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Towards Motivation And Development Of Scientific Attitude Among College Science Students

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Abstract - Attitude is an expression of favour or disfavour towards a person, place, thing or event. It influences view of science. In this perspective of revolution of science and technology, importance of science education has become more noteworthy and pertaining to this developing a science temperament among the learners is necessary. Scientific attitude has three basic component, belief, feeling and action. With the help of selective characteristics of Nobel Prize winners as they inherent, objectivity, open mindedness, persistence, creativity and flexibility like attitudes are describe. The belief that their contribution to world definitely proposes relevant directives to improvement in learner's attitude towards not only in science but also concerning development and aspiration in various fields and need of the society. Some advance teaching techniques are also suggested to develop scientific attitude. For simplicity, three approaches of practical work to understand the meaning of teaching and learning in context to motivation and development of scientific attitude at college level among the science students have proposed. Teacher is an aspirator, a facilitator, a good narrator; and an educator. Science teachers should accustom themselves with latest developments in the field of science and technology and skills so as to attract learners toward science. Teacher's role is aspiration and strengthening new generation for better society. What are we teaching? What are they learning? What are we auditing? Answer to this is discussed in this paper.
Key words - descriptor, mentor, aspirator, educator, scientific attitude.

Introduction - The investigation of student's attitude towards study science has been a substantive feature for the work of science education community for last 20 years. Many facts as gender, teacher, curricula and other variables are important to inculcate science attitude among the learners. It is the aspiration to know and understand, Attitudes towards science and scientists influence views of science. (Jonathan Osborne ,2003, Farahhnaz Movahdzadeh, 2011). It encourages questioning mind and a spirit of enquiry. An attitude in science encourages learners to develop safe and sound, accountable and collaborative working practices when carrying out experimental work. Developing attitude in science would help nation to cope up with vigorous advances in technology all around the world. (Rajib Mukhopadhyay, 2014) Career consciousness, and classroom participation, television programs, commercials, books, and the social network around the learners strongly influence attitude towards science. Belief is the cognitive basis of scientific attitude, which provides learner scientific information of several phenomenon's, eminent scientists, and inventions etc. Science teachers should accustom themselves with latest developments in the field of science and technology and skills so as to attract learners toward science.

Twenty general science attitudes found among the learners are,

1. **Empiricism** Knowledge comes only or primarily from sensory experience. A scientist prefers to "look and see."You do not argue about whether it is raining outside-just stick a hand out the window,
2. **A thirst for knowledge, an "intellectual drive**
3. **Determinism** "Cause-and-effect" underlies everything,
4. **Precision** Scientists are impatient with vague statements,
5. **Parsimony** Prefer the simple explanation to the complex,
6. **Skepticism** All statements make assumptions of prior conditions,
7. **Respect for paradigms** Universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners,
8. **Aversion to superstition and an automatic preference for scientific explanation** A scientist

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jects superstition and prefers science paradigms out of an appreciation for the power of reality based knowledge,

A respect for power of theoretical structure "That is all right in theory but it won't work in practice",

0. **Scientists** are addicted puzzle-solvers,
1. **Awareness of assumptions** Good scientist starts by defining terms, making all assumptions very clear, and reducing necessary assumptions to the smallest number possible. Scientists are very specific about what they "know" or will say with certainty,
2. **Suspended judgment** Difficult to give an opinion already investigated matter,
3. **Willingness to change opinion** When Harold Urey, author of one textbook 'theory on the origin of the moon's surface', examined the moon rocks brought back from the Apollo mission, he immediately **recognized this theory did not fit the hard facts** laying before him. **"I've been wrong!"**he proclaimed without any thought of defending the theory he had supported for decades,
4. **Loyalty to reality** Dr. Urey above did not convert to just any new idea, but accepted a model that matched reality better. He would never have considered holding to an opinion just because it was associated with his name,
15. **Ability to separate fundamental concepts from the irrelevant or unimportant,**
16. **Respect for quantification and appreciation of mathematics as a language of science,**
17. **An appreciation of probability and statistics,** Effectiveness of results is proved by analyzing data by its probability and statistical significance,
18. **An understanding that all knowledge has tolerance limit** Values that scatter at least slightly around the average point. E.g. Human's core body temperature,
19. **Empathy** - the capacity to place oneself in another's position, Capacity to share or recognize emotions experienced by another sentient it means ability to feel, perceive, or to experience subjectivity.
20. **A belief that problems have solutions** perhaps not easily, but possible.

Earlier researchers found common aspects of teaching that, we perceived to be effective by both teachers and pupils, these are:

I. Clear goal for pupil learning
II. Use of preview and review of lesson content
III. Clarity of communication of lesson goal and agenda to pupils
IV. An ability and willingness to allow for different cognitive styles and of engaging with learning process among pupils. The interpreted a range of components in the measures of attitudes to science include:

I. Nature of classroom environments
II. Motivation towards enjoyment of science and the value of science
III. The perception of science teacher
IV. Anxiety towards science
V. A fear of failure course
VI. Self-esteem of science
VII. Attitudes of peer, friends and parent's towards science
VIII. In achievements in science (Munby,1983, Kobella et al, 1889, Utibe et al, 2013)

Learners attention could be drawn by judging properly student's aptitude level that is important decide teaching parameter accordingly the level of learner. We have defined following descriptor to decide student's achievement level at 10 scale attitude? **(See in the last page)**

Many teaching techniques are evolved and suggested to develop scientific attitude.(Hakan 2010 , Chandrashakar, 2014,and Deshpande, 2010). Some out of them are, innovative teaching plans, designing of animation, use of power point presentation, screening of science documentaries and movies, use of ICT, smart class rooms as well as designing simple experiments to demonstrate laboratory course, Virtual classroom practical's and lessons Organization of Seminars, Science fair, Science exhibition, Conferences, Science quiz's, competitions, Workshops, Anveshan and Avishkar could fascinate learners to develop science attitude. Organization of academic visits to institute and industries boosts clarification of future ideas about carrier in science. (Mahajan et al 2016)

Additional attention could be strained from emphasis on Computer literacy (ICT) among the learners and teachers. Good mentor- mentee relations, Quality of teacher, clarity in communication, help of teaching aids, defining learners vision, mission and goal could help to develop scientific attitude and science related values among learners of science faculty.

Improving social wellbeing through education, research and innovations -

Argumentation: Teaching and learning using practical work - Practical work we mean tasks in which learner, observe or manipulate real objects or materials or witness a teacher's demonstration.

Practical work can -

I. Motivate pupil by stimulating interest and enjoyment
II. Teach laboratory skills
III. Enhance the learning of scientific knowledge
IV. Give insight into scientific method and develop expertise in using it
V. Develop scientific attitudes such as open-mindedness and objectivity

We put following point to learners knowledge to make practical work more effective

I. The teaching objectives should be clear ,relatively few in number for any given task
II. The task design highlights the main objective and keeps noise to minimum.
III. A strategy is used to stimulate the students thinking before hand, so that the practical task is answering a question, the student is already thinking about.

V. In the context of teaching scientific knowledge; practical work is best seen as communication and not as discovery.

We would like to suggest some examples of simple experiments to motivate and to develop scientific attitude among science students

Experiment 1 - Innovative ideas to demonstrate various practical exercises based on titration using 0.1 N HCl and 0.1 N NaOH . Such experiments not only provide practical knowledge on different aspects but also facilitate to conduct examination at graduate and post graduate level students. Acidity or alkalinity of a given sample is calculated by simple titration using appropriate indicator, standard 0.1 N NaOH and 0.1 N HC1 solutions are used for such study. The utility of this practical exercise is applied for number of practical's routinely carried out at post graduate and under graduate courses of biosciences. Such study includes analysis of i. fermentation ii.urine excretion iii. Stomach function iv. Protein chemistry v. Applied chemistry vi. Enzymology vii., Oil chemistry and viii. Metabolic study. This classroom activity is useful as teaching tool to students who are not opted chemistry as subject at S Y B. Sc level at several Universities. At low cost time saving, economic kit prepared serves as a tool for chemical education which improves skill, better understanding chemical principles. It has been found that SY students of above category are slow learner and sensitive for these practical's

Experiment 2 - Use of edible and non edible oil cake as source of nitrogen for culturing various organisms Oil cakes are rich in protein ,fibre and energy contents. Owing their availability at low cost they may be included in the studies concerning microbiological and biotechnological practicals. They could be used as fermentation substrates in developing bioprocesses for the production of organic chemicals and bimolecular, for the studies of industrial enzymes, antibiotics, biopesticides, and vitamins and other biochemicals production using microbes

Experiment 3 - Standardization of simple protocol to study proteolytic enzyme activity of locally available laticiferous garden plants

In our laboratory a simple protocol established to study proteolytic activity of latex of garden plants to introduce enzyme chemistry and its utilizations for commercial industrial application. Native plants of Khandesh region belonging to various families such as *Apocynaceae, Asclepidaceaae, Caricaceae, Moraceae* and *Euphorbiaceae* possess caseinolytic , gelatinolysis and milk clotting properties . The latter is used for searching a substitute for animal rennet to clot milk, in turn, used for cheese production.Simple protocols are i. Digestion of casein ii. Degradation of gelatin from X- ray film iii. Clotting of milk. All these protocols are simple, time and money saving and can be taught to UG and PG students of life sciences without much complications. Setting and conducting all above experimental approach, lead to improvement in student's skills , attitude and research culture is motivated at college level.

To develop scientific attitude in science and related values in subject, here are examples of some Nobel laureates, explaining nature of their work with keywords, these are:

i. **Curiosity** An eager or desire to know, Galileo Galilei's curiosity about the heavenly bodies made him the first person to use a telescope to study the moon, the sun, the planets, and the stars. With his telescope, he discovered the moons of Jupiter, the craters on the earth's moon, and the sunspots
ii. **Logical and systematic behavior**, careful and accurate record keeping among the reasons why Gregor Mendel discovered the principles of heredity when others have failed was his logical experimental methods and his careful and accurate record keeping.
iii. **Open Mindedness and Free of Bias**, An open minded person is one who can modify or discard hypothesis, if necessary. Johannes Kepler- develop evidence that planet moved along perfect circles But after 15 years of work, he broke away from that idea and discovered that planets follow elliptical orbits.
iv. **Intellectualy honest**, Newton built his laws of motion on the previous work of Gallileo and others. In fact, Newton's fist law was very similar to Galileo's concept of inertia. He never claimed that he worked out his laws by himself.
v. **Work Hard and Is Persistent**, Marie Curie was the first person ever to be awarded the Nobel Prize twice. It was not surprising considering how hard she worked in a small wooden shed with a dirt floor and a leaky roof. This is where she discovered radium and polonium.
vi. **Creativity**, Albert Einstein was able to derive his theory of relativity because he went beyond what was given and known at that time. He studied links and connections where others did not. He looked at things from different perspectives.

Nobel Prize is the most coveted award of the world, awarded to eminent personalities contributing valuably to various walks of life. The following Indian have made us proud by winning the Nobel Prize

i. Ravindra Nath Tagore – in literature (1913) for his work "Gitanjali"
ii. Sir C. V. Raman, in physics (1930) for "Raman Effect"
iii. Dr. Hargovind Khorana in medicine and physiology (1968) for interpreting the genetic code and analyzing its function in protein chemistry
iv. Dr. Subramaniam Chadrashrkar in Physics (1983) for his theoretical work on stars and their evolution
v. Mother Teresa, in Peace (1979) she dedicated her life serving the poor , and sick people around the world
vi. Dr. Amartya Sen in Economics (1998) for social support in development appeared humane and wise
vii. Dr. Rajendra Kumar Pachauri In Peace (2007) on the behalf of the intergovernmental panel on climate change

Conclusion - This paper provides information regarding many facets of teaching on student's attitude to science. Science educators have much to learn from the growing body of the literature on the study of motivation and update recent information Teachers training, quality of teacher, infrastructure and learning resources offer opportunity to students to achieve excellence in learning outcomes. The amount of research or studies being done on the science topic is continuously increasing. Motivation offers important pointer to the kind of classroom environment and activities that are raise pupils interest in study science and lead to focus for future research. This is our general observation, based on last 30 years of teaching at science College students. Research culture among UG and PG college student is initiated, such initiatives inculcate student's ability to participate and present their research work as budding researchers in seminar, workshop and Avishkar etc.

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Achievement level	Level indicator Student requires
0	The student does not reach a standard described by any of the descriptors below
1-3	**Some guidance** to work safely and **some assistance** when using material and equipment. **Some guidance** to work responsibly with regards to the living and non-living environment. When working as part of a group, needs **frequent reminders to cooperate with others**
4-6	**Little guidance** to work safely and **little assistance** when using material and equipment.**Works responsibly** with regards to the living and non-living environment. When working as part of a group cooperates **with others on most occasions.**
7-10	**No guidance** to work safely and uses material and equipment **competently**.Works responsibly with regards to the living and non-living environment. When working as part of a group, cooperates **with others**.

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