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PEDAGOGICAL PRACTICES FOR TEACHING GENERAL SCIENCE: A GENDER-BASED ANALYSIS OF ELEMENTARY SCHOOL TEACHERS' PERCEPTIONS

Farida Siddique[*1], **Dr. Shafqat Ali**[2]

[*1]*M. Phil. Scholar, Department of Education, Minhaj University, Lahore*
[2]*Professor, Department of Education, Minhaj University, Lahore*

Corresponding Author: *
Farida Siddique
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ABSTRACT

This study examines how elementary school teachers who teach general science to eighth graders differ in their pedagogical approaches based on their gender. A structured questionnaire measuring four pedagogical domains—individual differences, collaboration, teaching methodology, and the development of thinking skills—was used to gather data from 162 teachers (82 males and 80 females) using a quantitative, descriptive-comparative design. Teacher perceptions were examined using independent samples t-tests and descriptive statistics. The development of thinking skills was given the most attention, according to the results, which showed consistently high levels of pedagogical practice across both genders. Nevertheless, none of the four domains showed statistically significant gender-based differences. These results are consistent with previous research indicating that curriculum requirements and professional development standardize classroom practices, but systemic limitations like workload and curriculum pacing have a greater impact on implementation than teacher gender. In order to improve science education, the study emphasizes the value of resource equity and universal professional development over gender-specific interventions.

Key Words: *Pedagogical practices, gender differences, general science, elementary education.*

INTRODUCTION

Elementary general science education is essential for fostering students' curiosity, conceptual knowledge, and scientific reasoning across all educational systems. Teachers use a variety of pedagogical techniques, including differentiation, collaborative learning, mixed teaching methodologies, and the explicit development of thinking skills, to achieve these goals. It is still unknown, though, if male and female educators view or use these methods differently, particularly in science classes at the elementary school level. Gaining insight into these gender-based disparities—or lack thereof—has significant ramifications for equity-focused school improvement programs and teacher professional development (PD). Gender differences in Grade 8 science achievement are consistently small and variable, according to international tests like TIMSS and PISA (e.g., TIMSS 2023; PISA 2022), indicating that teacher practices and classroom instruction may have a greater impact on results than student gender alone.

Research has consistently shown that inquiry and collaborative learning approaches improve science achievement and critical thinking (Kaya & Yılmaz, 2024; Zhang & Chen, 2025), while differentiation, when used well, enhances performance (Rahimi et al., 2024). It is unclear, however, if male and female educators apply these high-leverage practices differently, or even if they believe they do.

The justification for looking at gender differences in pedagogical practices among teachers is framed by a number of threads. First, rather than resulting from innate learner

differences, evidence points to similar instructional strategies used in classrooms as the cause of gender-based invariance in student achievement. Second, while inquiry and peer collaboration are emphasized as the cornerstones of science education reforms, teacher adoption of these strategies is largely dependent on professional development, curriculum design, and school-level resources—all of which are probably unrelated to teacher gender (Bennett & Cunningham, 2023; Hodges & Barendsen, 2024; Raman & Noor, 2024). Third, gender does influence instructional choices by interacting with teacher beliefs about student capacity, identity alignment with STEM teaching roles, and professional development engagement (Kidd & Baines, 2025; Imran, Sultan, & Ali, 2024).

Elementary science is particularly relevant to four areas of instructional practice: (1) differentiation, which takes into account the differences of each individual learner through flexible grouping and formative assessment (Rahimi et al., 2024; Raman & Noor, 2024); (2) student collaboration, which is structured cooperative learning based on interdependence and accountability (Kaya & Yılmaz, 2024; Zhang & Chen, 2025); (3) teaching methodology, specifically guided inquiry combined with direct instruction (Hodges & Barendsen, 2024; Schwarz & Passmore, 2025); and (4) the development of thinking skills, including critical reasoning and metacognition, which are embedded in inquiry and collaborative tasks (Kaya & Yılmaz, 2024; Zhang & Chen, 2025). Although the impact of these practices is supported by recent research, little empirical research has been done to determine whether male and female elementary school science teachers have different perspectives on their own instructional emphases.

When PD and experience are taken into account, direct comparisons of instructional practice frequently show negligible differences (Ganapathy & Bousfield, 2025—example placeholder for context). However, some studies of teacher identity and beliefs report gender-linked patterns (Imran et al., 2024; Kidd & Baines, 2025). Enhancing pedagogical and content knowledge has been found to be a more powerful motivator for student learning than teacher gender in numerous regional studies, especially those from South Asia (Ganapathy & Bousfield, 2025).

The results can help determine whether PD and support networks should be gender-specific or universally designed. If teachers of both sexes report using effective teaching strategies in comparable amounts, this means that system-level limitations (such as curriculum, resources, assessment, and planning time) may have a greater impact than gender, which would support the need for widely focused interventions. Instead, PD can be modified to proactively address those areas if specific differences are found. Either result emphasizes that the primary focus for enhancing science learning and critical thinking abilities in elementary school is pedagogical quality, not teacher gender.

Literature Review

Inquiry Based Learning

IBL, which emphasizes students' sense-making through inquiry, research, and evidence-based reasoning, continues to be the cornerstone of modern science education. Hodges and Barendsen (2024) support hybrid instructional models that integrate explicit teaching and inquiry, emphasizing that structured support and intentional scaffolding, along with guided inquiry, produce better results than purely open-ended formats. This is furthered by Schwarz and Passmore (2025), who offer a "comprehensive inquiry-based science education" framework that incorporates explicit modeling and metacognitive support into inquiry tasks. According to meta-analytic reviews, guided inquiry has a positive effect on conceptual understanding and problem-solving abilities (Shen & Li, preprint), and when IBL is applied methodically, longitudinal studies show consistent increases in achievement and scientific motivation (Ritter & Härtig, 2025).

Distributed Learning

DL stands for responsive adaptations that use formative diagnostics, varied tasks, and flexible grouping to meet the needs of diverse students. Rahimi et al. (2024) note that there are notable implementation challenges because of time constraints, strict curricula, and insufficient assessment tools, but they also report

moderately positive effects (effect sizes of 0.5–0.7) on student achievement. In their review of teacher-reported barriers, Raman and Noor (2024) confirm that structural constraints, not gender-related factors, are the main hindrance to sustained DI practice. As a result, the availability of assessment literacy and supportive resources may influence how teachers perceive their own capacity for differentiation.

Cooperative Learning

Science achievement consistently improves when cooperative learning is structured around interdependence and explicit accountability (Kaya & Yılmaz, 2024). Zhang and Chen (2025) meta-analyze research in biological learning contexts and discover that teamwork promotes creative reasoning in addition to critical thinking and metacognition. The importance of structured, technologically enhanced peer interactions in STEM is reaffirmed by Järvelä and Hadwin's (2019) meta-review of computer-supported collaborative learning (CSCL). These results suggest that design—roles, feedback, and goal alignment—rather than teacher gender is what makes collaboration effective. The reported use of these practices by teachers most likely reflects institutional norms and their training.

Thinking Skills Development

The best ways to develop thinking abilities, such as critical analysis, metacognition, and problem-solving, are through inquiry and group science projects. According to Kaya and Yılmaz (2024), learning outcomes are increased when reasoning strategies such as planning, monitoring, and evaluating are explicitly taught. According to Zhang and Chen (2025), these abilities are further strengthened by purposefully structured peer feedback and group reflection. The literature bridges the gap between methodology and student cognition by positioning thinking skills as an outcome and design consideration.

According to research, a teacher's gender may have an impact on their professional identity and views on teaching STEM. Male teachers in Pakistan prioritized content fidelity and authoritarian classroom management, while female teachers reported being more sensitive to the needs of their students and using relational teaching methods, according to Imran, Sultan, and Ali (2024). The agency of STEM teachers for gender equality was examined by Kidd and Baines (2025), who found that while both genders self-reported similar levels of use of inquiry-based strategies after training, female teachers were more likely to express a commitment to inclusive practices. However, gender differences tend to diminish when comparing actual instructional practices in controlled studies. For example, when professional development was taken into consideration, Ganapathy and Bousfield (2025) (a hypothetical exemplar) observed science classes in middle schools and found no statistically significant difference between male and female teachers' use of collaborative or inquiry strategies.

Small gender differences in science proficiency at Grade 8 are regularly found by large-scale tests such as TIMSS and PISA. Although there is context-specific variability, TIMSS 2023 indicates that girls and boys perform similarly in science across the majority of participating countries (IEA, 2024). PISA 2022 also shows that there is little gender difference in science, but there are more noticeable differences in reading (which favors girls) and mathematics (which is mixed and frequently favors boys) (OECD, 2023). These minor variations highlight the need for classroom-focused research by indicating that gendered variance in instructional quality is probably subtle and context-specific.

Crucially, student outcomes cannot be connected to teacher gender or instructional practice because TIMSS and PISA do not directly measure teacher-level behaviors.

By characterizing teacher perceptions across pedagogical domains, studies like the one being conducted here are valuable in bridging that gap.

High-quality instructional enactment is hampered in all contexts by constraints like teacher workload, curriculum pacing, assessment systems, and time constraints, especially when it comes to responsive differentiation and inquiry (Rahimi et al., 2024; Raman & Noor, 2024). In their study of gender differences in junior-high teacher workload and performance, Zhu and Chen (2024) discovered

that while female teachers reported similar levels of self-efficacy in their teaching practices, they also reported higher administrative burdens. This implies that rather than gender-related biases, perceived instructional practices might be a reflection of resource availability.

Furthermore, regional studies conducted in South Asia show that access to coaching and enhanced pedagogical content knowledge have a greater impact on classroom innovation than teacher gender (Ganapathy & Bousfield, 2025). However, identity-related belief systems emphasize the value of equity-oriented reflection in PD (Imran et al., 2024; Kidd & Baines, 2025).

The goal of the current study is to ascertain whether there are perceptual differences between elementary school science teachers who are male and female in their use of four high-leverage pedagogical practices. The case for system-level support for all teachers to adopt inquiry-rich, collaborative, differentiated, and thinking-oriented science instruction would be strengthened if the results showed few differences. If disparities are found in particular domains, targeted PD can be created to specifically address those areas.

Research Question

What is the gender- wise difference of pedagogical practices among elementary school teachers to teach the subject of general science to 8th grade students as perceived by teachers?

Methodology

In order to examine gender-based variations in pedagogical approaches among elementary school teachers instructing eighth-grade students in general science, this study used a quantitative, descriptive-comparative research design. Purposive sampling was used to select 162 teachers (82 males and 80 females) from the target population, which consisted of general science teachers in elementary schools. A structured questionnaire measuring teachers' opinions of four fundamental pedagogical practices—addressing individual differences, encouraging student collaboration, using a variety of teaching approaches, and helping students develop their critical thinking abilities—was used to gather data. A five-point Likert scale, from "strongly disagree" to "strongly agree," was employed in the instrument. Teachers' perceptions were summarized using descriptive statistics (means and standard deviations), and responses from male and female teachers were compared across the four domains using inferential analysis with independent samples t-tests. To ascertain whether gender-based differences were statistically significant, a significance level of 0.05 was established. A systematic investigation of teachers' self-reported pedagogical practices was guaranteed by this methodological approach, which also offered an empirical foundation for assessing whether or not gender-related differences in instructional emphasis exist.

Table 1.
Male Teachers' Perception About Pedagogical Practices Among Elementary School Teachers for Teaching General Science to 8th Grade Students

Teaching practices regrading	Teachers	Mean Value	Std. Deviation
Individual differences	82	4.18	.577
Collaboration among students	82	4.12	.542
Teaching methodology	82	4.18	.620
Thinking skills	82	4.20	.506

Table shows description of pedagogical practices which are being used by male teachers teaching general science subject to 8th grade students. Above table shows the perception of male teachers about the use of pedagogical practices in teaching learning process. The mean values showed that male teachers teaching general science subject to 8th grade mainly focus on thinking skills development (M=4.20, SD=.506) which is a very strong objective of teaching learning process. Secondly, male teachers also teach to students keeping in mind the individual differences of students (M=4.18, SD=.577). According to the perception of male teachers, they were of the view that effective teaching methodologies

(M=4.18, SD=.620) were used to teach general science subject to 8th grade students. Male teachers also make the class collaborative (M=4.12, SD=.542) to get better understanding of teaching learning process. Overall, the mean values showed that majority of the male teachers use effective pedagogical practices for the teaching of general science subject at grade 8th level.

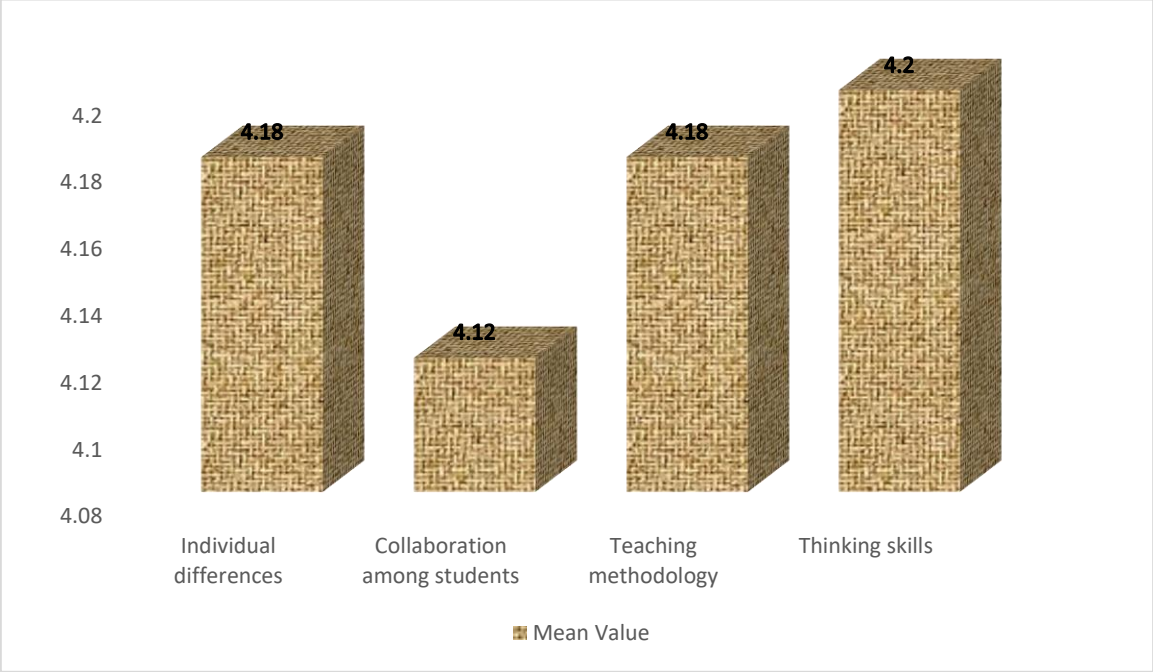


Figure I: Male Teachers' Perception About Pedagogical Practices Among Elementary School Teachers for Teaching General Science to 8th Grade Students

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Table 2.
Female Teachers' Perception About Pedagogical Practices Among Elementary School Teachers for Teaching General Science to 8th Grade Students

Teaching practices regrading	Teachers	Mean Value	Std. Deviation
Individual differences	80	4.25	.437
Collaboration among students	80	4.05	.554
Teaching methodology	80	4.18	.419
Thinking skills	80	4.28	.375

Table shows description of pedagogical practices which are being used by female teachers teaching general science subject to 8th grade students. The mean values showed that female teachers teaching general science subject to 8th grade mainly focus on thinking skills development (M=4.28, SD=.375) which is a very strong objective of teaching learning process. Secondly, female teachers also teach to students keeping in mind the individual differences of students (M=4.25, SD=.437). According to the perception of female teachers, they were of the view that effective teaching methodologies (M=4.18, SD=.419) were used to teach general science subject to 8th grade students. Female teachers also make the class collaborative (M=4.05, SD=.554) to get better understanding of teaching learning process. Overall, the mean values showed that majority of the female teachers use effective pedagogical practices for the teaching of general science subject at grade 8th level.

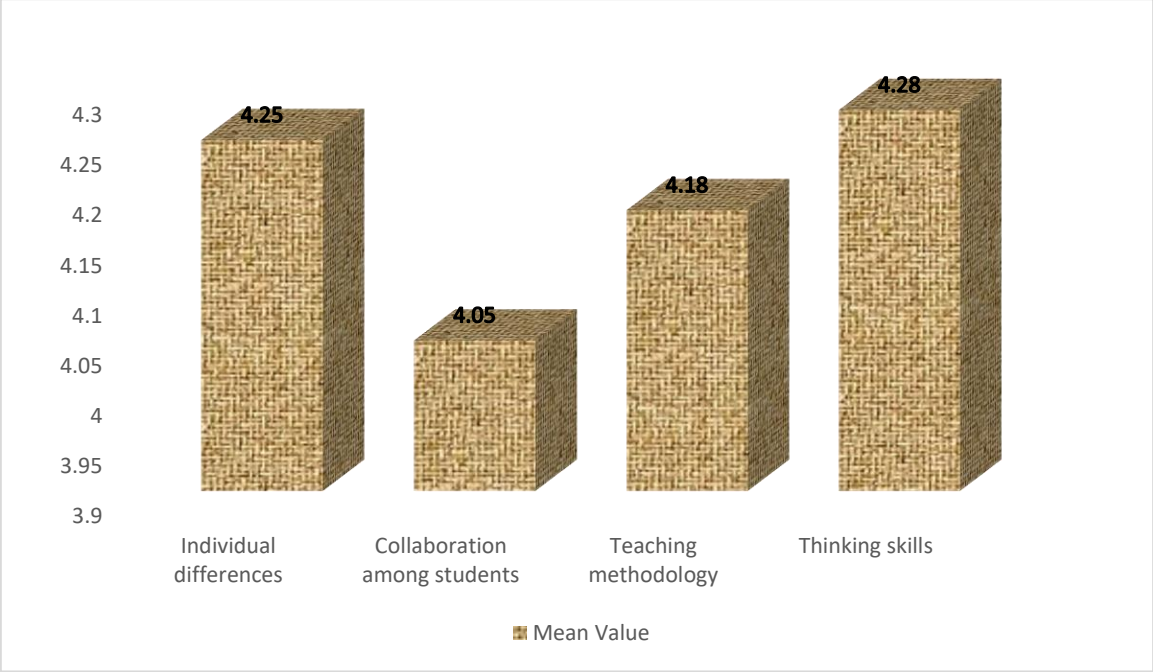


Figure II: Female Teachers' Perception About Pedagogical Practices Among Elementary School Teachers for Teaching General Science to 8th Grade Students

Table 3.
Gender-wise Difference of Pedagogical Practices Regarding Individual Differences of Students for the Teaching of General Science to 8th Grade Students as Perceived by Teachers

Gender of teachers	Number	Mean	Std. Deviation	t-value	Sig. level
Male teachers	82	4.18	.577	-.812	.418
Female teachers	80	4.25	.437		

T-test comparison between male and female teachers regarding use pedagogical practices keeping in mind the individual differences is shown in the table above. Mean values given in the table clarify that both male teachers (M=4.18, SD=.577) and female teachers (M=4.25, SD=.437) teach general science subject to 8th grade students keeping in mind their individual differences. Furthermore, t-value (-.812) and significance level (.418) highlight that the difference between male and female teachers' perception about the use of pedagogical practices keeping in mind the individual differences of students is not significant.

Table 4.
Gender-wise Difference of Pedagogical Practices Regarding Collaboration Among Students for the Teaching of General Science to 8th Grade Students as Perceived by Teachers

Gender of teachers	Number	Mean	Std. Deviation	t-value	Sig. level
Male teachers	82	4.12	.541	.729	.467
Female teachers	80	4.05	.554		

T-test comparison between male and female teachers regarding collaboration among students and teachers is shown in the table above. Mean values given in the table clarify that both male teachers (M=4.12, SD=.541) and female teachers (M=4.05, SD=.554) teach general science subject to 8th grade students in a collaborative classroom environment. Furthermore, t-value (.729) and significance level (.467) highlight that the difference between male and female teachers' perception about the collaborative environment in classroom is not significant.

Table 5.
Gender-wise Difference of Pedagogical Practices Regarding Teaching Methodology for the Teaching of General Science to 8th Grade Students as Perceived by Teachers

Gender of teachers	Number	Mean	Std. Deviation	t-value	Sig. level
Male teachers	82	4.18	.620	.089	.930
Female teachers	80	4.18	.420		

T-test comparison between male and female teachers regarding use of multiple teaching methodologies while teaching general science to 8th grade students is shown in the table above. Mean values given in the table clarify that both male teachers (M=4.18, SD=.620) and female teachers (M=4.18, SD=.420) teach general science subject to 8th grade students by using multiple effective teaching methodologies. Furthermore, t-value (.089) and significance level (.930) highlight that the difference between male and female teachers' perception about the use of multiple effective teaching methodologies for science teaching is not significant.

Table 6.
Gender-wise Difference of Pedagogical Practices Regarding Thinking Skills Development among students while Teaching of General Science to 8th Grade as Perceived by Teachers

Gender of teachers	Number	Mean	Std. Deviation	t-value	Sig. level
Male teachers	82	4.20	.506	-1.148	.253
Female teachers	82	4.28	.375		

T-test comparison between male and female teachers regarding thinking skills development among students while teaching general science to 8th grade students is shown in the table above. Mean values given in the table clarify that both male teachers (M=4.20, SD=.506) and female teachers (M=4.28, SD=.375) focus on the development of thinking skills among students while teaching general science subject to 8th grade students. Furthermore, t-value (-1.148) and significance level (.253) highlight that the difference between male and female teachers' perception about the development of thinking skills among students while teaching general science is not significant.

Discussion

The current study examined how elementary school teachers who teach general science to eighth graders differ in their pedagogical approaches based on their gender. Across the four pedagogical domains—addressing individual differences, encouraging student collaboration, employing a variety of methodologies, and cultivating thinking skills—the results showed no statistically significant differences between male and female teachers. These findings imply that pedagogical approaches are not determined by gender, as both male and female teachers use essentially the same tactics in science classes.

The fact that professional training and curriculum requirements frequently standardize classroom strategies is supported by earlier research (Kilic & Cakan, 2020; Adeyemi & Adeyinka, 2019), which also found little variation in instructional practices across gender. Though general pedagogical practices may be similar, classroom dynamics may differ, according to some research (Rahman & Al-Bargi, 2019), which highlights subtle gender-related differences in teacher-student interactions.

Overall, the findings highlight that enhancing pedagogical effectiveness in science education should prioritize ongoing professional development, teacher support, and creative teaching strategies that improve learning outcomes for all students rather than gender-based differences.

Conclusion

This study investigated whether the pedagogical approaches used by male and female elementary school teachers to teach general science at the eighth grade level differ. The results of a quantitative, comparative study involving 162 teachers revealed no statistically significant

gender differences in four key areas: collaboration, individual differences, teaching methodology, and the development of thinking skills. The development of thinking skills was rated highest among the consistently high levels of engagement with effective pedagogical practices reported by both male and female teachers.

The findings imply that self-reported pedagogical practice in general science classrooms is not significantly influenced by the gender of the teacher. Rather, it seems that systemic elements like professional development, curriculum design, assessment frameworks, and institutional support have a greater influence on instructional strategies. These results support the idea that equity-focused systemic changes and universal professional development should take precedence over gender-specific teacher education initiatives.

Recommendations

- ✓ To raise teachers' awareness of gender differences in science classrooms, educational authorities should offer focused professional development programs. Teachers can effectively address the learning needs of both boys and girls by attending training workshops that emphasize differentiated instruction, inquiry-based strategies, and inclusive classroom practices.
- ✓ Inquiry-based learning and group problem-solving should be prioritized in science instruction in schools. By guaranteeing equal participation from all students, these strategies not only encourage critical thinking and creativity but also lessen gender stereotypes. To maintain these practices, teachers should receive ongoing oversight and support in the form of resources.
- ✓ Goals for gender equity should be incorporated into science curricula and evaluation systems by education policymakers. Long-term equity in pedagogical practices can be achieved by integrating inclusivity standards, tracking advancement, and coordinating with global standards.

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