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A Comparative Study of Scientific Attitude, Interest, and Problem-Solving Ability Across Demographic and Educational Variables

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Abstract: This research examined the effects of gender, school type, and medium of instruction on scientific attitude, scientific interest, and problem-solving ability among 394 secondary school students in Odisha, India. Using validated and culturally adapted instruments, data were collected via surveys from government and private schools, including Odia and English medium groups. Statistical analysis using t-tests revealed that boys showed significantly higher scientific interest than girls, while no gender differences were found in problem-solving skills. Private school students demonstrated greater scientific interest, whereas government school students excelled in problem-solving ability. Medium of instruction had no significant impact on scientific interest, but English medium students outperformed their Odia medium peers in problem-solving. These findings suggest that demographic and institutional factors influence scientific engagement and cognitive skills differently. The study underscores the importance of tailored educational strategies to reduce gender disparities, leverage the strengths of different school types, and support problem-solving skills across language media. These results have critical implications for educational policy and curriculum design aimed at fostering comprehensive scientific competencies in secondary education.

Keywords: *Scientific Attitude, Scientific Interest, Problem-Solving Ability, Gender, School Type, Medium of Instruction, Odisha.*

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I. INTRODUCTION

Education is a crucial aspect of life, aimed at preparing a better generation. The relationship between education and science is inherently intertwined. In this era of globalisation, the rapid advancement of technology and science necessitates the application of scientific knowledge to address global challenges. Science education should be aligned with studies that reflect the cultural heritage and the greater character of the nation to prevent the advancement and modernisation within science education from leading to ambivalence, anti-humanitarian sentiments, anti-religious views, and inconsistencies in behaviour relative to religious teachings, culture, and the goals of education in Indonesia. To ensure the effectiveness of science education, a series of strategic measures is required, including choices of models, approaches, teaching strategies, assessments, research, development, dissemination, and the contextual enhancement of curriculum content and educational needs in science (Nuralam & Eliyana, 2017).

Science education at the secondary level is a crucial element in shaping students' futures and the overall progress of society. Its importance goes beyond just providing factual knowledge, serving as the foundation for lifelong skills, personal growth, and societal development. A solid understanding of science gives students the essential knowledge needed to understand and engage with the world around them. In today's highly technological society, basic scientific literacy is vital for making informed decisions in everyday life, from understanding health-related information to assessing technology and environmental issues. Science education also creates the basis for many careers, including medicine, engineering, research, and technology, all of which are important for national growth and innovation.

Studying science promotes curiosity, questioning, and investigation. This develops critical thinking—the ability to analyse data, evaluate evidence, and solve problems systematically. Through hands-on activities, experiments, and the scientific method, students learn to approach challenges logically and creatively, skills that are valuable in any career and daily life. The process of scientific inquiry nurtures

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creativity by encouraging students to think beyond conventional frameworks, develop original solutions, and innovate. These skills are vital in a rapidly changing world where adaptability and inventive thinking are highly valued.

Science education fosters environmental awareness and a sense of global responsibility. Understanding scientific principles helps students recognise urgent issues like climate change, sustainable resource management, and public health, enabling them to make thoughtful, informed decisions for themselves and their communities. These fundamentals are essential for creating citizens who can address societal challenges and actively participate in civic life.

Secondary-level science not only prepares students for higher education in various fields but also helps them develop essential skills like communication, teamwork, and digital literacy that are in demand across many professions. Hands-on activities, practical experiments, and the integration of technology make learning more engaging and relevant, boosting motivation and retention for long-term success. Therefore, science education at the secondary level is not just a subject but a catalyst for intellectual growth, societal advancement, and personal empowerment. It develops critical thinking, fosters innovation, promotes scientific literacy, and prepares young people for meaningful participation in an increasingly complex, science-driven world.

Scientific interest, scientific attitude, and problem-solving attitude are essential attributes for secondary school students, playing a pivotal role in their academic and personal development. Scientific interest refers to a student's curiosity and enthusiasm toward science-related concepts, motivating them to explore, investigate, and actively participate in scientific endeavours, which not only increases engagement but also predicts higher achievement and fosters lifelong learning. A scientific attitude embodies a mindset rooted in curiosity, objectivity, rationality, intellectual honesty, and openness to new ideas; such an attitude encourages students to question assumptions, seek evidence, and make logical, evidence-based conclusions, thereby equipping them to combat superstition and bias and to engage effectively in scientific inquiry. The problem-solving attitude, characterised by persistence, logical analysis, creativity, and confidence when faced with challenges, empowers students to independently resolve academic and real-life problems, encouraging creative and critical thinking and resiliency. Together, these qualities provide a foundation for success in STEM careers, promote informed and responsible citizenship, and support personal growth by nurturing analytical thinking and adaptability. In an increasingly complex and science-driven world, fostering scientific interest, attitude, and problem-solving skills at the secondary level equips young learners to thrive academically. It prepares them to navigate social challenges, make responsible decisions, and contribute as innovative leaders in society.

II. REVIEW OF RELATED LITERATURE

A strong scientific attitude enables students to engage effectively in scientific reasoning and display enthusiasm for learning (Schiepe-Tiska et al., 2016). Curiosity, an essential component of this attitude, motivates inquiry, questioning, and active participation in scientific exploration. Critical thinking skills, such as analysing objective evidence, and traits like openness and collaboration, further contribute to effective engagement in science (Supardi et al., 2019). Promoting a positive scientific attitude is vital, as it influences educational choices, career aspirations (Virtič, 2022), and fosters problem-solving and critical thinking skills in secondary learners (Bennett & Hogarth, 2009; Mujtaba et al., 2018).

Multiple factors shape scientific attitudes, including perceptions, learning challenges, instructional methods, and self-motivation (Olasehinde & Olatoye, 2014). Studies show a positive correlation between scientific attitude and academic achievement in science (Steinkamp & Maehr, 1983; Mao et al., 2021). Incorporating hands-on activities and problem-based tasks can boost interest, particularly during early adolescence when engagement often declines. Notably, males often display more positive attitudes toward science than females (Hu et al., 2018; Bennett & Hogarth, 2009). Instructional strategies that sustain challenge and enhance motivation are critical, especially in domains such as chemistry (Mujtaba et al., 2018). Context-based and science-technology-society (STS) approaches further enhance scientific attitudes by linking learning to real-world contexts (Bennett & Hogarth, 2009).

Scientific interest is closely linked to achievement (Alhadabi, 2021) and is strengthened by hands-on experiments and interactive learning, which increase motivation and foster positive attitudes (Holstermann et al., 2009). Addressing real-world problems in lessons enhances both interest and engagement, creating pathways toward STEM careers.

Developing problem-solving ability is a key objective of modern STEM education, enabling students to address complex, real-life issues (Dewi et al., 2023). Problem-Based Learning (PBL) supports this by integrating scientific interest and critical thinking (Da Silva et al., 2018; Suhirman & Ghazali, 2022). Effective problem-solving in science education relies on creativity, communication, teamwork, and adaptability (Aswan et al., 2018). Incorporating real-life applications into the curriculum strengthens students' analytical and decision-making skills (Yaki, 2022).

The interconnectedness of scientific attitude, interest, and problem-solving ability is well established (Adita & Yuenyong, 2021). A positive scientific attitude, driven by curiosity and open-mindedness, fosters persistence and critical thinking when confronting challenges (Firdausy & Prasetyo, 2020). Similarly, scientific interest motivates learners to seek solutions, which in turn builds their problem-solving competence. This creates a reinforcing cycle where each dimension enhances the others, promoting deeper scientific understanding, sustained engagement, and an inquiry-based learning environment that encourages exploration and experimentation (Ariastya et al., 2023).

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➢ *Rationale*

Studying the scientific attitudes, interests, and problem-solving abilities of secondary school students in Odisha is essential for several reasons. Odisha, like many regions in India, is working to improve educational outcomes and develop a generation prepared for the challenges of a rapidly changing scientific and technological world. Understanding scientific attitudes helps educators and policymakers determine whether students have a positive outlook toward science, which is key to fostering curiosity, critical thinking, and lifelong learning. Exploring students' interests in science provides insight into motivational factors that influence engagement, choice of academic streams, and future career options, allowing for more targeted curricular and extracurricular strategies. Additionally, assessing problem-solving skills shows how well students can apply scientific concepts to real-world situations and problems, which is crucial for success in higher education and careers. Together, these areas of study lay the groundwork for evidence-based reforms in teaching methods, curriculum development, and resource distribution—efforts that can improve the quality of science education and support the socio-economic growth of Odisha.

➢ *Objectives*

- To compare the level of Scientific attitude to their gender, school type, and medium of instruction.
- To compare the level of Scientific interest to their gender, school type, and medium of instruction.
- To compare the level of Problem-solving ability to their gender, school type, and medium of instruction.

- *Hypothesis*

✓ H_0 1 There is no significant difference between the mean score of the scientific attitude of boys and girls.
✓ H_0 2 There is no significant difference between the mean score of the scientific attitude of government and private school students.
✓ H_0 3 There is no significant difference between the mean score of the scientific attitude of students studying in Odia and English medium schools.
✓ H_0 4 There is no significant difference between the mean score of the scientific interest of boys and girls.
✓ H_0 5 There is no significant difference between the mean score of the scientific interest of government and private school students.
✓ H_0 6 There is no significant difference between the mean score of the scientific interest of students studying in Odia and English medium schools.
✓ H_0 7 There is no significant difference between the mean score of the Problem-solving ability of boys and girls.
✓ H_0 8 There is no significant difference between the mean score of the scientific attitude of government and private school students.
✓ H_0 9 There is no significant difference between the mean score of the scientific attitude of students studying in Odia and English medium schools.

➢ *Delimitation of the Study*

- The investigation of the study is limited to secondary school students of selected districts of the Central Revenue Division of Odisha.
- The study is limited to 394 samples only.
- The study is limited to class IX students only.

III. METHODOLOGY

In the present study, the researcher has adopted the survey method. The researcher has used the qualitative paradigm to test the hypothesis statistically in order to study the scientific attitude, interest and problem-solving ability among secondary school students with their gender, school type and school-recognising board. The survey method involved distributing questionnaires to a sample of secondary school students from different schools and boards. The collected data were then analysed using statistical methods to determine the relationship between scientific attitude, interest, and problem-solving ability, and their correlations with gender, school type, and board.

➢ *Population*

All the secondary school students of districts under the central revenue division constitute the population of the study.

➢ *Sample*

The researcher adopted multistage sampling for the collection of Data. The sample included boys and girls, students from both government and private schools, as well as different media of instruction, such as Odia and English medium. The multistage sampling method allowed for a diverse representation of students in the study. The researcher selected 394 filled booklets out of 458 booklets distributed at the time of data collection. The sample size of 394 was deemed sufficient for the study's objectives. The diverse representation of students from various backgrounds and educational systems enhances the generalisability of the findings.

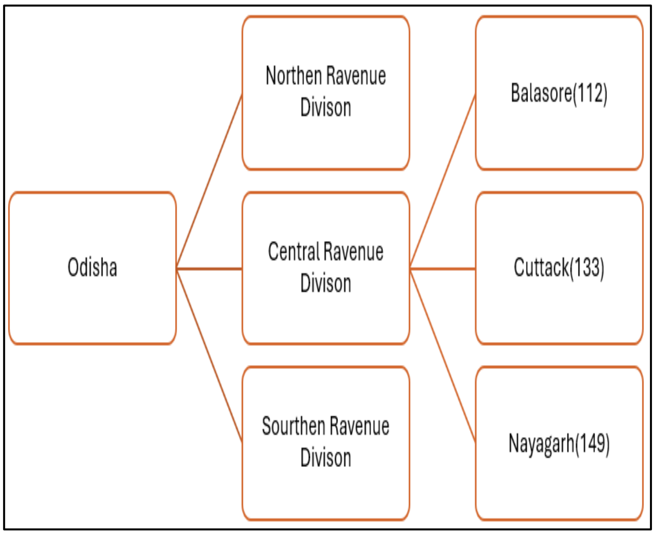

Fig 1 Sample

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➢ *Distribution of the Sample Among Districts of Odisha*

- *Tools and Techniques of the Study*

The researcher adopted the Scientific Interest Inventory developed by K.S. Mishra, the Scientific Attitude Scale developed by Dr. A. Kaur and Dr. S C. Gakhar, and the Problem-Solving Ability Test developed by Dr. J.K. Tandon and Dr. T.H. Mir. The tools were translated into Odia, as they were to be implemented in Odia medium schools as well. The translated tools were standardised. The translation and standardisation process ensured that the tools were culturally appropriate and accurately measured the desired constructs in the study. This attention to detail helped maintain the validity and reliability of the research findings across different language media. The researchers also conducted pilot testing to ensure the clarity and understanding of the translated tools among the target population. This rigorous process contributed to the overall robustness of the study's methodology and results.

- *Statistical Techniques used*

After the collection of data, the data was subjected to rigorous statistical treatment, based on which descriptive and inferential analysis was done. The researcher used the mean, standard deviation, and t-test for hypothesis testing. The statistical analysis provided a comprehensive understanding of the relationships between variables and allowed for the testing of hypotheses. This methodological approach enhanced the credibility and rigour of the study's findings.

- *Data Analysis and Interpretation*

✓ *Objective-1*

The objective was to compare the level of scientific attitude across different genders, school types, and mediums of instruction. Gender, school type, and medium of instruction were categorised into two groups: Boy and Girl, Government and Private, and Odia and English Medium School. The data was analysed using the t-test, and the results are shown in Table 1.

Table 1 Gender, School Type, and Medium of Instruction-wise Distribution of N, M and SD and T-Values of the Scientific Attitude of Secondary School Students of Odisha

Variable	**Categories**	**N**	**M**	**SD**	**t-value**	**Remark**
Gender	Boys	192	182.5	40.8	3.44	p>0.05
	Girls	202	197.6	46		
School Type	Government	186	176.9	44.3	3.38	p>0.05
	Private	208	192.6	49		
Medium of Instruction	Odia	175	183.7	42.6	1.29	Not Significant
	English	219	189.7	48		

From Table 1, the t-value for the gender variable is 3.44, which is very statistically significant at the 0.05 level of significance with df = 392. It shows that the scientific attitude of boys and girls differs significantly. Thus, the null hypothesis that there is no significant difference between the mean score of the scientific attitude of boys and girls is rejected. Furthermore, the mean score of the scientific attitude of girls is 197.6, which is statistically higher than that of boys, whose mean score of scientific attitudes is 182.5. So, it may therefore be said that gender has a significant impact on scientific attitude, with girls scoring higher on average than boys in this study. This difference may be influenced by various factors such as societal norms, educational experiences, and personal interests. The t-value for the school type variable is 3.38, which is very statistically significant at the 0.05 level of significance with df = 392. It shows that the scientific attitude of government and private school students differs significantly. Thus, the null hypothesis that there is no significant difference between the mean score of the scientific attitude of government and private school students is rejected. Furthermore, the mean score of the scientific attitude of private school students is 192.6, which is statistically higher than that of government school students, whose mean score of scientific attitudes is 176.9. It can therefore be said that students from private schools tend to have a more positive scientific attitude compared to students from government schools. This difference in scientific attitude could be attributed to various factors such as the quality of education, resources available, and teaching methods employed in private schools. The t-value for the medium of instruction variable is 3.44, which is not statistically significant at the 0.05 level of significance with df = 392. It shows that the scientific attitude of Odia and English medium school students does not differ significantly. Thus, the null hypothesis is that there is no significant difference in the mean score between students studying in Odia and English medium schools; this hypothesis is not rejected. So, it may therefore be stated that the language of instruction does not have a significant impact on the scientific attitude of students in this study. This suggests that factors other than the medium of instruction may be influencing students' attitudes towards science.

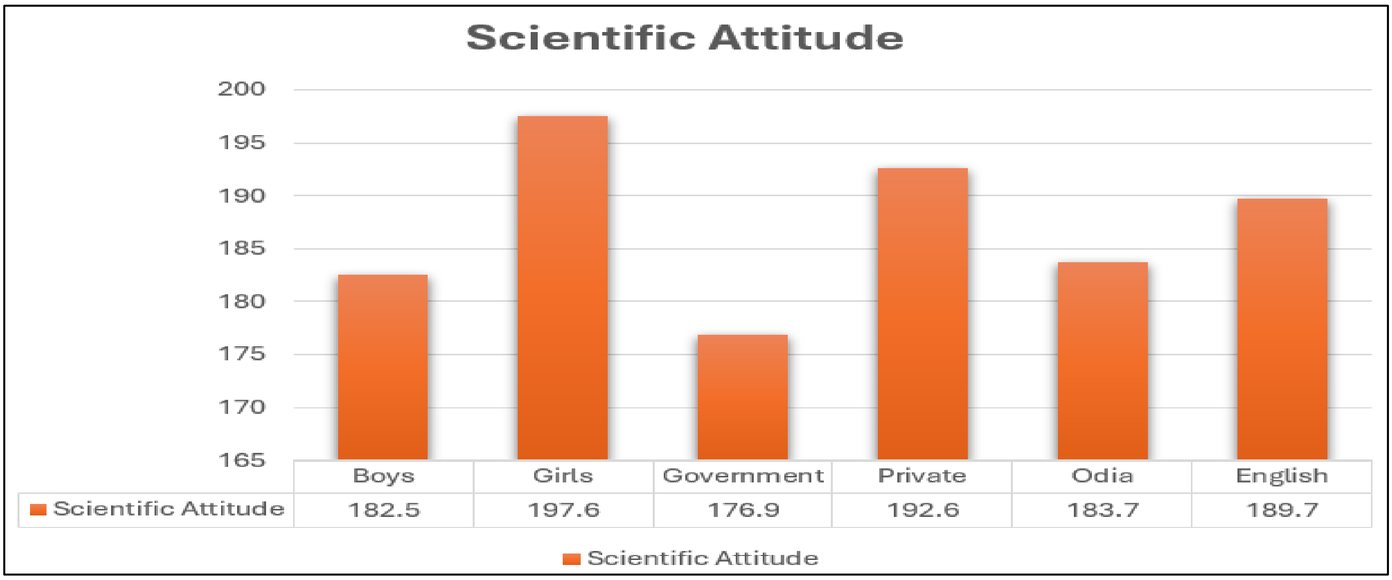

Fig 2 Scientific Attitude

Graphical Presentation of Gender, School Type, and Medium of Instruction-wise Distribution of N, M and SD and T-Values of Scientific Attitude

- *Objective-2*

The objective was to compare the level of scientific interest across different genders, school types, and mediums of instruction. Gender, school type, and medium of instruction were categorised into two groups: Boy and Girl, Government and Private, and Odia and English Medium School. The data was analysed using the t-test, and the results are shown in Table 2.

Table 2 Gender, School Type, and Medium of Instruction-wise Distribution of N, M and SD and T-Values of Scientific Interest of Secondary School Students of Odisha

Variable	Categories	N	M	SD	t-value	Remark
Gender	Boys	192	151.6	28.8	2.03	p>0.05
	Girls	202	145.8	27.7		
School Type	Government	186	140.2	22.3	7.21	p>0.05
	Private	208	157.7	25.5		
Medium of Instruction	Odia	175	150.3	28.5	1.38	Not Significant
	English	219	154.6	32.2		

From Table 2, the t-value for the gender variable is 2.03, which is very statistically significant at the 0.05 level of significance with df = 392. It shows that the scientific interest of boys and girls differs significantly. Thus, the null hypothesis that there is no significant difference between the mean score of the scientific interest of boys and girls is rejected. Furthermore, the mean score of the scientific interest of boys is 151.6, which is statistically higher than that of girls, whose mean score of scientific interest is 145.8. So, it may therefore be said that there is a gender difference in scientific interest among the sample population. This suggests that further investigation into the factors influencing this difference could be beneficial for understanding and addressing disparities in interest levels between boys and girls in science. The t-value for the school type variable is 7.21, which is very statistically significant at the 0.05 level of significance with df = 392. It shows that the scientific interest of government and private school students differs significantly. Thus, the null hypothesis that there is no significant difference between the mean score of the scientific interest of government and private school students is rejected. Furthermore, the mean score of the scientific interest of private school students is 157.7, which is statistically higher than that of government school students, whose mean score of scientific interest is 140.2. Therefore, attending a private school may have a positive impact on students' scientific interest compared to government schools. This difference in mean scores suggests that the type of school attended can influence students' levels of interest in science. The t-value for the medium of instruction variable is 1.38, which is not statistically significant at the 0.05 level of significance with df = 392. It shows that the scientific interest of Odia and English medium school students does not differ significantly. Thus, the null hypothesis is that there is no significant difference in the mean score of scientific interest between students in Odia and English medium schools; this hypothesis is not rejected. So, it may therefore be said that the language of instruction does not have a significant impact on students' scientific interest levels. This suggests that students in both Odia and English medium schools have similar levels of interest in science.

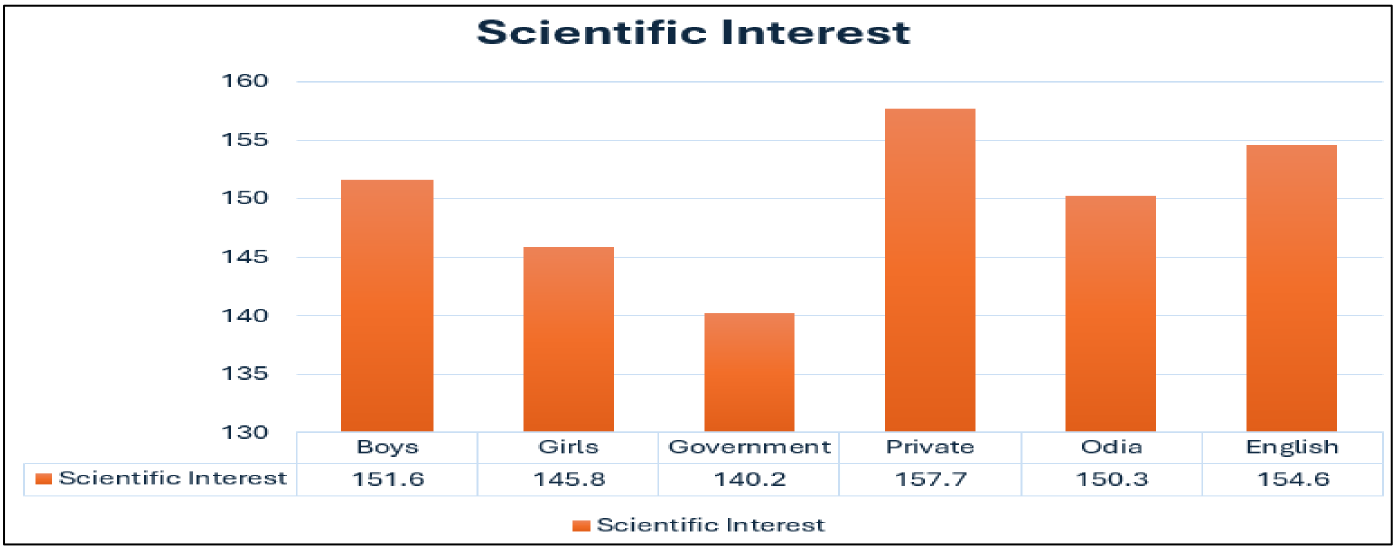

Fig 3 Scientific Interest

Graphical Presentation of Gender, School Type, and Medium of Instruction-Wise Distribution of N, M and SD and T-Values of Scientific Interest

- *Objective-3*

The objective was to compare the level of Problem-solving ability across different genders, school types, and mediums of instruction. Gender, school type, and medium of instruction were categorised into two groups: Boy and Girl, Government and Private, and Odia and English Medium School. The data was analysed using the t-test, and the results are shown in Table 3.

Table 3 Gender, School Type, and Medium of Instruction-Wise Distribution of N, M and SD and t-Values of Problem-Solving Ability of Secondary School Students of Odisha

Variable	Categories	N	M	SD	t-value	Remark
Gender	Boys	192	77.1	15.6	0.51	Not Significant
	Girls	202	77.9	15.3		
School Type	Government	186	72.7	18.2	3.47	p>0.05
	Private	208	67.3	11.5		
Medium of Instruction	Odia	175	69.7	15.2	3.30	p>0.05
	English	219	74.3	12.4		

From Table 3, the t-value for the gender variable is 0.51, which is very statistically significant at the 0.05 level of significance with df = 392. It shows that the Problem-solving ability of boys and girls does not differ significantly. Thus, the null hypothesis that there is no significant difference between the mean score of the Problem-solving ability of boys and girls is not rejected. So, it may therefore be said that gender does not play a significant role in determining problem-solving ability in this particular study. This suggests that other factors may be more influential in predicting performance in this area. The t-value for the school type variable is 3.47, which is very statistically significant at the 0.05 level of significance with df = 392. It shows that the Problem-solving ability of government and private school students differs significantly. Thus, the null hypothesis that there is no significant difference between the mean score of the Problem-solving ability of government and private school students is rejected. Furthermore, the mean score of the Problem-solving ability of government school students is 72.7, which is statistically higher than that of private school students, whose mean score of Problem-solving ability is 67.3. It can therefore be said that government school students have a higher level of Problem-solving ability compared to private school students. This suggests that the type of school attended may have an impact on students' Problem-solving skills. The t-value for the medium of instruction variable is 3.30, which is statistically significant at the 0.05 level of significance with df = 392. It shows that the Problem-solving ability of Odia and English medium school students differs significantly. Thus, the null hypothesis that there is no significant difference between the mean score of Problem-solving ability of students studying in Odia and English medium schools is rejected. Furthermore, the mean score of the Problem-solving ability of English medium school students is 74.3, which is statistically higher than that of Odia medium school students, whose mean score of Problem-solving ability is 69.7. It can therefore be said that students in English medium schools tend to have better problem-solving abilities compared to those in Odia medium schools. English medium school students exhibit better Problem-solving ability compared to Odia medium school students based on the statistical analysis conducted.

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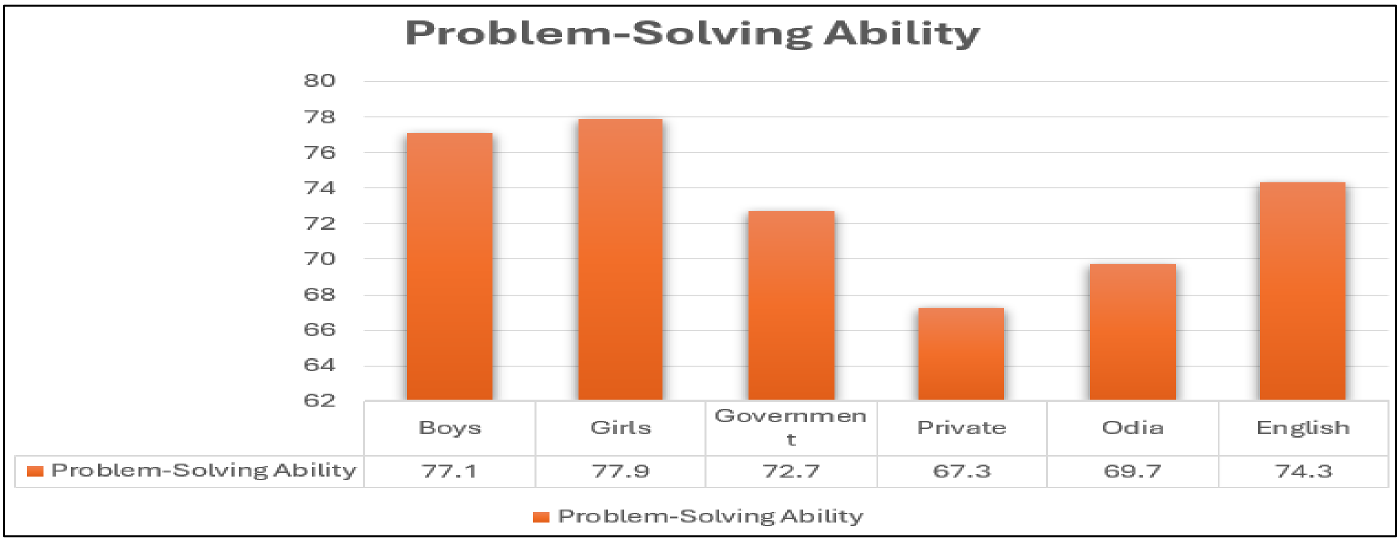

Fig 4 Peoblem-Solving Ability

Graphical presentation of Gender, School Type, and Medium of Instruction-wise distribution of N, M and SD and t-values of Problem-solving ability.

IV. CONCLUSION

The present study examined the influence of gender, school type, and medium of instruction on two important educational outcomes — scientific interest and problem-solving ability — among students. The analysis revealed that these factors have differential impacts on the two domains, suggesting that a complex interplay of demographic and institutional variables shapes the development of scientific engagement and cognitive skills.

In terms of gender differences, findings indicate that boys demonstrated significantly higher levels of scientific interest compared to girls. This disparity could be attributed to varied societal expectations, patterns of encouragement from teachers and parents, and differences in exposure to science-related activities. However, when it comes to problem-solving ability, no statistically significant difference was observed between boys and girls, implying that gender does not inherently determine analytical skill performance in this context.

School type emerged as a strong determinant for both scientific interest and problem-solving ability, albeit in contrasting ways. Students from private schools reported significantly higher scientific interest scores than their government school counterparts. This divergence may result from better learning resources, instructional quality, and enriched extracurricular opportunities in private institutions. Conversely, government school students outperformed private school students in problem-solving ability, suggesting that factors such as curriculum orientation, real-world contextual learning, and examination practices might provide them with stronger analytical problem-solving training.

The role of medium of instruction was also found to be domain-specific. No significant differences were observed in scientific interest between students from Odia and English medium schools, indicating that curiosity and enthusiasm for science may be influenced more by pedagogical practices than by the language of instruction. However, English medium students demonstrated significantly higher problem-solving ability scores compared to Odia medium students. This advantage may stem from greater access to diverse learning materials, interactive learning approaches, and internationally aligned instructional methods.

Overall, the findings underscore that distinct educational and social factors shape scientific interest and problem-solving ability. Gender appears to influence interest but not ability; school type affects both, yet in opposite directions; and medium of instruction impacts cognitive skills but not interest levels. These insights carry important implications for educational policy and classroom practice. Efforts to foster balanced scientific competencies should integrate the strengths of different school systems, address gender disparities in science engagement, and ensure that students across language mediums are equipped with both curiosity and analytical skills. Such targeted interventions could help create a more equitable and effective learning environment for all students.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed to enhance both scientific interest and problem-solving ability among students across different demographic and institutional backgrounds: Targeted initiatives are needed to foster greater scientific interest among girls, such as mentorship programs, science clubs, and exposure to female role models in STEM fields. Schools and policymakers should work to counteract stereotypes and provide equal opportunities for engagement in science-related activities.

Private schools should integrate pedagogical strategies and curricular elements from government schools that have proven effective in building problem-solving skills.

Simultaneously, government schools could adopt resource-rich methods and innovative teaching practices commonly found in private schools to stimulate students' interest in science. Collaborative programs between government and private institutions can facilitate this exchange of best practices. Odia medium schools should focus on providing students with access to diverse problem-solving exercises, interactive materials, and exposure to global best practices in analytical skill development. Teacher training workshops and curriculum enrichment can address gaps experienced by students in these settings. As the medium of instruction was not associated with differences in scientific interest, science outreach programs and enrichment activities should be designed inclusively, ensuring that students from both Odia and English mediums benefit equally from resources and opportunities. Teachers should receive ongoing training in student engagement strategies, differentiated instruction, and methods to cultivate higher-order thinking skills. This will help them tailor approaches to the unique needs and backgrounds of their students. Further longitudinal studies are recommended to monitor the effectiveness of these interventions and to explore additional factors—such as parental involvement, socio-economic status, and extracurricular participation—that may influence students' scientific development.

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