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Research Article

Predictive effects of scientific attitudes on gender-specific academic performance in science

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ABSTRACT

In a world where the pulse of progress hinges on the rhythmicity of scientific inquiry and technology, cultivating a robust scientific attitude in learners holds the potential of elucidating the antecedents of the disparities in gender performance in science. Scientific attitudes transcend the confines of laboratory walls and permeate all facets of students' lives. This article explored these attitudes and whether they hold the potential to influence observed performance gaps in science based on gender. Adopting a descriptive survey design, the researchers gathered data from 344 participants using the Scientific Attitude Assessment (SAA) questionnaire and a Science Achievement Test (SAT). The data obtained were analysed using both parametric and non-parametric methods to examine the differences and the interactions that exist between the variables. Contrary to known assumptions, the analysis reveals that there exist no significant differences in the performance of students in the subject of science based on gender. However, it was observed that both the performance of males and females in the subject are influenced by their respective levels of scientific attitudes. On an individual correlation analysis, even though all seven scientific attitudes positively affect performance, critical thinking appeared to have a stronger positive influence on students' performance in the subject. Moving forward, interventions aimed at enhancing critical thinking skills could prove instrumental in narrowing achievement gaps and promoting equitable outcomes in science learning.

Keywords: academic performance, gender-specific, scientific attitudes

INTRODUCTION

Today, life strives within the confines of science and the growing walls of technology making science and its attitude an important aspect of human culture necessary for the existence of mankind. Developing interest in science subjects (attitudes toward science) and the development and inculcation of scientific attitudes in students are part of the important priorities of science education (Arısoy, 2007; Azizoğlu & Çetin, 2009). Scientific attitudes are the thinking patterns, and behavioral dispositions which are characteristic of individuals that are or have the intention of becoming scientists. Such behavioral dispositions include objectivity, open-mindedness, cause-and-effect relationships, justifying conclusions with evidence, faith in the scientific method, curiosity, aversion to superstition, questioning, and suspended judgment (Shivani, 2012). Olasehinde and Olatoye (2014b) agreed in different words that scientific attitude "is the ability to do things in a way that relies on proven principles rather than unverified principles". They further demystified that a scientifically inclined individual does not depend on famous opinions with unproven basis and that the person is free from unverified propositions and superstition. To Barot (2013), "scientific attitude enables an individual to develop a sense of vision for a better life, to make life meaningful and teaches him or her to do all work systematically." From the view of Barot (2013), everybody must have scientific attitudes whether they are scientists or not, because they form the foundation of our daily decisions and activities. The focus of science education is the modification and development of the behavior of learners. This is possible if the depth and horizon of the concept (attitude and scientific attitudes which are important components of behaviors) are fully explored through research.

Statement of the Problem

The performance of girls and boys in the West African senior school certificate examination (WASSCE) in the five Northern regions of Ghana has been a subject of research and analysis, with the chief examiners' reports serving as a valuable guide for understanding the trends and patterns. Gunu (2022) argued that poor academic performance in Northern Regions' Senior High Schools in the WASSCE is not a result of mere chance or luck but rather a phenomenon that

requires careful examination by educators and researchers. Gunu (2022) emphasizes the responsibility of educationists and researchers to investigate the underlying causes of the dismal performance of northern schools in the WASSCE. His report did not only shed light on the strengths and weaknesses of students in the WASSCE but also highlight areas that require improvement. One particular area of concern is the performance of both girls and boys in the five Northern Regions of Ghana. Gunu's (2022) perspective underscores the importance of addressing the challenges faced by students in these regions and developing strategies to enhance their academic outcomes.

Studies have revealed mixed findings on the performance of girls and boys in the WASSCE in the five Northern Regions of Ghana. Some studies have reported no significant gender differences in performance (Osei-Tutu, 2016), while others have indicated variations in performance between boys and girls (Mohammed, 2014). For example, the chief examiners' report for WASSCE 2019 revealed that in some subjects such as English language, mathematics, and integrated science, girls performed slightly better than boys, while in other subjects such as social studies and business management, boys performed slightly better (West African Examinations Council [WAEC], 2019). Adams (2023) recently indicated that, in the Northern region, even though performance is generally low, boys tend to outperform girls in science, with a notable gap in mean scores. Also, in the Upper West Region, boys achieved higher mean scores in science compared to girls (Dauda, 2023).

These findings suggest that the performance of girls and boys in the WASSCE in the five Northern regions of Ghana may be influenced by various factors, including gender-related stereotypes, societal expectations, teaching and learning practices, and access to educational resources. Additionally, cultural and other contextual factors including gender roles, traditional beliefs, and economic disparities may also shape the achievement of boys as well as girls in the WASSCE in the northern regions of Ghana. Cognizant of this persistent gap and the scarcity of studies focusing on students' scientific attitudes as probable causes of gender-specific academic performance in science, the current research investigates the predictive effects of scientific attitudes on academic performance in science based on gender in the Jirapa Municipality.

Significance of the Study

This study which focuses on the predictive effects of scientific attitudes on gender-specific academic performance in science is worthwhile for the following reasons;

Firstly, it addresses the gender gap in science education, which has been observed in various parts of the world, including Ghana. According to Appiah (2018), addressing the gender gap in STEM education in Ghana is crucial, and this study contributes to filling the research gap in Jirapa, a rural municipality in Ghana. Previous research has shown that girls tend to underperform in science due to various social, cultural, and psychological factors (Archer et al., 2012; Negishi et al., 2015). However, limited studies have been conducted on this issue in Jirapa, making this study significant in addressing this research gap (Appiah, 2018).

Additionally, scientific attitudes, which includes curiosity, critical thinking, and positive attitudes toward science, is associated with better academic achievement in science (Osborne et al., 2003). Thus, investigating the role of scientific attitude in the context of gender-specific academic achievement in science in Jirapa can provide valuable insights for designing effective interventions to improve science education.

Also, it would contribute to the existing inconsistencies by interpolating the several fragments of studies on the variables via the addition of an intellectual voice using its findings, to have a better understanding of the disparities in the studies of yesteryears. This would also provide a reference literature document that will serve as a compass for future research on the variables.

Research Objectives

1. To examine the association between scientific attitudes and academic achievement in science based on gender.
2. To determine whether there are significant differences in the scientific attitude levels of boys and girls.

Research Hypotheses

H_1. There is no correlation between scientific attitudes and academic performance in science based on gender.

H_2. There are no significant differences in the levels of scientific attitudes in boys and girls.

LITERATURE REVIEW

The purpose of this review is to contextualize the current study within the larger academic discourse and build upon it as well as expand the findings of prior research (Creswell & Creswell, 2018). By drawing upon existing literature, the researchers aim to situate the study within a broader perspective, contribute to ongoing scholarly conversations, and advance knowledge in the field.

Scientific Attitudes

Scientific attitude refers to an individual's disposition towards science, including their interest, motivation, and beliefs about the nature of science (Osborne et al., 2003). A positive scientific attitude is associated with greater engagement, curiosity, and motivation to learn science, which can in turn influence academic achievement (Buccheri, 2017). Notable examples of scientific attitudes include; objectivity, open-mindedness, cause-and-effect relationships, justifying conclusions with evidence, faith in the scientific method, curiosity, aversion to superstition, questioning, and suspended judgment (Olasehinde & Olatoye, 2014b; Shivani, 2012). Previous research has suggested that there may be gender differences in scientific attitude, which could potentially contribute to the gender-specific academic performance gap in science (Gorrell & Kahveci, 2017; Sheldrake & Mujtaba, 2019). However, in the Ghanaian context, there are no studies on whether the said gap could be attributed to the levels of scientific attitudes in both boys and girls.

Scientific Attitudes and Academic Performance

An area of educational concern that has gained the interest of researchers is whether or not scientific attitudes are in a way related to the academic performance of students. In response to this, many studies were carried out on the effect of the variable on other variables including academic achievement. For instance, Shivani (2012) quantitatively investigated the association between scientific attitudes and academic success of 120 high school students in India and reported the correlation that exist between the variables was a positive one. This implies that as the scientific attitudes of students in the study population increase, there is a corresponding increase in their academic achievement and vice versa. In a descriptive study using the same approach and population but in a different context (Nigeria), Olasehinde and Olatoye (2014a) found a positive correlation though insignificant between scientific attitudes and achievement in science. Similarly, the research conducted by Kant (2015), on the relationship between learning styles, scientific attitudes, and academic progress in science confirms the findings of the aforementioned studies using the same population and approach in India.

In furtherance, a study by Romine and Sadler (2016) also revealed that scientific attitudes were positively correlated with science grades, standardized test scores, and interest in science. The influence of scientific attitude as a predictor variable of academic performance was also confirmed in the findings of studies conducted by Kristiani et al. (2015), Rajendran and Anandarasu (2020), etc. using the same approaches with different designs, populations, and locations.

In Ghana, as in many other countries, the importance of science education has been recognized as a key driver of national development. Therefore, understanding the relationship between academic performance and scientific attitudes in science is crucial for science educators. As a result, researchers have conducted studies on the variable and how it influences other variables, particularly academic achievement in science.

For instance, a study by Opoku and Amankwah (2019) found that students' scientific attitudes were positively correlated with their academic achievement in science. Additionally, a study by Asare and Mensah (2013) revealed that students' academic performance in science was significantly influenced by attitudes toward science.

In another study, Abreh et al. (2018) found that students who had better scientific skills achieved higher academic grades than those with lower scientific skills. The study also found that students who were exposed to practical science activities had better scientific skills than those who were not.

In conclusion, scientific attitudes and academic achievement are essential components of human capital development, and they play a critical role in a country's social and economic development. In Ghana, efforts to improve scientific skills and academic achievement must focus on addressing the mediating factors such as gender, socioeconomic status, and teacher quality. This would provide useful insights for policymakers, educators, and researchers working towards improving education in Ghana.

METHODOLOGY

Research Design

The study relied on the blueprints of the survey design. According to Creswell and Plano Clark (2017), this is a design that allows the numerical description and analysis of emanating patterns and as well tests for the associations existing between the variables of interest by focusing on a representative sample of the population. By adopting this design, it provided an understanding as well as a vigorous methodological approach to investigating the relationships between the independent variable (scientific attitudes) and the dependent variable (performance in science). This design is specifically suitable for the topic under consideration as it helped gather a wide range of data for quantitative analysis and comparative assessments which provided longitudinal insights as well as directly correlated scientific attitudes with academic performance (Dillman et al., 2014).

Research Area

The study was conducted in Jirapa Municipal, a district situated in the Upper West Region of Ghana. Jirapa Municipal is one of the eleven districts in the Upper West Region of Ghana. It was originally known as the Jirapa Lambussie District until it was split in 2008 to form the Lambussie-Karni District and the Jirapa District. On March 15, 2018, it was elevated to the status of a municipality and is now called the Jirapa Municipal District Assembly. The municipality is located in the Northwestern part of the region, with Jirapa serving as its district capital. With an area of 1166 square kilometers, the Municipal District is bordered by the Lambussie-Karni District to the North, the Lawra District to the West, the Nadowli-Kaleo District to the South, and the Sissala District to the east. The climate in Jirapa municipality is tropical, characterized by high temperatures throughout the year and the rainy season from March to October.

The municipality is home to two tertiary institutions (St. Joseph's Midwifery Training School and the Jirapa Community Health Nurses Training School) and four secondary schools, two of which are the focus of this study. It also has several primary schools and private institutions. Additionally, there is a municipal hospital, a police station, and a magistrate court in the area.

Jirapa Municipal is characterized by a unique mix of rural and urban communities, making it an ideal location for studying various aspects related to research. Jirapa Municipal provides an appropriate context for studying the variables in the research topic due to its diverse demographic characteristics, educational institutions, and urban-rural mix. This setting allows for a comprehensive examination of how gender dynamics and scientific attitudes could impact science education within this specific community.

Population of the Study

The study focused on a population of enrolled students from two senior high schools (SHS) in the municipality. These schools include Jirapa SHS and St. Francis Girls' SHS. These two schools, Jirapa SHS and St. Francis Girls' SHS were purposively selected to participate in the research. These

schools were chosen because they were the only ones in the Municipality offering a pure science program. Additionally, St. Francis Girls' SHS being a single-sex school contributed to increasing the number of females in the science program at Jirapa SHS, which is a mixed school.

The total population consisted of 2,419 students, with 1,885 being girls and 534 boys. The study specifically targeted form three students from Jirapa SHS and St. Francis Girls' SHS. Final-year SHS students are generally more mature and have higher-order cognitive abilities compared to students in earlier years. They have been exposed to complex scientific content and have had the opportunity to refine their cognitive abilities and critical thinking, which are crucial for successful learning in science (Brown & Smith, 2019). The study specifically aimed to examine gender-specific academic performance making the distribution of male and female students particularly relevant. The age range of the population fell between 14 and 21 years old. The students in the population came from various socioeconomic backgrounds, including different income levels, family structures, and communities. Socioeconomic factors can have an impact on educational opportunities, resources, and support available to students, which can influence their academic achievement. To ensure fair inferences of outcomes, the researchers assumed that all students had a common socioeconomic background.

Sample and Sampling Techniques

Simple random sampling was employed in selecting the participants for the study. This sampling technique gave each member of the population an equal chance of being selected for inclusion in the sample (Cooper et al., 2019). The goal of simple random sampling is to ensure that enough respondents that represent the population are picked out, allowing the findings to be generalized and accurate conclusions drawn (Babbie & Mouton, 2019). By randomly selecting participants, biases, and preferences are minimized, increasing the likelihood of obtaining an unbiased sample (Levy & Lemeshow, 2013; Yuorsuu, 2024).

A list or a sampling frame of all individuals in the accessible population of interest was first obtained (Trochim & Donnelly, 2008). Then, a randomization method called the random number generator or a lottery system, was used to select participants from the sampling frame (Cooper et al., 2019). This process ensures that each individual has an equal and independent chance of being chosen, enhancing the representativeness of the sample (Babbie & Mouton, 2019).

Random sampling technique was used to sample 344 participants from a total population of 2,419 students for the study. These 344 participants included both science and nonscience students. Out of this number, the sample is made up of 172 girls and 172 boys. Equal representation of both genders is ensured for comparative analysis. The sample size was determined using Taro Yamane's formula ($n = N / (1 + Ne^2)$), where 'n' represents the sample size, 'N' is the population size, and 'e' signifies the margin of error. This sample size calculation formula is simple and also provides a sample size that is both manageable and statistically meaningful, allowing researchers to obtain reliable insights without needing an excessively large sample. Also, the formula incorporates the margin of error ('e') as a factor in sample size calculation. The margin of error indicates the maximum acceptable level of uncertainty in estimating population parameters from the sample data.

Research Instruments

The study employed two instruments; the scientific attitudes assessment questionnaire and the science achievement test (SAT). The scientific attitudes assessment (SAA) questionnaire is a comprehensive tool designed to measure the scientific attitudes of participants, which significantly influence their engagement in scientific activities and problem-solving approaches (Yuorsuu, 2024). The SAA instrument is a self-constructed tool used to assess the level of some scientific attitudes in the participants. Five questions each were constructed under seven relevant scientific attitudes based on the literature. These attitudes include; intellectual honesty, objectivity, skepticism, creativity, critical thinking, open-mindedness, and curiosity. The items were constructed on a four-point Likert scale, where participants were expected to choose the alternative that best described their scientific attitudes.

The SAT instrument was designed to assess the academic performance of participants in the field of integrated science. This instrument is also a self-constructed tool with items adopted from past exam papers. The test is an objective one and consists of two parts: part one collects demographic information from the participants, while part two comprises 40 items derived from past integrated science papers from the years 2021 and 2022 with each item having four alternatives.

Part two of the SAT covers the four major areas of integrated science, namely agriculture, biology, chemistry, and physics with questions distributed across all the five themes of the syllabus. For each of these areas, the first five questions from the past papers were thoughtfully selected to ensure a comprehensive representation of different respective subject areas. This approach guarantees that the SAT effectively measures participants' knowledge and understanding across the breadth of the integrated science curriculum. Participants were instructed to circle the correct response with ink.

Validity and Reliability

Reliability is one of the vehicles to reaching the validity of a study. Reliability talks about the degree to which the results from a measured construct or variable in one study could be repeated or confirmed by others. Validity in research acknowledges the accuracy of measured data, transparency in data-gathering processes, and how the analysis, interpretations, and findings from a study are warranted by existing propositions, and evidence (Creswell & Plano Clark, 2017). To enhance the validity and reliability of the SAT, the instrument went through expert scrutiny. Experts in the field of integrated science education and assessment carefully reviewed the test items to verify their alignment with the learning objectives and the subject content. Their inputs further refined the SAT, ensuring that it accurately measures the intended academic performance.

To establish the reliability of the SAT, a pilot testing phase was conducted at Daffiama SHS which is located in a sister district within the Upper West Region. This pilot testing

involved administering the test to a sample of participants in the school. These participants included both science and non-science students that were in form three at the time of administration of the instrument. The results obtained from the pilot test were analyzed to assess the consistency and stability of the test scores over time. The Cronbach's alpha obtained from the results of the pilot test was 0.737, which further ascertained its suitability. Also, expert scrutiny of the items and each item's reliability were taken into consideration leading to the reduction of the size of the instrument from 50 items to 40 items. By doing so, the researcher gained valuable insights into the instrument's reliability and identified any necessary adjustments or improvements.

To ensure content validity, the SAA underwent meticulous development, guided by an extensive review of scientific attitude literature. This process led to the identification of seven key attitudes: intellectual honesty, curiosity, open-mindedness, critical thinking, creativity, skepticism, and objectivity. A total of 35 items were thoughtfully crafted on a four-point Likert scale, with five items dedicated to each attitude. Data obtained from a pilot test was used to compute the reliability coefficient of the SAA instrument. A Cronbach's alpha of 0.855 was obtained confirming the ability of the instrument to produce reliable data when used to study scientific attitudes in the participants (Yuorsuu, 2024).

Data Collection and Analysis Procedure

Data was collected in this research using the two distinct instruments. Firstly, a suitable sample (344) of participants was selected, representing the target population. Informed consent was obtained from the participants (Creswell, 2014). SAA was administered to the participants at their various schools in the form of questionnaires. Clear instructions were provided to ensure accurate responses. The SAA responses were collected, collated, and analyzed. Also, the SAT was administered to the participants, under standardized conditions to minimize external influences were ensured. Participants completed the test within a period of an hour, which assessed their science achievement levels. The SAT responses are scored using predetermined scoring rubrics and guidelines that were developed by the researcher and the results were analyzed.

In this study, both parametric and non-parametric data analysis methods are employed to examine the relationship between scientific attitude and gender-specific academic performance in the field of science. The initial step in the data analysis process was to organize and prepare the collected data for analysis. This involved cleaning the data by removing any errors, inconsistencies, or outliers after which data was entered into the statistical software for easier manipulation and analysis. The data were now summarized and described using descriptive statistical measures such as measures of central tendency (e.g., mean [M]) and measures of variability (e.g., standard deviation [SD] and range) to provide an overview of the data and highlight patterns, distributions, and trends.

Finally, Statistical analysis was employed to test hypotheses and answer research questions. The specific statistical techniques used depend on the nature of the research question. Pearson correlation (bivariate) was used in answering research hypothesis 1 since it sought to identify if there exists a relationship between scientific attitudes and academic achievement in science based on gender. Also, research hypothesis 2 tried to test whether there are significant differences in the scientific attitude levels of boys and girls making the t-test a plausible one.

Table 1. Correlation between scientific attitudes and SAT

	Scientific attitudes	
	r	Sig.
SAT	0.71	0.03

RESULTS AND DISCUSSION

H_1. There Is No Correlation Between Scientific Attitudes and Academic Performance in Science Based on Gender

In **Table 1**, a Pearson moment correlation coefficient was computed to examine the nature of the association that existed between scientific attitudes and the academic performance of students in science. A statistically strong positive correlation was obtained (r [342] = 0.71, $p < 0.05$), thereby indicating that a linear association exists between these variables, hence the hypothesis was rejected. This relationship simply means that participants with scientific attitudes tend to perform better in science and vice versa. The findings align with a body of existing literature, providing further credence to the pivotal role of scientific attitudes in academic performance. Several studies conducted in diverse jurisdictions and utilizing various research designs, populations, and samples have arrived at similar conclusions (Olasehinde & Olatoye, 2014a; Priyanka & Neetu, 2019; Shivani, 2012; Sradhanjali & Parismita, 2021). These studies collectively corroborate the robustness of this finding. The consistency of these findings across different studies underscores the universal importance of scientific attitudes in shaping academic success. It highlights the notion of cultivating scientific attitudes in students as predictors of learning and achievement.

Correlation of Individual Scientific Attitudes With Science Achievement Test

Table 2 shows the correlation of the subscales under the SAA tool and how they individually affect academic performance in science. The analysis delved deeper into the specific subscales of scientific attitudes. Notably, it was observed that a very high positive correlation existed between critical thinking as a scientific attitude and academic performance in science (r [342] = 0.80, $p < 0.05$). This suggests that fostering critical thinking skills in students is particularly crucial for enhancing their academic performance in science. While other attitudes also demonstrated positive and significant correlations with academic performance, skepticism exhibited the lowest Pearson's 'r' (r [342] = 0.56, $p < 0.05$). Despite this lower correlation, it is important to note that skepticism still played a role in influencing academic performance positively. These subtle variations underscore the multifaceted nature of scientific attitudes and highlight the need to incorporate a holistic approach to developing these

Table 2. Correlation of individual scientific attitudes with SAT

	Intellectual honesty	Curiosity	Objectivity	Skepticism	Creativity	Open-mindedness	Critical thinking
SAT	0.70	0.68	0.65	0.56	0.79	0.69	0.80

Table 3. Independent sample t-test of the independent variables in male and female participants

Levene's test for equality of variances			t-test for equality of means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Standard error difference
Scientific attitude	0.721	0.396	0.793	342	0.074	0.052	0.515

attitudes in students. The results are consistent with a growing body of research that emphasizes the role of scientific attitudes as a predictor of academic success in science. Romine and Sadler (2016) reported similar findings, demonstrating positive correlations between scientific attitudes and science grades, standardized test scores, and interest in science. Moreover, studies by Kristiani et al. (2015), and Rajendran and Anandarasu (2020), despite their diverse research designs, populations, and locations, have all affirmed the influential link between scientific attitudes and academic performance. In the Ghanaian context, a study by Opoku and Amankwah (2019) found a positive correlation between students' scientific attitudes and their academic achievement in science. Similarly, Asare and Mensah (2013) discovered that students' attitudes toward science significantly impacted their academic performance in science. These findings underscore the importance of considering local distinctions and educational contexts when examining the relationship between scientific attitudes and academic performance.

H_2. There Are No Significant Differences in the Levels of Scientific Attitudes in Boys and Girls

In **Table 3**, an independent sample t-test was performed to determine if there exist significant differences in the scientific attitude levels of students based on gender, the results revealed that there is no statistically significant difference in scientific attitudes between male and female students. The mean difference of 0.052 units, accompanied by a t-statistic of 0.793, resulted in a p-value (Sig. 2-tailed) of 0.074, which exceeds the conventional alpha level of 0.05. Consequently, the hypothesis asserting the absence of significant differences in scientific attitudes between boys and girls, is not rejected.

The above results affirm the findings from a study by Lavy and Schlosser (2011), which highlighted the relevance of gender-neutral instructional interventions, indicating that resources and strategies designed to improve metacognitive skills and scientific attitudes should be made universally accessible to both genders and that, gender should not be a determining factor in education. The results further suggest that educators and curriculum developers should design materials and implement pedagogical approaches that are effective for all students irrespective of gender (Hattie & Timperley, 2007).

CONCLUSIONS AND RECOMMENDATIONS

The study explored the predictive effects of scientific attitudes on gender-specific academic performance in science among a cohort of students in the Jirapa Municipality.

First and foremost, the study examined gender-based differences in academic performance. Contrary to some existing literature, the findings unambiguously demonstrated the existence of no significant disparities in the academic performance of boys and girls in science.

Secondly, the study probed deeper into scientific attitudes, illuminating their profound impact on academic performance. Scientific attitudes were found to be powerful predictors of students' performance in science. Furthermore, fostering critical thinking skills arose as particularly central, emphasizing the multilayered nature of scientific attitudes. These findings accentuate the importance of cultivating the ability to think critically in students to promote a holistic approach to science education.

Additionally, it was revealed that both genders exhibited equal levels of scientific attitudes. This equality suggests that both boys and girls are equally equipped with the necessary cognitive abilities and scientific attitudes needed for science learning, which translate into their performance in the subject.

From the results, the following recommendations are suggested as a beacon of guidance for stakeholders, educators, policymakers, and advocates, outlining a definitive path toward an equitable educational landscape. These include Instructional materials, such as textbooks, diagrammatic illustrations, and examples that are used in teaching and learning materials should characterize a diversity of genders and backgrounds. These representations foster a sense of belonging and participation in the classroom. Instructors and educational materials should evade using gendered language or reinforcing stereotypes related to specific genders. For instance, avoid phrases like "males are good at math" or "females are good at arts," which can reinforce harmful biases. Instead, focus on individual abilities and interests. Also, open discussions should be encouraged where all students, regardless of their gender, can comfortably articulate their thoughts and ideas. The classroom environment should be respectful, inclusive, and free from discrimination.

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Availability of data: All data generated or analyzed during this study are available for sharing upon request. Interested parties are encouraged to direct their inquiries to the corresponding author, who will facilitate the provision of the data in a timely and appropriate manner.

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