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Investigating the Relationship Between Secondary School Students' Attitudes Toward Science and Their Classroom Engagement

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Abstract

This study investigated the relationship between secondary school students' attitudes toward science and their classroom engagement. Employing a quantitative correlational design, data were collected from 200 randomly selected students enrolled in six secondary schools in Gujranwala, Pakistan. Standardized instruments measured students' attitudes toward science and their levels of classroom engagement. Descriptive statistics, independent samples t-tests, and Pearson's correlation analysis were applied to examine patterns and relationships. Findings revealed a strong positive correlation between attitudes toward science and classroom engagement, indicating that students with more favorable attitudes were more active, emotionally, and cognitively engaged in science learning. Gender-based analysis showed significant differences in favor of female students for both attitudes and engagement. The results highlight the reciprocal nature of attitudes and engagement, with each reinforcing the other. The study concludes that fostering positive attitudes toward science is a key strategy for enhancing engagement and, ultimately, science achievement. It recommends integrating attitude-enhancing interventions, such as inquiry-based activities, real-world applications, and supportive classroom environments, to sustain motivation and participation in science education. These insights can guide educators, curriculum developers, and policymakers in designing targeted strategies to improve science learning outcomes.

Key Words

Attitude toward Science, Classroom Engagement, Correlational Study, Secondary School, Science Education

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Introduction

During the past few years, there has been a growth in the academic literature addressing the interaction between how students feel about science and how they engage in the classroom, especially at the secondary school level, where interest in science may start to dissipate (Osborne et al., 2023). This drop has wide-ranging implications for

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science achievement, career interest, and the development of scientific literacy in a more technological society. Awareness of such effects is crucial for educators and policymakers who aim to sustain students' interest in science learning.

Attitude toward science refers to the thought process of students on the significance of science, their feelings toward scientific ideas, and their thinking on their competency to do science-related actions (Hassan & Sariah, 2018). It is well-known that positive attitudes have overall impacts on academic success and increase the chance of becoming involved in STEM occupations (Sithole et al., 2017). On the contrary, negative attitudes can act as a barrier to engagement and can demotivate participation, which can also result in reduced engagement in science classrooms.

Engagement in a classroom setting is also rather essential to facilitating science learning: it includes behavioral, emotional, and cognitive levels (Pentaraki & Burkholder, 2017). Interested students actively explore the classroom tasks, demonstrating curiosity and commitment to learning scientific concepts. The fact that attitude and engagement are linked seems to be two-way correlated: positive attitude is related to greater engagement, and prolonged engagement may positively affect attitude (Jackson et al., 2023). Nonetheless, demographic factors, pedagogy, and learning space may mediate this association, inducing ways in which they have different effects under varying circumstances (Chang et al., 2023).

Although the significance of this relationship is increasingly appreciated, there has been a need for empirical evidence in the Pakistani secondary school setting. This paper fills this gap and focuses on the relationship between students' attitudes towards science and classroom engagement of students at the secondary level.

Research Objectives

1. To investigate secondary school students' attitudes toward science.
2. To find out the level of classroom engagement in science among secondary school students.
3. To examine the relationship between students' attitudes toward science and their classroom engagement.

Literature Review

Attitudes toward science are multidimensional constructs reflecting learners' cognitive beliefs, affective responses, and behavioral tendencies regarding science as a subject and scientific inquiry as a process (Osborne et al., 2023). The cognitive component concerns beliefs about the relevance, usefulness, and trustworthiness of science in addressing real-world issues (Gardner, 2014). The affective dimension reflects emotional responses, such as enjoyment, curiosity, or anxiety toward science learning, while the behavioral component relates to the intention or willingness to participate in science-related activities (Koballa, 2012).

Favourable attitude towards science has been associated with improved academic achievement, continued enrolment in sciences, and increased propensity to take up STEM-related careers (Thomas & Zubkov, 2023). The determinants of such attitudes are past performance, standard of science instruction, parental support, peer pressure, and social-cultural expectation (Larry & Wendt, 2022). The pedagogical strategies, especially those focused on promoting an inquiry-based learning approach, practical experimentations, and enhancing the skills of applying science to real-life situations, are likely to have a positive effect on attitudes, given the increased relevance and appeal of the field (Pucillo & Perez, 2023) as critical thinking and life skills have been focused in current literature (Jamil et al., 2024; Jamil et al., 2024; Jamil et al., 2024; Naseer et al., 2022). On the other hand, the teacher-centred approach and excessive focus on rote learning are related to Borderline dynamics, characterised by diminishing interest in study, particularly among female learners and other underrepresented populations (Nja et al., 2022).

The concept of classroom engagement was used to describe the extent to which students were engaged, emotionally and cognitively, in the learning environment (Fredricks et al., 2004). It is generally thought of in three interrelated dimensions. The first one is behaviour involvement, which is about increasing trackable involvement in academic functions, compliance, and insistence on finishing the work (Skinner & Belmont, 1993). The second aspect is emotional involvement, involving positive affective and negative responses related to the learning, instructors, and classmates (Pekrun et al., 2002). The third aspect is cognitive engagement, which is a readiness to apply mental energy to comprehend difficult ideas, solve complex problems, and use higher-order reasoning abilities (Corno & Mandinach, 1983).

Studies repeatedly demonstrate that the higher the levels of engagement, the better the academic performance and learning processes, and the superior the recall of information (Rajabalee et al., 2020). The factors that affect engagement are the instruction strategies, classroom environment, interpersonal relationships between peers, relevance of curriculum, and resource accessibility (Picton et al., 2018; Shernoff et al., 2017). Active learning techniques, in particular, engaging with collaborative projects, problem-based learning, and using technology, are especially useful in keeping learners interested (Dörnyei & Muir, 2019). On the other hand, unsupportive, exclusive, or poorly equipped environments would restrict the desire of individuals to contribute significantly (Schmidt et al., 2018).

It has been scientifically proven that attitudes to science and classroom activities are strongly correlated (Suryawati & Osman, 2017). Positive attitude enhances students to portray enduring behavior, emotions, and cognitive activity that results in improved performance and continued learning of science. On the other hand, there are negative attitudes that are frequently associated with a lack of motivation, low participation, and superficial learning strategies (Boonk et al., 2018).

Research Methodology

The current study employed a quantitative correlational research design to investigate the relationship between secondary school students' attitudes towards science and their classroom engagement. A correlational design was considered an appropriate one since it helps to analyze both the strength and direction of the relationship between variables without their manipulation (Sullivan, 2024).

All students in secondary schools, both public and private, located in Gujranwala, Punjab province, Pakistan, were the target population. A sample of 200 students was taken through simple random sampling because it allowed all students to have an equal probability of being selected and minimised the probability of sampling bias under all students being sampled. The sample consisted of students from six secondary schools, with the ratio of males and females (85.5% and 14.5%, respectively).

Two standardized instruments were used to measure the study variables. Students' attitudes toward science were assessed using a validated attitude scale that captured cognitive, affective, and behavioral dimensions. Classroom engagement was measured using a scale encompassing behavioral, emotional, and cognitive engagement components (Fredricks et al., 2004). Both instruments have been widely used in prior research and demonstrated strong psychometric properties. In the present study, reliability was confirmed through Cronbach's alpha, with coefficients exceeding the acceptable threshold of 0.70 for both scales, indicating high internal consistency.

Before data collection, formal permission was obtained from the relevant school authorities. Students were informed about the purpose of the study, assured of confidentiality, and invited to participate voluntarily. Questionnaires were administered during regular class hours to ensure clarity of instructions and minimise missing data.

Collected data were entered into the Statistical Package for the Social Sciences (SPSS) 26 for analysis. Descriptive statistics (means, standard deviations) were calculated to summarize students' attitudes and engagement levels. An independent sample t-test was conducted to investigate gender-based differences in both variables. Pearson's correlation coefficient was used to determine the strength and direction of the relationship between attitudes toward science and classroom engagement. Statistical significance was set at $p < 0.05$.

Results of the Study

Table 1

Descriptive Statistics for Attitude Toward Science by Gender

Gender	N	M	SD
Male	171	81.91	10.39
Female	29	85.72	9.84

Table 1 shows the descriptive statistics for students' attitudes toward science, disaggregated by gender. Female students (M = 85.72, SD = 9.84) scored higher on average than male students (M = 81.91, SD = 10.39), suggesting that females in the sample held more favorable attitudes toward science.

Table 2

Descriptive Statistics for Classroom Engagement by Gender

Gender	N	M	SD
Male	171	78.27	9.86
Female	29	83.18	9.41

Table 2 presents the descriptive statistics for classroom engagement scores by gender. Female students (M = 83.18, SD = 9.41) again outperformed male students (M = 78.27, SD = 9.86) in self-reported engagement.

Table 3

Pearson Correlation Between Attitude Toward Science and Classroom Engagement by Gender

Gender	r	p
Overall	.76	<.001
Male	.74	<.001
Female	.78	<.001

Table 3 reports Pearson correlation coefficients for the relationship between attitudes toward science and classroom engagement, overall and by gender. The overall correlation was strong and positive ($r = .76$, $p < .001$), indicating that students with more positive attitudes were significantly more engaged. The correlation was also strong for both males ($r = .74$, $p < .001$) and females ($r = .78$, $p < .001$), suggesting that the positive relationship between these constructs is consistent across genders.

Table 4

Descriptive Statistics for Attitude Toward Science by Gender

Gender	N	M	SD
Male	171	81.91	10.39
Female	29	85.72	9.84

Female students (M = 85.72, SD = 9.84) scored higher than male students (M = 81.91, SD = 10.39) on attitudes toward science, indicating that females in the sample held more favourable beliefs, feelings, and behavioural intentions toward science. While both groups displayed generally positive attitudes, the difference suggests that female students may perceive science as more relevant or engaging, aligning with prior findings that highlight gender-based variations in affective orientation toward science.

Table 5

Descriptive Statistics for Classroom Engagement by Gender

Gender	N	M	SD
Male	171	78.27	9.86
Female	29	83.18	9.41

Female students (M = 83.18, SD = 9.41) reported higher classroom engagement compared to males (M = 78.27, SD = 9.86). This difference indicates that females were more behaviorally, emotionally, and cognitively involved in science learning activities.

Table 6

Pearson Correlation Between Attitude Toward Science and Classroom Engagement by Gender

Gender	r	p
Overall	.76	<.001
Male	.74	<.001
Female	.78	<.001

There was a powerful, positive connection between attitudes to science and rates of engagement in the classroom in general ($r = .76$, $p < .001$) and between the two sexes separately (male: $r = .74$, female: $r = .78$; $p < .001$).

Discussion

The current research was fruitful, as it evaluated the types of connections between the attitudes of secondary school students towards science and their engagement levels in the classroom, paying specific attention to the gender-based disparities. Results showed three major trends: (a) the attitude toward science was greater in female students as compared to the male students, (b) female students exhibited greater classroom engagement as well, and (c) the strong positive relationship that existed between the attitude toward science and classroom engagement in both genders.

The greater mean values of the attitude and engagement scale administered to female students indicate that they were more positively disposed to learning science and more actively engaged in active learning in the given sample. The above result is contrary to the findings of studies that have more frequently yielded low self-efficacy and less positive attitudes towards science, especially in physical science, of female students (Nja et al., 2022). One reason could be that the contextual and pedagogical factors, like classrooms conducive to women, inclusive teaching styles, or emphasis on that particular subject matter, may have led to further action on the part of women and improved perceptions about the school in this case (Parker & Rennie, 2002).

The positive correlation between the attitudes towards science and the engagement in the class is in line with the multiple studies in the past that show that those students who feel that science is relevant, interesting, and useful are more apt to participate in the science learning behaviorally, emotionally, and cognitively (Suryawati & Osman, 2017). The results of the given study confirm the bidirectional correlation, as suggested by Sinatra et al. (2015), in which favorable attitudes lead to engagement, and prolonged engagement reaffirms favorable attitudes.

Interestingly, the correlation was slightly stronger when the sample consisted of females (r = .78), based on the premise that females' participation might be tied more to their attitudes. The trend supports the need for attitudinal-based interventions, i.e., inquiry-based learning, real-world applications, and collaborative projects, which have the potential to increase the interest factor and participation levels across the board of students, and may even lead to even better results in females (Pucillo & Perez, 2023).

Generally, the results can be summarized as adding to the sparse empirical evidence in the Pakistani learning facility of high school education to conclude that specific, attitude-based interventions have the potential to be of paramount importance to increase interest amongst students of diverse backgrounds regarding science.

Conclusion

This paper examined the correlation between science attitude and classroom engagement among secondary school students in Gujranwala district, Pakistan. The result showed that female students have more favorable attitude towards science and increased classroom engagement than the male students. Also, positive correlation with attitude and engagement was found to be strongly correlated in both genders, which proves that positive considerations of science have close relations to science learning engagement. These findings support the significance of dealing with not only the attitudinal and behavioral aspects in science learning. By improving the attitudes of the students towards science, a higher degree of engagement may be achieved, thus, furthermore, contributing to the improved results and a lasting interest in scientific activities. The results also add to the shortage of existing empirical evidence in the Pakistani setting, and there is a necessity to design specific interventions that focus on gender-specific dynamics and contextual realities in science rooms at secondary schools in Pakistan.

Recommendations

The following are the recommendations on the basis of the findings of the study:

1. Student-centred, inquiry-based pedagogies may be used to foster exploration and experimentation to promote problem-solving and enhance both attitudes towards science and engagement among students.
2. Interpret design science lessons in the real lives of students pursuing their communities by enabling learning to be more meaningful and encouraging.
3. Establish strategies to maintain and potentially increase positive engagement among female scholars.
4. Laboratory equipment, digital resources, and learning materials may be provided to facilitate active, practical involvement in science practice.

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