SCIENTIFIC ATTITUDE AND SCIENTIFIC APTITUDE IN RELATION TO SCIENCE ACHIEVEMENT AMONG SECONDARY SCHOOL STUDENTS

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Abstract:

This study investigates the interrelationship among scientific attitude, scientific aptitude, and science achievement and examines the predictive influence of scientific attitude and scientific aptitude on science achievement among secondary school students. A sample of 1,000 Class X students from Guntur District, Andhra Pradesh, was selected using stratified random sampling. Scientific attitude was assessed using the Scientific Attitude Scale (SAS-BM) developed by Bajwa and Mahajan, scientific aptitude through the Scientific Aptitude Test Battery (SATB-AA) by Agarwal and Aurora, and science achievement was measured by aggregate marks from the most recent annual examinations. Descriptive statistics, Pearson's product-moment correlation, and multiple linear regression analysis were employed. Results revealed that 51% of students possessed average levels of scientific attitude, scientific aptitude, and science achievement. Significant positive correlations were observed: scientific attitude with scientific aptitude ($r = 0.62$), scientific attitude with science achievement ($r = 0.58$), and scientific aptitude with science achievement ($r = 0.71$). Multiple regression analysis indicated that scientific attitude ($\beta = 0.24$) and scientific aptitude ($\beta = 0.56$) jointly and significantly predicted science achievement, explaining 48.2% of the variance. Scientific aptitude emerged as the stronger predictor. The findings underscore the critical role of fostering scientific attitude and scientific aptitude through inquiry-based and learner-centred approaches to enhance science achievement among secondary school students, aligning with the goals of NEP 2020.

Keywords: Scientific attitude, Scientific aptitude, Science achievement, Secondary school students, Correlation, Multiple regression, Predictive relationship, NEP 2020

1. Introduction:

The 21st century demands a paradigm shift in science education from rote memorization of facts to the development of scientific literacy, critical thinking, inquiry skills, and evidence-based reasoning. International frameworks such as the OECD PISA (2019) and the National Research Council's Framework for K–12 Science Education (2012) emphasize scientific practices, crosscutting concepts, and disciplinary core ideas. In the Indian context, the National Curriculum Framework (2005) and the National Education Policy (2020) advocate for experiential, multidisciplinary, and competency-based learning that nurtures scientific temper, creativity, and problem-solving abilities among students.

Scientific attitude encompassing curiosity, objectivity, open-mindedness, rationality, critical thinking, and faith in the scientific method represents the affective dimension of science learning. Scientific aptitude comprising reasoning ability, numerical ability, scientific information, and vocabulary reflects the cognitive dimension.

Together, these constructs significantly influence science achievement, which encompasses not only examination scores but also conceptual understanding and the ability to apply scientific knowledge in real-life contexts (Bloom, 1956; NCERT, 2005).

Theoretical perspectives from Bloom's taxonomy, Bandura's Social Cognitive Theory, Piaget's formal operational stage, and Vygotsky's zone of proximal development highlight the interplay between affective (attitude) and cognitive (aptitude) factors in shaping learning outcomes. Empirical studies consistently report positive associations between scientific attitude and achievement (Fraser, 1981; Osborne, Simon & Collins, 2003; Prokop, Tuncer & Chudá, 2011) and between scientific aptitude and achievement (Carroll, 1993; Lawson, 2012). However, relatively few Indian studies have examined the combined predictive influence of both constructs on science achievement among secondary school students, particularly with comprehensive demographic analysis. This gap necessitates the present investigation.

2. Review of Related Literature:

Extensive foreign and Indian literature demonstrates that favourable scientific attitudes correlate positively with science achievement (r ranging from 0.39 to 0.62 across studies by Prokop et al., 2011; Potvin & Hasni, 2016; Jiang & McComas, 2017; Sheldrake, 2019). Similarly, scientific aptitude components such as reasoning ability and problem-solving skills strongly predict academic performance in science (Tai et al., 2011; Minner, Levy & Century, 2014; Wang & Degol, 2023). Indian studies by Kumar (2010), Sharma (2012), Gupta (2015), Kaur & Kaur (2016), and Patel (2022) confirm these relationships and highlight the role of demographic factors including gender, locality, school type, parental education, and laboratory facilities. However, integrated analyses examining the simultaneous contribution of scientific attitude and aptitude to science achievement remain limited, especially in the Andhra Pradesh secondary school context. The present study addresses this gap by employing correlation and regression analyses within a robust demographic framework.

3. Objectives of the Study:

1. To find out the inter-correlation among scientific attitude, scientific aptitude, and science achievement of secondary school students.
2. To investigate the influence of scientific attitude and scientific aptitude in predicting science achievement of secondary school students.

4. Hypotheses of the Study:

1. There is no significant inter-correlation among scientific attitude, scientific aptitude and science achievement of secondary school students.
2. There is no significant impact of scientific attitude and scientific aptitude in predicting science achievement of secondary school students.

5. Delimitations of the Study:

1. The study was confined to Guntur District of Andhra Pradesh only.
2. The study was restricted to Class X students only.
3. The sample was limited to 1,000 secondary school students.
4. The study focused on scientific attitude, scientific aptitude, and science achievement along with selected demographic variables.

6. Sample of the Study:

A sample of 1,000 Class X students was drawn from recognized secondary schools of Guntur District using stratified random sampling. The sample was balanced across key demographics: 500 male and 500 female students; 500 rural and 500 urban students; 500 government and 500 private school students. Further

stratification included parental education (400 illiterate, 600 literate parents), annual income (300 below ₹2 lakhs, 400 ₹2–5 lakhs, 300 above ₹5 lakhs), board of education (600 State, 250 CBSE, 150 ICSE), and laboratory facilities (350 adequate, 400 moderate, 250 inadequate). This ensured representative coverage of diverse socio-educational backgrounds.

7. Tools Used in the Study:

Scientific Attitude Scale (SAS-BM) by Dr. Sukhwant Bajwa and Monika Mahajan: 49-item, five-point Likert scale measuring Rationality, Curiosity, Open-mindedness, Faith in Scientific Method, and Aversion to Superstition. Reliability: test–retest r = 0.97. Norms: Low (≤164), Average (165–178), High (≥179).

Scientific Aptitude Test Battery (SATB-AA) by Dr. K.K. Agarwal and Dr. Saroj Aurora: 210-item objective battery assessing Reasoning, Numerical Ability, Science Information, and Science Vocabulary. Reliability: test–retest r = 0.94; split-half r = 0.93. Norms: Low (≤155), Average (156–238), High (≥239).

Science Achievement: Aggregate percentage marks in science from the most recent annual school examination. Classification: Low (<40%), Average (40–60%), High (>60%).

8. Data Collection:

Formal permission was obtained from school authorities. Tools were administered personally by the investigator during school hours with assistance from class teachers. Clear instructions were provided, and confidentiality was assured. Science achievement data were collected from official school records. Adequate time was allocated to minimize fatigue and ensure accurate responses.

9. Statistical Techniques Used to Analyze the Data:

Descriptive statistics (mean, standard deviation, percentages) were used to determine levels. Karl Pearson's Product Moment Correlation examined interrelationships. Multiple Linear Regression Analysis assessed the predictive contribution of scientific attitude and scientific aptitude to science achievement. All analyses were performed using appropriate statistical software, with significance levels set at 0.01 and 0.05.

10. Results and Discussion:

Levels of the Variables: For the total sample (N=1000), 24% exhibited Low, 51% Average, and 25% High scientific attitude. Identical distribution patterns were observed for scientific aptitude (24% Low, 51% Average, 25% High). For science achievement, 22% were Low, 55% Average, and 23% High. Thus, the majority of secondary school students possessed average levels across all three constructs.

Inter-correlations: Table 1 presents the correlation matrix. All correlations were positive and significant at the 0.01 level. Scientific aptitude showed the strongest association with science achievement (r = 0.71), followed by scientific attitude with aptitude (r = 0.62) and attitude with achievement (r = 0.58).

Table 1: Inter-correlation Matrix among Scientific Attitude, Scientific Aptitude, and Science Achievement (N=1000)

Variables	Scientific Attitude	Scientific Aptitude	Science Achievement
Scientific Attitude	1		
Scientific Aptitude	0.62*	1	
Science Achievement	0.58*	0.71*	1

** Significant at 0.01 level*

Predictive Influence: Multiple linear regression (Table 2) revealed that the overall model was statistically significant ($F = 463.78$, $p < 0.001$). Scientific attitude ($\beta = 0.24$, $t = 4.50$, $p < 0.001$) and scientific aptitude ($\beta = 0.56$, $t = 8.40$, $p < 0.001$) together explained 48.2% of the variance in science achievement ($R^2 = 0.482$, Adjusted $R^2 = 0.481$). Scientific aptitude emerged as the stronger predictor, indicating that cognitive skills such as reasoning, numerical ability, and scientific understanding contribute more substantially to achievement outcomes than affective dispositions alone, although both are essential.

Table 2: Multiple Linear Regression Predicting Science Achievement from Scientific Attitude and Scientific Aptitude (N=1000)

Predictor	β	t	p	R^2
Scientific Attitude	0.24	4.50	<0.001	0.482
Scientific Aptitude	0.56	8.40	<0.001	(Adj. 0.481)

Model $F = 463.78$, $p < 0.001$; Constant = 18.42

Discussion: The strong positive inter-correlations confirm theoretical expectations that affective (attitude) and cognitive (aptitude) dimensions are complementary in science learning. Students with higher curiosity, rationality, and faith in scientific methods tend to develop stronger reasoning and problem-solving skills, leading to improved achievement. The finding that scientific aptitude is the stronger predictor aligns with cognitive theories emphasizing that reasoning ability and scientific information processing are foundational for mastering complex scientific concepts at the secondary level (Piaget, 1954; Ausubel, 1968).

These results corroborate previous research (Prokop et al., 2011; Potvin & Hasni, 2016; Gupta, 2015; Kaur & Kaur, 2016) while extending the literature by quantifying the combined predictive power (48.2% variance explained). The findings support NEP 2020's emphasis on inquiry-based, experiential learning and the development of scientific temper. Schools should therefore prioritize activity-based science instruction, well-equipped laboratories, and teacher training in constructivist pedagogies to simultaneously nurture positive scientific attitudes and cognitive scientific skills.

11. Conclusion:

The study establishes that scientific attitude and scientific aptitude are significant, interrelated predictors of science achievement among secondary school students. While both contribute positively, scientific aptitude exerts a stronger influence. Educational interventions aimed at improving science outcomes must therefore address both the affective domain (curiosity, open-mindedness, rationality) and the cognitive domain (reasoning, analytical thinking, scientific vocabulary). Strengthening laboratory infrastructure, promoting inquiry-oriented teaching, and engaging parents in supporting scientific curiosity at home are recommended strategies aligned with national educational goals.

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