

## **CHAPTER-1**

### **Theoretical Background**

#### **1.1 Introduction**

Science, society, and culture are deeply interwoven threads of the human experience, each shaping and being shaped by the others in a complex and dynamic relationship that has evolved over centuries. Science, as the pursuit of knowledge about the natural and social worlds through observation and experimentation, does not exist in a vacuum—it is both a product and a driver of cultural values, societal priorities, and collective worldviews. The emergence of modern science during the Enlightenment period, for instance, marked a cultural transformation where reason, empirical evidence, and skepticism began to challenge long-standing religious and traditional authorities, leading to shifts in political power, education, and economic structures. As science matured into a formal discipline, its applications began to revolutionize everyday life, from the Industrial Revolution's technological innovations to the digital revolution that has interconnected the world. These transformations fundamentally altered how people interact with each other and their environments, reshaping everything from communication and transportation to education, healthcare, and governance. Society, in turn, influences the direction, funding, and ethics of scientific research. Governments, institutions, and even grassroots movements play critical roles in determining which areas of science receive attention and resources—whether it's curing diseases, advancing artificial intelligence, exploring outer space, or mitigating climate change. Social values and public perception also shape science's acceptance and application; for example, genetically modified organisms (GMOs) and vaccines are seen as scientific advancements in some cultures, while they face skepticism or resistance in others due to historical, ethical, or religious concerns.

The digital age has further deepened the connection between science, society, and culture. The proliferation of information—both accurate and misleading—has created a cultural environment where scientific authority is both amplified and challenged. On the one hand, digital platforms allow scientists to communicate directly with the public, share data openly, and collaborate across borders. On the other hand, they also enable the rapid spread of misinformation, conspiracy theories, and pseudoscience, which can undermine trust in legitimate science. This duality reflects broader cultural tensions between expertise and populism, between evidence and belief. Science in society must therefore navigate an increasingly complex media landscape where credibility, transparency, and engagement are more important than ever. Scientists must become effective communicators, while citizens must develop critical thinking skills to assess the quality and intent of scientific claims.

Finally, science offers society a framework for understanding and improving the human condition. It equips us with tools to address poverty, disease, inequality, and environmental degradation, while also reminding us of our limitations and fallibility. It invites us to be humble before the vastness of the universe and the intricacy of life, to value curiosity and imagination, and to see ourselves as part of a shared human and planetary story. Culture, in turn, gives science its meaning and direction—shaping what we choose to explore, why we pursue certain goals, and how we interpret our findings. This mutual influence makes the relationship between science, society, and culture not just important but foundational to human progress. In an age of rapid technological change, climate instability, and global interconnectedness, nurturing a culturally aware and socially engaged science is not just

desirable—it is essential. Only by understanding and honoring this relationship can we hope to harness science's full potential for the betterment of all humanity.

So, science and technology are deeply embedded in the fabric of daily life, often invisibly underpinning the activities, conveniences, and capabilities that define the modern human experience. They empower us to solve problems, improve health and well-being, connect globally, create cultural richness, and address pressing environmental and societal challenges. The continuous advancement of science and technology depends on curiosity, creativity, collaboration, and ethical reflection, inviting each individual to participate in a world shaped by knowledge and innovation. Recognizing the omnipresence and significance of science and technology fosters appreciation, critical engagement, and responsibility, enabling humanity to navigate the future with insight and hope.

## **1.2 Meaning and Origin of Science**

Science, at its most fundamental level, is a systematic pursuit of knowledge aimed at understanding the natural world and the phenomena that govern it. The term itself originates from the Latin word "scientia", which means knowledge. This knowledge is not random or anecdotal but is acquired through careful observation, experimentation, and reasoning, which form the cornerstone of scientific inquiry. Unlike other forms of knowledge acquisition, such as tradition, superstition, or revelation, science demands evidence, repeatability, and logical coherence. It is a process that encourages questioning, skepticism, and the constant testing of ideas to either validate or refute hypotheses. This methodological approach ensures that scientific knowledge is dynamic and self-correcting, always open to revision and refinement as new evidence emerges. The essence of science lies in this openness and rigor, making it a unique and powerful tool for deciphering the complexities of the universe.

The origin of science is deeply rooted in humanity's innate curiosity and desire to make sense of the environment. From the earliest days, humans observed the patterns in the sky, the cycles of the seasons, and the behavior of animals, which were crucial for survival. These observations gradually evolved into systematic explanations and practical applications. Ancient civilizations such as the Mesopotamians, Egyptians, Greeks, Indians, and Chinese made significant early contributions by developing early forms of mathematics, astronomy, medicine, and engineering. The Babylonians, for instance, charted celestial movements, laying the groundwork for astronomy. The Egyptians mastered the practical use of geometry in architecture and land measurement. Ancient Indian scholars contributed to mathematics with the concept of zero and algebraic ideas, while Chinese inventors developed sophisticated technologies like papermaking and gunpowder. These early developments were often intertwined with religious and philosophical beliefs, yet they laid the essential foundation for what would later become the scientific enterprise.

Today, science is a global enterprise involving millions of researchers working across diverse fields, from fundamental physics to applied biomedical research. It relies on collaborative networks, advanced instrumentation, and sophisticated computational tools. The principles that underpin science remain constant: systematic observation, hypothesis testing, reproducibility, peer review, and a commitment to truth. The origin of science as a quest for knowledge through reason and evidence remains as relevant now as it was millennia ago. The continual accumulation of scientific knowledge shapes modern life profoundly, influencing medicine, communication, transportation, energy, and environmental stewardship. Science not only expands the boundaries of human understanding but also provides practical solutions to the challenges facing humanity, demonstrating its enduring significance and vitality.

So, science emerged from humankind's fundamental curiosity and need to understand and predict the world, evolving through contributions from diverse cultures and epochs. It developed from early observational practices intertwined with philosophy and religion into a rigorous, empirical, and experimental discipline during the Scientific Revolution. The scientific method remains the backbone of this discipline, enabling the accumulation of reliable and objective knowledge. The origin and meaning of science encapsulate a remarkable human journey toward deciphering the laws of nature, a journey that continues today with ever-expanding scope and depth, underscoring science's central role in shaping human civilization and our future.

### **1.3 Definition of Science:**

The word Science comes from the Latin „Scientia“ meaning knowledge. Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. In an older and closely related meaning, “Science” refers to the body of reliable knowledge itself, of the type that can be logically and rationally explained. Over the course of the 19th century, the word "Science" became increasingly associated with scientific method, a disciplined way to study the natural world including physics, chemistry, geology and sociology.

There is no one definition of science to which is universally accepted. There are, perhaps, as many definitions of Science as true as scientists, According to Columbia Encyclopedia (1963) 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.”

According to Plato, “Science is nothing but perception”.

According to Spencer, “Science is organized knowledge”.

According to Dr.Sheldon Gottlieb in a lecture series at the University of South Alabama, “Science is an intellectual activity carried on by human that is to discover the ways in which this information about the natural world in which humans live and to discover the ways in which this information can be organized into meaningful patterns.”

According to Robert H.Dott. Jr., and Henry L.Batten, Evolution of the Earth (2nd Edition), “Science consists simply of the formulation and testing of hypotheses based on observational evidence; experiments are important where applicable, but their function is merely to simplify observation by imposing controlled conditions.” According to Webster's New Collegiate Dictionary, the definition of science is “Knowledge attained through study or practice.”

The Chamber's Dictionary defines science as “systematized knowledge”. It refers to the pursuit of knowledge or truth and principles that which refers to abstract principles, as distinguished from arts.

From the Multicultural History of science page at Vanderbilt University, Science involves more than the gaining of knowledge. It is the systematic and organized inquiry.

## **1.4 Learning:**

Learning is acquiring new or modifying existing knowledge, behaviours, skills, values or preferences and may involve synthesizing different types of information. Learning takes place directly in the classroom and indirectly outside classroom. Learning has been defined differently by different psychologists.

They are as follows:

According to Munn, „To learn is to modify behaviour and experience.“

According to Skinner, „Learning is a process of progressive behaviour adaptation.“

According to Gates and others, „Learning is the modification of behaviour through experience and training.“

“Learning refers to the growth and decay of interests, knowledge and skills and the transfer of these two new situations” Encyclopedia of Educational Research.

According to Gardener Murphy, “The term learning covers every modification in behaviour to meet environmental requirements.”

Learning is acquiring new knowledge, behaviours, skills and values. It does not happen all at once, but builds upon and is shaped by what we already know. To that end, learning may be viewed as a process, rather than a collection of factual and procedural knowledge. Human learning may occur as part of education, personal development, schooling or training. It may be goal oriented and may be aided by motivation. Learning may occur as a result of habituation or classical conditioning. Learning may occur consciously or without conscious awareness. There is evidence of human behavioural learning prenatally, in which habituation has been observed as early as 32 weeks into gestation, indicating that the central nervous system is sufficiently developed for learning and memory to occur very early on in development.

## **1.5 Learning Difficulties:**

Teachers and educationists make frequent use of the terms 'learning problems' and 'learning difficulties', but no generally accepted definition exists of their precise meaning. Yet, it seems that without some clarification of these terms it is hardly possible to begin to identify such difficulties. It is possible, of course, to apply the term 'learning difficulty' to any situation where a student fails to understand a relatively easy concept or notion that we wish him or her to acquire as the result of some instructional intervention.

Such description of 'learning difficulty' is of little practical value, though: it is too general and all-embracing and, in addition, does not even hint at the possible causes of such difficulties.

Learning difficulties is a general term meaning that a child or adult has difficulty learning in a typical manner because the brain has trouble processing information. A learning difficulty is not an indication of intelligence level, but it means the child will have trouble learning in the same way others may do and may have trouble performing certain types of tasks.

The definition given in Good's Dictionary of Education is, "The degree to which a given topic is hard to learn determined by the percentage of pupils who learn the topic under normal conditions."

Consultant pediatrician Dr. Martin Ward Platt points out that the term "Learning difficulties" is used by some people to cover the whole range of learning disabilities, from children with a slightly lower IQ to those who will never be able to live on his own." It is easy to give the impression, by using a term "learning difficulties", that a child has less of a disability than they really do, says Dr. Martin Ward Platt.

### **1.6 Learning difficulties in science subject:**

Learning difficulties in school science subjects represent a multifaceted challenge faced by a significant number of students globally, often rooted in a complex interplay of cognitive, emotional, pedagogical, linguistic, socio-cultural, and systemic factors. Science, by its nature, is an abstract, conceptually dense, and process-driven subject that demands higher-order thinking skills such as critical analysis, logical reasoning, spatial visualization, problem-solving, and the ability to understand dynamic systems and abstract phenomena—skills that do not develop uniformly across all learners, especially at the primary and secondary school levels. Many students struggle to comprehend scientific concepts like force, energy, matter, or ecosystems because they are often taught through traditional textbook-based approaches, emphasizing rote memorization over hands-on learning, investigation, and inquiry. This reliance on theoretical instruction without adequate use of experimentation or real-world context leads to disengagement and poor conceptual understanding. Language is another major barrier in science learning. Scientific language is often technical, formal, and filled with domain-specific vocabulary and symbols that students find unfamiliar and intimidating. This is particularly challenging for students whose first language is not the medium of instruction, or for those with underdeveloped reading comprehension skills. Terms like "photosynthesis," "oxidation," or "evolution" require not only memorization but also conceptual clarity and contextual understanding, which many students lack due to limited exposure or ineffective teaching methodologies. Moreover, the symbolic representations in science—such as chemical equations, circuit diagrams, or mathematical formulas in physics—demand a level of abstract thinking and symbolic literacy that can be overwhelming for learners with cognitive difficulties like dyslexia, dyscalculia, ADHD, or working memory deficits. Students with specific learning disabilities often find it hard to follow complex multi-step instructions or retain sequential information, which are critical skills in conducting experiments, solving numerical problems, or understanding scientific processes.

Learning difficulties in school science subjects are a result of a wide spectrum of interlinked factors, including cognitive processing issues, emotional and motivational challenges, inadequate pedagogical practices, language and communication barriers, rigid assessment methods, lack of teacher training, socio-economic disparities, and insufficient systemic support. Overcoming these difficulties requires a holistic and inclusive approach that goes beyond academic instruction to consider the psychological, cultural, and social dimensions of learning. By embracing diverse teaching strategies, integrating technology mindfully, reforming assessment systems, and equipping educators with the tools and empathy needed to support all learners, schools can foster a learning environment where science becomes accessible, engaging, and empowering for every student, regardless of their individual challenges.

## **1.7 Rationale of the study:**

Science teaching in schools plays an indispensable role in shaping the intellectual, practical, and moral dimensions of young learners. In an age dominated by rapid technological advancement and global interconnectedness, science is no longer a distant, abstract discipline confined to laboratories. Instead, it is a living, evolving field that permeates all aspects of modern life—from the smartphones we use to the food we eat, the health care we receive, and the energy that powers our homes. The teaching of science in schools is therefore not merely about transferring factual knowledge; it is about nurturing a mindset of inquiry, critical thinking, creativity, and responsibility among future citizens. Through systematic exposure to scientific principles and processes, students gain the skills and attitudes necessary to navigate and contribute meaningfully to a complex, technologically driven world.

Equally important is the role of science in promoting "technological and scientific innovation". Many of the transformative inventions and discoveries that have shaped modern civilization—electricity, antibiotics, the internet, vaccines, renewable energy—are the fruits of scientific endeavor. By exposing students to the history and impact of scientific breakthroughs, teachers can inspire the next generation of inventors, engineers, and researchers. Science teaching can ignite a passion for innovation and entrepreneurship, encouraging students to pursue STEM (Science, Technology, Engineering, and Mathematics) careers and contribute to national development and global progress.

Science also cultivates "ethical and moral reasoning". Scientific knowledge is powerful, but it must be used responsibly. Teaching science in schools provides an opportunity to discuss the ethical implications of scientific research and technological advances. Questions such as "Should we clone humans?", "What are the risks of artificial intelligence?", or "How should we distribute limited medical resources?" encourage students to consider not just what science can do, but what it should do. This fosters a balanced perspective where scientific knowledge is guided by human values and societal needs.

In conclusion, the significance of science teaching in schools cannot be overstated. It is the cornerstone of a modern, enlightened, and progressive society. Science education develops critical thinking, nurtures curiosity, promotes innovation, and fosters ethical responsibility. It prepares students to deal with personal, national, and global challenges with confidence, competence, and compassion. As we look toward the future, where science and technology will play an even more dominant role in shaping our lives, investing in quality science education for all learners becomes not just a necessity, but a moral imperative. Schools must strive to make science engaging, inclusive, and relevant, ensuring that every student is equipped with the knowledge, skills, and values to thrive in the 21st century and contribute meaningfully to a better world.

## **1.8 Significance of the research work:**

Science, as a school subject, holds a central position in modern education because of its relevance in understanding the world around us, promoting logical thinking, and fostering innovation. Despite its significance, many students across the globe face considerable challenges in learning science. These difficulties range from conceptual misunderstandings and language barriers to pedagogical shortcomings and lack of motivation. Identifying and addressing these challenges is critical to improving science education outcomes and

cultivating a scientifically literate society. The difficulties students face in learning science are not monolithic; they emerge from a complex interplay of cognitive, emotional, instructional, and environmental factors.

One of the foremost difficulties students face in learning science stems from the “abstract nature of scientific concepts”. Science involves a vast range of ideas that are not directly observable. For example, concepts such as atomic structure, photosynthesis, electromagnetism, and chemical bonding require students to imagine processes or entities they cannot see or experience directly. This level of abstraction demands a high level of cognitive ability, including logical reasoning, visualization, and inferential thinking. Many young learners, especially in the middle and secondary school years, struggle to develop these abstract thinking skills. Consequently, they find science content intimidating and inaccessible. Without concrete experiences or effective visualization tools, these concepts remain vague and confusing, leading to misconceptions and lack of understanding.

"Language barriers" further compound these conceptual difficulties. Science has its own technical language, including terminologies, symbols, equations, and conventions. For many students, especially non-native speakers or those from underprivileged backgrounds, this specialized vocabulary poses a formidable challenge. Words such as "oxidation," "equilibrium," "velocity," or "refraction" carry specific meanings in scientific contexts, often different from their everyday usage. If students do not fully grasp these meanings, they may misinterpret instructions or explanations, hampering their comprehension and engagement. Moreover, reading and interpreting scientific texts, lab manuals, or examination questions require literacy skills that many students have not yet developed adequately, making the subject even more daunting.

"Pedagogical methods" used in teaching science also influence learning difficulties. Traditional teaching approaches often rely heavily on rote memorization, textbook-based instruction, and lecture methods, which may not cater to diverse learning styles. Such methods do not encourage inquiry, experimentation, or active engagement — core principles of science itself. When teachers fail to contextualize scientific concepts or relate them to students' real-life experiences, the subject becomes disconnected from their world. As a result, students perceive science as a body of static facts rather than a dynamic, evolving process of discovery. This perception discourages curiosity, hinders understanding, and leads to poor academic performance.

"Lack of practical experiences" is another significant barrier to effective science learning. Science is inherently a hands-on discipline that is best understood through observation, experimentation, and application. However, many schools, particularly in rural or underfunded areas, lack the necessary laboratory infrastructure and materials. Without opportunities to conduct experiments, handle apparatus, or witness phenomena firsthand, students miss out on essential experiential learning. Theoretical knowledge without practical application tends to remain superficial, leading to poor retention and understanding. Furthermore, when students are not exposed to experiments, they miss the chance to develop important skills such as scientific reasoning, hypothesis testing, and data interpretation.

"Teacher competence and attitude" also play a crucial role in determining how well students learn science. A teacher who lacks content mastery or pedagogical training may inadvertently pass on incorrect information, reinforce misconceptions, or fail to engage students meaningfully. Moreover, a teacher's attitude toward the subject and students can

significantly affect learners' motivation. If a teacher is enthusiastic, approachable, and passionate about science, students are more likely to develop a positive attitude and a desire to learn. Conversely, if a teacher is rigid, discouraging, or indifferent, students may become disinterested, anxious, or fearful of the subject. Many students internalize their teachers' attitudes, which then affect their self-confidence and willingness to participate in science activities.

"Cognitive learning disabilities" such as dyslexia, attention deficit hyperactivity disorder (ADHD), and specific learning disorders can also interfere with science learning. Students with these conditions may struggle with reading comprehension, retaining information, following multi-step procedures, or organizing thoughts. These difficulties are often exacerbated in science, where students are expected to understand complex texts, perform calculations, follow lab procedures, and write structured reports. If teachers are not trained to identify or support students with special needs, these learners may be left behind, experience frustration, and develop a negative attitude toward the subject.

In conclusion, learning difficulties in science at the school level are multifaceted and deeply rooted in cognitive, linguistic, pedagogical, social, and institutional factors. Addressing these challenges requires a holistic approach involving curriculum reform, teacher training, inclusive pedagogies, equitable resource allocation, and supportive assessment practices. Science should be taught not just as a body of knowledge but as a way of thinking — through inquiry, exploration, and reflection. Teachers must be equipped to make science relatable, engaging, and accessible to all learners, irrespective of their background or abilities. Students must be given opportunities to experiment, ask questions, and construct knowledge actively. Only then can science education fulfill its true purpose — nurturing critical thinkers, informed citizens, and innovative problem-solvers for the future.

### **1.9 Statement of the Problem:**

**“A Study of Learning Difficulties faced by Class IX Students in Science Subject”**

### **1.10 Operational definition of the terms:**

**Learning Difficulties:** The degree to which a given topic is hard to learn is determined by the percentage of pupils who learn the topic under normal conditions.

**Science Subject:** Science is the field of study concerned with discovering and describing the world around us by observing and experimenting. Biology, chemistry, and physics are all branches of science. Science is an "empirical" field, that is, it develops a body of knowledge by observing things and performing experiments. For the present study science subject taught in the schools from class VI-IX is considered.

### **1.11 Objectives of the study:**

The following are the objectives of the present study:

- 1) To understand the overall nature of the student towards the science subject.
- 2) To identify the most difficult areas for the student in the science subject of class IX standard.
- 3) To identify the issues related to the teaching process used for those difficult chapters of class IX standard.



### **1.12 Research Questions:**

The following are the objectives of the present study:

1. What is the overall nature of students toward the science subject?
2. What are the most difficult areas for the student in the science subject of class IX standard?
3. What are the issues related to the teaching process used for those difficult chapters of class IX standard?

### **1.13 Delimitation of the study:**

Along the period of study, support for the general research effort will serve as a barrier. It is also possible that some individuals will not be capable or eager to finish the survey forms that are delivered to them. It is anticipated that these obstacles will be overcome, yet, by making the most of the resources at fingertips while devoting more time to the research compared to what is absolutely required. Thus, it is quite likely that these limitations will have very little effect on the findings in this research, supporting the success of the study's goal and usefulness.

Some delimitations are:

- 1) This research is delimited to class IX students.
- 2) This research is delimited to JNV RAJGARH and PM SHRI K V 39 GTC Schools