



HOW TO SUCCEED IN SCIENCE AT SENIOR SCHOOL LEVEL – A TEACHER’S PERSPECTIVE

A personal perspective by

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Abstract: This paper gives an idea of effective techniques to be used to teach science in classes at senior Secondary levels. Observation, identification, description, experimental inquiry and theoretical justification are integral part of Science. Science induces the thirst of search of knowledge and exposing general truths. It helps to make sense to understand about the world and enables to develop technologies and improve our lives and other issues. Science encourages creativity, develops analytical thinking, scientific curiosity, improves communication skills and foster scientific literacy. It is necessary to study science to make technical advancements and progress. The role of a teacher and planning / strategy play an important role in succeeding science. By adapting various methods a teacher can achieve and help his students to gain success in Science. Proper planning, adapting appropriate teaching techniques, following proper time management, making study groups and providing motivation to his students are some steps to achieve it. The first and most important step is to plan the content of the syllabus, the format of the exams, the experiments, and any additional lectures or exercises. It is definitely desirable to use effective teaching methods in order to attain the best results in the classroom. Time management skills are necessary for lab trips, managing extra classes, covering topics in class, and finding motivation for dejected students. Study groups can be created by an effective and competent teacher to improve teaching and learning. Student levels should be represented in study groups. A successful educator is one who serves as a strong motivator. He must work on intrinsic and extrinsic motivation, negative and positive motivation, rewarding success in class, and remedial socialisation for dejected kids.

Index Terms - Experimental investigation, Theoretical explanation, Analytical Thinking, Scientific inquiry and curiosity, Integral Lecture Method, TEB→ SEB→ SEE model, Study groups, Negative and Positive motivation, Intrinsic and Extrinsic motivation, Remedial socialization

I. INTRODUCTION

Neil deGrasse Tyson, astrophysicist and science communicator defines **Science as a method to learn the working of the world**. Oxford Dictionary of Science defines “**science as an intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment.**” Science can be defined as the structured study of the physical world and its phenomena. It involves observing, experimenting, and analyzing data to generate knowledge and understand the underlying principles that govern the natural world. Science encompasses various fields such as physics, chemistry, biology, geology, astronomy, and many others. Scientists use the scientific method

to formulate hypotheses, conduct experiments, and make evidence-based conclusions. Through scientific investigation, we gain a better understanding of the universe, develop technologies, and improve our quality of life.

Observations involve using our senses or specialized tools to gather information about the natural world. These observations can be qualitative, involving descriptions and characteristics, or quantitative, involving measurements and numerical data. By carefully observing and documenting phenomena, scientists can identify patterns, trends, and relationships. Systematic experimentation involves designing controlled experiments to test hypotheses or investigate specific questions. This typically involves manipulating variables, collecting data, and analyzing the results. Controlled experiments help scientists isolate the effects of specific factors and establish cause-and-effect relationships. The combination of observations and systematic experimentation allows scientists to gather empirical evidence, refine their understanding, and develop scientific theories and models. These theories and models are continuously tested and refined through further observations and experiments, leading to the advancement of scientific knowledge.

Science includes a search of knowledge that basically exposing general truths or the applicability of fundamental principles. By uncovering and understanding these general truths and fundamental laws, science provides a framework for explaining phenomena, predicting outcomes, and making advancements in various fields. It helps us comprehend the world around us and enables us to develop technologies, improve our lives, and address challenges.

In Conclusion, Science involves the systematic process of observing, identifying, describing, experimenting with, and theoretically explaining natural phenomena. Let's break down each component:

1. **Observation:** Scientists use their senses or instruments to gather data and information about the natural world. Observations can be qualitative (descriptive) or quantitative (measurable).
2. **Identification:** Scientists identify and classify the observed phenomena, assigning them to specific categories or groups based on their characteristics and properties.
3. **Description:** Scientists describe the observed phenomena in detail, noting their features, behavior, and relationships to other phenomena. Clear and accurate descriptions are essential for developing a comprehensive understanding.
4. **Experimental investigation:** Scientists design and conduct controlled experiments to investigate specific aspects of the natural world. Controlled experiments involve manipulating variables while keeping other factors constant, allowing scientists to isolate the effects of individual variables and establish cause-and-effect relationships.
5. **Theoretical explanation:** Scientists develop theories and models to explain the observed phenomena and make predictions about their behavior. Theoretical explanations are based on evidence, logical reasoning, and rigorous analysis of experimental data.

By following these steps, scientists contribute to the accumulation of knowledge, refine existing theories, propose new hypotheses, and advance our understanding of the natural world.

II. WHY SCIENCE TEACHING IS IMPORTANT

Science teaching is important because it equips students with the skills, knowledge, and mindset needed to engage with and contribute to the scientific advancements and challenges of our rapidly changing world.

There are many thoughts those proves the importance of science in life.

2.1 Science Promotes innovation or Creativity

Trial and error are the necessity of experimentation. It is well said that if something does not work first time, try again and again. Allowing experimentation with new concepts encourages imagination and resourcefulness.

2.2 Science improves critical or analytical Thinking

To analysis a phenomenon means look or search deeply. Taking observations in Science help to analyse any event . Students can subsequently make a prediction or draw a conclusion on what they observe.

2.3. Science enhances Communication

The study of Science gives an opportunity to improve both reading and verbal skills in a gracious way. It can also set a common aim for a group of students.

2.4. Science expands viewpoint or perspective

Study of science alters your perspective on a variety of topics whether it is music or art or games. A student can enjoy and improve in games when he learn about the conservation of momentum.

2.5. Science develops scientific inquiry and curiosity

Science teaching nurtures a sense of wonder and curiosity about the natural world. It encourages students to explore, investigate, and ask questions, promoting a scientific mindset that values evidence and encourages a lifelong learning approach.

2.6. Science foster scientific literacy

Science is an integral part of everyday life. It helps individuals make informed decisions about their health, environment, and technological advancements. Science teaching equips students with the knowledge and skills necessary to understand scientific concepts, evaluate scientific claims, and critically analyze information.

2.7. Science enhances scientific and technological innovation

Science education lays the foundation for future scientists, engineers, and innovators. By providing students with a strong understanding of scientific principles and practices, it prepares them to contribute to advancements in various scientific disciplines and technological breakthroughs.

2.8. Science addresses societal challenges:

Many societal issues, such as climate change, public health, and sustainability, have scientific dimensions. Science teaching helps students understand these complex issues, equipping them with the knowledge and skills to contribute to finding solutions and making informed decisions that positively impact society.

2.9. Science encourages career opportunities:

Science education opens doors to a wide range of career opportunities in scientific research, engineering, medicine, technology, environmental sciences, and more. By igniting interest and providing a solid scientific foundation, science teaching can inspire and prepare students for fulfilling careers in these fields.

III. METHODS TO ACHIEVE EFFECTIVE SCIENCE TEACHING LEARNING PROCESS

To succeed in Science, teacher needs to keep five steps in his mind and then execute properly, however all these steps need active participation of learners. These are-

3.1 Planning

Before anything else, planning is key to success.

- Graham Bell

Plans are of little importance, but planning is essential

- W Churchill

These two quotes show the importance of planning in teaching process. Planning is indeed crucial for effective teaching. Before starting of session, teacher need to plan about how to cover syllabus, when to cover the syllabus, scheme of examinations, planning and selection of demonstration and experiments and any need of extra classes or exercises. Syllabus outlines the content, objectives, and expectations of a course or subject. It serves as a road map for both teachers and students, providing a structured framework for learning. By carefully planning the coverage of a syllabus, teachers ensure that the content aligns with the curriculum goals and objectives. Planning the coverage helps teachers allocate sufficient time to each topic, ensuring that all the essential content is covered within the given time constraints. It helps avoid rushing through certain topics or spending too much time on others, promoting a balanced and comprehensive learning experience.

Teachers can link exams with the course topic thanks to a carefully designed syllabus covering. They are able to create tests that precisely gauge pupils' comprehension of the subjects being studied. By scheduling review and practise time in advance, teachers may make sure that their pupils are well-prepared for exams. While establishing a syllabus's content is crucial, it is as important to be flexible and adaptable. Based

on the needs, feedback, and learning rate of the students, teachers should be flexible in their approach. Although planning offers a general framework, it should be flexible enough to account for unforeseen events or the need for additional help. All of these plans need to be reviewed with students and shared with them.

3.2 Teaching Techniques

Teacher need to select proper teaching technique for effective teaching learning process. Integral lecture method is basically lecture method but it is integrated by using questions, examples, inquiries, resources and class activities. It seeks to go beyond passive listening and encourages active participation and critical thinking. Active learning strategies, student interaction and engagement, the integration of multiple learning styles, and assessment and feedback make up the integrated lecture method.

Use of TEB→ SEB→ SEE is very helpful in science teaching. Here

TEB→ means Teacher, example on board

SEB→ Student, example on board

SEE→ Student, example in exercise book.

TEB also acts as a role model for clear and organised information presentation and idea articulation in scientific discourse. Students can actively create their knowledge and get a greater comprehension of scientific ideas because to SEB's emphasis on interaction and involvement. SEE also gives students the chance to get feedback from their teachers and peers, establishing a collaborative and encouraging learning atmosphere. Teachers can design a balanced and all-encompassing learning experience by incorporating TEB, SEB, and SEE into scientific instruction. TEB lays a foundation of information, SEB stimulates active learning and application, and SEE promotes introspection, dialogue, and greater comprehension.

Teacher needs to give notes to all the students, He has to break derivations or concepts into steps /parts to make memorization easy for the students. The use of AV aids enhances the effectiveness of teaching learning process. The absorption of knowledge is much better than traditional learning. But all these need an active participation of students.

3.3 Time Management

Making informed decisions, increasing productivity, completing goals, lowering stress, improving the quality of work, and maintaining a healthy work-life balance all depend on effective time management. It lets people to utilize their time effectively, resulting in success on both a personal and professional level while also promoting happiness and fulfillment. Time management is important for both teacher and taught. It needs active participation of both. A proper time management is key to success.

Teacher need to cover topics, syllabus and experiments at appropriate time. He has to manage extra classes, if required, well within time frame. The teacher needs to give appropriate time to a discouraged student and encourage them. He can take help of peer students to explain the topics/concepts. For such students counsellor/ psychologist can help a lot. Most important thing is that teacher need to counsel discouraged students separately.

3.4 Study Group

Study groups help to make teaching and learning more successful. Designing study groups is most helpful in Science. They provide a number of advantages that enhance the educational experience. Study groups often consist of students with diverse backgrounds, , calibre, experiences, and perspectives. This diversity enhances the educational setting by exposing pupils to various modes of problem-solving and thinking. Students expand their viewpoint and build cultural competency by connecting with classmates from various social, academic, and cultural backgrounds. A study group made up of students with various skill levels but a common objective offers several benefits. Such study groups encourage effective learning, personal growth, and a deeper comprehension of the subject matter by utilising complementary strengths, participating in peer teaching and learning, providing mutual support, and fostering collaboration.

Study groups give participants the chance to exchange various study methods, approaches, and resources. Each person might approach learning in a different way that is advantageous to others. Group members can learn new strategies and hone their own study skills by debating and using various study tactics. They can pick up efficient note-taking practices, time management skills, and group learning approaches, all of which will help them become better students overall. Study groups require effective communication for successful collaboration. Communication skills can be developed through conversation, teaching people about concepts, and paying attention to various viewpoints. Through these exchanges, people can hone their communication skills and learn how to respectfully discuss opinions and effectively communicate information. Members of a study group can encourage and inspire one another to remain committed to their

academic objectives and focused. Group members can promote a good and motivating environment by sharing successes, establishing shared goals, and offering support through trying moments. Peer support, shared passion, and appreciation of one another's work all contribute to maintaining motivation and desire for achievement. Study groups foster a spirit of cooperation and teamwork. The pursuit of a common objective fosters group cohesion and collaboration. They discover how to appreciate and respect one another's efforts, rely on one another's assets, and cooperate to get things done. This sense of camaraderie aids in the development of essential skills including cooperation, teamwork, and compromise, which are crucial in both academic and professional contexts.

In conclusion, study groups provide collaborative learning, critical thinking, peer support, and knowledge application. They offer a setting where students may actively interact with the subject matter, gain from one another, and refine important skills. Study groups can help and enhance the teaching-learning process by establishing a lively and engaging learning atmosphere.

3.5 Motivation

Motivation can be defined as a process of initiating, directing, and maintaining goal-oriented behaviors. It is the impetus that propels people to act, endure, and accomplish their objectives. It is necessary for success in many facets of life and plays a significant part in the learning process.

Teacher needs to practice both positive and negative motivation. Utilizing rewards and positive reinforcement to promote desirable behaviors and actions is known as positive motivation. In order to encourage people, it emphasizes rewarding and promoting positive behaviour. Negative motivation refers to the use of penalties, repercussions, or unpleasant stimuli to deter undesirable behaviors and actions. In order to inspire people, it emphasizes the fear of unfavourable results. The motivation can also be defined on the other terminology namely intrinsic and extrinsic. The source of intrinsic motivation can be from internal whereas extrinsic motivation is caused by external factors. When a student participate in an activity and he feels happy it means he is intrinsically motivated but when he does it for any reward, it is because of extrinsic motivation. Suppose when a student goes to school because he loves it, it is intrinsic motivation; but when he goes to school to avoid punishment, it is extrinsic motivation. The combination of both intrinsic and extrinsic motivation proved fruitful at school level teaching. Motivation helps students to maintain expectation for success. It provides frequent opportunities for students to respond and to receive feed back about teacher's academic work. Finding strategies to encourage and inspire discouraged or disengaged students to engage in remedial programmes and return to their studies is crucial.

In conclusion, motivation is essential for rehabilitative socialization of discouraged students. Teachers can help students regain their enthusiasm for learning and get over their discouragement by fostering collaboration, creating a supportive environment, setting realistic goals, giving personalized feedback, and using a variety of instructional strategies. Students can achieve success, develop resilience, and adopt a positive view on their academic path through a combination of support, encouragement, and targeted interventions.

IV. CONCLUSION

Science helps us comprehend the world around us and enables us to develop technologies, improve our lives, and address challenges. Science gives students the abilities, information, and frame of mind necessary to interact with and contribute to the scientific advances and problems of our fast changing world, science education is crucial. Science advances technical and scientific progress as well as addresses social issues. Therefore it is necessary to study science. The role of teacher and his teaching planning / strategy play a vital role in succeeding science. By adapting various process a teacher can achieve and help his students to achieve success in Science. Main steps/ processes are proper planning, adapting appropriate teaching techniques, following proper time management, making study groups and last providing motivation to his students. Planning for coverage of syllabus, scheme and pattern of examinations, experiments and extra exercises/classes is first and prime step. Adopt appropriate teaching techniques to achieve optimum goal in class is highly desired. It consists of integral lecture method, follow TEB→ SEB→ SEE model, provide notes and assignments to students and use of AV aids. A proper Time Management is required in Coverage of Topics in Classes, lab visits, management of extra classes and time to motivate / Counsel the discouraged Students. An effective teacher makes Study groups to make teaching and learning more successful. Study groups should consists of students of different calibre. A study group has pupils of different abilities but with one Goal. It helps to learn faster, sharpen study skills, motivate and inspiring one another and above all develop team spirit. A successful teacher is one who plays an effective role of motivator. He has to practice negative and positive motivation, intrinsic and extrinsic motivation and provide feedback and reward of performance in class and remedial socialization for discouraged students.

V. ACKNOWLEDGEMENT

The authors are thankful to Hon'ble Commandant, Rashtriya Indian Military College, Dehradun, and Principal, Bhagwati Senior Secondary School, Gangapur City, Rajasthan for their encouragement and for providing all the facilities to carry out this research work.

REFERENCES

- [1] Crutcher, K. A. (1991). How to succeed in science. *Perspectives in Biology and Medicine*, 34(2), 213-218.
- [2] Passon, O. (2004). How to teach quantum mechanics. *European journal of physics*, 25(6), 765.
- [3] Redish, E. F., & Vicentini, M. (Eds.). (2004). *Research on physics education* (Vol. 156). IOS Press.
- [4] Rebello, N. S., & Zollman, D. A. (2005). Trends in physics education research-a personal perspective. *Department of Physics, Kansas State University*.
- [5] Bredan, A. S., & Van Roy, F. (2006). Writing readable prose: when planning a scientific manuscript, following a few simple rules has a large impact. *EMBO reports*, 7(9), 846-849.
- [6] Garrison, H., & McGuire, K. (2007). Education and employment of biological and medical scientists. *Bethesda, MD: Federation of American Societies of Experimental Biology*. <http://opa.faseb.org/pdf/Training%20Presentation,202007>.
- [7] Yewdell, J. W. (2008). How to succeed in science: a concise guide for young biomedical scientists. Part I: taking the plunge. *Nature Reviews Molecular Cell Biology*, 9(5), 413-416.
- [8] Steffe, L. P., Thompson, P. W., & von Glasersfeld, E. (2012). Teaching experiment methodology underlying principles and essential elements. In *Handbook of research design in mathematics and science education* (pp. 267-306). Routledge.
- [9] Cherry, K. (2018). Extrinsic vs. intrinsic motivation: What's the difference. Retrieved April, 4, 2018.

