Literary Enigma *ISSN (Online): 3049-2033*
The International Journal of English Language, Literature and Culture
(Peer-Reviewed and Indexed)
Vol. 2, Issue 6 (December 2025)

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A Study on the Contribution of Science Process Skills to the Development of Scientific Attitude among Secondary School Students

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Page No. 180-186

Received: 10/12/2025 **Reviewed: 16/12/2025** **Accepted:23/12/2025**

Abstract: *The current article analyses how science process skills contribute to the formation of scientific mindset among secondary school pupils. Science process skills are not limited to laboratory techniques; they include a cluster of basic and integrated skills such as observation, measurement, classification, prediction, communication, control of variables, hypothesising, experimentation, and data interpretation that help learners approach knowledge in a scientific way. Scientific attitude, in turn, refers to a disposition distinguished by curiosity, rationality, objectivity, open-mindedness, respect for facts, and freedom from superstition, all of which are fundamental to effective scientific learning at the secondary level. Existing research reveals a considerable positive link between students' scientific process abilities and their attitudes toward science, with one secondary-level study finding a correlation coefficient of 0.69 between the two dimensions. Building on these findings, the paper develops a research-oriented framework for publication by presenting the background, rationale, research gap, objectives, questions, hypotheses, methodology, tools, analysis plan, expected findings, educational implications, limitations, and references in an integrated form. The report contends that when science education promotes inquiry, experimentation, and evidence-based reasoning, students do not just do better in science; they also become more scientific in thinking and attitude.*
Keywords: *Science process skills; scientific attitude; secondary school students; science education; inquiry learning; scientific temper; science achievement; school research.*

Introduction

Secondary science education is supposed to accomplish more than only impart definitions, regulations, and facts. Since science only becomes relevant when students participate in processes of inquiry rather than memorising discrete facts, it should assist students in learning how scientific knowledge is created, tested, understood, and used in daily life. Science process skills play a crucial role in this setting because they provide students the tools they need to observe closely, categorise evidence, make predictions, evaluate data, test theories, and methodically convey results.

Because information without attitude does not always result in logical or evidence-based action, scientific attitude is equally vital in educational science. An disposition to think objectively, have an open mind, seek confirmation, challenge unsubstantiated assertions, and

ISSN (Online): 3049-2033

approach issues using reasoning rather than superstition or blind faith is often interpreted as a scientific mindset. Students are more likely to internalise these beliefs and mindsets when they engage in scientific activities on a regular basis, such as experimentation, project work, observation, and debate.

Therefore, the relationship between scientific mindset and science process abilities is important for education. Science process skills are influenced by attitudes and learning motivation, according to secondary research, and inquiry-based or guided inquiry techniques support the development of these abilities. Science process skills and attitudes toward science were shown to be significantly positively correlated in another research of secondary school students. This suggests that as students get more proficient in scientific processes, their attitudes toward science also become more positive and engaged. This article attempts to give a publishable research manuscript format on the chosen subject and is based on that extensive theoretical and empirical expertise.

Background of the Study

Science process skills are commonly divided into two broad categories: basic skills and integrated skills. Basic skills include observation, measurement, classification, prediction, and communication, while integrated skills include controlling variables, hypothesising, experimentation, and data interpretation. These skills are considered foundational for scientific literacy because they enable students to participate in inquiry, solve problems, and understand the logic of scientific investigation rather than simply reproduce textbook information.

Scientific attitude is a more affective and dispositional outcome of science education. It includes traits such as curiosity, objectivity, rationality, critical thinking, open-mindedness, intellectual honesty, respect for evidence, and freedom from superstition. Educational thinkers have long argued that science teaching should develop these qualities because they influence how students interpret reality, respond to social problems, and make decisions in daily life.

The school years, especially the secondary stage, are a crucial period for the development of both science process skills and scientific attitude. At this level, students are cognitively ready to move from simple observation to more integrated forms of reasoning such as hypothesis testing and variable control, and they are also forming stable habits of thought that influence future academic and social behaviour. For this reason, any study that explores how science process skills contribute to scientific attitude addresses an important concern of school education.

Need and Significance

The need for the present study emerges from a persistent imbalance in science classrooms. Many school systems continue to emphasise examination performance and factual recall while giving less importance to process skills and affective outcomes such as scientific attitude. The result is that students may know scientific facts but may not always display a scientific way of thinking in interpreting events, solving problems, or evaluating claims.

This study is significant because it connects two essential dimensions of science education that are often studied separately. If science process skills meaningfully contribute to the development of scientific attitude, then curriculum planners and teachers must treat laboratory work, inquiry tasks, and process-oriented learning not as optional extras but as core pedagogic strategies. The study is also relevant for school practice because previous evidence indicates that students often perform better in basic process skills than in integrated skills, especially in

ISSN (Online): 3049-2033

areas such as controlling variables and experimentation, revealing a pedagogic gap that may affect the development of a deeper scientific outlook.

The findings of such a study can support teachers, teacher educators, curriculum framers, and educational administrators. Teachers can use the evidence to design learning experiences that promote curiosity, reasoning, and objectivity; curriculum framers can align science content with inquiry-based learning; and school leaders can justify science fairs, projects, laboratory activities, and discussions as essential instruments for building scientific temper among adolescents.

Statement of the Problem

The problem of the research may be put as follows: What is the role of science process skills to the formation of scientific mindset among secondary school students? This dilemma is founded in the fact that scientific education commonly evaluates performance in topic areas while underemphasising the procedural and attitudinal components of science learning. Since science process skills represent the technique of science and scientific attitude reflects the disposition needed for rational inquiry, it becomes vital to analyse if competence in the former support's progress in the latter.

Research Gap

A review of the available literature indicates that many studies have examined science process skills independently, while others have studied scientific attitude or general attitudes toward science as separate variables. Some studies at the secondary level have reported a positive relationship between science process skills and attitudes toward science, and some have described the levels of these variables across gender or locality groups. However, there remains a need for context-specific research that directly investigates the **contribution** of science process skills to the **development of scientific attitude** among secondary school students, especially in school settings where process-oriented teaching is still unevenly implemented.

A second gap lies in the conceptual distinction between "attitude toward science" and "scientific attitude." Existing studies often focus on students' liking for science, interest in science lessons, or preference for practical work, which are valuable but not identical to traits such as objectivity, rationality, and freedom from superstition. Therefore, there is room for a study that explicitly links science process skills to scientific attitude as an educational disposition rather than only to general subject preference.

A third gap concerns the limited attention given to integrated science process skills in school-based studies. Evidence shows that students are often more familiar with basic science process skills than with integrated skills, and unfamiliarity with integrated skills suggests a gap in science teaching and learning. This gap is important because integrated skills are likely to be more strongly associated with mature scientific attitudes such as critical judgment, evidence-based reasoning, and systematic problem solving.

Objectives of the Study

The study is intended to examine the relationship between science process skills and scientific attitude among secondary school students in a systematic and measurable manner. More specifically, it seeks to understand the level of science process skills possessed by secondary school students and the level of scientific attitude demonstrated by them in the school context. It further aims to determine whether science process skills make a significant contribution to the development of scientific attitude and whether this contribution differs across selected background variables such as gender, school type, or locality if such variables are included in the design.

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Specific Objectives

1. To assess the level of science process skills among secondary school students.
2. To assess the level of scientific attitude among secondary school students.
3. To examine the relationship between science process skills and scientific attitude among secondary school students.
4. To determine the contribution of science process skills to the prediction or development of scientific attitude among secondary school students.
5. To compare science process skills and scientific attitude across selected demographic variables such as gender, school type, and locality, if included in the study design.

Research Questions

The current investigation may be directed by the following research questions. The first question asks what level of scientific process skills is displayed by secondary school pupils in regard to fundamental and integrated aspects such as observation, classification, prediction, communication, hypothesis creation, experimentation, and data interpretation. The second question asks what level of scientific mindset is held by secondary school pupils in terms of curiosity, objectivity, rationality, open-mindedness, and freedom from superstition. The third and fundamental question examines if there is a substantial association between science process abilities and scientific mindset among secondary school pupils. The fourth question examines if science process skills substantially contribute to or predict the development of scientific mindset among secondary school pupils. If background factors are addressed, extra questions may assess if science process abilities and scientific attitude change according to gender, area, or kind of school.

Formulated Research Questions

1. What is the level of science process skills among secondary school students?
2. What is the level of scientific attitude among secondary school students?
3. Is there any significant relationship between science process skills and scientific attitude among secondary school students?
4. To what extent do science process skills contribute to the development of scientific attitude among secondary school students?
5. Do science process skills and scientific attitude differ significantly with respect to gender, locality, and type of school?

Operational Definitions

In the present study, **science process skills** refer to the set of basic and integrated skills used by students in scientific inquiry, including observation, measurement, classification, prediction, communication, control of variables, hypothesising, experimentation, and data interpretation. These skills will be measured through a standardised or researcher-developed science process skills test suitable for secondary school learners.

Scientific attitude refers to the tendency to approach phenomena, events, and problems with curiosity, rationality, objectivity, open-mindedness, critical reflection, and respect for evidence while avoiding superstition and unsupported belief. In the study, scientific attitude will be measured through a scientific attitude scale appropriate for secondary school students.

Secondary school students refer to learners enrolled in the secondary stage of schooling, generally corresponding to adolescent students in classes IX and X or the locally equivalent grade level. The exact definition may be adjusted according to the state board or institutional context in which the study is carried out.

Methodology

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The study may be conducted through a quantitative approach because the problem requires measurement of variables, analysis of relationships, and possible prediction of one variable from another. A descriptive survey method is suitable when the purpose is to assess the present status of science process skills and scientific attitude among students, while a correlational design is appropriate for examining the strength and direction of the relationship between the two variables. If the researcher wishes to estimate contribution more directly, the correlational design may be extended through regression analysis.

Research Design

The most appropriate design for this topic is a **descriptive survey-cum-correlational design**. The survey component enables the researcher to describe the current levels of science process skills and scientific attitude, whereas the correlational component permits investigation of the association between them. If contribution is interpreted statistically, simple or multiple regression can be used to estimate how far science process skills explain variance in scientific attitude.

Population

The population may consist of all secondary school students studying in recognised schools within the selected district, subdivision, or educational region. The exact population should be clearly delimited according to the researcher's administrative feasibility, such as all Class IX and X students of secondary schools in a district of West Bengal.

Sample and Sampling Technique

A representative sample may be selected through stratified random sampling in order to ensure inclusion of relevant subgroups such as gender, school type, and locality. For example, the researcher may first divide schools into government and aided/private categories and rural and urban categories, and then select schools and students proportionately from each stratum. A sample size between 200 and 400 students would generally be adequate for a school-level correlational study, although the exact number may depend on access and institutional permission.

Tools for Data Collection

Data may be collected using two major tools. The first is a **Science Process Skills Test**, which should include both basic and integrated process skills; previous studies have used tests containing basic and integrated items for this purpose. The second is a **Scientific Attitude Scale**, preferably standardised, that measures dimensions such as curiosity, objectivity, rationality, open-mindedness, and freedom from superstition.

Where a standardised tool is not available in the local language or context, the researcher may adapt an existing scale and establish its validity and reliability through expert review, pilot testing, and internal consistency measures. Earlier secondary-level work reported high reliability for an attitude toward science questionnaire, with Cronbach's alpha reaching 0.95 in pilot testing, showing the importance of establishing psychometric quality before the main study.

Procedure of Data Collection

After obtaining institutional permission, the researcher may visit the selected schools and explain the purpose of the study to the school authorities, teachers, and students. The tools should be administered under standardised conditions so that all students receive the same instructions, adequate time, and equal opportunity to respond. It is desirable to collect data in classroom settings without disruption and to ensure that responses are used only for academic purposes.

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Educational Implications

If the study confirms that science process skills contribute significantly to scientific attitude, then science teaching at the secondary level must be redesigned to foreground inquiry, experimentation, and reflective discussion. Activities such as laboratory investigation, science projects, model construction, science exhibitions, observation tasks, and data interpretation exercises would become vital tools for shaping curiosity, objectivity, and rational judgment among students.

Teacher education programmes would also need to train prospective teachers in process-oriented pedagogy. Research suggests that where teachers neglect process skills and affective outcomes, science learning becomes narrowly content-driven, weakening students' engagement with scientific inquiry. Therefore, teacher preparation should include explicit attention to how classroom practices cultivate scientific attitude alongside content mastery.

The study may also encourage schools to evaluate science learning more broadly. If only written achievement is measured, then important dimensions such as scientific reasoning, problem solving, and attitude remain invisible in school assessment. Integrating process skills and scientific attitude into internal assessment could produce a completer and more humane picture of science

Conclusion

The topic of science process skills and scientific attitude addresses the very heart of science education. Science process skills help students learn how to investigate, question, test, interpret, and communicate, while scientific attitude shapes the disposition with which they engage the world around them. When these two dimensions develop together, science education becomes more meaningful, practical, and transformative for secondary school students.

The proposed study is therefore both timely and educationally valuable. Existing evidence already points toward a meaningful positive relationship between science process skills and attitudes toward science, and the present topic extends that concern into the more focused domain of scientific attitude. A carefully designed school-based study on this issue can make a useful contribution to educational research, classroom practice, and the wider goal of nurturing scientifically minded citizens.

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