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Exploring the Relationship between Students' Attitudes Towards Science and Academic Achievement: Evidence across Gender and Rural-Urban Contexts at the Secondary Level of Balasore District

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Abstract

Students' attitudes towards science represent an important affective aspect of science learning and may be associated with their academic achievement. The present study examined the relationship between students' attitude towards science and academic achievement at the secondary level, with particular consideration of the rural–urban context. A descriptive survey method was employed with a sample of 80 secondary school students selected from four schools in Balasore district, Odisha. Data were collected using an Attitude towards Science Inventory and an academic achievement measure. Descriptive statistics and Pearson's product–moment correlation were used for data analysis. The findings indicated that students' attitude towards science had a mean score of 130.51 (SD = 14.47), while academic achievement had a mean score of 238.75 (SD = 48.11). A positive and statistically significant relationship was found between attitude towards science and academic achievement ($r = .2836$, $p < .05$). The rural–urban analysis also revealed a positive and statistically significant association between the two variables ($r = .2719$, $p < .05$). The findings indicate that students with more favourable attitudes towards science tended to demonstrate higher academic achievement in the present sample. However, the modest magnitude of the correlations and the correlational nature of the study do not permit causal conclusions. The study highlights the relevance of fostering students' interest, confidence, engagement, and positive perceptions of science through meaningful, activity-based, inquiry-oriented, experiential, and collaborative learning experiences. Further research using larger samples and detailed group-wise analyses is recommended to examine the factors associated with students' attitudes towards science and academic achievement.

Keywords: *Attitude towards Science, Academic Achievement, Secondary School Students, Gender, rural-urban*

1. Introduction

Science education extends beyond the acquisition of scientific facts, concepts, and skills; it also seeks to develop students' interest, confidence, engagement, and positive dispositions towards science. The affective dimension of science learning is important because students' perceptions and attitudes towards science can influence their willingness to participate in science-related activities, sustain interest in learning, and persist when confronted with challenging scientific

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concepts. At the secondary level, this dimension becomes particularly significant as students encounter increasingly complex scientific content and begin to make decisions concerning subject choices, further education, and possible career pathways. Therefore, developing positive attitudes towards science is an important component of meaningful and sustained science learning.

Students' attitudes towards science encompass several interrelated affective components, including interest in science, enjoyment of science learning, perceived usefulness of science, confidence in learning science, and willingness to participate in science-related activities. These dispositions may influence how students approach science lessons, engage with classroom activities, respond to academic difficulties, and develop sustained motivation towards the subject. The importance of the affective and psychosocial dimensions of education has also been highlighted in recent educational research, which emphasises that educational development involves not only cognitive outcomes but also students' psychological and emotional development (Tikader & Mandal, 2025). The OECD (2023) similarly recognises the importance of students' engagement, interest, and attitudes in understanding their experiences and participation in science.

Academic achievement is an important indicator of students' educational outcomes and reflects the extent to which learners acquire and demonstrate knowledge and skills through educational experiences. Achievement in science is influenced by multiple factors, including motivation, self-concept, study habits, instructional practices, learning environment, socioeconomic conditions, and students' orientations towards the subject. A positive attitude towards science may encourage students to attend more actively to science lessons, participate in learning activities, practise scientific problems, and persist in overcoming academic difficulties. Consequently, the relationship between students' attitudes towards science and academic achievement represents an important area of investigation in science education.

The relationship between students' affective characteristics and educational outcomes has received increasing attention in educational research. Tikader et al. (2025), in their review of social media addiction among teenagers, highlighted the potential consequences of excessive digital engagement for students' academic performance, concentration, and psychosocial well-being (Tikader et al., 2025). Such evidence reinforces the broader view that students' academic outcomes are embedded within a range of affective, behavioural, and contextual factors rather than being determined exclusively by cognitive ability. Similarly, research focusing on educational practices at the secondary level has emphasised the importance of students' participation, feedback, reflection, and supportive learning environments in facilitating learning (Tikader et al., 2026).

Empirical research specifically examining attitudes towards science generally indicates a positive association between science attitudes and academic achievement, although the magnitude of the relationship varies across studies and educational contexts. A three-level meta-analysis of 37 studies involving more than one million participants reported a significant positive overall relationship between attitudes towards science and achievement in science (r = .248), while also demonstrating variation according to the type of attitude and achievement measure examined (Mao et al., 2021). Narmadha and Chamundeswari (2013) similarly reported a relationship between students' attitudes towards learning science and academic achievement at the secondary level. These findings suggest that students' affective orientations towards science may be meaningfully associated with academic outcomes, while also indicating the importance of examining this relationship within specific learner populations and educational contexts.

The relevance of the school context is particularly important when examining students' academic experiences. Research conducted by Tikader et al. (2026) on formative assessment practices at the secondary level in Mayurbhanj district demonstrated that teachers' assessment practices involve feedback, student participation, reflection, and adaptation of instructional strategies, while also being influenced by contextual challenges such as time constraints and traditional assessment practices (Tikader et al., 2026). Such findings suggest that students' academic experiences are shaped by the broader educational environment in which teaching and learning occur. Therefore, examining students' attitudes towards science and academic achievement within a particular geographical and educational context can provide useful context-specific evidence.

Gender represents one potentially relevant dimension in understanding students' attitudes towards science and academic achievement. Previous research has reported variations in students' scientific attitudes and science achievement according

to gender, although findings have not been entirely consistent across contexts (Ahuja, 2017). Such variation highlights the importance of examining the attitude-achievement relationship across male and female students rather than assuming that the relationship is identical for all learners.

Locality represents another potentially important contextual dimension. Students studying in rural and urban areas may experience differences in educational resources, learning opportunities, school environments, exposure to scientific activities, and access to academic support. These contextual differences may influence students' attitudes towards science as well as their academic experiences. Therefore, examining the relationship between science attitudes and academic achievement across rural and urban contexts may contribute to a more context-sensitive understanding of science learning at the secondary level.

The rationale for the present study therefore arises from the intersection of these cognitive, affective, and contextual dimensions of science education. Existing evidence indicates a positive association between students' attitudes towards science and academic achievement, but the strength and pattern of this association may vary according to the characteristics of learners and their educational contexts (Mao et al., 2021). At the same time, research in the Indian educational context has increasingly emphasised the importance of psychological well-being, student engagement, teacher practices, and contextual conditions in understanding educational outcomes (Samapika et al., 2026; Tikader & Mandal, 2025). However, relatively limited context-specific evidence is available concerning the relationship between students' attitudes towards science and academic achievement among secondary school students in Balasore district of Odisha, particularly when examined across gender and rural-urban locality.

Accordingly, the present study examines the relationship between students' attitudes towards science and academic achievement at the secondary level, with particular reference to gender and rural-urban locality. Specifically, the study examines the relationship between attitude towards science and academic achievement among male and female secondary school students and among students from rural and urban areas. The problem of the present study is therefore stated as follows: Exploring the Relationship between Students' Attitudes Towards Science and Academic Achievement: Evidence across Gender and Rural-Urban Contexts at the Secondary Level.

2. Objectives of the Study

1. To study the relationship between attitude towards science and academic achievement among boys and girls of secondary school.
2. To study the relationship between attitude towards science and academic achievement among secondary school students studying in rural and urban areas.

3. Hypotheses

$H_0$1: There is no significant relationship between attitude towards science and academic achievement among secondary school students with reference to gender.

$H_0$2: There is no significant relationship between attitude towards science and academic achievement among secondary school students with reference to rural and urban locality.

4. Methodology

4.1 Research Design

The present study adopted a descriptive survey research design to examine the relationship between students' attitudes towards science and academic achievement among Class IX students. The design was considered appropriate because the study sought to assess the existing level of students' attitudes towards science and examine their association with academic achievement across gender and rural-urban locality without manipulating any study variable.

4.2 Population of the Study

The population of the study comprised Class IX students studying in secondary schools of Balasore district, Odisha. Class IX students were selected because this stage represents an important phase of secondary education in which students encounter increasingly complex science content and develop relatively stable attitudes towards science and learning.

4.3 Sample and Sampling Procedure

A sample of 80 Class IX students was selected from four secondary schools of Balasore district through random sampling. The sample consisted of 38 male and 42 female students. With regard to locality, the sample included 40 students from rural areas and 40 students from urban areas. The distribution of students across the selected schools was as follows: Balasore Zilla School (22), Public High School (18), Remuna High School (20), and Nuapadhi High School (20).

Table 1: School-wise Distribution of Secondary School Students in the Sample

School	No. of Students	Percentage
Balasore Zilla School	22	27.5%
Public High School	18	22.5%
Remuna High School	20	25.0%
Nuapadhi High School	20	25.0%
Total	80	100%

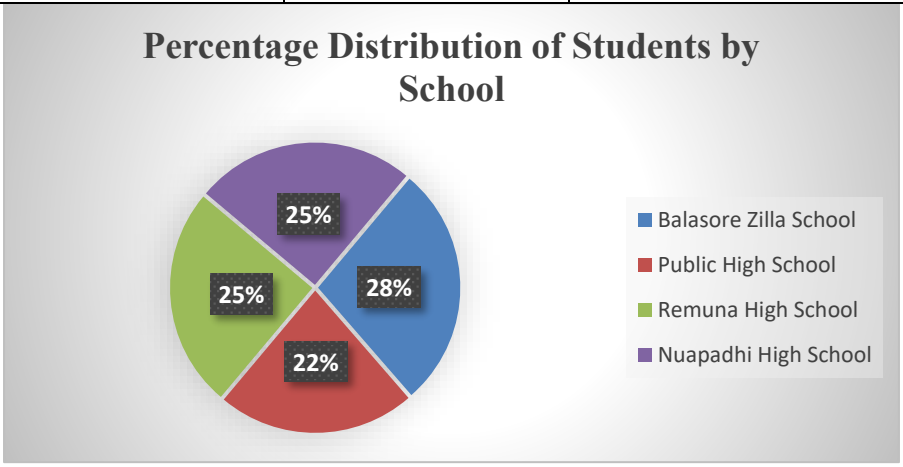


Figure 1 shows the school-wise distribution of Secondary School Students in the Sample

Table 2: Gender-wise Distribution of Secondary School Students in the Sample

Gender	**Number of Students**	**Percentage**
Male	38	47.5%
Female	42	52.5%
Total	**80**	**100.0%**

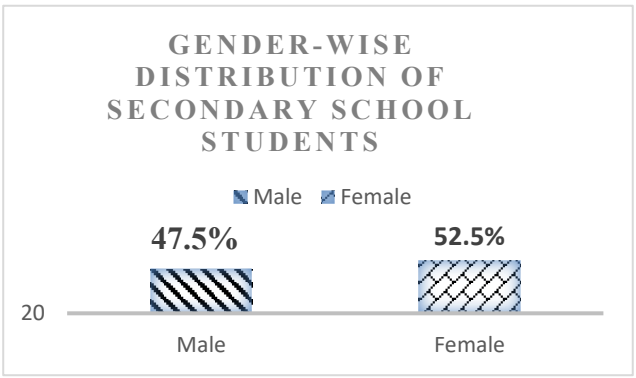


Figure 2 shows the gender-wise distribution of Secondary School Students in the Sample

Locality	**Number of Students**	**Percentage**
Urban	**40**	**50.00%**
Rural	**40**	**50.00%**
Total	**80**	**100.00%**

Table 3: Locality-wise Distribution of Secondary School Students

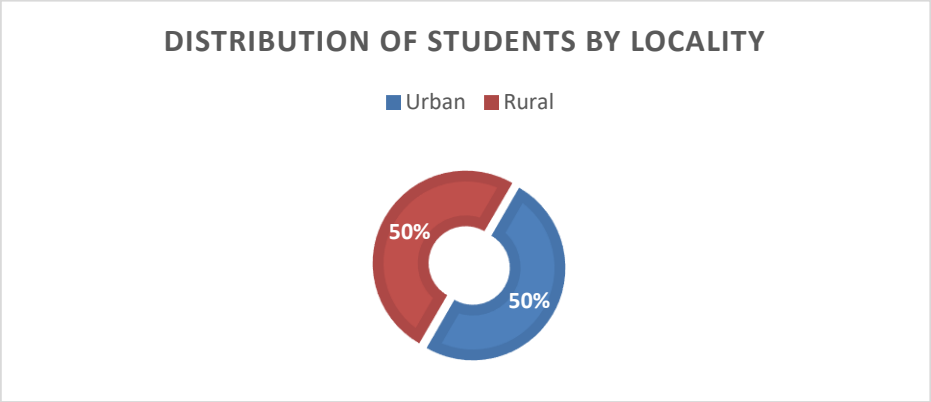


Figure 3. shows the Locality-wise Distribution of Secondary School Students

4.4 Variables of the Study

The major variables considered in the present study were:

1. **Attitude towards Science** - the affective orientation of Class IX students towards science, including their interest, enjoyment, perceived usefulness, confidence, and willingness to participate in science-related learning activities.
2. **Academic Achievement** - students' achievement in science.
3. **Gender** - male and female students.
4. **Locality** - rural and urban students.

4.5 Research Tool

To assess students' attitudes towards science, the Attitude towards Science Inventory developed by Savita Mishra (2017) was used. The inventory was administered to the selected Class IX students under standardized conditions. The instrument was used to obtain an overall measure of students' attitudes towards science.

Academic achievement was assessed using the students' science achievement scores as specified in the study.

4.6 Data Collection Procedure

Prior permission was obtained from the concerned school authorities before collecting the data. The researcher personally visited the selected schools and explained the purpose of the study to the students. The Class IX students were provided with appropriate instructions for completing the Attitude towards Science Inventory. They were informed that their responses would be treated confidentially and used only for academic and research purposes.

After completion of the inventory, the responses were collected and scored according to the prescribed scoring procedure. The corresponding academic achievement scores were also obtained for analysis. The collected data were subsequently organized and coded according to gender and rural-urban locality for statistical analysis.

4.7 Statistical Techniques

The collected data were analysed using appropriate descriptive and inferential statistical techniques. The following statistical techniques were employed:

- Frequency and percentage were used to describe the distribution of students according to school, gender, and locality.
- Mean and standard deviation were calculated to describe students' scores on attitude towards science and academic achievement.
- Pearson's product-moment correlation coefficient (r) was used to examine the relationship between attitude towards science and academic achievement.
- The level of significance was considered at 0.05.

Microsoft Excel was used for statistical processing, as reported in the original study.

4.8 Ethical Considerations

The study followed basic ethical principles of educational research. Participation was conducted with the permission of the concerned school authorities. Students were informed about the purpose of the study, and confidentiality of their responses was maintained. The collected information was used solely for academic and research purposes.

5.0 Results and Analysis

5.1 Relationship between Attitude towards Science and Academic Achievement with Reference to Gender

Table 4. shows the relationship between Attitude towards Science and Academic Achievement with Reference to Gender

Variables	*N*	*M*	*SD*	Attitude towards Science	Academic Achievement
1. Attitude towards Science	80	130.51	14.47	1.000	.2836*
2. Academic Achievement	80	238.75	48.11	.2836*	1.000

The table shows that the mean score for attitude towards science was 130.51 (SD = 14.47), whereas the mean score for academic achievement was 238.75 (SD = 48.11). The Pearson product-moment correlation coefficient between attitude towards science and academic achievement was r = .2836, which was reported as statistically significant at the 0.05 level. The positive correlation indicates that students with more positive attitudes towards science tended to have higher academic achievement scores. However, the finding represents an association between the two variables and does not imply a causal relationship.

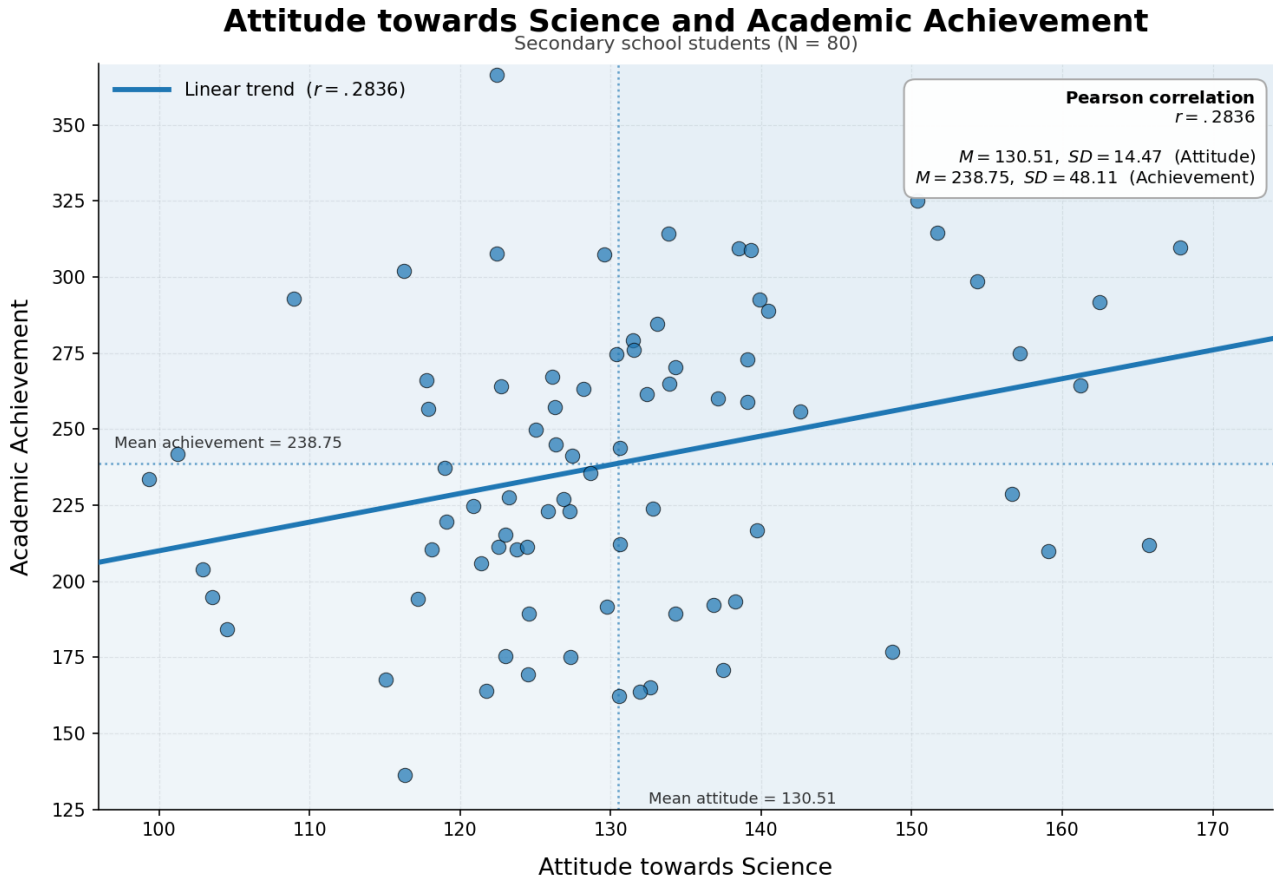


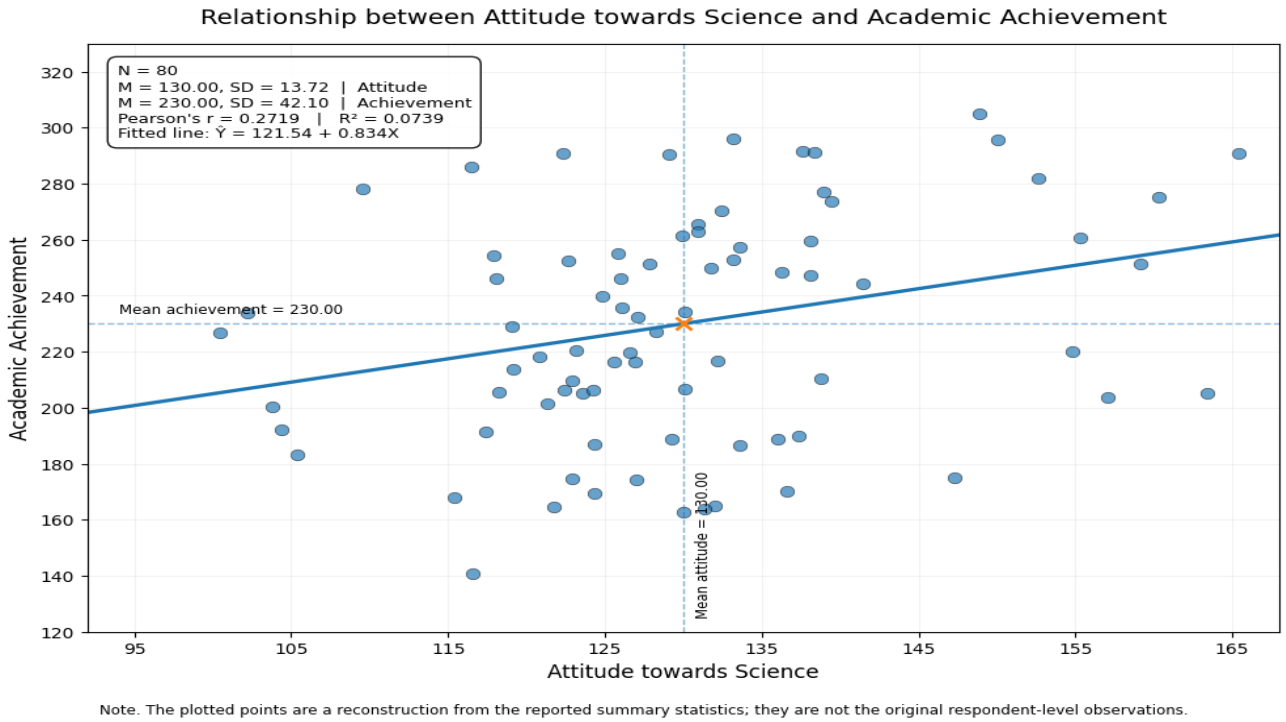
Figure 4 shows the gender-wise relationship between Attitude towards Science and Academic Achievement

5.2 Relationship between Attitude towards Science and Academic Achievement with Reference to Locality

Table 5 shows the relationship between Attitude towards Science and Academic Achievement with Reference to Locality

Variable	*N*	Mean (*M*)	SD	Attitude towards Science	Academic Achievement
Attitude towards Science	80	130.00	13.72	1.000	**.2719***
Academic Achievement	80	230.00	42.10	**.2719***	1.000

The mean score for attitude towards science was 130.00 (SD = 13.72), while the mean score for academic achievement was 230.00 (SD = 42.10). Pearson's product-moment correlation indicated a positive association between attitude towards science and academic achievement, $r = .2719$, $p < .05$. Thus, higher attitude towards science was associated with higher academic achievement in the rural-urban analysis. The finding indicates an association between the variables and does not establish causation.



Note. The plotted points are a reconstruction from the reported summary statistics; they are not the original respondent-level observations.

Figure 5 shows the locality-wise relationship between Attitude towards Science and Academic Achievement

6.0 Discussion

The present study examined the relationship between students' attitude towards science and academic achievement at the secondary level, with particular consideration of the rural–urban context. The findings revealed a positive and statistically significant relationship between attitude towards science and academic achievement (r = .2836, p < .05). Similarly, the rural–urban analysis indicated a positive association between the two variables (r = .2719, p < .05). These findings suggest that students who demonstrate more favourable attitudes towards science tend to show higher levels of academic achievement. This finding is consistent with previous research reporting a positive relationship between students' attitudes towards science and their science achievement (Ahuja, 2017; Narmadha & Chamundeswari, 2013). More broadly, a three-level meta-analysis by Mao et al. (2021), based on 37 studies, 132 effect sizes, and more than one million participants, found an overall positive relationship between attitude towards science and science achievement (r = .248, p < .001). The correlation observed in the present study (r = .2836) is therefore broadly comparable in direction and magnitude with the relationship reported in the wider literature.

Although the relationship observed in the present study was statistically significant, its magnitude was modest. This suggests that attitude towards science is one of several factors associated with students' academic performance rather than an isolated determinant of achievement. Mao et al. (2021) similarly demonstrated that the relationship between attitude and science achievement varies according to characteristics such as the type of attitude measured and the method used to assess achievement. Their findings also indicated that self-efficacy-related attitudes may show stronger associations with achievement than some other forms of attitude. Thus, the present finding should be interpreted within the broader multidimensional nature of science learning rather than as evidence that attitude alone explains academic achievement.

The positive relationship identified in the present study highlights the importance of the affective dimension of science learning. Attitudes towards science encompass students' interest, confidence, perceptions of usefulness, willingness to engage, and general orientation towards the subject. The OECD's PISA science framework also recognises an affective component of science competence, noting that students' attitudes and dispositions towards science can influence their interest, engagement, and motivation to act (OECD, 2023). Consequently, science education at the secondary level needs to address not only students' cognitive achievement but also their affective engagement with science.

The findings have important implications for classroom practice. Since favourable attitudes towards science were positively associated with academic achievement, science teachers may provide learning experiences that promote students' interest, confidence, participation, and positive perceptions of science. Activity-based, inquiry-oriented, experiential, and

collaborative approaches may make science learning more engaging and provide students with opportunities to actively construct and apply knowledge. Evidence from research syntheses indicates that inquiry-based science instruction can support students' conceptual learning, particularly when students are actively involved in scientific thinking and drawing conclusions from evidence (Minner et al., 2010). Similarly, a meta-analysis of inquiry-based science education reported positive effects on students' academic achievement as well as their attitudes towards science (Aktamış et al., 2016).

Providing opportunities for laboratory activities, projects, science exhibitions, quizzes, science clubs, demonstrations, and field visits may enable students to connect scientific concepts with practical experiences and their everyday lives. Such experiences can provide opportunities for students to observe scientific phenomena, investigate questions, apply concepts, and develop greater engagement with science. Experiential learning has also been examined as an approach for supporting science learning, although the effectiveness of particular approaches may depend on their design, implementation, and learning context (Susiloningsih et al., 2023).

Another important implication concerns students' perceptions of the usefulness and relevance of science. Students may develop more favourable attitudes when they can understand how scientific knowledge relates to everyday life and their surrounding environment. Teachers may therefore connect classroom concepts with everyday phenomena, local environmental issues, health and community concerns, technological developments, and other real-life applications. Such contextualisation may help students recognise that science is not limited to textbook knowledge but is relevant to understanding and responding to situations in their immediate environment. This interpretation is consistent with the broader emphasis placed on students' interest, motivation, self-beliefs, and dispositions within contemporary science education frameworks (OECD, 2023).

The findings also indicate the importance of developing students' confidence in learning science. Students who experience repeated difficulty or limited success may develop less favourable perceptions of their ability to learn the subject. Teachers may therefore provide constructive feedback, encouragement, appropriate scaffolding, and opportunities for successful participation. This is particularly relevant because Mao et al. (2021) found that self-efficacy-related attitudes demonstrated stronger associations with science achievement than some other forms of science attitude. Therefore, developing students' confidence and sense of competence may be an important component of a broader strategy for supporting positive engagement with science.

Particular attention may be given to students who demonstrate comparatively low levels of interest, confidence, or engagement in science. Appropriate academic guidance, encouragement, and motivational support may help such students participate more actively in science-learning activities. A supportive classroom environment that encourages interaction, questioning, collaboration, and positive teacher–student relationships may further contribute to students' engagement. However, these implications should be regarded as educational considerations arising from the observed association rather than as interventions whose causal effectiveness was established by the present study.

The rural–urban analysis is also noteworthy because it revealed a positive association between attitude towards science and academic achievement ($r = .2719$, $p < .05$). This result indicates that the positive association between the two variables was also observed in the rural–urban analysis. However, the finding should not be interpreted as evidence that locality itself causes differences in students' attitudes or academic achievement. The present analysis does not independently establish the effects of school resources, laboratory facilities, instructional practices, family support, socioeconomic conditions, or exposure to scientific activities. These factors may warrant examination in future research.

Experiential learning may have particular relevance in this context. Field visits, hands-on activities, demonstrations, laboratory experiences, projects, and problem-solving tasks can provide students with opportunities to observe, investigate, experiment, and apply scientific knowledge beyond conventional classroom instruction. Research on experiential approaches in science education suggests that such approaches can provide meaningful opportunities for students to connect learning with experience, although their effectiveness depends on how learning activities are designed and implemented (Susiloningsih et al., 2023).

The findings further suggest that science teaching should accommodate variation in students' learning needs and interests. Students may differ in their prior knowledge, confidence, motivation, and level of interest in science. Consequently,

teachers may employ varied instructional strategies rather than relying exclusively on a single mode of teaching. Combining explanation with demonstrations, practical activities, group work, inquiry tasks, projects, visual resources, and real-life applications may provide diverse opportunities for students to engage with scientific knowledge. Such approaches are consistent with research emphasising active engagement and scientific thinking in science instruction (Minner et al., 2010).

The present findings are also consistent with the broader understanding that attitudes towards science and academic achievement are related but distinct aspects of science education. Academic achievement represents students' demonstrated learning outcomes, whereas attitude reflects an affective orientation towards the subject. The positive relationship identified in the present study is consistent with earlier secondary-level research by Narmadha and Chamundeswari (2013), who reported a positive correlation between attitude towards learning science and academic achievement among 422 secondary-level students. Similarly, Ahuja (2017), in a study of 208 secondary school students in Delhi, reported a significant positive correlation between scientific attitude and science achievement. These findings, together with the meta-analytic evidence reported by Mao et al. (2021), provide support for considering the affective dimension of science learning alongside cognitive outcomes.

At the same time, the present findings should be interpreted cautiously. The study employed a correlational approach; therefore, the observed relationship does not establish that a positive attitude towards science causes higher academic achievement. It is possible that other factors influence both variables, or that achievement and positive attitudes reinforce each other over time. The modest size of the observed correlation further indicates that students' academic achievement is likely associated with multiple individual, instructional, and contextual factors. Thus, the present findings provide evidence of a relationship rather than evidence of a causal mechanism.

Overall, the findings support the importance of considering students' attitudes towards science as an important affective component of secondary science education. The statistically significant positive associations observed in the study indicate that more favourable attitudes towards science were related to higher academic achievement in the present sample. This finding is broadly consistent with previous empirical studies and the wider meta-analytic literature on the attitude–achievement relationship (Ahuja, 2017; Mao et al., 2021; Narmadha & Chamundeswari, 2013). Accordingly, science education may benefit from an integrated approach in which conceptual understanding and academic achievement are accompanied by deliberate opportunities to foster students' interest, confidence, engagement, and positive perceptions of science. Future research may examine additional factors such as self-efficacy, motivation, teaching practices, learning resources, parental support, school environment, and socioeconomic or locality-related characteristics to develop a more comprehensive understanding of students' science learning outcomes.

7.0 Conclusion

The present study examined the relationship between students' attitude towards science and academic achievement at the secondary level, with consideration of the rural-urban context. The findings revealed a positive and statistically significant relationship between attitude towards science and academic achievement ($r = .2836$, $p < .05$). The rural-urban analysis also indicated a positive and statistically significant association between the two variables ($r = .2719$, $p < .05$).

These findings suggest that students who demonstrate more positive attitudes towards science tend to achieve higher academic performance. The findings highlight the importance of developing students' interest, confidence, engagement, and positive perceptions towards science as part of effective science education. However, the observed correlations are modest and, being correlational in nature, do not establish a causal relationship between attitude towards science and academic achievement.

Therefore, science education at the secondary level should provide meaningful, engaging, and experiential learning opportunities that may encourage students to develop favourable attitudes towards science. Activity-based learning, practical experiences, inquiry-oriented activities, field visits, collaborative learning, and supportive classroom environments may be useful in this regard. Overall, the study underscores the relevance of students' attitudes towards science in understanding academic achievement and provides a basis for further research involving larger samples and more detailed comparisons across gender and rural-urban groups.

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