. The difficulty, for a classroom teacher, lies in finding an accurate and reliable method which is not too time consuming. There are many methods for determining conceptual understanding and misconceptions such as, Open-ended questions, two-tier diagnostic test, concept mapping, prediction-observation explanation, interviews about instances and events, interviews about concepts, drawings, fortune lines, burr diagrams, and word association, questioning techniques, essays, two-tier multiple choice instruments, etc. Potential methods for identifying students' misconceptions are plays significant role. Interview is a widespread technique used to identify students' misconceptions because; interview is to tease out the students' meaningful understanding of a particular concept. The diagnostic instrument including true/false type questions, Concept Evaluation Statement, Proposition Generating Task, and writing essay also used to assess students' understanding of a particular topic. In addition, combinations of these methods have been utilized by many researchers to identify misconceptions. Nowadays, in the science, concept maps, V diagrams, clinical interviews, portfolios and conceptual diagnostic tests, etc are using as new assessment strategies to encourage meaningful learning and conceptual understanding (Deshmukh, 2015).

A search in the literature reveals that textbook, reference books, teachers, language, cultural beliefs and practices are some of the principal sources of high school students' misconceptions of many science concepts (Soyibo, 1993). Students hold misconceptions that are developed before and during their school years, and these misconceptions may be compounded by daily life experience, use of everyday language in a scientific context, compartmentalization of concepts, teaching strategies, and textbook. According to Storey (1992) the occurrence of misconceptions by students is textbook, which include many errors and incorrect information. In many textbook, many concepts are interrelated and they are keys to understanding other concepts. Therefore, not only lack of integration among topics but also in appropriate presentation of topics in textbook influence students' further understanding. Some of them rooted in everyday experiences. Many terms in science, mathematics and other subjects are used in an alternative way in daily life, for this reason, some misconceptions may arise from the use of words that mean one thing in everyday life and another in a scientific context such as heat, temperature, climate, fraction, area, chunking, food, respiration, and energy, etc.

Examples of students' common errors or misconceptions

Research has long documented that people of all ages – elementary school children, college students, and adults hold misconceptions or made errors. Here below are examples of some common errors or misconceptions from science, mathematics, language, etc.

a. Day and Night: Baxter (1989) identified six ideas about day and night and showed that students tend to move through these ideas as they get older:
   - The Sun goes behind hills.
   - Clouds cover the Sun.
   - The Moon covers the Sun.
   - The Sun goes behind the Earth once a day.
   - The Earth goes around the Sun once a day.
   - The Earth spins on its axis once a day.

b. Other misconceptions about day and night include:
   - The Sun moves across the sky.
   - The Earth rotates in a clockwise manner.
   - The Sun travels around the Earth.
   - Seasons Misconceptions
   - Earth is closer to the Sun during summer and farther away during winter.
   - Seasons happen at the same time everywhere on Earth.
   - Seasonal characteristics and change are the same everywhere on Earth.

c. Some of the common mistakes students do while solving problems in physics:
   - Applying conservation laws wrongly.
   - Applying formulae in mechanics wrongly.
   - Remembering only the important formulae and not the exact meaning of variables.
   - Not knowing the limitations of the formulae.

d. Mixing units: The most common error made in solving physics problems involves mixing the units from one system with another system.

e. Getting refraction angles wrong: When you deal with refraction problems, make sure you get the angles right; they're measured with respect to a line perpendicular — called the normal — to the interface from one medium to the other. Many people incorrectly use the angle between the ray of light and the interface between the two mediums.

f. Plants: Elementary school children think of plants as nonliving things.

g. Gravity: Heavier objects fall faster than lighter objects. Many students learning about Newtonian motion often persist in their belief that heavier objects fall faster than light objects.

h. Subtraction: When subtracting from 0 (when the minuend includes a zero), there are two subtypes of misconceptions:

307	856	606	308	835
-182	-699	-568	-287	-217
285	**157**	**168**	**181**	**618**

i. Multiplication of decimals:
   Example: 0.3 X 0.24 ; Correct Answer = 0.072;
   Misconception answer: Multiply 3 x 24 and adjust two decimal points. 0.72.

j. Langauge: A correct understanding of language includes the knowledge that language can be used both literally and nonliterally. The misconception is that language is always used literally. Many elementary school children have difficulty understanding nonliteral or figurative uses of language, such as metaphor and verbal irony. The

correct understanding of poems includes the notion that a poem need not rhyme. Misconceptions are that poems must rhyme.

Dealing with students' common errors or misconceptions

Avoiding students' misconceptions at school level is a real challenge for teachers, curriculum planners and developers. Fisher and Lipson (1986) suggested that errors in learning provide a window through which glimpses of mental functioning can be obtained. Errors are valuable and normal occurrences in the process of learning. A student can use his/her errors to develop a deeper understanding of a concept as long as the error can be recognized and appropriate, informative feedback can be obtained. A safe, non-threatening, and nonpunitive environment which encourages dialogue helps students to express their conceptions and to risk making errors. Pedagogical methods that systematically address common student errors produce significant gains in student learning.

Overcoming misconceptions is crucial for student learning. Researches on students' conceptual misunderstandings of natural phenomena shows that new concepts cannot be learned if alternative models that explain a phenomenon already exist in the learner's mind. Clement (1982), proposed two steps to modify students' preconceptions: i) students need to be encouraged to articulate their ideas and to use them to make predictions; and ii) students are encouraged to make explicit comparisons among their preconceptions, accepted scientific theories, and convincing empirical observations, to see which theory makes the most consistent and accurate predictions.

If misconceptions are not detected and corrected immediately; students' subsequent learning gets adversely affected. These deep-rooted misconceptions are major learning problems and continue to impact further learning process in schools. An important part of teaching is discovering how students make sense of course topics and using this knowledge to plan instruction that helps students recognize and change their misconceptions. Many researchers believe that students overcome misconceptions by recognizing and replacing them. Various instructional methods and remedial materials can be used to promote meaningful learning and to eliminate or prevent students' misconceptions. Research shows that the initial intuitive ideas become so deeply rooted in the student's mind that they continue to exert an unconscious control over mental behaviour even after the child has acquired formal notions of the idea that are solid and correct (e.g. Fischbein et al, 1985). Students' conceptual frameworks develop from their experiences and change as they mature. However, frequently their intuitive understanding of the world around them does not agree with the scientific explanation. It is important in planning instruction to know how these misconceptions differ from the scientific explanation, and why students construct these ideas. According to Vygotsky (1978), concepts that are acquired from everyday experience are closely related to real phenomena, but lack coherence, whereas those acquired in a school environment are coherent but are isolated from real phenomena by the context in which they are acquired. The purpose of instruction is to help bring these two together, so that concepts acquired from everyday experience could be integrated into a coherent framework, and those acquired from school instruction become applicable in everyday situations.

Some 'constructivist' approaches recommend using students' existing ideas as an explicit starting point for developing new learning. Learners require extensive and deep, meaningful

learning for the new, correct knowledge to come to mind. According to Perkins and Simmons' (1988) deep understanding involves four inter-locked levels of knowledge and teachers need to address all four: 1. Content: recalling facts, using vocabulary; 2. Problem Solving: strategies, self-regulation; 3. Epistemic: explaining rationales, providing evidence; and 4. Inquiry: critical thinking; extending and challenging domain-specific knowledge.
Rosalind Driver (1983) advocates a constructivist pedagogy which begins at the level of the individual learner, with student preconceptions. Students are encouraged to develop their models, step by step, alongside their experiences. The role of the teacher is to intervene, to pose questions, challenge the students' models, and guide them to a better understanding. Teachers are encouraged to look at the models embedded within student observations or questions, and become skilled at drawing these out. The teacher is thus a diagnostician, whose job it is to understand the learner's misconceptions and guide them to a superior understanding. These research findings provide researcher with knowledge base related to students' cognitive processes.

Discussion

As Charles Darwin quote suggested that, "False facts are highly injurious to the progress of science, for they often endure long; but false views, if supported by some evidence, do little harm, for everyone takes a salutary pleasure in proving their falseness; and when this is done, one path towards error is closed and the road to truth is often at the same time opened." Studies related to the students' conceptions are being conducted seriously all over the world. Deshmukh (2007), conducted a study to find out misconceptions of students about biological concepts such as respiration, reproduction, circulation, photosynthesis, nutrition, excretion and classification of living organisms, observed that students had many misconceptions and displayed an anthropocentric view about these biological concepts. He found that teachers had misconceptions about respiration, photosynthesis, nutrition, human blood circulation, reproduction, excretion and classification of living organisms. The textbooks analysis finding revealed that textbooks content had many errors in text and diagrams, illustration are not appropriate. This study also found that, textbooks and teachers were the sources of students' misconceptions. Researcher found that at the school level many complex and difficult concepts, such as photosynthesis, circulation, respiration, excretion, explained by providing correct notions and their fine elaboration of each concept and sub-concept, inter-relating the various concepts and sub-concepts and hands on activities approach was effective approach for remediation of students' misconceptions and helped students to correct concept formations (Deshmukh, 2012). Activity based or Inquiry based method may help in remediation and in bringing about conceptual change among students. Activities and questions have to plan in advance so teachers target their students' misconceptions. Ray & Beardsley (2008) explored the inquiry-based 5E (engage, explore, explain, extend, and evaluate) learning model and found that activities which incorporated different teaching styles engaged students with varied interests and were significant to overcome the students' misconceptions. The author, based on his experience in science education considered that confronting the misconceptions of the students through discussion, visual representations of concepts, and active involvement of students in learning through hand-on experiences enhances understanding. The proper sequencing and organization of the activities may help the students in overcoming the misconceptions and also learning the scientific concepts correctly. There should also be emphasis on history of

science and importance & growth of science as a science to personal life of students for contextualizing biology education.

Conclusion

Considering the purpose of this teacher conference and from this article teacher will understand:

- what errors pupils will typically make
- how and why children make (these) errors
- how to help pupils to resolve such misconceptions.

As a teacher we all are aware the fact that our students are often making mistakes in classroom. The real question is why they make these mistakes? We must interpret these mistakes in terms of a theory - a learning theory. As teachers, all our interventions in the classroom are guided by some theory - be it conscious or subconscious - of how students learn certain concepts in classroom. Different teachers have different learning theories and addressing students' mistakes in different ways. Teachers need to be aware of potential misconceptions and errors which may arise when students are learning specific concepts. As Olivier (1989), pointed out that, the knowledge does not simply arise from experience, it arises from the interaction between experience and our current knowledge structures. From a constructivist perspective misconceptions are crucially important to learning and teaching, because misconceptions form part of a student's conceptual structure that will interact with new concepts, and influence new learning, mostly in a negative way, because misconceptions generate errors. If teacher want to account for students' misconceptions, they must look at students' current schemas and how they interact with each other, with instruction and with experience. We have to understand the general principles of cognitive functioning from a constructivist perspective and we have to realise that, for the most part, students do not make mistakes because they are stupid - their mistakes are rational and meaningful efforts. As a teacher we have to find out the root/origin of students' common errors or misconceptions. Teacher need to discuss, communicate, reflect, and negotiate of meaning are essential features of a successful approach to deal with students common errors and misconceptions.

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Encouraging and Supporting Students' Thinking in the Learning of Science

Shilpa Patil
Green Finger Global School

Today's children are growing up in a world where science and technology are integral parts of their everyday lives and the careers that await them. Children are full of wonder about the world around them. Capture these interests and help bring them to life ……of SCIENCE.

Science is a way of understanding the world, a perspective, and a pattern of thinking that begins in the very early years "What would happen if …?" questions or present brainteasers to encourage children to be inquisitive and seek out answers. Children need to know that science isn't just a subject, but it is a way of understanding the world around us.
They should be instilled by the questions like

- What causes gravity?
- How do our brains store memories?
- How do water molecules interact with each other?
- The table salt, NaCl, which we eat, made of Na (sodium metal) which is highly corrosive and reactive metal and chlorine gas which is highly poisonous gas both the things come together to give us Salt, which we eat isn't it surprising?

We should lend a hand to find out those answers and eventually students would start thinking coherently.

It has been perceived that children, learn better by investigating and experimenting. It can be quite difficult to get students to be interested in science when your only resource is a textbook. The best way to spark interest in science is to bring it to life with exciting experiments. Younger students will be memorized by glowing water, or how specific items float or sink whereas the older crowd will benefit from observing a mock crime scene. When students "do" science they are more apt to be excited about it.

The word "science" probably brings to mind many different pictures: a fat textbook, white lab coats and microscopes, an astronomer peering through a telescope, a naturalist in the rainforest, Einstein's equations scribbled on a chalkboard, the launch of the space shuttle, bubbling beakers. All of those images reflect some aspect of science, but none of them provides a full picture because science has so many facets:

- Being science teachers it's a duty of all to inculcate the importance of science into students mind.
- Science is a process of discovery that allows us to link isolated facts into coherent and comprehensive understandings of the natural world.
- Science is exciting: Science is a way of discovering what's in the universe and how those things work today, how they worked in the past, and how they are likely to work in the future.
- Science is ongoing: Science is continually refining and expanding our knowledge of the universe, and as it does, it leads to new questions for future investigation. Science will never be "finished."

- Science, a study of hands-on experimentation and discovery, but still had been confined to textbooks and worksheets.

In designing curriculum and teaching hands-on labs, we should give the importance of allowing students to experiment for themselves. Demonstrations with a big "Wow" factor always proved successful. The "Wow" factor: an explosive, loud, or colorful reaction shows students that science is visible, fast-paced, and exciting.

Talking about Out-of-school learning is also an educational concept. The point of out-of-school learning is to overcome learning disabilities, development of talents, strengthen communities and increase interest in education by creating extra learning opportunities in the real world. It is now widely accepted that in order to improve student learning in science, we must acknowledge and understand the impact of out-of-school learning as well as learning that occurs in the classroom.

The element of surprise is also important. It is perceived that students are more excited to conduct the chemical reaction when they didn't know what to expect, allowing students to wonder why the reaction occurred, rather than concentrate on whether they got "the right result." Additionally, experiments that focused on science applications in everyday life—such as the "Household Acids and Bases" lab—shows students that science is relevant, and encourage students to ask scientific questions about the environment around them.

Encouragement is like oxygen to students so we should instill students for the participation in science projects as well as, hands-on science needs to become more accessible, students should be given autonomy in conducting experiments, and students need to feel supported and confident as they enter what some may view a daunting field. The process of doing hands-on science experimentation and research is one that brims with excitement and possibility, a kind of magic that often ends up suppressed in traditional textbook-based education.

I envision classroom environments that ignite interest in science by entrusting students with the design of their own projects and by introducing students to advanced laboratory techniques. This can be accomplished by mandating that science fair projects are included in school curriculum, providing students with science mentors, demonstrating to students that science is applicable to everyday life, and—most importantly—emphasizing the idea that the only prerequisite for science is curiosity

Understanding of science and technology is necessary not only for students, but also for any citizen who wishes to make informed choices about issues ranging from stem cell research to global warming to genetically modified organisms to teaching the theory of evolution in schools. And new issues are bound to emerge in the years to come. Science is a global human endeavor, which is unbounded.

Students' Questions and Diverse Experiences: A Potential Resource for Teaching and Learning

Sanchita Jadhav and Vipinkumar Yadav
Terna Vidyalaya and Junior College

Abstract: *Good science education is true to the child, true to life and true to science. The purpose of this paper is to emphasize on the paradigm shift brought about in learning science by stimulating investigative ability, inventiveness and creativity among the learners. The paper shows a study undertaken by the authors to highlight the role of students' question and diverse experiences strengthened by multilingual context in meaningful learning and scientific inquiry thus fueling scientific temper among students. A study involving 100 students from grade 11 of higher secondary concluded that considering diverse group of learners and multiple intelligences the teacher as a facilitator should understand the needs of diverse group of learners and engage the learners in acquiring the methods and processes that lead to generation and validation of scientific knowledge and nurture the natural curiosity and creativity of the child thus stimulating investigative skills and inventiveness among the students.*

Questioning is an integral part of meaningful learning and scientific inquiry. The formulation of a good question is a creative act, and at the heart of what doing science is all about. As Cuccio-Schirripa and Steiner have stated, 'Questioning is one of the thinking processing skills which is structurally embedded in the thinking operation of critical thinking, creative thinking, and problem solving'. Moreover, as we will show, students' questions play an important role in the learning process, as they are a potential resource for both teaching and learning science. Out of school experiences collaborated with in school learning stimulates investigative questioning skills among learners and supports and strengthens inventiveness and creativity among them. But for those learners who could not benefit from peer interaction and have difficulties in associating out of school experiences needed multilingual context in learning of science. Learners with semantic learning ability are benefited with discussion and write up of problem solving model in the context of using two or more languages especially local language playing an important role in understanding the learning of science and scientific language. This problem-solving model suggests that teachers encourage their students to progress through different forms of language. In the model the casual / informal language of students, and the corresponding contexts with which they are familiar, and within and from which their language draws its meaning, are used by the teacher to begin a discussion of a concept, problem or issue. As the discussion progresses, students are encouraged by the teacher to move from the casual / informal to a more structured standard form of scientific language.

In a study based on visit at a river cleaning drive conducted by Terna Vidyalaya and Junior College on Gadi river at Panvel in collaboration with German students of Rubey Kemp, Schulzentrum, Bremen, Germany where the students investigated the effects, causes of biological parameters for assessment of water pollution. They tested the evidences of pollution content by conducting BOD, COD test and PH value of water. The response of the students to the questionnaire based on river cleaning activity provided by the authors

concluded that 10% of students were able to frame questions and doubts from the observation they made, 60% of students benefited from peer interaction and doubts raised by peers whereas 75% of students could collaborate out of school experiences in the in-school activities .An average of 10 % students who had difficulties in learning through peer doubts and interactions were interviewed and were provided with write up of problem solving model in the context of using two or more languages especially local language used by the teacher to begin the discussion of the concept, problem or issue. As the discussion progress, students were encouraged by the teacher to move from the casual / informal to a more structured standard form of scientific language.

Through this paper it is strongly recommended that the content, process, language and pedagogical practices of discovering and learning science should be within the cognitive reach of the child enhancing their investigative ability and inventiveness.

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Active Learning in Science

Dr. Vini Sebastian
St. Xavier's Instute of Educaiton

The Merriam Webster Dictionary defines Science as 'knowledge about or study of the natural world based on facts learned through experiments and observation'. If we follow this definition and we examine what is happening in the teaching of Science then we can say that we do teach science through experiments and observation but we keep our students away from the real world. What meaning is there in the Science learning if it does not cater to the real natural world or if it does not relate to the natural world.

Every student of science therefore must learn how Science is useful to them in their daily living and how the concepts can be applied to the real world. Schools must therefore expose the students more to the natural world rather than restrict them to classroom learning. There are two perspectives to this- one is when the curriculum is related to the environment outside the textbook and the second is when the children bring in their own personal experiences to the class.

It is however natural that when the teacher is teaching in the class the child relates to his world, his context and when the new information does not fit into his context he wants to question. At this point of time if the teacher says that the questions are not welcome then the student is demotivated and that information moves out of his frame of reference as it doesnot fit in his schema. Children come to class with a myriad of ideas which they find conflicting with scientific principles. The inquiry based learning encourages as many questions as possible from students in order to quench their thirst for knowledge. There are various methods that promote inquiry based learning. The methods are project method, problem solving method and problem based method.

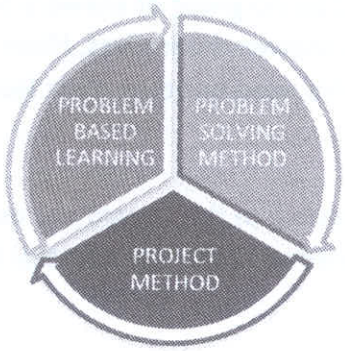

Fig 1: Methods of Teaching related to Inquiry based learning.

The above methods promote active learning in Science, where students can explore their thinking, do self analysis, question their own perceptions about things and present their thoughts in a systematic manner.

The media can be a good source of learning for Science. Nowadays it is seen that children are so much with technology. Technology can be used for inquiry based learning. This kind

of learning is seeking knowledge and information through questioning. The topic force could be started with a newspaper article on a natural calamity like earthquake which has taken place in Japan. Then the teacher looks for concepts- Definition of Force, Types of forces – Gravitational force and any other. Ask students to raise questions if any. This will be followed by generating student resource, discussion and the teacher pitching in wherever required. The students can then apply the concepts to new situations.

Sometimes students have so many questions on their daily experiences. For eg: Why does the milk boil over? Where does the sun go? How do we get seasons? . Teachers must encourage such questions in the class and conduct a discussion for the same. This will not only develop interest in the student but also make them aware that science is all around them.

All schools have a lot of co curricular activities. Teachers can highlight the Science in organizing and conducting these co curricular activities. For eg: If the school is conducting an "ANNUAL DAY" a lot of science concepts could be covered incidentally. The concepts like sustainable development, area, sound, light etc.can be covered. Teachers have to be alert and open to reasoning out when student express their curiosity.

The planning, organization and execution of a programme can all have Science in it. The role of the Science teacher then will change to a 'Mentor in Science'. She will be using the 'Follow Through' experience rather than just being the classroom teacher, where she has a well defined job. A change in role would require the teacher to be friendlier in nature, patient and calm with the students. She must not consider her role as a provider of all answers to quench the student's thirst for knowledge but consider her role as to provide more thirst for knowledge.

The answers to problems are the end of the quest for knowledge. Teachers must delay in giving answers, in fact there should be no giving of answers to the students. Students must learn to inquire and search for the answer themselves. Most of the time the situation itself consists of the answers that students need but they must learn how to get it and analyse it for their advantage.

Science is not science unless it is tested; in this regard the out of school experience can provide them a stimulus for demonstrating their conceptual knowledge in Science.

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Students' questions – a pathway to learning

Seema Vickyraj
Euro School

What is learning?

Learning is a process of gaining knowledge or skill by studying, practicing, being taught, or experiencing something. It is a permanent change in behaviour that breeds hope. It reflects adaptation to the environment. However, what is most important is the ability to learn and any method that can enhance this ability will make learning simpler.
Every teaching methodology will lead to learning. However, an effective teaching methodology is the one that engages students in the learning process and helps them develop critical thinking skills. This indeed depends on the interaction between teacher and learners, the most important feature of a classroom.

Questioning leads to learning-

Learning is all about asking questions and finding answers to them. Questioning helps us learn, explore the unknown, and adapt to change. Questioning is a methodology that helps the learners as it encourages interaction and focuses their thinking on key concepts and ideas. Questioning is fundamental to successful communication. It enables teachers to check students' understanding as well. The ability to ask questions is essential for academic achievement. Students who learn to ask their own questions consistently are more engaged, take greater ownership of their learning, and learn more.

Questioning is thinking-

Thinking is not driven by answers but by questions. It is the questions that fuel and drive ones thinking. Questions are one of the most powerful tools for building learning environments and promoting successful performance. Questions define tasks, express problems and delineate issues. Answers on the other hand, often signal a full stop in thought. Only when an answer generates a further question does thought continue its life as such. Students who have questions are really thinking and the questions they ask determine where their thinking goes. A student asking a question is at that moment a self-motivated learner.

Socratic Questioning-

There is a special relationship between critical thinking and Socratic Questioning because both share a common end. The art of Socratic questioning is important for the critical thinker because the art of questioning is important to excellence of thought. Critical thinking gives one a comprehensive view of how the mind functions and Socratic Questioning takes advantage of that overview to frame questions essential to the quality of that pursuit. The use of Socratic questioning creates an active classroom where learning is student centred and inquiry-based.

Encouraging questioning-

Many a times students tend to feel a little foolish when asking questions. With my four years of teaching experience, I easily recollect students who would always mention before asking a question that "Ma'am I have a question but I feel it is stupid."
It is very important to encourage questions constantly and the best technique to do that is to always answer questions kindly.

To encourage questioning a teacher must:

- Create an environment where questioning becomes a strength, where it is welcomed and desired.
- Show them how to use the 'Why/What if/How' sequence of questioning as a fun.
- Praise the question.
- Make questioning a habit.

A teacher learns too-
While teaching the concept of water cycle in grade 7, I remember before I began with the topic, there was a question rose by one of the students that "When there is water cycle, we know water will not get over then why should we save water?" The question disclosed what was going on in the mind of the questioner. It also shows up the questioner's prior knowledge. It points to an enquiring mind. Asking a question usually leads students to new and deeper knowledge.

Students' questions have a great impact on teaching as well. Their questions are an immediate feedback to know whether the concept is understood or not. Also, when students' questions are answered appropriately, their confidence in their teacher increases. While answering students' questions, a teacher learns too. It helps a teacher to improve the teaching strategies for future lessons and the student-teacher relationship becomes responsive. Thus it is very important that questioning must be nurtured.

Questioning and society-
Today's students need critical thinking and problem-solving skills, which can be enhanced by encouraging them to 'Question the Answer.' Learning should transform students into informed, engaged, experienced, positive individual who can make the difference they seek to make in the society. Students' questioning can enhance this aspect of learning. When students question, they learn the skill of social inquiry to help them in becoming purposeful and tolerant. Questioning helps students to investigate the world, consider a variety of perspectives, communicate ideas, and take meaningful action.

To guide students on the learning process, we must stimulate it with questions that lead the students to further question.

Students' Questions – A Pathway to Learning

Brijmohan Naidu
Podar International

"There is always a brighter mind in frequent questioner but there is the brightest mind hidden in a student who never asks."

Science is an art of understanding the events and happenings all around us. It is not a particular subject and should not be made limited to it. Science tells us every detail of largest body in the universe to the smallest individual particle atom and even the particles inside it. The way you sit, stand, walk, speak, etc. Everything is science. Chemistry is eating food, Physics is chewing it and Biology is its digestion. We never take these small events into our consideration. The students also are not aware about these events. Science is a topic of research in every day's activity and for research you start to know the unknown and for the unknowns you are required to question. A person who debars from asking creates a cloud of doubts which are never solved. This creates the gap between the student and the subject. Once the interest is over they try to run away from subject which is not only a loss for the subject but also for the development of intellectual minds which in turn is a loss for society. Teachers tend to explain every details of the chapter in the book provided to them but most of times it is seen that the subject has a broad view than only what is printed in the book. Like for example we say that light travels in a straight line but actually it doesn't so imparting this knowledge in students is essential. When teachers with explanation it is necessary that they also create room for questions and doubt clearing sessions so that pupils are able to analyze, visualize and apply the concepts in real world. It is often seen when the topic is being explained students tend to have more doubts and ask more questions during the lecture. In a hurry to complete the chapter teacher avoids questions from students and continues with the teaching process. The concepts which are not understood remains as confusion for the student which is also one of the reasons for students lacking interest in the subject.

Every topic or a lesson must start with a question from the teacher and students must be asked to find out. A time frame must be allotted to the students depending upon the understanding the topic requires. The question must be framed in such a way that student understand what they are asked without giving the exact answer.

Making a room in between the delivery of lecture for discussion session of Why's and How's creates entertaining environment in class and instead of just listening to the monotonous voice of the speaker they also participate as the speaker. The teacher must use the policy of no hands to be raised and ask questions randomly avoiding answers from same students. The flow of student should not always be like teacher student teacher, it can be modulated as the teacher asks one question and student A gives the answer for which student B asks for explanation and Student C explains it and so on. Each student must not interrupted by other student or the teacher when he/she is trying to question or explain the

concept. This will not allow non speakers to open up and must be avoided as much as possible.

Evaluating on the basis of the answer teacher should never rank anyone on the question asked. All questions and answers must be appreciated even if it is not related to the topic. Once the questions will be appreciated the bar of questions will increase which in turns result in improved understanding. Students will tend to think faster and broader than just adhering to the book.

A wonderful quote on Albert Einstein's poster was that he too asked question so it should be inculcated in students that even the brightest man had doubts and the degree of doubts is never low or high it just shows how deep your thoughts are. The teacher should avoid judging the level of students' question. This will not only improve the standard of thinking but also create a room of researchers. Making students ask question also tests the knowledge of the guide or teacher as sometimes the question is way beyond their level but answering them becomes a challenge. Certain times the question is too basic but explaining the logic behind it tests the wits of the guide. Questioning is also a way to answer certain aspects than just giving out answers.

"*I never learn anything talking. I only learn things when I ask questions*" –Lou Holtz

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Using Students' Out-of-school Experience in Science Learning

Invited Talk
by
Mrs. Leena Kulkarni
Vice Principal, Dr. Antonio da Silva High School

Children are born with certain biological capacities for learning. They can recognize human sounds, can distinguish animate from inanimate objects, and have an inherent sense of space, motion, number, and causality. These raw capacities of the human infant are actualized by the environment surrounding a newborn. The environment supplies information, and equally important, provides structure to the information, as when parents draw an infant's attention to the sounds of her or his native language. Thus, developmental processes involve interactions between children's early competencies and their environmental and interpersonal supports.

Learning is promoted and regulated by the children's biology and their environments. The brain of a developing child is a product, of interactions between biological and ecological factors. Mind is created in this process. Students do not come to school as blank slates to be filled with instruction. Rather, they come to school with considerable knowledge, some correct and some not. Either way, that knowledge is based on intuition, everyday experience, as well as what they have been taught in other settings.

A major goal of schooling is to prepare students for flexible adaptation to new problems and settings. Students' abilities to transfer what they have learned to new situations is very important. Students develop flexible understanding of when, where, why, and how to use their knowledge to solve new problems if they learn how to extract underlying themes and principles from their learning exercises. Understanding how and when to put knowledge to use—known as conditions of applicability—is an important characteristic of expertise. Learning in multiple contexts most likely affects this aspect of transfer.

Science is a way to teach how something gets to be known, what is not known, to what extent things are known (for nothing is known absolutely), how to handle doubt and uncertainty, what the rules of evidence are, how to think about things so that judgments can be made, how to distinguish truth from fraud, and from show.

Identifying the relations between science and daily life as a method for understanding science enables students to associate the knowledge gained in classrooms with out-of-school experiences. Associating science classes such as chemistry, physics and biology with daily life is not only a strong teaching strategy for teachers, but also an approach that contributes significantly to a meaningful and lasting learning experience.

> Example: when we teach about 'Digestion in human body' the students can be asked to share their experiences about: result of eating very spicy, oily food, also weakness, feeling of acidity when not eaten for a very long time. Then importance and reason for feeling thirsty. Many more topics wherein the students can relate to

their own experiences. This gives a better understanding of the topic they are learning. Concepts get cleared, and transfer of knowledge become easier

A key aspect of the new ways of teaching science is to focus on helping students overcome deeply rooted misconceptions that interfere with learning. School learning enables students to connect their "everyday concepts" to "scientific concepts." In other words, schools help students draw generalizations and construct meaning from their own experiences, knowledge, and strategies.

Knowledge that is overly contextualized can reduce transfer; abstract representations of knowledge can help promote transfer. All new learning involves transfer based on previous learning, and this fact has important implications for the design of instruction that helps students learn.

- Bringing exciting curricular based on real-world problems into the classroom;
- Providing scaffolds and tools to enhance learning;
- Giving students and teachers more opportunities for feedback, reflection, and revision;
- Building local and global communities that include teachers, administrators, students, parents, practicing scientists, and other interested people; and expanding opportunities for teacher learning.

This transfer of knowledge will be effective if there is collaboration between actual classroom learning and out of school experiences. If students do not practice and reinforce the things that they learn, it can be forgotten.

Science is a subject that needs to be taught by co-relating with every other subject. It goes hand in hand with Mathematics too.

The children know simple things like money exchange. This they have observed when with their parents either in the shops, vegetable vendors or travelling by public modes. They know they have to give money and can buy things or travel tickets. They do not actually know the calculations. This knowledge is enhanced in the school set up when they actually learn to add, subtract, multiply and divide. These are basic mathematical operations. As his school grade changes so does his knowledge.

Consider a lesson on Speed, Time and Distance: The students have a background of speed of a vehicle, as they travel using different modes. When he has to calculate the speed of a vehicle per Km, he applies his mathematical knowledge and also his experience. He knows faster the vehicle goes lesser is the time needed. This is now very well learnt when he travels next time.

Similarly this knowledge is also applied when he has to learn about when a wall is being painted or built. More the people working lesser are the number of days. This knowledge he

learnt theoretically can be applied when work is being done in his own house or in the neighbourhood.

Look at another very common example but an important one – physical as well as community hygiene: The child has learnt from homes that he has to take bath, brush his teeth twice, wash hands before eating etc. He only knows that this will wash the dirt away. Slowly he learns about germs, bacteria, viruses, contaminated food, water and their harmful effects. He relates this knowledge with his personal experiences of having undergone problems like loose motions, vomiting, viral fevers, etc. Also spread of diseases like Dengue, Malaria, Chickun-gunia, TB and many more. Thus, knowledge about clean surrounding and hygiene gets down his system.

Very useful example is that of Solar system. Children learn that Solar energy is an alternate source of energy that is inexhaustible. They learn in school about solar lights, solar signals, solar water heaters etc. When they travel they observe solar signals they correlate at the same curiosity increases , they try to get more details.

Many such examples can be incorporated while teaching learning Science. Using real life experiences misconceptions that set in fears can also to a large extent lowered and in some cases wiped out. The children can become more scientifically and practically oriented.

Thus, when those students who do have relevant experiences are given an opportunity to share them, the knowledge of entire group of students is enriched. Moreover, when students see that their experiences and knowledge are valued, they are motivated to listen and learn in new ways, and they are more likely to make important connections between their own learning and "school" learning. They become empowered, more observant and more alert when they are actually in the community.

Thus in short, outstanding teaching requires teachers to have a deep understanding of the subject matter and its structure, as well as an equally thorough understanding of the kinds of teaching activities that help students understand the subject matter in order to be capable of asking probing questions. Teachers need expertise in both subject matter content and in teaching.

The teachers should focus on understanding rather than memorization and routine procedures to follow, and they should engage students in activities that help students reflect on their own learning and understanding. Practicing teachers should continue to learn about teaching in many ways. Teachers should never forget that they are learners and the principles of learning and transfer for student learners apply to teachers also.

Using Students' Out-of-School Experience in Science Learning

Ms. Sudha verma
Terna Vidyalaya and Jr. College

"Thinking is a main gate to success"

Cognitive abilities like thinking; reasoning and problem solving may be considered to be some of the chief characteristics, which distinguish human beings from other species including the higher animals. Good poetry, a beautiful painting, or magnificent buildings are all products of the thinking, reasoning and problem solving capabilities of their creators and inventors.
"If one can think to learn new things, and by more & more learning process the thinking will be much better".

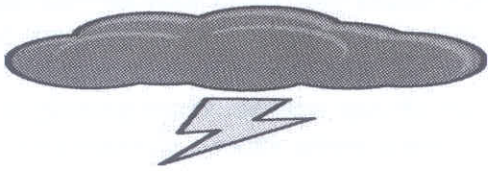
"Learning" –Learning is the acquisition of habits, knowledge and attitudes .It involves new ways of closing things and it operates on an individual's attempts to overcome obstacles or to adjust to new situations. It represents progressive change in behavior. It enables him to satisfy interest to attain goals. – Crow and Crow

Science is a systematic enterprise that creates builds and organizes knowledge is the form of testable explanations and prediction about the universe.
Science is a subject which is their in our surroundings, we use in our day today activities almost in everything breathing, walking; flow of blood in each and in everything science is present.

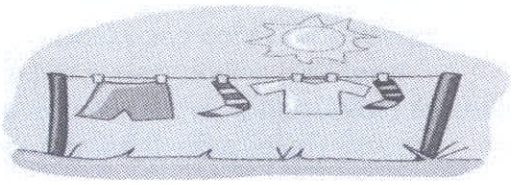
During learning process the important thing for teachers is to grasp the interest of the students, and their focus and most important alertness of their mind.

A for Apple, B for ball very common start for nursery or Jr. Kg. kids;
Do you know why?
Ball which they play every day, Apple in red colour again they saw almost every day in their life. Teachers, educationist uses these examples for their better understanding with interest. The greatness of science lies in the subject itself since its present in every bit of our surrounding. So teachers can take benefit of this in their teaching, they can take students experience as a tool for explanation of the new concepts. This tool first of all, takes the student interest towards the topic and they themselves relate with their experience, and easily they understand the science concept behind that.

For Example: 1) "The speed of light is much faster than the speed of sound". So we can relate it to thundering and lighting, where light we see first and then thunder sound reaches to our ears.



2) Concept of evaporation, which states that: - Evaporation is the process of a substance in liquid state changing to a gaseous state due to an increase in temperature; where we can give example of wet clothes which dry due to sunlight, because of evaporation.



3) Concept of seven color from white light (rainbow)

4) Inertia of direction, which states that, "The inherent property of a body by virtue of which it cannot change its direction of motion." For better understanding in textbook also some examples are given which are from day to day activities, which already students experienced, so with that examples they can understand the concept properly. That is while sharpening a knife, sparks fly off tangentially from the grinding stone.

5) And even for balanced force example of tug of war is given in textbook so student can understand the concepts that when force acting on both sides are equal, they are balanced.

Many more examples are there, which we as a teachers use in class, these all are experience of the students, which they already saw or felt. But the science behind that may or may not be known to them, by this kind of examples they can get long lasting understanding related to the concepts.

So, here we can conclude that out of school experience is a great tool of science learning. And for teachers it's a great tool of teaching too.

Encouraging and Supporting Students Thinking in Science Learning

Chaitra Gowda
Green Finger Global School

There are many ways to encourage students in learning. As teachers, we know that Science, Technology, Engineering and Mathematics are the wave of future. Each and every aspect of our life is either directly or indirectly based on science. We as teachers have an important role in promoting and finding out how to motivate students to excel in science.as we all know that today's children are tomorrow's citizen so by increasing student participation, we can ensure that the youth of today will have a bright and successful tomorrow. So here are few ideas that will help us to learn how to motivate students to enjoy science and to incorporate scientific methods in their lives.

1. Students' questions – a pathway of learning: Yes we all know that as the generations passes by children are born with more intelligence quotient and maturity as they grow they become more brilliant, when teaching and learning process begins they end up several doubts and queries but only few students come forward to clear their doubts but majority of students do not turn up this situation is may be because of hesitation and lack of interest towards clearing the doubts. So we teachers should handle this situation in a clever way by creating such an environment where students feel comfortable and more enthusiastic in clearing their doubts. Teachers should follow scientific method, new technologies like smart class and convert a rote teaching and learning process to an interactive session by encouraging students to interact and learn the concepts. Teacher should always motivate students by his/her friendliness so that students will develop their interest in learning there by rote learning is replaced by healthy interaction patience is all that matters for the healthy interaction.

2. Be a postitive role model: When students see a teacher he or she should feel that they have to become like their teacher this is possible only when teacher is passionate, knowledgeable and enthusiastic about science. Once if students consider you as role model then they start following your behavior, interest towards once if they start following your ideas and everything in each and every aspect of life they start approaching or reacting scientifically.

3. Using Studnets out-of-school experience: An essential element to turning students on to science is to show them how it's used in their daily lives. Science is behind the creation of their cell phones, tablets, and videogames—let your classroom explore and understand how this subject matter touches more in their day-to-day activities than they think. The best way to spark interest in science is to bring it to life with exciting experiments. Younger students will be memorized by glowing water, or how specific items float or sink whereas the older crowd will benefit from observing a mock crime scene. When students "do" science they are more apt to be excited about it. You can develop student interest in science by enhancing their natural curiosity and connecting science to their daily lives. To help students develop an even deeper understanding (and form questions of their own), we can create new explorative and creative opportunities to ensure that our students will be able thrive in the many years beyond their scholarly career.

4. Encouraging non-paritipcants to participate: It can be quite difficult to get students to be interested in science when your only resource is a textbook. Internet created a platform for teachers to learn the concepts more clearly and incorporate it in

classroom technology so that students who don't want to participate in anything will develop interest in participating. You can request science stations, iPads, computers, and such to help promote STEM education and get (and keep) students captivated. When these facilities are given to students slowly they start involving in learning and participating.

5. Provide learning experiences where students feel they can be successful: Set challenging but attainable goals and assignments (success within reach) Especially early in the course, help students experience success; for example, incorporate early, shorter assignments that account for a small percentage of their final grade. Encourage student choice in how to achieve a particular assignment or learning outcome. Let students know that you believe they can be successful – that you have set high expectations and you are confident they have what it takes to meet them.

6. Structure your course and each class to help students know what to expect: Use the syllabus to clarify what the student will learn, your expectations, and how the course will be conducted .At the beginning of class, explain the focus of the class and what they should be able to know and do by the end. Align what happens with this initial framing of the class. Close the class with a summary; provide opportunities for students to summarize by asking them to: Respond to clicker questions that gauge what they learned in class. Draw a concept map of what they learned. Write a one minute paper about what they have learned. Prepare students for future classes and other learning opportunities.

7. Some new ways of teaching

- Create a positive climate/community for learning where students feel supported
- Get to know your students. Learn students' names and create relationships with them a few at a time (e.g., feature students of the day, or invite the class to meet with you in their small groups)
- Craft specific opportunities for individual students to participate in the learning experience (e.g., feature students' work in front of the class, arrange for volunteers to come to the board or lead out in discussion).
- Promote social exchanges for learning among peers. Class interaction is livelier when the conversation broadens beyond just alternating between you and one person in the class.
- Make explicit that you (and TAs, etc.) are interested in their success, are available to support them, and have provided or pointed them to ample ways for them to get the help they need.
- Craft activities that encourage application of content to situations they will likely encounter Experts believe that in order for students to stay interested in science long term, they must be involved with the subject by fourth grade. You can nurture this attraction to science by making it fun and interesting—hands-on experiments and programs like Dragonfly TV combines interactive media with textbook knowledge for the audience.
- Along the same exploration track, you can create contests that encourage your children to use science to generate a design that may peak their interest. For example, most students love playing on their smartphones and tablets—challenge your classroom to create an app that they'd use every day. You could even turn this into a friendly, group competition. This opportunity may be just the motivator to keep them students interested in a Science.

Do. Explore. Learn.

Dr. Reeshma Suri
Avalon Heights International School

Tell me and I will forget, teach me and I will remember, involve me and I will learn.
- Benjamin Franklin

In the recent past there has been a lot of speculation about teaching methods and their impact. As a person who has been in this profession for more than fifteen years and having taught students of ages ranging from eleven to twenty years, I firmly believe in the words of Mark Van Doren-"The art of teaching is the art of assisting discovery". "Discovery requires realization, the realization that learning is an active process. We learn by doing. Only knowledge that is used sticks in our mind," says Dale Carnegie.

"Education is not the filling of a pail but the lighting of a fire." To add fuel to this fire we start our session in Biology class of grade 8 where we are learning the topic – Blood – the circulatory fluid in our body. Concepts to be learnt include components and function of blood, types of blood vessels, structure of heart, cardiac cycle, pulse, blood pressure, blood groups and blood transfusion. The lesson was planned so as to include kinesthetic ways of learning, real life experiences, games, videos and songs.

Students are first shown a short video on blood and heart structure. Students then weave a story or a song about the heart, its structure and function. The rhyming peg method is used as a trick for memorizing how many times a heart beats in a minute. They relate to the heart as a double story house where the two upper rooms belong to Mrs. Atria and the two lower ones belong to Mrs. Ventricle. They are encouraged to come up with short forms like TPMA (Tricuspid, Pulmonary semilunar, Mitral, Aortic semilunar valves).

A hopscotch showing heart chambers is drawn on the floor and the valves are marked. Students are told that you are blood. Now trace your journey through the heart hopscotch and announce your arrival at every standpoint, and thus comprehend the pathway of blood in the Cardiac cycle. Every child is given his turn on the heart hopscotch. Initially there will be mistakes, which the teacher has to guide and correct. After observing the pathway being followed repeatedly majority of the students are able to understand as well as recall the cardiac cycle easily. Students are asked to work with a squeezed ball to understand the effort that the heart muscles make every time they contract.

To include more real life experiences, the teacher walks in the class wearing a doctor's coat and stethoscope. This instantly builds up curiosity in the young minds. *Main bhi doctor* activity in class gives the students an opportunity to listen to their heartbeat-using stethoscope. The school nurse first measures the blood pressure using a sphygmomanometer in the class. The students then measure each other's blood pressure using digital sphygmomanometers provided in the class. They also measure their own normal pulse rate. They are then asked to dance to the heart song and stopped suddenly and asked to measure their pulse again. The cause of the difference in the pulse rate is then arrived at by investigative method. The idea is to not tell them but let them feel and discover. The joy of learning imbibed by the students by these methods leaves them with long lasting understanding and educators with the surreal sense of satisfaction.

The students play the game of dumb charades on functions and components of blood, which are pre-written on small chits. One representative from each team comes up, picks the chit and enacts the clue while the others try to guess it. Such techniques involve and motivate all the students and create a long lasting impression on the curious minds and generate a first-hand understanding about the concept.

These activities not only create holistic development in a student but also raise the curiosity level thereby increasing the questioning attitude of an individual. There is engagement of the students, collaboration as well as individual learning. Use of memory tricks and real life experiences in a supportive learning environment motivates all the students and ensures effective teaching. Asking them to generate worksheets, quizzes and puzzles further deepens the understanding of the concept. Such learner-centered approach shifts the onus of learning on to the students and makes them active participants in the process of education. The idea is not to teach them to study, but to inculcate the habit of learning. With the changing times, plenty of knowledge is available at the click of a button. The teacher's role today is that of a facilitator and a counselor, constantly propelling the students in the right direction and guiding them to filter knowledge, and thus, adapting to changing times. John Dewey has rightly said, "If we teach today as we taught yesterday, we rob our children of tomorrow."

I am not saying that it is going to be easy, but what I am trying to focus on is that it's going to be worth it.

Encouraging And Supporting Students' Thinking In The Learning Of Science

Mrs. Satyabhama V. Vishwakarma
Terna Vidyalaya and Junior College

Introduction

Science education needs to begin with immersion in the phenomenal world and out of this immersion questions arise that guides further inquiry. Science refers to a system of acquiring knowledge through a systematic and experimental approach. Science education should be discovery-based and open ended. It's not about memorizing facts or theories. In this approach, nature is the expert, the teacher is the guide and students are the apprentices helped by the guide to learn from the expert. The knowledge that arises is not knowledge disconnected from human experience; rather, it enhances our ability to understand the world we live in.

I strongly believe in the encouraging students by connecting the science to their everyday life and the technology which makes them eager to learn than the conventional method of teaching-learning. The best way to spark interest in science is to bring it to life with exciting experiments. Audio-visual and in hand experiences make the child eager to know and learn the subject.

Connect Science to Students' Everyday Life and Bring it to Life:

An essential element to turning students on to science is to show them how it's used in their daily lives. The students are more eager to know their vicinity and how the nature plays an important role in their life. As we know the science is a systematic knowledge of whatever we are having, whether it is materialistic or non-materialistic. We are gathering the information from our everyday life. Our experiences play a vital role in connecting them with science learning which can be used in the classroom teaching in a very effective manner. Whatever discoveries had happened that had happened only by relating the things which we are experiencing in everyday life.

Teaching of the subject chemistry from last 7 years, I found that the student with high IQ and the one with weak IQ, both of them are having a same problem of learning and retaining the subject for longer period.

Once I implemented the different strategies for teaching Electrochemistry to grade 12. (1) In one class, I started the chapter with teaching basics and reactions; I completed small section with the constructions and working of batteries. (2) In the other class, I started the chapter by correlating those basics in our everyday life and experiences. I started with the batteries or cells which we use in mobile phones, torches, cars, electronic toys etc. and how are they made up and the process which are happening during the conversion of chemical to electrical energy and electrical to chemical energy. I asked students to bring a cell which we are using in remotes and torches one day before. I asked them to open the cell carefully. They started opening and at the same time I explained them the construction and working of the cell.

I found in class 1, only 20% of student retained in their memory the topic taught in earlier period while other have forgotten whereas in the class 2, 80% of them retained the topic in their memory.

In hand experience indulges the students in thinking. Which make them eager to know the methodology behind having such type of learning. You can nurture this attraction to science by making it game and interesting—hands-on experiments. The properties of magnets can be taught by having magnet and different magnetic and non-magnetic materials like plastics, paper, Aluminium cans, steel pins etc. Ask the student to separate the material and simultaneously explain.

Science is everywhere in the creation of their cellphones, tablets, and videogames—let your classroom explore and understand how this subject matter touches more in their day-to-day activities than they think. You can use educational videos which incorporate more interest in students than showing the charts in the classroom. Example, instead of teaching the digestive system, respiration, photosynthesis etc. with the help of chart, it can be taught with the help of educational videos available on www.makemegenius.com website and similar other websites.

Conclusion:

You can develop student's interest in science by enhancing their natural curiosity and connecting science to their daily lives. To help students develop an even deeper understanding (and form questions of their own), we can create new explorative and creative opportunities to ensure that our students will be able thrive in the many years beyond their scholarly career.

Encouraging "Non Participant" students to participate to thinking

Invited Talk
of
Mrs Norina Fernandes
Principal, Lilavatibai Podar High School

Presented by
Mrs. Preethi Kumar
Headmistress, Lilavatibai Podar High School

Class participation is an important aspect of student learning. Every teacher desires an active class for the obvious benefits. Students that participate in the class are more likely to understand and retain the information delivered that day. The thinking skills are stimulated, the entire class benefits, and an environment conducive to cooperative learning are created.

Despite these benefits, majority of the classes face the problem of non-participation due to several reasons. To address this problem it's worth investing time to find out the possible causes not only at the class level but also at an individual student level. The common ones are big class sizes, shyness, distraction, lack of interest, individual personality barrier, lack of relevant knowledge, critical teacher, classroom atmosphere that jeers rather than nurtures.

There could be varying reasons for their non-participation. They include lacking confidence, confined to their peers, passive nature, not being adequately prepared, not outward looking, lacking experience for the activity, goals for participation not being clearly conveyed by instructor / teacher, environment not conducive for student, etc.

It becomes very important for every student to recognize the importance of participation. With the goal of education being to shape the overall personality of a student, participation becomes imperative to gain experience in an activity of interest.

For most students, however, it becomes difficult realizing the importance of sheer participation. It therefore is a teacher's role to identify and make the student realize its importance. A teacher should make a student realize that the experience gained through participation is for more important in learning and shaping a personality than winning or being the best at an activity.

All of this has to begin with them thinking about participation and what they would gain from it. A teacher can highlight the importance of being aware of happenings around us. Living in a social environment it is essential for every student to be aware of the world they live in and interact expressing their ideas. It is these ideas conveyed through one's thoughts that makes them aware and facilitates participation. Therefore, a teacher can gain success with involvement of non – participating students by encouraging them to start thinking as the first step.

Most students simply do not have the confidence and therefore do not participate. Lack of confidence can sometimes be a student's negative simply because they have never got the opportunity. Giving students the opportunity in class discussions, group activities like class debates, presenting an academic topic helps greatly.

Students who are shy to speak could be given assignments on topics they like through which they may be able to express themselves better. In today's digital savvy world an online

assignment does help a student to open up and start thinking, participate and express himself or herself.

Few students are not comfortable speaking in front of their peers. Speaking to them on a one to one basis in a classroom helps. In extreme cases, talking in the break time or after school helps the child to think and participate as they are not comfortable being conscious in front of their peers.

It will help to try and find out the interest of the student and conduct an activity with the topic of their interest assigned to the student. Social media, gadgets, sports, automobiles, art and films, etc., hugely influences students. Having specific knowledge about these topics helps a teacher hugely to encourage a non-participant to think, get involved and participate.

It is very important for a teacher to be innovative and keep oneself updated with the world around them. Students often are great teachers for teachers of a school. The teacher in a school should keep an open mind and learn from students, adapting to different student types and encouraging them all the time.

Above all give the student time to open up and shed their inhibitions. It takes time for a pupil to realize how thinking brings great ideas on the table, beneficial to all and giving them valuable experience for the long journey of life.

A good method is to encourage student help each other. As teachers, we can give them guidelines and allow them to work as a team. It makes them responsible for each other, while inculcating in them the values of helpfulness and unselfishness; thus benefitting each child. An admirable trait in children is that, with the right guidance and motivation, they will not only move to the next level but will also take their teammates with them. The same principle can be applied in order to get optimal participation in all activities.

The most important point for teachers to remember is to not force the child if he does not want to participate. We must understand that he may either not be interested, or may not to able to participate in the way others want him to. And trying to push a child to do something he does not want to, will serve only in pushing him away from the activity. The best approach that works is to either give him time to get to know and like the activity you have planned, or for you to plan another activity which is to his interest and liking. And lastly, avoid forcing a child to participate in too many activities at the same time; especially if it is not in his field of interest. One step at a time can go a long way in encouraging him to not only put in his maximum effort but also enjoy what he is doing, which in the long run is what matters most. As it is rightly said, "Slow and steady wins the race".

Educating Science Effectively to Children in Classroom in Present Times

Mrs. Vasanthi Murali
St. Mary's Multipurpose High School and Junior College

Abstract – *Classroom teaching of the Science at our school is presently supplemented with practical, working models and charts to make it's learning easy. It makes the children to look for answers and with the modern tools of audio, visual teaching, the children feel that Science is thrilling. It is in tune with – I SEE and I REMEMBER, I DO and I UNDERSTAND. Besides creating the awareness, involving all children in question answer sessions give a spark to them to think, prepare details on easier scientific concepts. In our School, during the past few years, due to the group activity and exhibits on applications of Science, children are made to swell in their scientific activity contributions. This year junior level children from our institution have reached to participate at national event in the National Children Science Congress – to display their applications and utility of Science for modern days. Children being energetic, the ways of teaching and reaching the facets of Science though challenging, is managed effectively at our School. This paper would bring out the modalities in imparting classroom activities on Science learning at our school to make it easy and student friendly.*

Introduction

In the present syllabi for our secondary studies, the concepts of science have been identified with Physical, Chemical, Biological, Environmental components. Besides, the amount of subject matter included in science, even to the lower classes, has undergone much value addition. Thus, the concepts in science, has become challenging to teach and reach out effectively to children in classroom due to the varieties of queries / doubts they have. Some children have liking developed based on academic interest in scoring marks, while few of them are interested in applications of science. Remaining set of children are not focused towards the concepts of science, thinking it is very difficult, beyond their comprehension. It is for this kind of children and for those not interested in science academically – the task of Science teacher is cut out – to educate them, involve them and bring clarity in the concepts of Science. Since it is perceived as difficult, our new methodologies bring it closer to their interest level along with improved mark score. Science is what concepts of science can exhibit – rather exhibited by practical means.

Training Methodology Human mind has retention and understanding capacity of visuals in a better manner than the audio aspect of the same. Children of secondary section at our institute are taught with both black board teaching and audio-visual depiction of the same, which pictorially enables their thinking and learning the nuances of science. The concepts of science like force, machines, motion, atom, compounds; chemical reactions, blood flow, human anatomy, biological systems and environmental concepts are better explained. Using Acronyms for easy memory, easy ways of drawing scientific sketches, cooperative learning, solution from easier to difficult concepts, hands on learning do I to teach children the beauty of science adopt few of techniques. It enables children to learn better than what was taught on science a few years ago.

Interactive Sessions

Children from secondary section are grouped in few teams and with certain incentives / bonus points to their scientific acumen/activity/preparation of working model or the question & answer sessions. It makes the children involved in preparing them for the competitive mode of learning, understanding and improving their presentation skills. Besides,

the activity mode of learning has made the minds of younger children, who were non – participants earlier, to think and learn the scientific concepts. The present system of Continuous Comprehensive Evaluation on science is mandatorily followed for the internal assessment of the children, at all levels in secondary section at our school. By encouraging them to participate in intra-school and inter-school scientific activities, we could promote thinking in learning of science in an effective manner. The junior level students of our school presented their science acumen in the project work on Understanding Weather and Climate. They were successful at all qualifying events and reached National Level Competition held by National Children Science Congress at Chandigarh in Dec 2015. They exhibited the posters, model of their project and experimental data to substantiate their learning to apply science in modern times / environment. Their presentations and guidance imparted by me were well appreciated at the National event and whole team was honored with recognition and awards.

Conclusion

Children at lower standards, especially in the secondary section, look for their career guidance. We, the teachers of science, with teaching experience of over a decade, have adapted to the new scheme of things – encouraging non-participant students to participate in thinking on learning science. It has enabled us to teach and reach out to children in a manner for better understanding of science. We are sure to make the scientific advancements to technologically viable to this generation of IGNITED MINDS.

Encouraging non participant students to participate in thinking

Mrs. Sheeja Edelbert
Terna Vidyalaya and Junior College

As a teacher it is our duty to make sure the students receive the best learning experience we can provide. To ensure this, it is important for a teacher to understand his/her students and what makes them tick. No matter what the subject, the students must enjoy learning, that must be the main motive.

To make learning experiences better, active participation from students is essential. We need to first understand what are the factors or reasons which lead to students not paying attention or avoiding participation during class. Some of the factors are as below:

Disliking the subject

Firstly we need to understand why exactly the student dislikes the subject. Then we need to work keeping in mind the motive. Giving home assignments which includes the very basics of the subject will not only gradually make him understand the subject better but will also build interest in the student. As the student gets more and more familiar with the subject the assignments given can be more chapter centric. So the student will be prepared for the lesson in class. To make sure that the student is making progress, ask him questions based on the assignment that he could answer. This will boost his confidence which is the most important factor.

Don't like the teaching method

Most students do not enjoy continuous lecture. They like it when the lecture is interactive. The teacher could divide the lecture into two parts. First they teach the concept. In the later half the students should be asked to solve problems based on the topic taught. The second half may differ with the subject. It could either be problem solving, a pop quiz or a group discussion. During this the teacher can pay attention to individual students and make sure their doubts are cleared.

Distraction caused by friends in the classroom

One of the most common things that happen in a classroom is that few students don't pay attention to the teacher because they are busy talking to their friends. This causes distraction and if this goes on for long enough the student naturally loses touch with the lesson and ends up not understanding anything. Making them sit in the front benches helps because it makes the student feel obligated to pay attention. As an alternative the teacher must maintain continuous eye contact with the student while explaining, this gives the student the feeling that the teacher is giving importance to the student. He doesn't feel neglected and as a sign of respect to the teacher, he pays attention.

Don't like the teacher

Solving this problem requires efforts on a personal level from the teacher. If the teacher feels the student dislikes him/her, they must have a conversation with the student to make things clear. Speaking to the student sweetly always helps. Bring them into confidence and make them feel comfortable with you.

There could be a lot of other problems, solutions of which might be one of the below:

- Make them understand the importance of active participation in class
- Maintain a welcoming classroom environment*
- Create confidence in teacher's teaching ability
- Make them feel free to ask doubts to the teacher
- Appreciate them for clearing their doubts, don't discourage.
- Proper planning of the class by the teacher
- Explore issues and ideas in depth
- Make clear from the beginning your expectation from the class
- Use variety of teaching methods like lecture, discussions, assignments, group activities instead of sticking to one method
- Prompt students to develop their own questions, which could be used in group discussions.

Goal of promoting thinking is to create an environment which ensures that students learn.

"Teaching is a beautiful job; as it allows you to see the growth day by day of people entrusted to your care. It is a little like being parents, atleast spiritually. It is a great responsibility." – Pope Francis

Encouraging Non- participating Students to Participate in Thinking

Preetha.B.Nair,
Terna Vidyalaya & Junior College

Introduction

When a teacher enters a class they are not aware about the nature of the students, eventually when they start interacting with the students they find some to be interactive and proactive but some students might not interact or participate in the sessions hence the biggest challenge for the teacher is to make these students participating and ensure that the entire class has understood the topic.

These students do not participate or interact in the class due to various reasons; some of the problems identified are as mentioned below with solutions.

Problem: The content is repetitive

Solutions

- This could be as simple as asking students, "What do you know about (topic)?" and writing their responses on the board. You could also try a pre-test. The goal is to find out what they already know (or think they know). You create buy-in for the students because they feel smart, and you can tailor your lesson to the information they don't know or don't remember correctly.
- Divide the class into groups and give each group a topic. Set some guidelines and then let them teach each other. Encourage them to do interesting activities – write tests for each other, design review games, etc. – and evaluate each group on the accuracy of their content, the creativity of their approach, and how well they work together as a team. This is also a great way to discover *how to motivate students.*

Problem: Asking questions in Class due to fear of being mocked.

Solutions

- Make the entire class to read some lines from the chapter to ensure all students are paying attention
- Give each student an index card and ask him or her to write something about the reading assignment they did for homework. If they don't have a question, instruct them to write a comment on the reading. Collect the cards and use them to lead a class discussion. You'll easily recognize what parts of the reading confused a lot of students and they won't feel embarrassed.

Problem: There's too much information to present in too short a time.

Solutions

- Sometimes there's no way around it: you simply have to get a lot of information out there in a short amount of time. So you opt for a lecture and just want your students to absorb the content. Instead, they fall asleep or stare out the window. Research shows the average student's attention span is as long as her age. So even high school kids can only handle about 15 minutes. If you have a lot of information to convey, re-arrange your lesson plan so you never lecture for more than 10-15 minutes.

Problem: The lesson emphasizes the teacher, not the students.

Solutions

- Having students work in groups is one of the best ways to increase student participation. Don't keep them in the same groups all the time –give them a chance to be the "smart kid" who can help someone one day and the kid who needs help the next.
- Take a traditional worksheet or activity and give it to students in groups. Offer a reward to the group who finishes first with the most answers correct and watch them go! Note: it helps to have additional prizes available to keep groups motivated after the first group "wins." Even high school students enjoy these competitions.
- There will always be some unreachable student who won't respond, even with these efforts. But if you give these a try, you may be presently surprised at the previously unreachable students who just might join in!

Encouraging Non-participating Students to Participate in Thinking

Rohita Tiwari
Podar International

"It is the supreme art
Of the teacher to awaken
Joy in creative expression
And knowledge" – Albert Einstein

Introduction

The joy of learning appears differently in every teacher's classroom. The balance between a learners abilities and the task is crucial to the joy of learning. The feeling of capability provides learners with courage and makes them active participants in the classroom. Effective classroom participation can result in insight comments &interesting connection being made by the students& can foster a high level of energy and enthusiasm in the classroom environment.

What does participation means?

Participation is often equated with discussion, which typically involves a lengthy conversation with the whole class. However participation can also include short exchanges between instructors and students.

How to encourage participation?

We can improve participation of non-participants students in following ways:

Shaping the environment
Reserve the room that will accommodate the kind of participation you have in mind .If you lead frequent discussion or are carrying activities then arrange the chairs in the class in' U' form so as to ensure that students can see and speak to one other and to the teacher. While giving lectures or during discussion the teacher should not only stand at the podium but also move in the classroom.

Use positive body language and vocabulary
Learn and use student's name, they will be more engaged if they believe that you perceive them as individuals, rather than anonymous members of group. Encourage them to learn each other's name as well; this strategy will help them to know each other.

The teacher should use the following vocabulary in the classroom like "Do not interrupt other's when they are talking", 'Do not criticize the person", "Listen attentively to your friends". Teacher should praise the student if they attempt the question though the answer may be incorrect.

Listening & Responding
Use verbal and non-verbal clues to encourage participation. Move to the part of the room where quiet students are sitting; smile at and make an eye contact with these students to encourage them to speak up. Call the students who do not raise their hands.

Establish a sense of belonging

According to students, their sense of belonging is fostered by an teacher that demonstrates warmth and openness, encourages students participation, is enthusiastic, friendly, respectful and is organized and prepared for class.

Allow anonymous questions

Put a" question box "where students can submit a question or frame their own questions any time. If they don't have a question instructs them to write a comment on the reading. Collect the cards and use them to lead a class discussion. Take care do not disclose the name of the students. You will immediately recognize the students who took least interest or got confused in different parts of the lesson and they won't even feel embarrassed.

Allow them to work in groups

Divide the class into small groups and assign each group with specific problems (activities), as shyer students usually participates in small groups. Offer a reward to the group who finished first with the most correct answer and watch them go. Keep additional prizes available to keep groups motivated after the first group wins.

Keep it "bite –sized"

You will definitely increase participation and comprehensions too, if you have a lot of information to convey; re-arrange your lesson plan so you never lecture for more than 10-15 minutes. Break up large concepts into smaller sections –give a brief lecture then take up some activities, games, and puzzles to help it 'sink in'.

Real life experiences

It's very true for all the students the below said lines "Tell me and I'll Listen, Show Me and I'll Understand, Involve Me and I'll Learn. "In order to foster intrinsic motivation, try to create learning activities that are based on topics that are relevant to your student lives. Strategies include using practical examples, teaching with events in the news, using pop culture technology (I-pods), cell phones, you-tube videos to teach or connect the subject with your students' culture; outside interest or social lives.

Devise activities that elicit participation

Discussion based activities such as case study analyses, role-playing, and jigsaws encourage students to talk to one another and with the teacher. Participation can also be facilitated by certain Learning Technologies .For example use of Clickers, and collect students response to multiple choice questions; micro- blogging technologies such as twitters. Use of games, quiz and puzzles helps the non -participants to take interest in the class.

Project Based Learning

One way the educational system can address to this issue is with Project Based Learning. In this kind of learning students discover how things work in real world and also discover their own strength. This enhances our life skill curriculum learning different subjects designed to prepare students for life in the real world. Projects that support and give life to the principles taught will help the students to integrate those principles into their lives and make it much more likely that will act upon these principles as adults.

Inspiring Creativity

"Creativity isn't the icing on the cake. It is the cake", said Professor Claxton. Before starting with the class topic, give the application of the theory by performing experiments in the class. This will play an important role in attracting the non-participants. They are a great way to add visual stimuli to your lectures. They should always be used as an extension of the lecture and not as a replacement. When used properly they can help to

heighten the educational experience for students and raise the level of engagement achievement during lectures.
Students will be engaged in scientific discourse, hold competing hypothesis, looking for evidence, communicating their ideas with supportive arguments. This technique could be applied to a "geo-science" classroom via simple demonstrations with physical models, videos or rock samples

Technology support in the classroom
Use of technology tools and multimedia has helped to enhance the atmosphere of the classroom. Each student is now actively engaged in learning process. It has been seen that students who are not good in studies, may have more knowledge about technology (gadgets). Use of electronic devices like smart -boards, clickers, I-pads, ted-talks, pod-casts, educational videos, e-learning, and m-learning while teaching will allow non-participants to come up and be an active part of learning.
"I see, I remember; I listen, I learn; I touch; I understand."

This practical truth has proven to be of good help in teaching and learning of science for non- participating students.

Some Observations on Involvement of Students in Learning of Science

Dr. A. M. Bhagwat
Navi Mumbai Science Foundation

As part of Navi Mumbai Science Foundation's (NMSF) various activities , I am personally involved in coducting workshops of two types, namely:

- Fun with Science Workshops (FWS) mainly for students of std. VI to IX. The topics covered are some of the following: air flow, pressure, centre of gravity, buoyancy, centrifugal force, Newton's laws, vision, light, magnetism, electricity, etc.
- Guidance Workshops (GWS) for students participating in National Children's science Congress (NCSC) activity; they belong to the age group of 10 - 17 years (std. VI to XI) – however, most of the students who actually take part in this activity are from std. VI to IX, as above. Some of the topics covered in recent years have been:
    - understanding weather & climate
    - energy: explore, harness & conserve
    - land resources : use for prosperity, save for posterity
    - planet earth-our home: explore, share & care.

Over the last 8 -10 years I have been involved in organising close to 200 workshops in aggregate. They have given me a lot of insight into our organizational effort, students' behaviour & their thinking pattern. Through this brief writeup, I am sharing some of my observations with you and expect that they are subjected to a thorough analysis.
My observations are mainly related to sub-theme (3), i.e. "Encouraging "non-participant" students to participate in science learning". They are summarised as under:

Size of the group being addressed:
It is the most important parameter in any workshop, specially the ones related to hands-on experience of science experiments. It is important from the point of view of students attending it as well as the the teacher guide (the same shall be true for a purely theory class too). The ideal number, in my opinion is about 50 students - 6 rows of 8 students each, or 5 rows of 10 students each. It may, however, very a bit from one teacher guide to another. It makes an eye to eye contact possible with all the students present. Here the teacher also gets a feel of i) whether sudents are able to follow him or not and ii) if at all, when repetition is necessary.

In some schools, where students have been very disciplined, handling even 100 children has not been difficult. But then, that is the limit, I should say. Here, we have made the students sit in a semi-circular pattern, something like 8 rows of 12 students each. Thereafter we enter into an area of diminishing returns – more the no. of students, lesser the success of WS.

Despite these limitations communicated to schools in advance, I have been required to hanle as many as 400 students at a time in a workshop. This has however remained confined to NCSC workshops where there is no practical demonstration of any kind. Such W.S. only serve the purpose of meeting school's requirements on paper, i.e. to complete official formalities.The above observations are important because they are of a technical nature – a point that should not be overlooked at any point of time.

Free movement in the audience:
Another physical requirement is the provision of one or two passages in the sitting

arrangement of students. These passages already exist in regular class rooms. Attention needs to be paid only when the activity is aranged in a hall. Such an arrangement guarantees better interaction (eye-to-eye contact) with students than when the speaker is confined to the podium alone.

Level of success:
Practical experience tells us that FWS workshops have always invariably been more sucessful in terms of student involvement. It is because they have two plus points i) the students see something happening right before their eyes & ii) they, or some of their own colleagues, carry out the experiment under the guidance of the expert, invited for the WS. The second point acquaints them with down-to-earth reality of the experiment & wipes out doubts regarding any tricks playing a role in the experiment. Here it is also necessary to involve students from the last one or two rows to give them a sense of belonging.

There is another way, which is more authentic, of judginging the success of the WS. It originates from students. If the students like the WS, it gets reflected in the wide smiles on their innocent faces & twinkles in their curious eyes. This is the real certificate which has no parellel any where else in the "world of appreciation". These smiling faces also convey a sense of gratitude for having been witness to something very much different.The climax in the joy of conducting a WS is felt when some of the students approach, at the time of departure, and enquire – "Sir, will you visit us again ?" -- what more can we expect from students in that innocent age group.

Final Assessment:
The overall experience of the author can be summed up under 2 categories:

- for NCSC activity, where more invitatations are received for WS every alternate year. It coincides with new topic being announceded every alternate year for the project work. But the WSs are confined, more or less, to same schools which look at project work for students with great respect.
- for FWS activity, the experience is of a different nature. Though the event draws great appreciation & an instantaneous positive response, it is not taken note of seriously by the school principals or the school managements. One of the common reasons cited for this is their inability to provide a 2-hour time slot for the event in regular school hours. "How true is this" may be decided by you as individuals – because you all belong to the teacher community. Further, may I request you to weigh the benefits of such WSs against the difficulty in meeting requirement of time needed to conduct them (before expressing your opinion) – one way or the other.

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  - Navi Mumbai Science Foundation for the years 2008-09 to 2014-15 & 2015-16 (partial).

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Experiential Learning

Sharmistha Bhattacharya
Avalon Heights

Education is all about learning, collaborating and sharing your skills. As an ancient Chinese proverb says, "Tell me and I'll forget; show me and I may remember; involve me and I'll understand". During the 1980s, reformers of education looked to experiential education as an antidote for traditional education, which was under attack for being passive and concerned solely with transferring already assimilated knowledge from teacher to student.

Experiential learning in the classroom was given a boost when Chickering and Gamson (1987) recommended, "active learning" as one of the seven "principles of good practice" for excellence in education. Active learning in the classroom requires that students do more than just listen. In its simplest form, experiential learning means learning from experience or learning by doing. We as teachers at Avalon try to live up to this method of learning through role-plays, probing questions, acting, dumb-charades and many other interesting activities.

So today we, through our paper would like to present the different skills we try to inculcate into our teaching to make it experiential and interesting. After this brief introduction I would like to discuss a lesson I taught in Grade 6- WORK AND ENERGY; where I wanted the little inquisitive minds to be soaked in knowledge through various activities. Just as you like to eat a dinner laid and garnished beautifully similarly, children too, soak in better, when knowledge comes to them in a multicolored platter, in a day comprising of ten periods.

Simulation-

The lesson started with the game 'Simon says.' The children were taken aback that how could a game like this be used in Physics class! I asked them to do the following actions—

> "Simon says lift your book, Simon says stand straight; Simon says push the wall, Simon says push your table, Simon says calculate 42 x2 mentally; Simon says read a book without moving your body," and some more likewise exercises.

The children did the task enthusiastically and then asked why did they do all this? They were then told to find the difference between

- Pushing a wall and pushing their desk. The answer received was that the wall did not move but the table moved.
- Lifting a book and doing a sum mentally. The answer received was the book moved but while they were calculating there was no movement and so on.

This led to the conclusion that when force is applied through a distance work is said to be done and when force is applied but there is no displacement, work is not done. Thereafter, unit of work, the person who researched on this ,i.e. James Joule and numericals based on work were done.

This exercise of simulation helped the children understand the concept clearly and easily.
The next concept in line was energy. These classes were held outside in the lap of nature and the children enjoyed it thoroughly.
To understand energy they were asked to jump and to stop only when they were tired. This exercise made them realize that the ability to do work is known as energy. Now an experience of the skill of asking probing questions. In this lesson of Work and Energy a True or False question was asked that – We use energy when we are asleep. This one question set the whole class rolling and thinking. A handful said yes but the majority said no. They wanted to know how is it posssible that energy is used when we are asleep ?

The students who had said true were asked to justify their answer. They asked how are we breathing if we do not have energy in us. The 'False 'group replied, 'But it is the job of the lungs! The 'true 'group- ' But then how is your heart sending the blood to the lungs ? The 'false' group cried –' But that is an involuntary action of the lungs ! It was then clarified to them that even though it is an involuntary action the energy required to do so comes from the food they eat.

While doing energy making a simple toy helped them understand potential and kinetic energy. They were asked to take a clothes peg, a bottle cap and GEMS. They stuck the bottle cap on the clothes peg and put a GEMS in it. They then pressed the peg for some time and then let it go. The gems catapulted out and a child caught it in his mouth. This made them realize that the stored energy in the peg helped the GEMS to fly out. So this stored energy is called potential energy and the energy in motion is called Kinetic energy.

Humane angle

At Avalon we strive to ensure that our students develop empathy and compassion not only towards their parents, peers and family, but they should also nurture a similar attitude towards their surrounding, environment and nature.

Keeping this in mind, before starting the next topic on types of energy, the children were asked to identify the sounds they can hear around them, what could they visualize in front of their eyes. And what did they feel in just sitting quietly in tune with nature. This helped them identify the energies nature has already given us.

Next when the topic moved to energy in action one driving question made them all sit and ponder. One kind of energy in action is electricity. They were asked that think, no matter how costly a gadget you have, if there was no electricity how would they function! So should we waste energy! This question generated a lot of discussion and realization towards conserving energy.

Student's choice and voice

This is a major learning tool used in Avalon. Students are given a choice to choose their next plan of action and voice out their strategy. In this context the children were asked how would they know that was energy being conserved in society, was any intervention required? They immediately jumped at the conclusion that they should carry out a survey in their neighborhoods and find out the status of conservation of energy. They readily agreed to take it up as a winter vacation project. They were just given guidelines and the children of grade 6 did a marvelous job by presenting some amazing factsheets.

Hence our endeavor at Avalon to ensure holistic development of a child was met to a certain extent through this lesson. Hence we see, that through experiential learning not only our target of imparting knowledge is met, it also ignites the young minds conscience to become a responsible citizen of the country.

Encouraging and Supporting Students' Thinking in the Learning of Science

Anupama Bhattacharya
Avalon Heights

"*More hands make for lighter work*" – John Heywood.
"*Two heads are better than one*".

I use these adages as a proof to the fact that children learn better when they are presented an opportunity to work with others. The aim of this paper is to shed light on how non-participative children in a class can be made an active part of the learning process.

Researches prove that children become active learners when they are put in a group. They develop collaborative skills, co-operative skills and the most important skill of all, life skills. At Avalon, we seek to inculcate life skills in our students. We believe that good teaching is to equip the student to learn by himself. To achieve this, we plan lessons where the students have a chance to question, look for answers, observe, infer from the observations and data gathered and come to a conclusion. This helps in effective learning of the content and also in shifting the onus of learning on the students.

I give an example of Grade 8 Physics and Geography class where learning of the chapter The Universe was made more effective by turning the chapter in to a research based learning project. The aim was to have the students have a better understanding of the solar system – the sun, planets and the natural satellites, to generate curiosity about the universe by exploring the known and unknown facts, to make the learning effective for a life time and not just a mark oriented one.

The purpose of doing the chapter in a project based manner was to make the content interesting, involve maximum number of students in the class in the learning process, shift the onus of learning on the students, make them more equipped to ask the how's, why's, when and where's of the science as well as imbibe life skills in them.

The research conducted by them was to be later on presented in the form of a paper in an in-house "Solar System Conference" held by the school. The aim of this conference was to give a meaningful end to the learning of the content by presenting their expertise of the subject in front of a group of panelists and audience.

To begin with, the students were divided in to 5 groups of 6 students each. Each child could choose his/her area of research (as per the lottery system). We followed the lottery system as it gave the students a sense of making their own choice to learn the content. Following were the list of choices they could make from –

- The comparative study of Earth and Mars
- The comparative study of Earth and Mercury
- The comparative study of Earth and Venus
- The comparative study of Earth and Jupiter
- The comparative study of Earth and Saturn

As a teacher, it is our general experience that students tend to feel bored, monotonous when we take the agenda to the class. Sometimes, it is a fresh change to allow them to choose the topic they want to learn about. In doing so, the class becomes more excited about the learning material and the receptivity of the students increases. Also a number of non-participative students suddenly become more active with their participation and inputs in the class.

The class was divided in to 5 groups of 6 students each. Care was taken that the groups made were of mixed abilities. There are many benefits of making a mixed-ability group. A few mentioned here are that the students learn to seek help from each other, they learn to support and trust each other. It enhances social skills and interactions and gives opportunities for generation of alternative ideas and point of views.

The students were provided with common driving questions. Driving questions were provided to help the students in keeping a check on the area of research that they are involved in and also in understanding the status of their research progress. A few examples of the driving questions are given below:

1. Looking at the distance of the planet from the Sun and its resulting temperature, how do you think the temperature will impact the atmosphere of the planet?
2. Looking at its gravitational force, what would be the ratio of human weight as compared to Earth and how will it impact life or living on that planet?
3. Looking at its size, what could be the capacity of that planet to hold life as populated as on Earth?

We found that the students were sometimes going off track from the research even after providing the driving questions. At the stage the role of the teacher was to read the research material gathered and help the student sort, sift through the important aspects pertaining to the questions provided. Doing this exercise equipped the students in making an informed choice about the topic of research. E.g. they had a better understanding of which questions needed more research and comprehension of content and which ones were easy to find.

The students assigned various roles to each other among themselves. One would be the record keeper—a compiler of all research material for the whole group, one would be the checker—who would ensure that the research being done by the group members had a bearing with the topic of choice, etc. It was seen that the students who seem to be generally casual about their approach in classes were seriously pursuing the project.
Every day, the students were given a specific period for research. A timeline was provided to them so that it would help keep track of the progress of the research. It led to a brainstorming session on how does the distance of a particular planet from the sun affect its climate, what are the impacts of exposure to high/low gravitational force on life on that particular planet, etc. Brainstorming is a technique that is well received by both, the active and the passive learners in the classroom. This is so because it gives an opportunity to get the creative juices flowing. All ideas are welcome, everyone is a part of the team as it encourages involvement and participation by all, and it is exciting and easy—no one has to be a genius to be involved in a brainstorming session.

The role of the teacher here was to guide the students in adhering to the timeline given, giving regular feedback for the data gathered and inferences drawn, asking questions to assess their understanding of the research being carried on, etc.

It was seen that generally the students who were non-participative in class were taking an interest in doing the research. Their peers were taking in their inputs to consideration. A few of them were found to open up and interact better with their peers. The opportunity to learn from each other and to teach each other helped in reducing the feeling of isolation in some students. Quiet students had the opportunity to speak and be heard thus overcoming the anonymity in class. Students developed skills like decision-making, problem solving,

values of respecting other's views, healthy communication, negotiation, conflict resolution, teamwork, etc.

The day of the conference saw a lot of enthusiasm and energy among the students to present their hard work and team spirit among their peers and teachers alike. The presentation of papers not only provided an opportunity to the students to showcase their diligence and learning, it also builds a sense of confidence among them. In my experience, most of us also feel nervous to address a crowd as we feel like we are the center of attention. The same feeling is magnified for the students. Yet, it was thrilling to see many average, regular students make an effort to present their research findings in front of an audience without battling an eyelash.

The idea of doing the chapter in this manner not only provided an opportunity to make the topic of study challenging, interesting, motivating, engaging and fun to learn but also had many passive students develop an interest in learning science, exploring more of science and making the learning of science meaningful.

Language Simplification of Science Texts – Glimpses From an Action Research Project

Invited Talk
by
Meena Kharatmal
HBCSE, TIFR

The National Curriculum Framework 2005 suggests emphasizing language development through and for science learning at the primary stages. Various means are suggested towards this effort such as – creating favorable environment, material development, teaching and teacher education, and student learning.

Science learning needs the effective use of language. Research on the role of language in science learning has led to better understanding of science activities. It is considered that having skills in comparisons, drawing inferences, understanding cause effect relationships, are specific to language in concept formation in science. Simplifying the language of textbooks has been found to improve teacher pupil interaction in classrooms. An action research project on studying the linguistic barrier and testing the effect of simplifying the language of instructional material was conducted.

The study focused on analyzing the language level in general science textbooks in Marathi for students V, VI, and VII and comparing it with the language level in Marathi textbooks. Five typical passages were selected and these were re-written for simplification of language. Both these kinds of passages were administered for comprehension-based test. The study was conducted with about 600 students in 19 schools from 4 districts of Maharashtra. The findings suggested that students reading a linguistically simplified version performed substantially better than those reading the normal text. The study will be presented with examples.

Another research being proposed is that use of concept mapping with the focus on the linking words. This can be used as a pedagogical method for science learning where science is taught to students in English as a second language. The linking words such as – part of, includes, surrounded by, located in, has size, has color, has function, etc. that belong to natural language vocabulary, would not be difficult to learn for second language learners in science learning. Some examples of concept maps will be illustrated.

Encouraging and supporting students' thinking in the learning of Science"

Mrs. Nilofer Shakeel Shaikh
TernaVidyalaya and Junior College

Abstract

This essay notes that in order to teach science to young children, teachers need Pedagogical Science Knowledge which includes an understanding of science content and inquiry processes, knowledge of children and how children learn, and skills for facilitating children's experiences in ways that support their active inquiry and conceptual development.

Teaching Strategies:

Teaching strategies shape the learning environment. As part of the lesson design, an effective teacher selects a particular teaching strategy or set of strategies to engage students in learning. There are teaching strategies that can be transferred from one subject to the next. There are also strategies that are more specific to a subject area.

Conducting Science with Students: Following are the methods, which take different approaches to assisting educators in conducting science with students.

- Indoor Labs- This teaching strategy encourages cooperation in small groups and participation in doing science. This resource gives tips for making individuals accountable during group work, making handouts, and structuring lab time.
- Field Labs- Field labs are engaging to students because they can experience the science that they have been taught in the classroom.
- Process of Science- Teaching the process of science means taking the aspects of how science is conducted and making these ideas explicit for students, allowing them to discover how scientific knowledge is gained.
- Process-Oriented Guided Inquiry Learning- In this approach, groups of students work together through data and questions to discover a scientific concept.
- Campus Based Learning - Campus-based projects can provide hands-on, real-world projects that can be accomplished without a field trip budget or transportation by using buildings and grounds as teaching tools.

Group Work Methods

Group work is a way of getting students to work together to solve a problem or learn new information. By using group work, educators teach students how to learn from one another's ideas.

- Cooperative Learning - Cooperative Learning involves structuring classes around small groups that work together so that each group member's success is dependent on the group's success.
- Jigsaws- In a jigsaw, teams of students prepare separate but related assignments. Teams regroup and peers then teach each other about their prepared portion of the learning.
- Gallery Walks - In a Gallery Walk, questions are posted at stations around the room. Teams of students rotate around the classroom, composing answers to questions while reflecting upon the answers given by other groups.

Innovative Methods for Application and Analysis

Student's ability to respond to higher order questioning demonstrates the degree to which they understand a particular topic. In the following methods, students are required to justify answers, apply information, or analyze ideas. These methods are very useful for eliciting

student's understanding of what they have been taught and also for identifying any remaining misconceptions students may hold.

- Game Based Learning - In game based learning, students compete to learn material. Included in this resource are tips for making a meaningful game, making rules fair, and grading.
- Interactive Lecture Demonstrations- This resource provides formatting for scaffolding learning from demonstrations. Students predict an outcome, observe the demonstration and reflect on their previous assumptions of the outcome.
- Experience based Environmental projects - Experience-based environmental projects offer a way for students to apply classroom topics like energy use, global warming, water quality and land use to their own lives, and to realize that although these issues may be global or regional, they ultimately have roots at the individual level.

Conclusion

Any Strategies or Method, Which are defined above are similar as their design is to approach and tackle different challenges, they involves the following procedure:

- Identify an objective
- Conduct research
- Generate ideas
- Develop solutions

Benefits of multi-lingual approach in science learning

Mrs. Savita Suresh Bhikale
Terna Vidyalaya and Jr. College

Language is key to all learning.

We use language to explain, to interpret, to formulate ideas, to express our thoughts and to gain knowledge. To learn in a meaningful way, learners need to competence in the language they are using. Yet many of our learners find themselves in situations where they lack this competence because the language of learning and teaching in their classroom is not their home language or one in which they are competent. As a result, these learners understand very little of what is taught in the classroom.

Therefore, we can take use of multi- lingual approach in teaching and learning. Multi-lingual education refers to the use of two or more languages in education.

One of the components of Multi-lingual education is-

Strong Foundation - Research shows that children whose early education is in the language of their home tend to do better in the later years of their education. Science teacher always face the problem of language barrier while explaining science concepts. This is mainly due to scientific terms are not used in day-to-day life of students. Vocabulary of scientific words is very limited at student level.

A systemic approach of using multi-lingual for teaching science will be useful to overcome this barrier. Every science teacher should have constructive approach and a pre plan ready to inculcate the scientific language in his or her students. Every teacher should be well prepared and homework should be perfect before doing this experiment of multi-lingual theory.

One aspect that is more important is the use of appropriate word from student mother tongue for any scientific word. This is very important as wrong meaning can mislead the whole phenomenon.

Suggestions for facilitating learning in multilingual classes:

- The best way to understand concepts is to encourage learners to discuss these terms first in their mother tongue or home language and then move to the scientific meaning.
- Encourage learners to use glossary in the learners' book wherever possible.
- Encourage learners to discuss the meanings of unfamiliar words wherever possible. Unfamiliar vocabulary should be explained and written on board, with picture or clues if necessary. This will help to that learner who do not speak in classroom.
- Peer translators can also provide explanations.
- Let learner who speak the same home language discuss pictures related to texts.
- If possible,you can use the home language of learners to introduce new concepts.
- As learners are more confident in their use of classroom learning and teaching language, provide them more opportunities to use that language in sustained ways, such as talking, discussing etc.

This approach of using multi lingual will help learners for better understanding then repetition type worksheets or exercise, which will help them for getting knowledge which is one of the purpose education.

Science Lab Project- a community intervention technique for the quality enhancement of underprivileged schools in Mumbai

Abdul Salam E
MERIT (Mumbai Education, Innovation, Research and Training) Trust, Chembur, Mumbai.

Extended Abstract

Science Lab Project is a community intervention method developed by MERIT Trust for the quality enhancement of underprivileged schools in Mumbai. Science lab project is presently being conducted in two schools. The role community can play in development of such institutions is described briefly here.

Key words
Underprivileged schools, Drop out prevention, Volunteer mobilization, Community media, Science Lab, Stake holders.

1. Introduction

Science lab project is one of the projects conceptualized and developed by MERIT Trust for the educational development of underprivileged society children. The objectives of this project are:

a) Involving the public in education of under privileged children
b) Quality enhancement of education system
c) Dropout prevention of high school students
d) Democratization of scientific knowledge

After conceptualization and development of this project, it is being presently executed in two schools on an experimental basis. Details of the project & analysis of experience gained are included in this discussion.

2. Education of Underprivileged children in Mumbai

Mumbai is the economic capital of India having very large population of under privileged people. Children of these societies are getting education either in municipal schools or low budget private schools. Primary education is available in different mediums like Marathi, Hindi, Urdu and English. These schools are mostly having poor infrastructure and unskilled or under qualified teachers. Major disadvantages of these schools are: i) Low quality of education ii) High dropout rate at high school level iii) Low enrollment rate in higher education.

3. Concept of Science lab Project

Science lab project is a multilevel intervention technique to deal with the above mentioned complex situation which prevents the quality education of underprivileged children. Basic concept of the project is to attract the participation of educated and skilled adults in education of underprivileged students by voluntary mobilization in a systematic way. Volunteer mobilization in metropolitan cities is easy compared to rural areas due to availability of rich human resource with professional background. They demonstrate basic concepts of science at school level through simple activities and practical experiments. Students having difficulty in reading and writing and

lacking quality education thus get an opportunity to understand the subjects in minimum time and with easy methods. It also provides an opportunity for the students to interact with many experts having different backgrounds. It may also encourage the students to continue education. Step by step process of science lab project is illustrated below.

A public or low budget private school with easy access is selected for the science lab project. A pilot study of the feasibility of the project is done in consultation with teachers, management, students of the selected school, educational activists & sponsors. Further steps involve: Setting up Science lab, Teaching basic concepts. Documentation of experiments, Conducting a science exhibition & finally Science lab projects (a multi-level intervention measure).

4. Importance of choosing science as subject

Many students find difficulty in learning science and mathematics at high school level especially when students are very poor in basics and languages. Providing extra classes for all subjects and for all students is not practically feasible. But the basic concepts of science subjects can be demonstrated within short span of time through attractive methods. Understanding basic concepts enhances the confidence of students. It also increases their curiosity and makes them rational thinkers. Conducting events like science exhibition further promotes science among underprivileged children. Democratization of science can also be achieved through such project at lower level. The other points which need extra attention are: curriculum objectives, frequency of classes, orientation program for volunteers, etc to mention a few.

5. Review of science lab projects (1 & 2)

First science lab project was conducted at Quwwathul Islam Arabic College (QIAC), Dongri, Mumbai. Second Science lab project was conducted at Trombay Public High school in cheeta camp which is an aided Urdu/ Hindi medium school. They have provided tremendous insights in to the entire education pattern of such schools & also given ideas about how easy the projects are if there is a will to do it.

6. Analysis of the inputs to the projects

The above work has also permitted the analysis of various parameters that go in to the success of the entire project. These parameters are: a) Support group for School management b) New exposure for Teachers d) Development of School Infrastructure d) Students' Level e) Volunteers' Level.

7. Conclusion

Community intervention technique developed by MERIT TRUST has been found to be successful in its objective of educational development of under-privileged societies. This program can be replicated by all Schools with the help of its alumni and various NGO s. These projects cost negligible amount of expenditure and they can attract volunteers easily.

About Navi Mumbai Science Foundation (NMSF)

Navi Mumbai Science Foundation (NMSF) is a science led NGO in India which is dedicated to development of "scientific temperament " in society in general & the student community in particular. This in turn will contribute towards the wholistic development of the nation & prepare it to face the challenges posed by a technologically advanced global environment without losing sight of its societal commitments.

Vision

- Kindle and nurture scientific temperament in students;
- Enhance soft skills like problem-solving and communication skills;
- Promote 'Pupil-centric' approach in education;
- Create awareness among public of science and scientific issues;

Mission

- To advance, popularize and promote the cause of science in Navi Mumbai.

Action Plan

- Develop a network of professionals and personalities to share their knowledge;
- Provide multi-disciplinary environment to students to understand their inter linkages;
- Provide a platform for interaction between leading educationists, teachers and students;
- Encourage participation in scientific activities like i) Science essay competitions, ii) HomiBhabha Young Scientist Award (HBYSA) Examination, iii) National Childrens' Science Congress (NCSC activity, iv) Science Utsav, v) 'Fun with Science' activity, vi) ScienceClub activity, etc;
- Create links with national organizations in the field of science and science education;
- Arrange discussions on scientific topics of current interest and publish scientific articles in local papers and magazines.

Achievements at Ground Level: About 3000 students & 250 teachers are now being reached through these activities each year.

IN SHORT, WE AT NMSF, ENDEAVOUR TO:

Give meaning to science in ways more than one, and Erase the artificial barriers that keep science away from the main stream of life.

OUR INDEBTEDNESS

We are indebted to several schools & colleges, a few institutions and a large number of individuals, who have been active partners in our activities year after year.

Website : www.navimumbaisaciencefoundation.org