



A Study of Science Curiosity Skills among Secondary School Students

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Abstract: The development of scientific literacy and 21st-century skills like creativity, critical thinking, and problem-solving primarily relies significantly on science curiosity, which is a natural motivation to investigate and inquire. This study investigates the levels of curiosity in science among secondary school students and analyzes the demographic factors—gender, medium of instruction, and parental education—and their influence on science curiosity. Applying a descriptive survey design, data were gathered from 405 students in Hyderabad through the Science Curiosity Scale. The results reveal that most of the students demonstrate average curiosity levels, with substantial differences influenced by the medium of instruction and parental education, while gender is not found to be a significant factor. This investigation highlights the significance of nurturing curiosity via inquiry-driven education and customized teaching strategies, providing valuable perspectives for educators and decision-makers to address disparities and enhance fair learning results.

Keywords: Science curiosity skills, 21st-century skills, secondary school students, inquiry-based learning

Introduction

Science curiosity is the innate drive to explore and understand natural phenomena, fostering critical thinking, creativity, and lifelong learning. Students with high science curiosity actively engage with concepts, ask meaningful questions, and pursue innovative solutions, making it a vital skill for the 21st century (Weible & Zimmerman, 2016). Education policies worldwide, including the Sustainable Development Goals (SDG 4) and India's National Education Policy (NEP) 2020, emphasize fostering inquiry-based and experiential learning to cultivate curiosity and innovation (United Nations, 2015; Ministry of Education, 2020).

Science curiosity is closely linked to competencies such as critical thinking, creativity, and innovation, which together form the foundation of scientific literacy. These competencies enable students to evaluate evidence, synthesize knowledge, and address real-world challenges (Chen & Wu, 2015). Nurturing curiosity through education can prepare students to adapt to the demands of a rapidly evolving world and contribute meaningfully to society.

Despite its importance, research on science curiosity in Indian secondary schools remains limited. Factors such as gender, medium of instruction, and parental education may influence curiosity levels, but their specific roles in shaping this trait are underexplored. Indian classrooms, marked by linguistic and cultural diversity, present unique opportunities and challenges for fostering science curiosity.

The NEP 2020 calls for equitable and curiosity-driven learning environments, yet there is limited empirical data to guide interventions addressing demographic disparities. This study aims to investigate the levels of science curiosity among Indian secondary school students and explore the influence of demographic factors. By bridging gaps in research, the study seeks to provide actionable insights for educators and policymakers to nurture curiosity across diverse learner groups.

Review of Related Literature

The exploration of curiosity, particularly in the discipline of science, along with its influence on academic achievement and its contribution to the enhancement of scientific and cognitive abilities, has drawn considerable interest. The current document of research offers significant perspectives on the complex dimensions of curiosity and its interaction with diverse educational and psychological frameworks.

Banupriya and Rajan (2019) investigated the intricate connections among curiosity, happiness, and academic achievement within a setting of high school students. Their research determined that although curiosity did not have a direct correlation with academic success, it played a significant role in influencing overall happiness. No significant differences between genders were detected in terms of academic performance, inquisitiveness, or overall contentment. This study elucidates the intricate interplay between curiosity and overall well-being, as opposed to merely focusing on direct academic outcomes.

Goldner and Scharf (2024) conducted an investigation into different aspects of parental psychological control and its impact on children's curiosity and academic self-concept. Their research indicated that the psychological control exerted by parents adversely affected children's curiosity and their academic self-concept, with fathers exhibiting greater levels of achievement-oriented control. This study highlights the significance of familial interactions in influencing the cognitive and emotional growth of children.

Zhang, Fan, and Huang (2024) investigated the role of out-of-school activities in promoting curiosity and creativity among students. They found that participation in artistic and sports activities enhanced both traits, while internet-based activities negatively impacted curiosity. These findings emphasize the significance of structured extracurricular engagements in fostering intellectual curiosity.

Way and Taffe (2024) provided a critical review of interpersonal curiosity, highlighting its importance in social-emotional learning and academic engagement. They emphasized the gap in research on interpersonal curiosity compared to intellectual curiosity and suggested that the former plays a critical role in human connection and perspective-taking. This dimension of curiosity could potentially broaden the scope of educational applications.

Mahama, Yusuf Dramanu, and Asamoah-Gyimah (2023) examined curiosity, creativity, and motivation as predictors of academic performance in science and mathematics. Their findings revealed that curiosity, creativity, and motivation collectively explained significant variances in academic performance, underscoring the synergistic effect of these attributes on learning outcomes.

Chen and Wu (2015) explored the effects of curiosity and digital literacy on digital competence and critical thinking among nursing students. Their study demonstrated that curiosity positively influenced digital competence and critical thinking, reinforcing its relevance in professional and academic contexts requiring advanced cognitive skills.

Osborne, Simon, and Collins (2003) examined perspectives on science, highlighting the importance of curiosity as an essential skill for engaging with scientific concepts. The study indicated that most participants exhibited an average level of curiosity in science, while a smaller segment demonstrated high levels of curiosity. This study emphasizes the necessity for initiatives aimed at enhancing scientific curiosity.

Subramaniam et al. (2018) examined the variations in science curiosity skills between genders among Malaysian high school students. The results revealed no notable gender differences, implying that curiosity in science is not intrinsically linked to gender but could be shaped by wider educational or cultural influences.

Herianto and Wilujeng (2020) conducted an analysis of the relationship between curiosity and generic science skills in junior high school students. The study revealed a notable connection between the two, suggesting that curiosity acts as a fundamental characteristic for cultivating scientific skills.

Hardianti et al. (2017) investigated the relationship between curiosity, intrinsic motivation, and science process skills in seventh-grade students. Although students exhibited considerable curiosity and motivation, their science process skills were found to be lacking, and there was no significant correlation among the variables. This discovery underscores the possible gap between emotional characteristics and intellectual abilities in specific situations.

Bhatnagar (2014) examined the connection between curiosity and scientific creativity in senior secondary science students. The findings indicated that male students demonstrated greater curiosity compared to their female counterparts; however, a significant relationship between curiosity and scientific creativity was not identified. This suggests that while curiosity might not directly lead to creative results, it could still serve as a fundamental component.

The findings from these studies highlight the complex characteristics of curiosity as both a cognitive and emotional attribute. Their emphasis is on its ability to boost academic involvement, foster scientific inquiry, and promote individual development, while also underlining the influence of contextual and demographic elements on curiosity. The results from this collection of studies establish a strong basis for additional investigation into science curiosity skills in secondary school students, in accordance with the objective of the current study.

Research Gap

Exploring New Areas Curiosity is recognized as an important skill for the 21st century, but not much research has been done on how it develops in secondary school students in India. This is especially true considering the wide range of languages and cultures in Indian classrooms. Many current studies tend to emphasize wider concepts such as scientific literacy, often missing curiosity as a unique and quantifiable characteristic. Moreover, the impact of demographic elements like gender, language of instruction, and parental education on curiosity about science is still largely unexplored. While programs like NEP 2020 stress how important it is to encourage curiosity in learning, the lack of solid empirical evidence about these effects makes it hard to create targeted

educational interventions. This study aims to fill these gaps by providing in-depth understanding of science-related curiosity and its influencing factors.

Research Question

1. What is the level of science curiosity skills among secondary school students?

Objectives

1. To study the level of science curiosity skills among secondary school students.
2. To find out the significant differences in the science curiosity skills of secondary school students, based on gender.
3. To find out the significant differences in the science curiosity skills of secondary school students, based on their medium of instruction.
4. To find out the significant differences in the science curiosity skills of secondary school students, based on mothers' educational qualification.
5. To find out the significant differences in the science curiosity skills of secondary school students, based on fathers' educational qualification.

Hypothesis

1. There are no significant differences in the science curiosity skills of secondary school students based on gender.
2. There are no significant differences in the science curiosity skills of secondary school students based on the medium of instruction.
3. There are no significant differences in the science curiosity skills of secondary school students based on mothers' educational qualification.
4. There are no significant differences in the science curiosity skills of secondary school students based on fathers' educational qualification.

Methodology

In order to assess secondary school students' scientific curiosity skills and investigate the influence of demographic variables like gender, instruction medium, and parental education, this study employed a descriptive survey research design. This design has been selected because of its efficiency in gathering information from a representative sample and its capacity to support variable analysis in a real-world learning environment, ensuring the findings' applicability and relevance.

Sampling

Sampling refers to the process of selecting a subset of individuals or observations from a larger population to draw conclusions or make inferences about that population. This method is essential in various fields, including statistics, research, and social sciences, as it allows for the analysis

The focus of this investigation was on 9th-grade students who are currently enrolled in government secondary schools located in Hyderabad. A multistage sampling technique was employed to guarantee a sample that is both diverse and representative. The administrative divisions known as mandals in Hyderabad were chosen randomly to serve as clusters for the study. In each designated mandal, schools were categorized based on their medium of instruction, specifically distinguishing between English and Urdu. The selection of schools within each stratum was conducted through a random process, encompassing all 9th-grade students from the chosen institutions in the sample. The study engaged a total of 405 students, which included 231 individuals from Urdu-medium educational institutions and 174 individuals from English-medium educational institutions. The implementation of this multistage sampling technique facilitated achieving of adequate representation for both groups, thereby allowing for substantive and meaningful comparisons to be drawn.

Tool used:

The main tool employed for the purpose of data collection was the Science Curiosity Scale, which was developed by Weible and Zimmerman in the year 2016. The selection of this scale was informed by its strong psychometric properties and its congruence with the objectives of the study. A twelve-item Likert scale, featuring response options that span from Always to Never. The responses were evaluated using a scoring system that ranged from 1 to 5, resulting in total possible scores that varied from 12 to 60. Increased scores indicated improved levels of curiosity pertaining to scientific inquiry. The scale exhibited an adequate reliability coefficient, specifically a Cronbach's alpha of 0.829, thereby affirming its capacity for consistent measurement.

Data Analysis Techniques

The collected data were analyzed using SPSS software, employing both descriptive and inferential statistical methods:

1. **Descriptive Statistics:**

- Mean, standard deviation, percentage and frequency distributions were calculated to summarize the levels of science curiosity among students.

2. **Inferential Statistics:**

- **t-test:** Used to determine whether significant differences existed in science curiosity scores based on gender and medium of instruction.
- **ANOVA:** Used to determine whether significant differences existed in science curiosity scores based on parental education.

Results and Discussion

Table 1: Descriptive Statistics of the sample

Whole-sample descriptive statistics									
	N	Minimum	Maximum	Mean	SD	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Science Curiosity Skill	405	17	55	44.21	5.92	-0.989	.121	1.31	0.24

The scores of the Science Curiosity Skill, as shown in Table 1, indicate a near-normal distribution. The skewness (Sk = -0.989) suggests a slight negative skew, meaning the scores are mildly tilted towards the higher end of the scale. The kurtosis (Ku = 1.309) indicates a distribution that is slightly leptokurtic (has a peak higher than a normal distribution).

While both the skewness and kurtosis values deviate from zero (the ideal value for a perfectly normal distribution), these deviations are not substantial enough to suggest a significant departure from normality, especially when considering the large sample size (N=405). The standard error values for skewness (0.121) and kurtosis (0.242) further support this inference. The skewness and kurtosis values, divided by their respective standard errors, fall within the commonly accepted range of -2 to +2, reinforcing the assumption of near-normality for the distribution of Science Curiosity scores.

Objective 1: To study the level of science curiosity skills among secondary school students.

Research Question: What is the level of science curiosity skills among secondary school students?

The criteria for classifying secondary school students in terms of science curiosity skills are: high = mean + SD, low = mean - SD, average = between high and low levels.

Table 2: Classification of Secondary School Students in Terms of Level of Science Curiosity Skill

Level of Curiosity Skill			
Category	Science Curiosity Skill Score	Frequency	Percentage
High	Above 50.13	42	10.4%
Average	Between 38.23 and 50.13	303	74.8%
Low	Less than 38.23	60	14.8%

The classification of secondary school students' scores for science curiosity skills is shown in Table 2. Out of a total sample of 405, 60 students (14.8%) with scores below 38.23 were found to have low science curiosity skills, 303 students (74.8%) with scores between 38.23 and 50.13 had average science curiosity skills, and 42 students (10.4%) with scores above 50.13 had high science curiosity skills.

The findings concluded that the majority of the respondents have an average level of science curiosity skill, indicating that they possess a basic interest in science and its related fields. However, the low percentage of respondents with a high level of curiosity skills leads to the inference that there is a need to encourage and develop science curiosity skills among individuals.

Based on the findings of this study, it is important to encourage and develop science curiosity skills among students. This is consistent with the findings of a previous study by Osborne et al. (2003), which showed that individuals who are more curious tend to engage more in scientific activities and demonstrate a greater interest in science.

Objective 2: To find out the significant differences in the science curiosity skills of secondary school students, based on gender.

H₀: There are no significant differences in the science curiosity skills of secondary school students based on gender.

We conducted an independent samples t-test to assess the differences in science curiosity skills based on gender. Table 3 presents the results of the t-test.

Table 3: Mean Difference Between Male and Female Students on Science Curiosity Skill

Group Statistics							
	Gender	N	Mean	SD	df	t value	p
Science Curiosity Skill	Male	190	43.92	6.35	403	0.96 ^{NS}	0.34
	Female	215	44.48	5.52			

*NS: Not Significant at 0.05 level

Table 4 displays the results of an independent sample t-test measuring science curiosity skills, broken down by gender. Out of 405 secondary school students, 190 were male and 215 were female. The mean scores of male and female students are 43.92 and 44.48, respectively, and both groups have a standard deviation (SD) of 6.35 and 5.52, respectively. At the 0.05 level of significance, the obtained 't' value of 0.96 is not significant. We conclude that there is no significant difference in the curiosity skills of male and female secondary school students in science. Therefore, we can deduce that gender does not significantly influence the curiosity skills of secondary school students in science.

Subramaniam, R. et al. (2018) also reported in their studies that male and female students have no significant difference with respect to curiosity skills. Their findings are consistent with the results of the current study. Teachers and parents could also contribute to this by giving equal importance and opportunities to both male and female students at home and school, respectively. As a result, girl children's education has greatly improved, as they are more focused on their studies.

Therefore, we accept the null hypothesis, which states that there is no significant difference in the curiosity skills of male and female secondary school students in science.

Objective 3: To find out the significant differences in the science curiosity skills of secondary school students, based on their medium of instruction.

H₀: There are no significant differences in the science curiosity skills of secondary school students based on the medium of instruction.

We conducted an independent samples t-test to assess the differences in science curiosity skills based on the medium of instruction. Table 4 presents the results of the t-test.

Table 4: Mean Difference Between Urdu Medium and English Medium Students on Science Curiosity**Skill**

Group Statistics							
	Medium of Instruction	N	Mean	Std. Deviation	df	t value	p
Science Curiosity Skill	Urdu	231	43.43	6.07	403	3.11*	0.002
	English	174	45.26	5.56			

*Significant at 0.05 level

The results of an independent sample t-test of Science Curiosity Skill, based on the medium of instruction, are presented in Table 6. Out of 405 secondary school students, 231 were Urdu and 174 were English-medium. The mean scores of Urdu and English medium students are 43.43 and 45.26, respectively, and both groups have a standard deviation (SD) of 6.07 and 5.56, respectively. We obtained a 't' value of 3.111, indicating significance at the 0.01 level. We conclude that there is a significant difference in curiosity skills between Urdu and English-medium secondary school students in science, with English-medium students demonstrating better curiosity in science. Therefore, we can deduce that the medium of instruction influences the scientific curiosity skills of secondary school students.

Thus, we reject the null hypothesis, which states that "there exists no significant difference between Urdu and English medium secondary school students in their science curiosity skill."

Objective 4: To find out the significant differences in the science curiosity skills of secondary school students, based on mothers' educational qualification.

H₀: There are no significant differences in the science curiosity skills of secondary school students based on mothers' educational qualification.

We conducted a one-way ANOVA to test the difference in science curiosity skills based on the mother's educational qualification. Table 5 presents the results of one-way ANOVA.

Table 5: Comparison of Science curiosity skills among Secondary School Students based on their Mothers' Educational Qualification (one-way ANOVA)

ANOVA					
Science Curiosity Skill					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4750.074	6	791.679	33.448	.000*
Within Groups	9420.237	398	23.669		
Total	14170.311	404			

* Significant at the 0.05 level.

We used a one-way ANOVA to compare the average scores of secondary school students' science curiosity skills based on their mother's level of education (illiterate, school dropout, SSC, intermediate, college dropout, graduate, and postgraduate). The results can be seen in Table 7. The F value obtained is (6, 398) = 33.448, $p < .01$, which is statistically significant at the 0.01 level. This indicates that there is a significant mean difference in science curiosity skills among secondary school students based on their mother's educational qualification.

In order to determine which category of mother's educational qualification, such as illiterate, school dropout, SSC, intermediate, college dropout, graduate, and postgraduate, had higher mean scores in science curiosity skills among secondary school students, post hoc analysis was conducted. The researcher used Tukey's Honestly Significant Difference (HSD), which finds the significant mean difference between different categories of the mother's educational qualification. The table presents the summary of the Tukey's (HSD) test analysis, which examined the mean Science Curiosity Skill among secondary school students across different categories of their mother's educational qualifications.

Table 5(a)
Post Hoc Tests

Multiple Comparisons				
Dependent Variable: Science Curiosity Skill				
LSD				
(I) Qualification of Mother	(J) Qualification of Mother	Mean Difference (I-J)	Std. Error	Sig.
Illiterate	School Dropout	-6.931*	.816	.000
	SSC	-9.057*	.824	.000
	Intermediate	-9.619*	.942	.000
	College Dropout	-13.837*	1.172	.000
	Graduate	-8.676*	1.077	.000
	Post graduate	-12.348*	1.617	.000
School Dropout	Illiterate	6.931*	.816	.000
	SSC	-2.126*	.646	.001
	Intermediate	-2.688*	.791	.001
	College Dropout	-6.906*	1.055	.000
	Graduate	-1.745	.948	.066
SSC	Post graduate	-5.416*	1.534	.000
	Illiterate	9.057*	.824	.000
	School Dropout	2.126*	.646	.001
	Intermediate	-.562	.799	.482
	College Dropout	-4.780*	1.061	.000
Intermediate	Graduate	.380	.955	.691
	Post graduate	-3.291*	1.538	.033
	Illiterate	9.619*	.942	.000
	School Dropout	2.688*	.791	.001
	SSC	.562	.799	.482
	College Dropout	-4.218*	1.155	.000
College Dropout	Graduate	.942	1.058	.374
	Post graduate	-2.729	1.604	.090
	Illiterate	13.837*	1.172	.000
	School Dropout	6.906*	1.055	.000
	SSC	4.780*	1.061	.000
	Intermediate	4.218*	1.155	.000
Graduate	Graduate	5.161*	1.267	.000
	Post graduate	1.490	1.750	.395
	Illiterate	8.676*	1.077	.000
	School Dropout	1.745	.948	.066
	SSC	-.380	.955	.691
	Intermediate	-.942	1.058	.374
Post graduate	College Dropout	-5.161*	1.267	.000
	Graduate	-3.671*	1.688	.030

Post graduate	Illiterate	12.348*	1.617	.000
	School Dropout	5.416*	1.534	.000
	SSC	3.291*	1.538	.033
	Intermediate	2.729	1.604	.090
	College Dropout	-1.490	1.750	.395
	Graduate	3.671*	1.688	.030
*. The mean difference is significant at the 0.05 level.				

On the basis of the analysis of Tukey HSD test among the various categories, by keeping 'mother's educational qualification' category- 'illiterate' as a base, it can be seen that it has the mean differences of -6.931*, -9.057*, -9.619*, -13.837*, -8.676* and -12.348* with the categories School Dropout, SSC, Intermediate, College Dropout, Graduate and Postgraduate respectively, in which the mean differences with School Dropout, SSC, Intermediate, College Dropout, Graduate and Postgraduate is significant which leads to the interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to illiterate and School Dropout, SSC, Intermediate, College Dropout, Graduate and Postgraduate have significant difference with the base category-'Illiterate'.

By keeping 'mother's educational qualification' category- 'School Dropout' as a base, it can be seen that it has the mean differences of 6.931*, -2.126*, -2.688*, -6.906*, -1.745 and -5.416* with the categories Illiterate, SSC, Intermediate, College Dropout, Graduate, Postgraduate respectively, in which the mean differences with illiterate, College Dropout and Postgraduate is statistically significant which leads to interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to School Dropout and illiterate, College Dropout, Postgraduate have significant difference and rest of the categories do not differ significantly with the base category-' School Dropout'.

By keeping 'mother's educational qualification' category- 'SSC' as a base, it can be seen that it has the mean differences of 9.057*, 2.126*, -.562, -4.780*, .380 and -3.291 with the categories Illiterate, School Dropout, Intermediate, College Dropout, Graduate, Postgraduate respectively, in which the mean differences with School Dropout, Intermediate, Graduate, Postgraduate is statistically significant which leads to interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to SSC and School Dropout, Intermediate, Graduate, Postgraduate have significant difference and rest of the categories do not differ significantly with the base category-' SSC'.

If we start with the "mother's educational qualification" category ("Intermediate"), we can see that it has mean differences of 9.619*, 2.688*, 0.562, -4.218*, 0.942, and -2.729 with the categories "Illiterate," "School Dropout," "SSC," "College Dropout," "Graduate," and "Postgraduate," in that order. The mean differences with "Illiterate" are statistically significant, which means that the average scores on the "Science Curiosity Skill" of secondary school students in the "Intermediate" category are significantly different from those in the "Illiterate" category. The other categories do not differ significantly from "Intermediate."

By keeping 'mother's educational qualification' category- 'College Dropout' as a base, it can be seen that it has the mean differences of 13.837*, 6.906*, 4.780*, 4.218*, 5.161* and 1.490 with the categories Illiterate, School Dropout, SSC, Intermediate, Graduate, and Post-Graduate respectively, in which the mean differences with Illiterate, School Dropout, SSC are statistically significant, which leads to the interpretation that among the

categories, the mean scores of Science Curiosity Skill of secondary school students belonging to College Dropout and Illiterate, School Dropout, SSC have a significant difference and the rest of the categories do not differ significantly with the base category-‘College Dropout’.

Using the mother's educational qualification' category, 'Graduate,' as a baseline reveals mean differences of 8.676*, 1.745, -0.380, -0.942, -5.161*, and -3.671 with the categories Illiterate, School Dropout, SSC, Intermediate, College Dropout, and Postgraduate, respectively. The mean differences with illiterate are statistically significant. This means that there is a significant difference between the mean scores of the Science Curiosity Skill among high school students in the graduate and illiterate categories. There is no significant difference between the other categories and the base category, "Graduate."

By keeping ‘mother’s educational qualification’ category- ‘Postgraduate’ as a base, it can be seen that it has the mean differences of 12.348*, 5.416*, 3.291, 2.729, -1.490 and 3.671 with the categories Illiterate, School Dropout, SSC, Intermediate, College Dropout, Graduate respectively, in which the mean differences with Illiterate and School Dropout is statistically significant which leads to interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to Postgraduate and Illiterate, School Dropout have significant difference and the rest of the categories do not differ significantly with the base category-‘Postgraduate’.

The above results lead to the following interpretations: Secondary school students belonging to the mother's educational qualification category—'Postgraduate' (M = 48.82; SD = 3.027)—have the highest mean scores of Science Curiosity Skill, while the mother's educational qualification category—'illiterate' (36.47; SD = 6.900)—has the lowest mean scores. The analysis reveals significant differences in the mean Science Curiosity Skill among students based on their mother's educational qualification. Specifically, students with illiterate mothers have significantly lower science curiosity skills compared to those with mothers who are school dropouts, SSC, intermediate, college dropouts, graduates, and postgraduates.

Thus, the null hypothesis formulated that there is no significant difference in science curiosity skills among secondary school students based on their mother's educational qualifications is rejected.

Objective 5: To find out the significant differences in the science curiosity skills of secondary school students, based on fathers’ educational qualification.

H₀: There are no significant differences in the science curiosity skills of secondary school students based on fathers’ educational qualification.

We conducted a one-way ANOVA to test the difference in science curiosity skills based on the father's educational qualification. Table 6 presents the results of one-way ANOVA.

Table 6: Mean Difference in Science Curiosity Skills of Secondary School Students on the basis of Fathers' educational qualification**One-way ANOVA (Father's Educational Qualification)**

ANOVA					
Science Curiosity Skill					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	843.274	6	140.546	4.197	.000
Within Groups	13327.037	398	33.485		
Total	14170.311	404			

* Significant at the 0.05 level.

We used a one-way ANOVA to compare the average scores of secondary school students' science curiosity skills based on their father's level of education (illiterate, school dropout, SSC, intermediate, college dropout, graduate, and postgraduate). The results can be seen in Table 8. The F value obtained is $(6, 398) = 4.197$, $p < .01$, which is statistically significant at the 0.01 level. This indicates that there is a significant mean difference in science curiosity skills among secondary school students based on their father's educational qualification.

In order to determine which categories of father's educational qualification, such as illiterate, school dropout, SSC, intermediate, college dropout, graduate, and postgraduate, had higher mean scores of science curiosity skills among secondary school students, post hoc analysis was conducted. The researcher used Tukey's Honestly Significant Difference (HSD), which finds the significant mean difference between different categories of the father's educational qualification. The table presents the summary of the Tukey's (HSD) test analysis, which examined the mean Science Curiosity Skill among secondary school students across different categories of their father's educational qualification.

Table – 6 (a)**Post Hoc Tests**

Multiple Comparisons				
Dependent Variable: Science Curiosity Skill				
LSD				
(I) Qualification of Father	(J) Qualification of Father	Mean Difference (I-J)	Std. Error	Sig.
Illiterate	School Dropout	3.256*	1.532	.034
	SSC	3.736*	1.462	.011
	Intermediate	3.535*	1.529	.021
	College Dropout	1.733	1.536	.260
	Graduate	.156	1.614	.923
	Post graduate	-.622	2.023	.759
School Dropout	Illiterate	-3.256*	1.532	.034
	SSC	.480	.873	.582
	Intermediate	.279	.982	.776
	College Dropout	-1.523	.993	.126

	Graduate	-3.100*	1.109	.005
	Post graduate	-3.878*	1.649	.019
SSC	Illiterate	-3.736*	1.462	.011
	School Dropout	-.480	.873	.582
	Intermediate	-.202	.869	.817
	College Dropout	-2.003*	.881	.024
	Graduate	-3.581*	1.010	.000
	Post graduate	-4.359*	1.584	.006
Intermediate	Illiterate	-3.535*	1.529	.021
	School Dropout	-.279	.982	.776
	SSC	.202	.869	.817
	College Dropout	-1.802	.989	.069
	Graduate	-3.379*	1.106	.002
	Post graduate	-4.157*	1.646	.012
College Dropout	Illiterate	-1.733	1.536	.260
	School Dropout	1.523	.993	.126
	SSC	2.003*	.881	.024
	Intermediate	1.802	.989	.069
	Graduate	-1.577	1.115	.158
	Post graduate	-2.355	1.653	.155
Graduate	Illiterate	-.156	1.614	.923
	School Dropout	3.100*	1.109	.005
	SSC	3.581*	1.010	.000
	Intermediate	3.379*	1.106	.002
	College Dropout	1.577	1.115	.158
	Post graduate	-.778	1.725	.652
Post graduate	Illiterate	.622	2.023	.759
	School Dropout	3.878*	1.649	.019
	SSC	4.359*	1.584	.006
	Intermediate	4.157*	1.646	.012
	College Dropout	2.355	1.653	.155
	Graduate	.778	1.725	.652

*. The mean difference is significant at the 0.05 level.

We used a one-way ANOVA to compare the average scores of secondary school students' science curiosity skills based on their father's level of education (illiterate, school dropout, SSC, intermediate, college dropout, graduate, and postgraduate). Table 8 displays the results. The F value obtained is $(6, 398) = 4.197$, $p < .01$, which is statistically significant at the 0.01 level. This indicates that there is a significant mean difference in science curiosity skills among secondary school students based on their father's educational qualification.

Post hoc analysis was used to find out which types of fathers' educational background (illiterate, school dropout, SSC, intermediate, college dropout, graduate, and postgraduate) were linked to higher mean scores in secondary school students' science curiosity skills. The researcher used Tukey's Honestly Significant Difference (HSD),

which finds the significant mean difference between different categories of the father's educational qualification. The table shows a summary of the Tukey's (HSD) test analysis, which looked at the average Science Curiosity Skill among high school students whose fathers had different levels of education.

On the basis of the analysis of Tukey HSD test among the various categories, by keeping 'father's educational qualification' category- 'illiterate' as a base, it can be seen that it has the mean differences of 3.256, 3.736, 3.535, 1.733, .156 and -0.622 with the categories School Dropout, SSC, Intermediate, College Dropout, Graduate and Postgraduate respectively, in which the mean differences with School Dropout, SSC, Intermediate, College Dropout, Graduate and Postgraduate is not significant which leads to the interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to illiterate and School Dropout, SSC, Intermediate, College Dropout, Graduate and Postgraduate have no significant difference with the base category- 'illiterate'.

By keeping 'father's educational qualification' category- 'School Dropout' as a base, it can be seen that it has the mean differences of -3.256, 0.480, 0.279, -1.523, -3.100 and -3.878 with the categories Illiterate, SSC, Intermediate, College Dropout, Graduate, Postgraduate respectively, in which the mean differences with Illiterate, SSC, Intermediate, College Dropout, Graduate, Postgraduate is not statistically significant which leads to interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to Illiterate, SSC, Intermediate, College Dropout, Graduate, Postgraduate have no significant difference with the base category- 'School Dropout'.

Using the 'father's educational qualification' category, 'SSC,' as a baseline reveals mean differences of -3.736, -0.480, -0.202, -2.003, -3.581*, and -4.359 with the categories of illiterate, school dropout, intermediate, college dropout, graduate, and postgraduate, respectively. The mean differences with the graduate category are statistically significant, indicating that among the categories, the mean scores of Science Curiosity Skill among secondary school students belonging to the graduate category have significant differences, while the rest of the categories do not significantly differ from the base category, 'SSC.'

Using the 'father's educational qualification' category as a base, we can observe that it has mean differences of -3.535, -0.279, 0.202, -1.802, -3.379*, and -4.157 with the categories of illiterate, school dropout, SSC, college dropout, graduate, and postgraduate, respectively. The mean differences with the graduate category are statistically significant, leading to the interpretation that, among the categories, the mean scores of the Science Curiosity Skill of secondary school students belonging to the graduate category exhibit a significant difference, while the rest of the categories do not significantly differ from the base category, 'Intermediate.'

By keeping 'father's educational qualification' category- 'College Dropout' as a base, it can be seen that it has the mean differences of -1.733, 1.523, 2.003, 1.802, -1.577 and -2.355 with the categories Illiterate, School Dropout, SSC, Intermediate, Graduate, Postgraduate respectively, in which the mean differences with Illiterate, School Dropout, SSC, Intermediate, Graduate, Postgraduate is not statistically significant which leads to interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to Illiterate, School Dropout, SSC, Intermediate, Graduate, Postgraduate have no significant difference with the base category- 'College Dropout'.

Using the 'father's educational qualification' category, 'Graduate,' as a base, we can observe mean differences of -0.156, 3.100, 3.581*, 3.379*, 1.577, and -0.778 with the categories of Illiterate, School Dropout, SSC, Intermediate, College Dropout, and Postgraduate, respectively. The mean differences with SSC are statistically significant, leading to the interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to SSC exhibit a significant difference, while the rest of the categories do not significantly differ from the base category, 'Graduate.'

By keeping 'father's educational qualification' category- 'Postgraduate' as a base, it can be seen that it has the mean differences of 0.622, 3.878, 4.359, 4.157, 2.355 and 0.778 with the categories Illiterate, School Dropout, SSC, Intermediate, College Dropout, Graduate respectively, in which the mean differences with Illiterate, School Dropout, SSC, Intermediate, College Dropout, Graduate is not statistically significant which leads to interpretation that among the categories, the mean scores of Science Curiosity Skill of secondary school students belonging to Illiterate, School Dropout, SSC, Intermediate, College Dropout, Graduate have no significant difference with the base category- 'Postgraduate'.

Based on the above results, we can deduce that secondary school students belonging to the father's educational qualification category, 'Postgraduate' (M=47.40; SD=5.717), have the highest mean scores of Science Curiosity Skill, while students in the 'SSC' category (M=43.04; SD=5.688) have the lowest. After looking carefully at the result of the analysis, we can conclude that the mean scores of science curiosity skills of secondary school students belonging to different categories of their father's educational qualification do not significantly differ with the base categories of illiterate, school dropout, college dropout, and postgraduate. However, there are significant differences between some of the mean scores and the base categories of SSC, Intermediate, and Graduate of Science Curiosity Skill of secondary school students. This infers that fathers' educational backgrounds may have some influence on their children's science curiosity skills, though this influence may not be substantial in all categories.

Overall, this study's findings suggest that further research is necessary to identify additional factors that may influence secondary school students' development of science curiosity skills.

Thus, the null hypothesis formulated that there is no significant difference in science curiosity skills among secondary school students based on their father's educational qualifications is rejected.

Conclusion

This study emphasizes the importance of scientific curiosity in engaging students with scientific concepts and developing essential 21st-century skills like creativity, critical thinking, and problem solving. A study of data collected from 405 secondary school students yielded several significant findings.

The majority of students demonstrated average levels of scientific curiosity, indicating a basic interest in science. However, only a small proportion showed high levels of curiosity, highlighting the need for increased efforts to promote deeper engagement with scientific inquiry. Regarding gender differences, the study discovered no significant difference in science curiosity skills between male and female students, implying that curiosity levels

are unaffected by gender. When equal opportunities are provided, this indicates that both genders have an equal chance of developing curiosity.

Significant differences, however, were found depending on the medium of instruction. Students in English-medium schools demonstrated higher levels of scientific curiosity than their peers in Urdu-medium schools. This finding emphasizes the role of language proficiency and access to resources in the development of curiosity skills. Furthermore, the educational backgrounds of parents, particularly mothers, emerged as a significant factor influencing students' curiosity. Higher parental education levels were associated with increased student curiosity. Students with postgraduate parents showed the most curiosity, while those with illiterate parents showed the least.

These findings highlight the complex role of demographic factors in shaping students' scientific curiosity. Addressing these inequalities through targeted and inclusive interventions can help to close the gap and promote equitable development of curiosity skills among diverse student groups.

Recommendations

The following recommendations are suggested to directly address the issues and patterns observed, as a result of the findings of this study:

1. To improve students' curiosity in science in Urdu schools compared to English schools, it's suggested to create bilingual science workshops, use interactive multimedia resources, and provide teaching materials that relate to their culture.
2. Schools and communities should create mother-centric educational interventions and host awareness programs for mothers because maternal education significantly influences students' interest in science. Programs like "Mother-Child Science Engagement Activities" or local science clubs could foster parental involvement in their children's natural curiosity.
3. Encourage students to ask questions and explore in order to foster inquiry-driven learning environments. Teachers can do this by using techniques like asking open-ended questions, doing hands-on science experiments, and organizing activities that encourage exploration. This is very important for students who show average or low science curiosity.
4. Both Urdu and English medium schools should have equal access to science education resources, such as libraries, labs, and digital tools. To close educational gaps, authorities should focus on providing language support to non-English-speaking students.
5. It is important to address any biases that may exist in classroom interactions or cultural norms to ensure that male and female students have equal opportunities to participate in science activities. This is essential, despite the absence of significant gender differences.
6. Make sure that educators receive targeted training on how to recognize and encourage curiosity in their students, especially those who show less curiosity. Teachers can help students who aren't naturally curious by making their lessons more interesting step by step with tasks that start simple and get more challenging.

7. Help students who are not curious by finding ways to make science more interesting for them. This can happen through personalized mentoring, programs that spark interest, or taking part in science competitions.
8. The curriculum should include examples and case studies that are relevant to different cultures. This will help make science interesting and relatable for students from various backgrounds, recognizing the cultural and language diversity in Indian classrooms.

Teachers, policymakers, and school leaders can improve students' interest in science by following these practical suggestions. This will make the learning space more welcoming and encourage exploration.

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