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INNOVATIVE PRACTICES FOR QUALITY IMPROVEMENT IN TEACHING PHYSICAL SCIENCE AT SECONDARY LEVEL

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ABSTRACT
With the curricular changes taking place in teaching science, the science teachers are expected to adopt innovative methods and practices, integrating technology in classroom teaching with a view to improve quality in teaching Physical Science at secondary level. There is lacuna in the teaching of Physical Science today in secondary schools. Most of the science teachers have been following still the traditional methods of teaching Physical Science. They should take every care in the transaction of Physical Science curriculum in the schools effectively and efficiently with a view to develop in their students the scientific attitude. The current trend in science education world wide focuses on inquiry-based instruction. The students of science are expected to develop scientific thinking and reasoning. They should be encouraged to develop certain skills such as observing, inferring, classifying, predicting, measuring, questioning, interpreting and analyzing data. This is possible only when the science teachers possess positive attitude and right perceptions towards the use of innovative practices in teaching Physical Science in secondary schools. The present investigation is an attempt to explore the perceptions of secondary school teachers towards innovative practices for quality improvement in teaching Physical Science at secondary level. The researchers used a self-developed questionnaire to collect data from a sample of 500 teachers (200 Headmasters and 300 School Assistants in Physical Science) from 200 selected secondary schools located in four north coastal district of Andhra Pradesh, viz., Srikakulam, Vizianagaram, Parvathipura, Manyam and Visakhapatnam using Stratified Random Sampling method. The researchers used differential and inferential statistics for analysis of data. The findings of the study revealed that the demographic variables – gender, professional qualification and teaching experience have no influence on the perceptions of teachers towards the use of innovative practices for quality improement in teaching Physical Science at secondary level. However, the location of the school has a significant positive influence on the perceptions of teachers towards the use of innovative practices in teaching Physical Science. The study suggested that the teachers should use new strategies and techniques in teaching Physical Science at secondary level in order to develop in their students the skills of enquiry, critical and creative thinking; and scientific temper. It is also suggested that the teachers need to attend professional development programmes to improve their own skills in the use of innovative practices in teaching Physical Science.

Key Words: Physical Science, Innovative Practices, Perceptions, Scientific attitude

INTRODUCTION
Science is often defined as a body of knowledge as well as a process of acquiring and refining knowledge. The 'search for truth' is the dominant motive in the prosecution of science. It is an organized system of knowledge which is based on inquiry born out of natural curiosity, logical reasoning and experimentation. Science has become a human activity, an attitude and an exercise of the mind that puts us as it were in a state of familiarity with nature. Etymologically, the word, 'science' comes from the Latin word, '*scientia*', which means

'knowledge' **(Barnhart, 1988).** Thus, science is understood as a body of knowledge. The facts and laws of science paint only a partial picture of the whole enterprise. A complete depiction of science should include the knowledge of the field and what the body of knowledge can provide in the process of understanding **(Krug, 1960).**

The Columbia Encyclopedia defines science as "an accumulated and systematized learning, in general usage restricted to natural phenomena. The progress of science is marked not only by an accumulation of facts, but by the emergence of scientific method and of the scientific attitude".

In the words of **Good (1945)**, "Science is an activity by means of which a person seeks to relate his current sense experience to his total structure of understanding in a manner that is in agreement with all his pertinent observations of properties and behavior." In the words of Aldous Huxley, "Science is nothing but a systematized and organized common sense" **(Rajan, K.M., 1999).**

Kothari Commission has remarked, "Science is universal, so can be its benefits. Its material benefits are immense and far-reaching - industrialization of agriculture and release of nuclear energy are two examples - but even more profound is its contribution to culture" **(Report of the Indian Education Commission, 1964-66).**

THE CONCEPT OF 'SCIENCE EDUCATION'

Science education is the process of teaching and learning science concepts, methods and principles. It aims to develop scientific literacy, enabling individuals to understand and apply scientific knowledge in everyday life. Effective science education often involves hands-on experiments, interactive activities and real world applications. Inquiry-based Science Education (IBSE) is a popular approach, wherein students investigate problems, ask questions and test ideas. Teaching strategies such as guided discovery, collaborative learning and the use of technology are very useful for students to enhance their understanding of different concepts in science. The science curriculum should be designed in such a manner that it should build a strong foundation in scientific concepts and processes. The goal of science education is to produce scientifically literate individuals who can make informed decisions, understand scientific issues and contribute to society's technological and scientific advancements.

Students should be encouraged to develop a scientific vision about acquiring and processing information, about scientific and technological developments, their relevance to everyday life; and their long-term implications to society. The responsibility of science teachers is not only to teach facts, principles and processes of science; but also to facilitate students discharge their social responsibilities and preserve democracy as well. It is important to develop in them the skills such as critical thinking, logical thinking and problem-solving for a healthy and sustainable society.

FUNCTIONS OF SCIENCE EDUCATION IN SECONDARY SCHOOLS

Science education in secondary school curriculum plays a multifaceted role in the development of students. The following are some of the primary functions of science education in secondary schools.

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(i) Knowledge acquisition

Science education helps students understand the natural world, the laws of nature and the principles governing physical, chemical and biological processes. It provides a strong foundation for students who wish to pursue futher studies in science-related fields such as engineering, medicine and research.

(ii) Skill development

Science encourages students to think critically, ask questions and solve problems using evidence-based approaches. It teaches students to conduct experiments, make observations, analyze and interpret data and draw conclusions.

(iii) Technological literacy

Science education helps students understand the principles behind modern technology and its applications in everyday life. It fosters creativity and innovation, enabling students to develop new technologies and solutions to problems.

(iv) Environmental awareness

Science education raises awareness about enviraonmental issues such as climate change, pollution and conservation; and encourages sustainable practices. It instills in individuals a sense of responsibility towards the protection of environment and the importance of preserving natural resources.

(v) Health and well-being

Science provides knowledge about human anatomy, physiology, nutrition and health, helping students make informed decisions about their well-being. It teaches students about safety precautions in various contexts such as conducting experiments in the laboratory and handling hazardous materials, measures to safeguard their health during educational tours and excursions, personal cleanliness etc.

(vi) Cultural and Social understanding

Science education often intersects with other subjects such as mathematics, history and geography, providing a holistic understanding of the world. It fosters an appreciation for scientific contributions from different cultures and promotes a global perspective on scientific advancements. Students develop tolerence towards the culture of other societies.

(vii) Career preparation

Science education exposes students to various career paths in science, technology, engineering and mathematics (STEM) fields. It equips students with skills such as analytical thinking, research and technical proficiency that are highly valued in the job market.

Science in the secondary school curriculum is essential for developing individuals with well-rounded personality with a view to mould them as critical thinkers and responsible citizens. It prepares students for future academic pursuits, careers and informed participation in societal issues. By understanding the functions of science education, students appreciate its importance in shaping them as innovators, problem-solvers and leaders in future.

PHYSICAL SCIENCE: MEANING AND NATURE

Physical science is the systematic study of the inorganic world, distinct from the study of the organic world. It encompasses four major areas, viz., physics, chemistry, astronomy and earth sciences. Physics is the study of matter, energy and fundamental forces of nature. It includes concepts like motion, force, energy and the laws governing the physical universe. On the other hand, chemistry is the science of matter, particularly its properties, composition and reactions. It explores how substances interact, combine and change to form new substances.

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Astronomy is the study of celestial objects and phenomenon beyond Earth's atmosphere. It covers the origin, evolution and properties of planets, stars, galaxies and the universe as a whole. Earth sciences cover the study of Earth and its components, including geology, meteorology, oceanography and environmental science. It examines the physical processes and materials that shape our planet. These branches help us understand the natural world and the principles governing it. Thus, physical science provides us a thorough understanding of the physical world around us. Physical science, by advancing our knowledge and capabilities, helps us to improve the quality of our life and address global challenges.

TEACHING PHYSICAL SCIENCE IN SECONDARY SCHOOLS

Physical Science provides insights into the natural world, from the cosmos to the tiniest particles, shaping our understanding of the universe. Teaching of Physical Science in secondary schools holds several important benefits. It helps students understand the fundamental principles of science, including matter, energy and their interactions. It develops certain skills such as critical thinking, creativity, problem solving and reasoning among the students.

The two science subjects - Physics and Chemistry have some similarities in the structures of knowledge. Therefore, these two science subjects are combined to form Physical Science. The description and characteristics of physics and chemistry have common strands; and hence may be taught using similar methods and approaches in the secondary schools.

Physics is one of the most fundamental sciences. It deals with the study of matter and energy. The study of physics helps us to understand other sciences such as chemistry, biology, geology, astronomy, medical science and environmental science; and physics is understood as the host of other sciences. At the same time, development of other sciences contributes to the development of physics itself. The most significant area to which physics can contribute is the development of alternative energy resources.

Chemistry is the study of properties and uses of matter. It is also one of the basic sciences and serves as foundation to understanding of biochemistry, molecular genetics, physics, geology, physiology, etc. It is concerned with the molecular behavior of substances. It plays a significant role in the way we cultivate crops using pesticides and other crop protection medicines. Identification of specific fuel additives and suitable vehicular material has made transportation efficient and comfortable. Similarly, electronics and computer technology have become advanced because of a variety of chemicals having specific properties.

OBJECTIVES OF TEACHING PHYSICAL SCIENCE AT SECONDARY LEVEL

At secondary stage of education, science is taught to the students with a view to develop in them scientific attitude and technological skills to solve their day-to-day problems. The following are the objectives of teaching Physical Science at secondary school level.

Teaching of Science at secondary level aims at making the students:

- understand the nature of science and technology
- understand the basic principles, concepts and laws of science
- apply basic scientific principles in finding solutions to problems related to agriculture, energy, health, nutrition etc.
- develop problem-solving and decision-making skills
- include values underlying science and technology
- develop rich and satisfying views of the universe

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- develop an understanding of various processes of environment and concern for its preservation and conservation
- understand and appreciates the joint enterprise of science, technology and society
- develop an attitude that would equip them to continue science and technology education throughout their life
- acquire process skills, which form part of the attitude for developing a scientific temper
- develop certain manipulative skills which are required in their day-to-day life situations

There is widespread agreement within the education and broader community that the primary purpose of science education is to develop scientific literacy. The momentum of technological development is itself a source of inspiration for science teachers in teaching science.

THE ROLE OF A SCIENCE TEACHER

The role of a science teacher has evolved in recent years from that of transmitter of knowledge to one of facilitator of knowledge. The teacher is expected to be a participant in the construction of knowledge and to develop in students an understanding of the nature of science.

The science teacher plays a crucial role in the development of scientific temper among students; and fosters in them the values such as truth, honesty and open-mindedness hidden in scientific method. The teacher can develop in the students the sense of inquiry by allowing them to explore their environment and by encouraging them to ask questions, even if, sometimes, these questions may appear trivial. In the process of teaching-learning, the science teacher should convey that science is tentative and nothing is fixed or final; and the quest for progressive refinement of theories and explanations continues in which the students can participate at that time and later when they grow old **(NCERT: Pedagogy of Science, 2013).**

Activities such as projects, field work, paper reading along with laboratory work and discussion would encourage students to do science. This in turn, would help them to learn the skills associated with the inquiry and processes of science such as observing, measuring, hypothesizing, predicting, analyzing and communicating.

INNOVATIVE PRACTICES IN TEACHING PHYSICAL SCIENCE AT SECONDARY LEVEL

There are several innovative teaching methods and practices in science education that are revolutionizing the way students learn and teachers teach. These methods use technology to make science teaching more accessible and enjoyable; and enhance creativity, scientific exploration, critical thinking and a lifelong love for scientific inquiry. Today, there is an increasing push towards technology integration in teaching various subjects in general and teaching Physical Science in particular by the teachers who can effectively navigate and leverage digital tools in the classroom.

The following are some of the innovative strategies and approaches in teaching physical science for students at secondary level.

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(i) The Constructivist Approach

The constructivist approach has been developed on the belief that students construct new knowledge based on their existing understanding and experiences. Teachers provide support and gradually increase the complexity of tasks as students' understanding intensifies. For constructing knowledge of the learner, the teacher may use various strategies of teaching-learning that come under the purview of constructivist pedagogy. There are certain common principles observed in constructivist pedagogies that are available **(Brooks and Brooks, 1993; Steffe & Gale, 1995; Larochelle, Bednarz & Garrison, 1998).** These principles include:

1. Learning should take place in authentic and real world environment;
2. Learning should involve social negotiation and mediation;
3. Content and skills should be understood within the framework of learners' prior knowledge;
4. Content and skills should be made relevant to the learner;
5. Students should be assessed formatively, serving to help them acquire further
6. learning experiences;
7. Students should be encouraged to become self-regulatory, self-mediated and self-aware of learning;
8. Teacher should serve primarily as a facilitator of learning, but not as an instructor; and
9. Teacher should encourage multiple perspectives and representations of content.

(ii) The 5E-Learning Model

This is a constructivist model of teaching–learning. In this model, the (five) 5Es are: **Engage, Explore, Explain, Elaborate and Evaluate.**

In this model, conceptual change can be achieved by using five distinct, but interconnected phases.

(a) Engage

The students need to be engaged and focused on the learning tasks by asking questions, defining a problem and drawing their attention to an interesting event. This is the process of motivating to learn.

(b) Explore

The students get an opportunity to explore through all senses. They are allowed to work together and build a base of common experience which assists them in the process of sharing and communicating. During exploration the students' inquiry process drives the teaching-learning.

(c) Explain

The teacher interacts with students to discover their ideas. The communication among the peers and with the facilitator may be observed to notice their questions, writing, drawing; and their performance of activities and experiments. This can help the teacher to facilitate progress in students' learning and integrating assessment with the teaching-learning process.

(d) Elaborate

Students are allowed to expand the concept they have learned, make connections to other related concepts and apply their understanding to real life situations. The teacher, who acts as the facilitator, helps the students to develop their understanding through additional hands-on work and minds-on activities.

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(e) Evaluate

In this stage the teacher sees if the students have attained understanding of concept and knowledge. During the teaching-learning process the teacher adopts continuous and comprehensive assessment of teaching-learning.

The Collaborative Learning Approach (CLA)

In Collaborative Learning Approach (CLA), students work in groups to complete the tasks assigned to them, solve problems and conduct experiments. This approach enhances in the students communication and teamwork skills. The learners take responsibility of their own learning. It promotes in them self-learning skills. The students discuss their ideas with the group members, relating it to their previous experiences. Teacher facilitates situations for active participation in teaching-learning process by encouraging collaboration among the learners. Collaborative learning approach develops both academic and social skills in learner in an integrated manner.

(iii) The Problem-Solving Approach (PSA)

Learning experiences that allow independent thinking and multiple ways of approaching the problem, encourage independence and creativity in learners. PSA is based on the idea of involvement of students in real life problems. It gives students opportunity to actively construct their learning by thinking, questioning, visualizing the situation, searching for solution, doing activities and experiments and arriving at conclusion on their own.

The teacher facilitates them in identifying the problem. For this, he/she may create a situation, pose a question, perform activity or experiment, elicit inquiry from students to make students realize that a problem exists and help them to identify the problem. He/she sets up the stage for solving the problem. He/she helps them pose questions to initiate thinking, listens to their thinking, facilitate them to recall their existing knowledge and reconstruct them as and when it is required, and to use that knowledge to solve problems.

(iv) Inquiry-based Learning (IBL)

Inquiry-based Learning is a student-centered approach that allows students gain knoledge about scientific facts basing on ‘inquiry’. It encourages them to ask questions among themselves, conduct experiments in collaboration and find answers to different problems through investigation. This approach promotes critical thinking and problem-solving skills among students. It allows students for hands-on activities, involving them in laboratory experiments, field work and interactive activities that permit them to explore scientific concepts actively.

(v) Project-Based Learning (PBL)

Project-Based Learning is an approach that believes in Real-world applications. This approach allows students to work on projects that require them to apply physical science concepts to address real-world problems. The approach fosters collaboration and practical application of knowledge.

Project-Based Learning approach is interdisciplinary in nature. This approach often integrates multiple subjects such as mathematics, engineering and technology, to provide a holistic learning experience.

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(vi) Flipped Classroom

A flipped classroom is an innovative teaching model that reverses the traditional learning environment by engaging students learn at their own pace. Flipped classroom allows students for active learning. In this approach students review content at home through videos or readings and engage in interactive activities and discussions in the classroom. In flipped classroom, the teacher remains a facilitator. The teacher guides and supports students as they apply their knowledge in solving real-world problems; and engage them in critical thinking exercises.

(vii) Concept Mapping

Concept maps are graphical tools for organizing and representing knowledge about certain concepts. A concept map represents an understanding of the relationship and hierarchy between important set of concepts. They promote meaningful learning in science. This can be understood by studying the following components of a concept map.

In concept mapping, the first step is to identify and enlist various key concepts in the topic. These concepts are then arranged in a two dimensional hierarchically in descending order, i.e. the more general concepts are placed at the top followed by the less inclusive concepts. Concepts occurring at same level of observation are placed at the same horizontal level.

Concepts in a concept map are interconnected together through well labeled linkages. Cross-links are particularly powerful connections, which form a 'web' of relevant and interrelated concepts. They tend to connect different sub-conceptual structures. There is no limit on the number of connecting lines. Concept mapping has been proved very useful in organizing concepts.

(viii) Technology-Enhanced Learning

Technology-enhanced learning approach makes use of digital tools in order to make learning more concrete and meaningful. This approach utilizes simulations, interactive software, virtual labs, and online resources to make learning more engaging and accessible. This approach aims to combine traditional classroom instruction with online learning activities and resources. This approach encourages student engagement in the teaching-learning process.

(ix) Experiential Learning

Experiential learning is the process of learning from direct experiences. However, experiential learning is not just a fieldwork or connected with learning from real-life situations. It is a theory that defines the cognitive process of learning, emphasizing the importance of developing four kinds of abilities, viz. concrete experience, reflective observation, abstract conceptualization and active experimentation, where a learner encounters some experiences **(Kolb & Fry, 1975).**

Concrete experience is followed by reflection on that experience on a personal basis. This may then be followed by the derivation of general rules describing the experience, or the application of known theories to it (abstract conceptualization), and hence to the construction of ways of modifying the next occurrence of the experience (active experimentation), leading in turn to the next concrete experience. All this may happen in a flash, or over days, weeks or months, depending on the topic. This complete process allows one to learn new skills, new attitudes or even entirely new ways of thinking.

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TECHNOLOGY INTEGRATION IN TEACHING PHYSICAL SCIENCE

The integration of different digital tools and technologies in the teaching-learning process helps to enhance the understanding of different scientific concepts and theories in a better way as compared to the traditional methods of teaching Physical Science in secondary schools.

(i) Use of Augmented and Virtual Reality technologies

Augmented Reality is a technology that allows a combination of real and virtual objects. It allows the overlaying between information and virtual objects in our real-world scenes. It depends on using the existing environment and adding information to it to make a new artificial environment. It enables users to perceive the real world around them and incorporate virtual objects that suit the purpose for which it's being used. On the other hand, virtual reality technology allows users to interact with virtual reality.

The integration of Augmented Reality **(**AR) and Virtual Reality (VR) technologies as one of the most innovative teaching methods in science has opened up new possibilities for immersive and interactive learning experiences. They allow students to explore and manipulate scientific concepts in virtual environments that closely resemble the real world experiences.

One of the most popular applications of AR and VR technologies is the virtual laboratory simulations. They are immersive and interactive 3D simulations that enable students to perform science experiments online, from their computers anytime and anywhere, without feeling pressured.

(ii) Use of Artificial Intelligence (AI) in Science Education

Artificial Intelligence (AI) has emerged as a transformative force in education, offering personalized learning pathways, adaptive feedback systems and virtual classroom simulations. AI-based tools such as **Tinkercad**, **Google Classroom**, and **Knewton** are used to provide personalized instruction to teacher trainees based on their learning progress and challenges. These tools allow educators to tailor their teaching strategies to meet the specific needs of their students, thereby promoting more effective learning outcomes.

'Tinkercad' is a free, online 3D design and modeling tool developed by Autodesk. It is designed to be user-friendly and accessible, making it an excellent resource for beginners, teachers and students alike. It allows users to create 3D models using a simple drag-and-drop interface. Users can start with basic shapes and combine them to create more complex designs. It includes a section for creating and simulating electronic circuits, which is highly useful in learning concepts relating to electronics and coding. It provides educational resources lesson plans, tutorials and projects aligned with educational standards, making it a valuable tool for classroom use.

'Google Classroom' is a free, web-based platform developed by Google for educational institutions. It integrates with Google Workspace for Education to streamline the teaching learning process. Teachers can create, distribute and grade assignments – all within the platform. Students can submit their work electronically and teachers can provide feedback and grades. It integrates with Google Docs, Sheets, Slides and other Google tools, allowing students and teachers to collaborate on documents and projects in real-time.

‘Knewton’ is an AI-powered adaptive learning platform designed to personalize education for students. It uses advanced algorithms to tailor educational content to the individual needs of each student, helping them achieve mastery of learning outcomes. It aims to create a more effective and engaging learning experience by leveraging the power of AI to meet the unique learning needs of each student.

Using Artificial Intelligence now is a vital method in science education for use by the teachers and the students. Schools can benefit from the power of artificial intelligence in science education by integrating it with existing digital lab environments that support Science, Technology, Engineering and Mathematics (STEM) education. These artificially intelligent systems will be able to take over manual tasks such as grading assignments and monitoring student progress etc., allowing teachers to spend more time in interacting with students.

REVIEW OF RELATED LITERATURE

The studies carried out earlier by the other researchers that aim at finding out the perceptions of teachers towards innovative practices in teaching Physical Science in secondary schools have been examined; and a brief review of the same is provided in the following paragraphs.

Aniruddha Ray & Anisha Nandy (2024) conducted a comparative study to explore the science teaching strategies of India, Singapore and the USA. This is a qualitative study with few-country comparison methodology. The authors depend on secondary data collected from Government documents of the three countries, various journal articles, edited books, websites, research thesis etc. to apply document-based analytical approach. It is found that, India has lagged behind than Singapore and the USA in case of applying Information and Communication Technology (ICT) and Science Technology Engineering Mathematics (STEM) classroom more effectively for science teaching at secondary level. Though various attempts for innovative science teaching strategies were made after NCF-2005, but practically all of them were not successful. Activity-based, inquiry-based, blended, student centric teaching strategies are highly solicited for India for better performance in various international tests like, Programme for International Student Assessment (PISA), Science Olympiads etc. Through NEP-2020, India has started to nurture creativity and incorporate critical-thinking skills in science teaching more vividly.

Sharon Raju, T. & Vinil Kumar, S. (2023) conducted a study to explore the perceptions of secondary school teachers towards quality improvement in teaching Physical Science. The researchers used a well prepared and standardized questionnaire as the tool for collection of data from a sample of 120 teachers (50 Headmasters and 70 School Assistants in Science) selected from 50 secondary schools located in Visakhapatnam of Andhra Pradesh using Stratified Random Sampling technique. Mean score values, standard deviations and independent t-tests were used for analysis of data. The findings of the study revealed that the demographic variables – Gender, Age, Marital Status and Length of service of teachers working in Secondary Schools have no influence on their perceptions towards quality improvement in teaching Physical Science.

Apata & Funke Susan (2022) conducted a study to explore the perceptions and attitudes of Physics Teachers to innovative teaching strategies in Senior Secondary Schools in Kwara State, Nigeria. The study used a descriptive survey design. A total of 141 physics teachers were selected as sample for the study using the purposive sampling technique. The data were collected using "Physics Questionnaire on Perception and Attitude to Innovative Teaching

Strategies (PQPAITS)", with a 0.78 reliability coefficient using Cronbach Alpha. The Data were analysed using descriptive methods, t-test, and analysis of variance. Results showed that physics teachers' perception and attitude to innovative teaching strategies were positive. The attitudes of male teachers were more positive towards innovative teaching strategies than their female counterparts. Teachers with 5-9 years of teaching experience exhibited high value in their perceptions. The study recommends training for senior school physics teachers in innovative teaching strategies.

Venkata Rao, Nimma & Victoria, P.G. (2022) conducted a study to explore the perceptions of Science Teachers towards the role of Science Teacher in developing scientific attitudes among secondary school students. The researchers used survey method for the present investigation. A sample of 200 teachers from the secondary schools of Visakhapatnam district was selected to collect data. A questionnaire was developed for instructors to get their opinions on how science teachers might encourage secondary school pupils to have a scientific attitude. The SPSS application was used to evaluate the data using various statistical techniques, including mean, standard deviation, t-test, and F-test (ANOVA). Finally, the researchers concluded that there is significant difference among the perceptions of teachers according to their demographic variables i.e., Teaching Experience, School Management and Locality of the School towards Role of Science Teachers in developing scientific attitudes among secondary school students in Visakhapatnam district.

NEED FOR THE PRESENT INVESTIGATION

There is lacuna in the teaching of Physical Science today in secondary schools. Even today, majority of teachers are following the traditional methods of teaching Physical Science in the classroom. There is a big gap between theory and practice in science teaching in schools. Most of the schools do not have science laboratories. There are some schools which have laboratories; but they do not have necessary equipment to conduct experiments. Most of the Science Teachers do not find an opportunity to update their knowledge and pedagogical skills through Professional Development Programmes.

The Physical Science teachers should strive for developing the necessary competencies among their students. Further, the teachers should develop among their students the skills such as critical thinking, creative thinking, logical thinking, reasoning, scientific attitude and scientific temper. They should contribute their mite to bring about improvement in quality in the teaching of physical science in secondary schools. They should take every care in the transaction of Physical Science curriculum in the schools effectively and efficiently with a view to develop in their students the scientific attitude.

It is felt by the researchers to conduct a study to explore the perceptions of teachers towards innovative practices in teaching Physical Science at secondary level. The present investigation is an attempt in this direction.

OBJECTIVES OF THE STUDY

The main objective of the present investigation is to study the perceptions of teachers towards innovative practices for quality improvement in teaching Physical Science at secondary level.

The study also aims at finding out the influence of four demographic variables – gender, professional qualifications, teaching experience and location of the institution on the perceptions of teachers towards innovative practices in teaching Physical Science at secondary level.

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HYPOTHESES OF THE STUDY

The following hypotheses have been formulated for the present investigation:

(i) There is no significant difference in the perceptions of male and female teachers towards innovative practices for quality improvement in teaching Physical Science at secondary level.

(ii) There is no significant difference in the perceptions of teachers with B.Ed. qualification and those with M.Ed. and above qualifications towards innovative practices for quality improvement in teaching Physical Science at secondary level.

(iii) There is no significant difference in the perceptions of teachers with an experience of less than 10 years and those with 10 years and above towards innovative practices for quality improvement in teaching Physical Science at secondary level.

(iv) There is no significant difference in the perceptions of teachers working in rural and urban schools towards innovative practices for quality improvement in teaching Physical Science at secondary level.

LIMITATIONS OF THE STUDY

The present investigation is an attempt to know the influence of four demographic variables, viz., gender, professional qualification, teaching experience and location of the institution on the perceptions of teachers towards innovative practices for quality improvement in teaching Physical Science at secondary level.

Further, the study also takes into its purview the perceptions of secondary school teachers towards innovative practices for quality improvement in teaching Physical Science with regard to four perceptional dimensions, viz., Teachers' beliefs towards Innovative practices in teaching Physical Science, Infrastructural and Instructional facilities, Working environment influencing Teacher performance and Service conditions determining the nature of employment.

DELIMITATIONS OF THE STUDY

The present investigation is limited to study the perceptions of 500 teachers (200 Headmasters and 300 School Assistants in Physical Science) working in 200 selected secondary schools located in the rural as well as urban areas in the four north coastal districts viz., Srikakulam, Vizianagaram, Parvathipuram Manyam and Visakhapatnam in Andhra Pradesh.

METHODOLOGY

(a) Method of Research

The investigators used 'Descriptive survey' method of research for the present investigation.

(b) Sample

The sample of the study consisting of 500 teachers (200 Headmasters and 300 School Assistants in Physical Science) working in 200 secondary schools located in four north coastal districts viz., Srikakulam, Vizianagaram, Parvathipuram Manyam and Visakhapatnam in Andhra Pradesh was selected using 'Stratified Random Sampling technique'.

(c) .Research Tool

The researchers used a well-developed 'questionnaire' consisting of 44 items in total, keeping 11 items in each of the four dimensions considered for the present investigation. This questionnaire with 44 items has been used as the research tool for Pilot study as a part of standardization of the tool.

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(d) Administration of the Tool

The tool was initially administered to a small sample of 50 teachers (20 Headmasters and 30 School Assistants in Physical Science) working in the secondary schools located in and around Vizianagaram town under pilot study. The measures of reliability, validity and objectivity of the tool have been calculated. Further, the researchers conducted item analysis for the items included in the tool. Out of 44 items selected for the tool, the discriminating power of 40 items has been found positive and is negative in respect of 4 items. The items whose discriminating power is negative have been removed; and the final tool consists of 40 items, which are pool proof in all respects. The final tool has been administered to 500 teachers (200 Headmasters and 300 School Assistants in Physical Science) from the 200 selected secondary schools.

STATISTICAL INTERPRETATION OF DATA

The data collected has been analyzed and interpreted using different statistical techniques.

Table showing significance of difference in the perceptions of teachers towards innovative practices for quality improvement in teaching physical science at secondary level

S. No.	Variable		N	Mean	S.D.	t-ratio	Result
1	Gender	Male Female	260 240	130.73 131.33	33.67 34.09	0.19*	*Not Significant at 0.05 and 0.01 levels
2	Professional Qualification	B.Ed. M.Ed. & above	440 60	130.64 133.83	33.78 31.23	0.74*	*Not Significant at 0.05 and 0.01 levels
3	Teaching Experience	Less than 10 years 10 years & above	290 210	132.09 133.45	35.14 34.21	0.43*	*Not Significant at 0.05 and 0.01 levels
4	Location of the institution	Rural Urban	280 220	124.43 136.50	34.25 34.01	3.93*	*Significant at 0.05 and 0.01 levels

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FINDINGS OF THE STUDY

On the basis of the analysis and interpretation of data, the researchers have arrived at the following findings and drawn the conclusions.

1. There is no significant difference in the perceptions of male and female teachers towards innovative practices for quality improvement in teaching Physical Science at secondary level.
2. There is no significant difference in the perceptions of teachers with B.Ed. qualification and those with M.Ed. and above qualifications towards innovative practices for quality improvement in teaching Physical Science at secondary level
3. There is no significant difference in the perceptions of teachers with an experience of less than 10 years and those with 10 years and above towards innovative practices for quality improvement in teaching Physical Science at secondary level.
4. There is significant difference in the perceptions of teachers working in Rural and Urban schools towards innovative practices for quality improvement in teaching Physical Science at secondary level.

The teachers working in urban secondary schools perceived higher towards innovative practices for quality improvement in teaching Physical Science at secondary level as compared to their counterparts working in rural schools.

CONCLUSION

From the findings of the study, it is concluded that gender, professional qualification and teaching experience have no influence on the perceptions of teachers towards innovative practices for quality improvement in teaching Physical science at secondary level. However, the location of the institution has a significant positive influence on their perceptions towards innovative practices for quality improvement in teaching Physical Science at secondary level.

EDUCATIONAL IMPLICATIONS

The following are the educational implications of the present study:

(i) The present investigation helps to make the teachers realize the importance of innovative practices for quality improvement in teaching Physical Science.

(ii) The study aims at developing in the teachers of Physical Science a positive attitude and right perceptions towards the use of innovative practices for quality improvement in teaching Physical Science in secondary schools.

(iii) The study would help the management to realize the need for providing necessary infrastructural and instructional facilities in the school for improving quality in teaching Physical Science.

(iv) The study is an eye-open to the policy makers to evolve policies in such a manner that they would help to motivate Physical Science teachers use innovative practices in teaching Physical Science in secondary schools.

(v) The study would help the teachers use simulations to conduct experiments virtually for the benefit of the students.

(vi) The study would help the Academic Organizations like SCERTs, IASEs and the State Departments of Education to take necessary steps for the organization of Orientation programmes and Refresher courses for teachers in the use of digital technologies in teaching Physical Science effectively in the classroom.

(vii) The present study suggests necessary measures in developing professional competencies among teachers in teaching Physical Science using digital platforms for the benefit of their students.

(viii) The study helps to motivate the students towards learning Physical Science with their total engagement in the teaching learning process.

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(ix) The study helps the Government realize the need for providing necessary resources and digital tools to meet the 21st century learning needs of the students in Physical Science.
(x) The innovative practices used by the teachers in teaching Physical Science would help to develop in them necessary competencies in teaching the subject.

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