Science Teaching Practices at Secondary Level: Cross Comparison of Public and Private Sector Teachers

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Abstract

The main purpose of the study was to learn about science education practices in both public and private schools and identify effective teaching practices in both sectors. To fulfil this purpose, a comparison between public teachers with private teachers and public students with private students was made. For this purpose, a random sample of 300 secondary school students and 80 teachers were selected to collect data. The selected teachers and students were given two rating scales as instruments to learn how to utilize teaching practices. The data were analyzed through the Statistical Package for Social Sciences (SPSS). To examine the gathered information, descriptive data analysis statistics and inferential statistics were used to diagnose the practices. Data analysis highlighted that male secondary school teachers in public and private schools needed to be successfully teaching science. The results led to the recommendation that all the teachers, particularly those employed by private institutions, should undergo refresher courses for effective science teaching practices training.

Keywords: Science Teaching Practices, Secondary Level, Public Schools, Private Schools.

Introduction

Science teaching practices in schools encompass a range of strategies aimed at fostering effective science education. These practices use inquiry-based learning, practical experiments, and interactive techniques to get students interested in investigating scientific ideas. To make science interesting and relevant, educators frequently incorporate technology, collaborative activities, and real-world applications. Science teaching strategies place a strong emphasis on problem-solving, critical thinking, and real-world application to foster students' scientific literacy and interest. Assessment techniques might involve summative and formative assessments, which promote ongoing learning. In general, modern science teaching strategies are dynamic and focused on the needs of the students, encouraging a greater comprehension and respect for the scientific method. Globally, the current focus of science education for the new millennium is on producing scientifically literate persons among all students (Lynch, 2010). Lea et al. (2003) contend that judgments made by instructors on (1) what children should learn and (2) how they should learn centre around their interactions with students in the classroom. This is especially true for scientific education in the elementary sector. As a result, to teach science in a way that engages children, teachers must have support (Abualhaija, 2019). If the opinions of the pupils regarding the

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instruction have not been considered, this support can be lacking. There are numerous reasons to consider students' opinions carefully while organizing courses and creating professional development opportunities.

The optimal methods for student assessment have also been examined via the prism of Danielson's instructional model. Formative assessment, often known as "assessment for learning," has grown to be a crucial component of education and classroom procedures. This illustrates how the instructor is keeping an eye on the comprehension of the class and how learning is occurring. Assessing if students require further assistance to understand important material and whether feedback is provided in a timely, constructive, and targeted manner are of greater importance. Throughout this process, students are also held accountable for keeping an eye on their education and acting appropriately. Naturally, this is only feasible if the instructor has already given the pupils the knowledge and abilities to assess their work against clear standards (Henze et al., 2008). Positive classroom dynamics will result from students and teachers having effective communication abilities as well as between students. This will have a favourable impact on student achievement. Most teachers who are loved and respected by their students are viewed as leaders (Bosch, 2006). One of the most useful tools for classroom management is a set of guidelines for potential disciplinary issues (Shin & Koh, 2007). The course and behavioural guidelines will avoid future disciplinary issues. If not, there is a greater chance that disciplinary issues may arise, which disrupt the teaching process. The most important thing is how well that time is spent teaching, not how much time is spent on it.

There are various reasons why researching "Science teaching practices at secondary level: cross comparison of public and private sector teachers" is essential. To inform policy decisions and educational reforms, it first identifies the variations in teaching approaches, resources, and educational outcomes between public and private schools. The study can contribute to closing the quality gap and guaranteeing that all children receive an equal education in science by revealing areas that require improvement and best practices. Furthermore, by customizing training programs to meet the unique needs of instructors in each area, an awareness of these distinctions promotes professional development. By presenting data-driven insights into how institutional circumstances affect teaching effectiveness and student engagement in science, the study also adds to the larger conversation about education. In the end, this study backs up the objective of improving secondary students' science literacy, critical thinking, and problem-solving abilities to better equip them for future academic and professional endeavours in a society that is becoming more and more focused on science.

Objective of the Study

1. To diagnose the science teaching practices used by public and private school science teachers at the secondary level.

Literature Review

Depending on the various instructional domains, important elements can be highlighted. For example, elementary school teachers emphasize flexibility in seating arrangements (Klassen & Chiu, 2010), whereas preschool teachers emphasize keeping children quiet and orderly (Levine, 2009). The primary goal of the project is to create a legitimate and trustworthy data-gathering instrument to find out how science instructors feel about classroom management. Finding out how gender, teaching experience, and graduating fields affect science instructors' opinions on classroom management is another goal of the research.

According to a different study, having collaboration skills might help students become more effective learners by teaching them how to organize, make decisions as a group, create objectives, manage time, accept roles, and foster a healthy work atmosphere (Mackenzie & Stanzione, 2010). Context, material, teachers, and students are the challenges that come with teaching students how to collaborate in a classroom (Pang et al., 2018). Collaboration skills are more than just a way to assess or develop information acquired via practice and learning. To foster collaborative learning among students, a model of instruction that encourages interaction, cooperative problem-solving, sharing, and shared accountability is required.

It is reasonable to expect teachers to actively try to align their instructional and managerial approaches despite educators' worries about a possible mismatch between management and instruction. Educators who adhere to a student-centred approach to learning probably make judgments regarding their lessons based on a foundational understanding of how kids learn and what they require in the classroom. It makes sense to assume, for instance, that teachers who hold the belief that children must actively participate in the learning process, exercise critical thinking, and solve problems will select classroom management techniques like peer mediation and conflict resolution that support these abilities (O'Connor et al., 2011).

Noell et al. (2000) popularized the idea of reflection in professional practices several decades ago. Acosta et al. (2019) writings serve as the foundation for much of what teacher education refers to as a reflective approach, which has also been influenced by the venerable writings of Tolstoy, Vygotsky, Piaget, and Wittgenstein, among others.

The choice to incorporate reflection into science classes needs careful consideration and planning of time. The first thing you need to do is choose the reflection technique. Students may be required to keep a diary throughout a project or other extended engagement in which they are to document their ideas, feelings, observations, questions, and actions. A team diary can be used for projects that call for a collaborative approach to guarantee communication within the group. To promote critical thinking and reflection on their project, students can participate in class discussions or be given a paper to write based on their journals. The approach or approaches chosen must be predicated on the project objectives, which are specified early in the planning phase (Gest, 2014).

According to previous literature, different studies have been reported. In a recent study, systematic review have been done regarding gamification in science education (Kalogiannakis et al., 2021). In the same way, another study by Sahin and Yilmaz (2020) analyzes the effect of augmented reality technology on students' achievement at the middle school level, as well as their attitude toward science education. In another recent study, Cooper (2023) examined science education in chatGPT regarding generative artificial intelligence. The technological impact has been assessed by Yılmaz (2021) regarding prospective teachers' perspective concerning twenty-first-century skills and academic achievement. In another study, the relationship between science process skills and the critical thinking of students in physics subjects has been explored (Kurniawan et al., 2020).

In the Pakistani context, different studies have been conducted related to the current topic. Two different studies, secondary school science teachers' practices have been observed related to the development of critical thinking skills (Jamil & Muhammad, 2019a); Jamil et al. (2021b). Teachers' perceptions and practices have been explored in another study by (Jamil et al., 2021a). In another study by Jamil et al. (2020), science curriculum documents have been analyzed regarding critical thinking as critical thinking is a buzzword today and focuses on the students for the twenty-first-century skills that are also focused on in different textbooks for development (Jamil, Bokhari, & Ahmad, 2024; Jamil, 2024; Shahzadi, 2024). Physics, Chemistry, Biology, and mathematics curricula have also focused on this aspect while teaching these science subjects

(Jamil, Bokhari et al., 2024; Jamil, Bokhari et al., 2024; Jamil, Bokhari et al., 2024; Jamil, Hafeez, et al., 2024).

Methodology

The research employed a quantitative methodology involving a random selection of 80 teachers and 300 students through stratified random sampling. Survey research is a prevalent approach in educational studies to collect data systematically from a sample to identify trends and patterns (Creswell & Creswell, 2017). A self-developed questionnaire, keeping in view the objectives of the study and previous literature, was administered to assess participants' perceptions. The instrument's predefined criteria enabled consistent opinions on teaching practices. The study adopted a descriptive statistical approach for analysis, providing a comprehensive overview of the collected data with mean and SD for the participants. This methodology facilitated insights into the participants' views on various aspects of science teaching practices, emphasizing objectivity and statistical rigour in interpreting the findings.

Data Analysis

Table 1: Secondary public and private schools teachers' views on instructional strategies used in Science classes

Science Teaching Practices	**Teachers in Public Schools =44**		**Teachers in Private Schools =36**	
	Mean	SD	Mean	SD
Classroom management activities	4.101	.431	4.198	.401
Collaboration among students	4.104	.429	4.332	.391
Students centered learning	4.211	.399	4.301	.371
Students' self-reflection in learning	3.891	.391	4.256	.300
Students' behavior management in the classroom	3.919	.400	4.411	.319
Students' assessment process	4.346	.399	4.201	.318
Total	**4.201**	**.399**	**4.311**	**.329**

Both public and private school teachers exhibit positive perceptions towards science teaching practices, with the total mean for public school teachers being 4.201 (SD = 0.399) and for private school teachers being 4.311 (SD = 0.329). Among the specific categories, collaboration among students has the highest mean for both public (4.104) and private (4.332) school teachers. Students' assessment processes also receive high mean values for both groups. However, notable differences are observed in certain categories. Private school teachers show higher mean values in classroom management activities, students' self-reflection in learning, and students' behavior management in the classroom. On the other hand, public school teachers have a higher mean in the students' assessment process.

Both public and private school teachers generally perceive science teaching practices positively, but variations exist in specific categories, suggesting potential areas for improvement or sharing of best practices between the two sectors.

Table 2: Secondary male public and private schools teachers' views on instructional strategies used in Science classes

Science Teaching Practices	Teachers in Public Schools =44		Teachers in Private Schools =36	
	Mean	SD	Mean	SD
Classroom management activities	4.031	.323	4.231	.399
Collaboration among students	3.989	.397	4.345	.402
Students centered learning	4.011	.400	4.452	.378
Students' self-reflection in learning	3.939	.387	4.345	.389
Students' behavior management in the classroom	3.888	.411	4.389	.392
Students' assessment process	4.120	.401	4.481	.369
Total	**4.212**	**.399**	**4.243**	**.339**

The mean values and standard deviations (SD) are presented for various categories of science teaching practices. Both public and private male teachers exhibit positive perceptions towards science teaching practices, with the total mean for public school teachers being 4.212 (SD = 0.399) and for private school teachers being 4.243 (SD = 0.339). Among the specific categories, collaboration among students has the highest mean for both public (3.989) and private (4.345) male teachers, showcasing a focus on interactive learning approaches. Students' self-reflection in learning and students' assessment process also receive relatively high mean values for both groups. Noteworthy differences include private male teachers showing higher mean values in classroom management activities, students' centered learning, and students' behavior management in the classroom. In contrast, public male teachers exhibit a higher mean in the students' assessment process. In summary, both public and private male school teachers generally perceive science teaching practices positively, with variations in specific categories indicating potential areas for further investigation or collaboration in enhancing teaching methodologies.

Table 3: Secondary female public and private schools teachers' views on instructional strategies used in Science classes

Science Teaching Practices	Teachers in Public Schools =44		Teachers in Private Schools =36	
	Mean	SD	Mean	SD
Classroom management activities	4.213	.356	4.342	.432
Collaboration among students	4.001	.388	4.212	.421
Students centered learning	4.112	.410	4.342	.376
Students' self-reflection in learning	3.872	.390	4.441	.399
Students' behavior management in the classroom	3.891	.388	4.310	.378
Students' assessment process	4.111	.398	4.398	.388
Total	**4.303**	**.401**	**4.320**	**.412**

Mean values and standard deviations (SD) are reported for various categories of science teaching practices. Both public and private female teachers exhibit positive perceptions towards science

teaching practices, with the total mean for public school teachers at 4.303 (SD = 0.401) and for private school teachers at 4.320 (SD = 0.412). Collaboration among students stands out as the highest-rated category for both public (4.001) and private (4.212) female teachers, emphasizing a shared emphasis on interactive learning. Notable differences include private female teachers reporting higher mean values in classroom management activities, students' self-reflection in learning, and students' behavior management, while public female teachers exhibit a higher mean in the students' assessment process. In summary, both public and private female school teachers generally perceive science teaching practices positively, with variations in specific categories suggesting potential areas for collaboration and improvement in science education.

Table 4: Secondary urban public and private schools teachers' views on instructional strategies used in Science classes

Science Teaching Practices	**Teachers in Public schools =44**		**Teachers in Private Schools =36**	
	Mean	SD	Mean	SD
Classroom management activities	4.323	.382	4.467	.421
Collaboration among students	4.221	.379	4.490	.404
Students centered learning	4.102	.406	4.401	.392
Students' self-reflection in learning	3.885	.380	4.291	.386
Students' behavior management in the classroom	3.879	.392	4.201	.393
Students' assessment process	4.101	.400	4.337	.391
Total	**4.011**	**.422**	**4.422**	**.433**

The mean values and standard deviations (SD) are presented for various categories of science teaching practices. Both public and private urban teachers generally express positive perceptions toward science teaching practices, with the total mean for public school teachers at 4.011 (SD = 0.422) and for private school teachers at 4.422 (SD = 0.433). Collaboration among students emerges as the highest-rated category for both public (4.221) and private (4.490) urban teachers, indicating a shared emphasis on interactive learning.

Noteworthy differences include private urban teachers reporting higher mean values in classroom management activities, students' centered learning, students' self-reflection in learning, and students' behavior management. Public urban teachers, on the other hand, exhibit a higher mean in the students' assessment process. In conclusion, while both public and private urban school teachers generally perceive science teaching practices positively, variations in specific categories suggest potential areas for collaboration and improvement in science education, particularly in urban settings.

Table 5: Secondary rural public and private schools teachers' views on instructional strategies used in Science classes

Science Teaching Practices	Teachers in Public Schools =44		Teachers in Private Schools =36	
	Mean	SD	Mean	SD
Classroom management activities	4.202	.434	4.223	.422
Collaboration among students	4.131	.482	4.432	.399
Students centered learning	4.198	.387	4.298	.381
Students' self-reflection in learning	3.691	.425	4.310	.387
Students' behavior management in the classroom	3.792	.421	4.091	.339
Students' assessment process	4.291	.372	4.289	.388
Total	**4.233**	**.323**	**4.398**	**.376**

The mean values indicate the average responses on a scale, with higher values suggesting more positive perceptions. In terms of classroom management activities, both public (4.202) and private (4.223) school teachers expressed high satisfaction, showcasing effective control of the learning environment. Collaboration among students received positive ratings, with private school teachers (4.432) showing slightly higher satisfaction than their public counterparts (4.131). Student-centered learning was well-received by both groups, with mean values of 4.198 (public) and 4.298 (private).

Private school teachers reported higher satisfaction in students' self-reflection (4.310) compared to public school teachers (3.691). Similarly, private school teachers demonstrated greater contentment with students' behavior management (4.091) compared to public school teachers (3.792). However, both groups showed comparable satisfaction in the students' assessment process, with mean values of 4.291 (public) and 4.289 (private). Overall, the total mean values were 4.233 for public school teachers and 4.398 for private school teachers, suggesting a generally positive perception of science teaching practices in both settings.

Table 6: Secondary public and private schools students' views of the methods used in Science classroom instruction

Science Teaching Practices	Students in Public Schools =191		Students in Private Schools =109	
	Mean	SD	Mean	SD
Classroom management activities	4.122	.467	4.188	.431
Collaboration among students	4.114	.321	4.342	.431
Students centered learning	4.231	.329	4.321	.371
Students' self-reflection in learning	3.791	.328	4.266	.300
Students' behavior management in the classroom	3.819	.368	4.431	.319
Students' assessment process	4.246	.371	4.261	.318
Total	**4.221**	**.328**	**4.291**	**.376**

Table 6 outlines the perceptions of secondary school students, both from public and private schools. The mean values reflect the average responses on a scale, where higher values indicate more positive perceptions. In terms of classroom management activities, students from private schools (4.188) reported slightly higher satisfaction than their public school counterparts (4.122). Collaboration among students received higher ratings from private school students (4.342) compared to public school students (4.114). Student-centered learning was well-received by both groups, with mean values of 4.231 (public) and 4.321 (private).

Private school students expressed higher satisfaction in students' self-reflection (4.266) compared to public school students (3.791). Similarly, private school students reported higher mean values in students' behavior management (4.431) than public school students (3.819). However, both groups showed comparable satisfaction in the students' assessment process, with mean values of 4.246 (public) and 4.261 (private). Overall, the total mean values were 4.221 for public school students and 4.291 for private school students, indicating generally positive perceptions of science teaching practices among students in both settings, with a slightly higher overall satisfaction reported by private school students.

Table 7: Secondary male public and private schools students' views of the methods used in Science classroom instruction

Science Teaching Practices	**Students in Public Schools =191**		**Students in Private Schools =109**	
	Mean	SD	Mean	SD
Classroom management activities	4.011	.389	4.345	.387
Collaboration among students	3.877	.392	4.389	.411
Students centered learning	4.231	.369	4.452	.401
Students' self-reflection in learning	3.939	.387	4.345	.389
Students' behavior management in the classroom	3.888	.411	4.389	.392
Students' assessment process	4.120	.401	4.481	.369
Total	**4.212**	**.367**	**4.331**	**.401**

Table 7 presents the perceptions of male secondary school students, both from public and private schools, regarding teaching practices in science subjects. The mean values represent the average responses on a scale, with higher values indicating more positive perceptions. In terms of classroom management activities, private school male students (4.345) reported higher satisfaction compared to their public school counterparts (4.011). Collaboration among students received higher ratings from private school male students (4.389) than public school male students (3.877). Student-centered learning was well-received by both groups, with mean values of 4.231 (public) and 4.452 (private), showing slightly higher satisfaction among private school male students.

Private school male students also expressed higher satisfaction in students' self-reflection (4.345) compared to public school male students (3.939). Similarly, private school male students reported higher mean values in students' behavior management (4.389) than public school male students (3.888). In the students' assessment process, private school male students (4.481) showed higher satisfaction than their public school counterparts (4.120). Overall, the total mean values were 4.212 for public school male students and 4.331 for private school male students, indicating generally positive perceptions of science teaching practices among male students in both settings, with a slightly higher overall satisfaction reported by private school male students.

Table 8: Secondary female public and private school students' views of the methods used in Science classroom instruction

Science Teaching Practices	Students in Public Schools =191		Students in Private Schools =109	
	Mean	SD	Mean	SD
Classroom management activities	4.213	.356	4.342	.432
Collaboration among students	4.001	.388	4.212	.421
Students centered learning	4.112	.399	4.342	.376
Students' self-reflection in learning	3.872	.378	4.441	.399
Students' behavior management in the classroom	3.891	.388	4.310	.378
Students' assessment process	4.111	.376	4.398	.388
Total	**4.303**	**.387**	**4.424**	**.432**

Table 8 outlines the perceptions of female secondary school students, both from public and private schools, regarding teaching practices in science subjects. The mean values represent the average responses on a scale, with higher values indicating more positive perceptions. In terms of classroom management activities, private school female students (4.342) reported slightly higher satisfaction compared to their public school counterparts (4.213). Collaboration among students received higher ratings from private school female students (4.212) than public school female students (4.001). Student-centered learning was well-received by both groups, with mean values of 4.112 (public) and 4.342 (private), showing slightly higher satisfaction among private school female students.

Private school female students also expressed higher satisfaction in students' self-reflection (4.441) compared to public school female students (3.872). Similarly, private school female students reported higher mean values in students' behavior management (4.310) than public school female students (3.891). In the students' assessment process, private school female students (4.398) showed higher satisfaction than their public school counterparts (4.111). Overall, the total mean values were 4.303 for public school female students and 4.424 for private school female students, indicating generally positive perceptions of science teaching practices among female students in both settings, with a slightly higher overall satisfaction reported by private school female students.

Table 9: Secondary urban public and private schools students' views of the methods used in Science classroom instruction

Science Teaching Practices	Students in Public Schools =191		Students in Private Schools =109	
	Mean	SD	Mean	SD
Classroom management activities	4.323	.382	4.467	.421
Collaboration among students	4.221	.379	4.490	.404
Students centered learning	4.102	.406	4.401	.379
Students' self-reflection in learning	3.885	.380	4.291	.406
Students' behavior management in the classroom	3.879	.404	4.201	.369
Students' assessment process	4.101	.392	4.337	.331
Total	**4.011**	**.411**	**4.422**	**.393**

Table 9 presents the perceptions of urban secondary school students, both from public and private schools, regarding teaching practices in science subjects. The mean values represent the average responses on a scale, where higher values indicate more positive perceptions. In terms of classroom management activities, private school urban students (4.467) reported higher satisfaction compared to their public school counterparts (4.323). Collaboration among students received higher ratings from private school urban students (4.490) than from public school urban students (4.221). Student-centered learning was well-received by both groups, with mean values of 4.102 (public) and 4.401 (private), showing slightly higher satisfaction among private school urban students.

Private school urban students also expressed higher satisfaction in students' self-reflection (4.291) compared to public school urban students (3.885). Similarly, private school urban students reported higher mean values in students' behavior management (4.201) than public school urban students (3.879). In the students' assessment process, private school urban students (4.337) showed higher satisfaction than their public school counterparts (4.101). Overall, the total mean values were 4.011 for public school urban students and 4.422 for private school urban students, indicating generally positive perceptions of science teaching practices among urban students in both settings, with a significantly higher overall satisfaction reported by private school urban students.

Table 10: Secondary rural public and private schools students' views of the methods used in Science classroom instruction

Science Teaching Practices	**Students in Public Schools =191**		**Students in Private Schools =109**	
	Mean	SD	Mean	SD
Classroom management activities	4.202	.434	4.223	.422
Collaboration among students	4.131	.482	4.432	.399
Students centered learning	4.198	.334	4.298	.381
Students' self-reflection in learning	3.691	.374	4.310	.434
Students' behavior management in the classroom	3.792	.422	4.091	.482
Students' assessment process	4.291	.388	4.289	.387
Total	**4.233**	**.387**	**4.410**	**.390**

Table 10 presents the perceptions of rural secondary school students, both from public and private schools, regarding teaching practices in science subjects. The mean values represent the average responses on a scale, where higher values indicate more positive perceptions. In terms of classroom management activities, private school rural students (4.223) reported similar satisfaction to their public school counterparts (4.202). Collaboration among students received higher ratings from private school rural students (4.432) than from public school rural students (4.131). Student-centred learning was well-received by both groups, with mean values of 4.198 (public) and 4.298 (private), showing comparable satisfaction among public and private school rural students.

Private school rural students expressed higher satisfaction in students' self-reflection (4.310) compared to public school rural students (3.691). Similarly, private school rural students reported higher mean values in students' behaviour management (4.091) than public school rural students (3.792). In the students' assessment process, both groups showed similar satisfaction, with mean values of 4.291 (public) and 4.289 (private). Overall, the total mean values were 4.233 for public school rural students and 4.410 for private school rural students, indicating generally positive

perceptions of science teaching practices among rural students in both settings, with a slightly higher overall satisfaction reported by private school rural students.

Key Findings

- Science teaching methods are usually seen favourably by educators in both public and private schools, as evidenced by most students.
- This category regularly receives the highest ratings from all groups, suggesting that interactive learning is highly valued.
- Compared to their public school counterparts, teachers and students at private schools typically report slightly higher mean values in most categories. This suggests that private school instructional practices are more highly regarded.
- Generally, both teachers and students at private schools—especially those in urban and rural areas—rate classroom management activities higher than those in public schools.
- Both groups place a high priority on student-centred learning, but respondents from private schools—teachers and students alike—show slightly higher mean values, particularly among students who identify as male and female.
- There are clear contrasts in this category: respondents from private schools consistently express greater satisfaction than those from public schools, both in terms of teachers and students.
- Respondents from private schools give behaviour management a higher approval rating than those from public schools, suggesting that they believe their classrooms are better run.
- Although student evaluations vary less, public school teachers often give the assessment procedure a better rating than private school teachers.
- In comparison to their public counterparts, teachers and students in urban private schools show greater levels of satisfaction in most categories. Respondents from rural private schools likewise report higher levels of satisfaction, albeit with somewhat narrower disparities.
- When compared to pupils in public schools, male and female students in private schools express greater satisfaction with the methods used in the classroom. In private institutions, there is a greater appreciation for behaviour management among female pupils in particular.

Discussion

In this study, several key patterns and insights regarding science teaching practices in both public and private secondary schools emerged from the data. Results from the data analysis provided evidence that, in general, teachers and students perceived science teaching practices positively across most of the categories, as observed from the high mean values obtained. One of the most striking findings is that private school teachers and students are consistently more satisfied than their public school counterparts with all dimensions of teachers' classroom practices. This difference is significant in multiple dimensions—classroom management activities, student-centred learning, self-reflection in learning, and behaviour management—overall, urban, and rural subsamples. In urban and rural private schools, the average satisfaction is significantly higher than in urban and rural public schools. These differences suggest that institutional factors or resources may affect teacher and student perceptions of their schools. The aim of science education warrants evaluation of the factor that contributes to effective science teaching practices. Basic practice involving demographics indicated that Collaboration among students is rated as the most by public, private, and Montessori school teachers and students. These findings align with contemporary education research that argues inquiry, problem-solving, and conceptual understandings emerge

through interactive and cooperative manner of learning (Akben, 2020; Jamil & Muhammad, 2019b).

Interestingly, public school teachers tend to have higher ratings for their satisfaction with the assessment process than private school teachers. This reward may naturally stem from differing methods or divergent instruction or resources between the two types of schools. Public school teachers have more opportunities or more standardized test frameworks, leading to higher satisfaction. An analysis based on gender uncovers that female students and teachers, especially in private schools, express higher levels of satisfaction with their science teaching practices compared to male students and teachers. This could be rooted in various causes, such as arrangements within the classroom, teaching styles, gender-specific support, or initiatives unique to the private school setting. The urban-rural split is evident as a factor that plays into beliefs about science teaching practices as well. While the level of satisfaction of urban private school teachers and students across almost all categories is significantly higher than that of their public school counterparts, the same general trend is observed in more rural areas, with the gaps between groups like those previously mentioned somewhat smaller. This is likely, in part, a result of resource availability, infrastructure, or the socioeconomic gap between urban and rural members of the population.

Conclusion

Results of the study reveal that overall, secondary science teaching practices are perceived to be positive in public and private schools. Nevertheless, significant differences have been identified between the two sectors regarding the satisfaction rate reported for various items. Private schools have reported higher satisfaction levels in the mentioned areas of classroom management, student-centred learning, self-reflection, and behaviour management. These items imply the impacts of institutional factors, resources at schools, and teaching methodologies on science education efficacy. There may be certain areas of overlap where private schools enjoy advantages — smaller classes, better facilities, access to educational technologies, and more chances for professional development — which might, in turn, be responsible for higher levels of teacher satisfaction. Among science teachers, the most appreciated element of teaching practices is cooperation among students, underlining the importance of an interactive and collaborative learning environment. Therefore, both sectors should encourage techniques that foster cooperation among students and provide opportunities for it to develop as a priority regardless of their age or science course because learning objectives and content standards, in addition to contemporary science education, support the development of critical thinking, problem-solving, and scientific inquiry skills. In addition, research demonstrates unfairness by gender and place. That requires strategies or policies consistent with these differences. Take, for example, skilled development programs, which are organized according to the requirements of male teachers and students, or measures to fill the gap of capital between urban and rural places. Significantly, the investigation paints a picture, but we need to be careful about drawing uni-faceted conclusions. To that end, the investigation could be replicated with a bigger array of subjects or by considering other variables like socioeconomic status or school infrastructure; thus, we could discuss a series of results better.

Recommendations

The following recommendations can be made based on findings:

- Given the variations observed between public and private schools, fostering collaboration initiatives could be beneficial. Organizing joint workshops, seminars, or sharing sessions

between teachers from different sectors would enable the exchange of successful teaching practices, contributing to overall improvement in science education.

- Tailored professional development programs should be designed to address specific areas where differences in perceptions exist. For instance, public school teachers could benefit from training sessions focusing on classroom management activities, self-reflection in learning, and behavior management. Similarly, private school teachers might find value in programs emphasizing assessment processes.
- Both teachers and students highly value collaboration among students. Encouraging educators to adopt more student-centered learning approaches, where collaborative activities play a central role, could enhance the overall learning experience. Additionally, this approach aligns with the positive perception expressed by students, reinforcing its importance in effective science education.

References

- Abualhaija, N. (2019). Using Constructivism and Student-Centered Learning Approaches in Nursing Education. *International Journal of Nursing Health and Care Research, 7*(3), 93-110.
- Acosta, J., Chinman, M., Ebener, P., Malone, P. S., Phillips, A., Wilks, A. (2019). Understanding the relationship between perceived school climate and bullying: A mediator analysis. *Journal of school violence, 18*(2), 200-215.
- Akben, N. (2020). Effects of the problem-posing approach on students' problem solving skills and metacognitive awareness in science education. *Research in Science Education, 50*(3), 1143-1165.
- Bosch, K. A. (2006). *Planning classroom management.* London: Sage Publications.
- Cooper, G. (2023). Examining science education in ChatGPT: An exploratory study of generative artificial intelligence. *Journal of Science Education and Technology*, *32*(3), 444-452.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.
- Gest, S. D., Madill, R. A., Zadzora, K. M., Miller, A. M., Rodkin, P. C. (2014). Teacher management of elementary classroom social dynamics: Associations with changes in student adjustment. *Journal of Emotional and Behavioral Disorders, 22*(2), 107-118.
- Henze, I., Van Driel, J. H., & Verloop, N. (2008). Development of Experienced Science Teachers' Pedagogical Content Knowledge of Models of the Solar System and the Universe. *International Journal of Science Education, 30*(10), 1321–1342. doi:10.1080/ 09500690802187017
- Jamil, M., Bokhari, T. B., & Ahmad, D. (2024). Evaluation of Critical Thinking Elements: A Qualitative Content Analysis of Physics Textbook Grade IX. *Qlantic Journal of Social Sciences, 5*(1), 344-350.
- Jamil, M., Bokhari, T. B., & Iqbal, J. (2024). Incorporation of critical thinking skills development: A case of mathematics curriculum for grades I-XII. *Journal of Asian Development Studies*, *13*(1), 375-382.
- Jamil, M., Bokhari, T. B., & Rafiq, M. (2024). Critical thinking skills development for 21st century: An analysis of Biology curriculum (2006). *Voyage Journal of Educational Studies*, *4*(1), 127-138.
- Jamil, M., Bokhari, T. B., & Zia, Q. (2024). Qualitative content analysis for critical thinking and skill development: A case of chemistry curriculum. *Journal of Asian Development Studies*, *13*(1), 147-155.
- Jamil, M., Hafeez, F., Abdul, & Muhammad, N. (2024). Critical thinking development for 21st century: Analysis of Physics curriculum. *Journal of Social & Organizational Matters*, *3*(1), 1-10.
- Jamil, M., & Muhammad, Y. (2019a). Teaching science students to think critically: Understanding secondary school teachers' practices. *Journal of Research & Reflections in Education (JRRE)*, *13*(2), 256-272.

- Jamil, M., & Muhammad, Y. (2019b). Teaching Science Students to Think Critically: Understanding Secondary School Teachers' Practices. *Journal of Research and Reflections in Education*, *13*(2), 256-272.
- Jamil, M., Muhammad, Y., Masood, S., & Habib, Z. (2020). Critical thinking: A qualitative content analysis of education policy and secondary school science curriculum documents. *Journal of Research and Reflections in Education*, *14*(2), 249-258.
- Jamil, M., Muhammad, Y., & Qureshi, N. (2021a). Critical thinking skills development: Secondary school science teachers' perceptions and practices. *sjesr*, *4*(2), 21-30.
- Jamil, M., Muhammad, Y., & Qureshi, N. (2021b). Secondary school science teachers' practices for the development of critical thinking skills: An observational study. *Journal of Development and Social Sciences*, *2*(4), 259-265.
- Jamil, M. M., W Saleem, A. (2024). Biology textbook grade X (2020): Analysis for the development of higher order thinking skills among secondary school science students. *Global Regional Review (GRR)*, *9*(1), 29-35.
- Kalogiannakis, M., Papadakis, S., & Zourmpakis, A.-I. (2021). Gamification in science education. A systematic review of the literature. *Education sciences*, *11*(1), 22.
- Klassen, R. M. & Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: Teacher gender, years of experience, and job stress. *Journal of Educational Psychology*, *102*(3), 741-756.
- Kuhn, D. (2015). Thinking together and alone. *Educational Researcher*, *44*(1), 46– 53.
- Kurniawan, W., Pathoni, H., Muliawati, L., Kurniawan, D. A., Romadona, D. D., Ningsi, A. P., & Dari, R. W. (2020). Relationship of science process skills and critical thinking of students in physics subject. *Universal Journal of Educational Research*, *8*(11), 5581-5588.
- Lea, S. J., Stephenson, D., & Troy, J. (2003). Higher education students' attitudes to student-centred learning: beyond' educational bulimia? *Study of Higher Education*,*28*(3), 321–334.
- Levine, L. (2009). *Teaching comprehension with questioning strategies that motivate middle school readers.* New York: Scholastic Teaching Resources.
- Lynch, D. N. (2010). *Student-centered learning: The approach that better benefits students,* Virginia Wesley.
- Mackanzie, R. J. & Stanzione, L. (2010). *Setting limits in the classroom. A complete guide to effective classroom management with a schoolwide discipline plan.* New York.US: Crown Publishing Group.
- Noell, G. H., Witt, J. C., LaFleur, L. H., Mortenson, B., Rainer, D. D., & LeVelle, J. (2000). Increasing intervention implementation in general education following consultation: A comparison of two follow-up strategies. *Journal of Applied Behavior Analysis*, *33*(9), 271-284.
- Sahin, D., & Yilmaz, R. M. (2020). The effect of Augmented Reality Technology on middle school students' achievements and attitudes towards science education. *Computers & Education*, *144*, 103710.
- Shahzadi, M. J. T. B. U. (2024). Critical thinking skills development among secondary school students: An analysis of Chemistry textbook grade X (2020). *Research Journal for Societal Issues*, *6*(2), 1-11.
- O'Connor, E. E., Dearing, E., & Collins, B. A. (2011). Teacher-child relationship and behaviour problem trajectories in elementary school. *American Educational Research Journal*, *48*(1), 120-162.
- Pang, J. Lau, C. P. Seah, L. Cheong, and Low, A. (2018). Socially Challenged Collaborative Learning of Secondary School Students in Singapore. Education Science, 8(24), 9-29.
- Shin, S. & Koh, M. S. (2007). A cross-cultural study of teachers' beliefs and strategies on classroom behavior management in urban American and Korean school systems. *Education and Urban Society*, *39*(2), 286-309.
- Yılmaz, A. (2021). The effect of technology integration in education on prospective teachers' critical and creative thinking, multidimensional 21st century skills and academic achievements. *Participatory Educational Research*, *8*(2), 163-199.