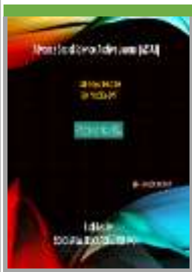

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FROM CURRICULUM TO CLASSROOM: PEDAGOGICAL PRACTICES OF SCIENCE TEACHERS AT THE ELEMENTARY LEVEL IN PUNJAB

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ABSTRACT

This descriptive study investigated the pedagogical practices of elementary school science teachers in public and registered private schools of Lahore and Kasur districts. The population comprised all public and private elementary school teachers and students in these districts. A sample of 299 teachers and 2,351 students was selected through two-stage random sampling. Data were collected using two researchers-developed instruments based on the National Curriculum for General Science (Grades IV–VIII, 2006): the Science Teaching Practices Questionnaire (STPQ) for teachers and the STPQ for students. Both questionnaires were pilot tested with 30 teachers and 50 students from four public and four private schools. Validity was established through expert review, while reliability analysis yielded Cronbach's alpha values of .94 for teachers' STPQ and .92 for students' STPQ, indicating strong internal consistency.The quantitative findings revealed that teachers' self-reported responses on the STPQ indicated a greater emphasis on constructivist pedagogies. However, students' responses reflected that classroom practices were largely traditional and teacher-centered. Chi-square tests further highlighted variations in teaching practices between public and private schools, as well as between male and female teachers in public schools. This discrepancy suggests a gap between teachers' claimed practices and students' observed experiences, with science instruction still dominated by teacher-centered approaches. It is recommended that professional development programs be strengthened to equip science teachers with practical strategies for implementing constructivist approaches, ensuring alignment between intended and enacted pedagogies in the classroom.

Keywords: *Science teaching practices, pedagogical approaches, constructivist pedagogy, traditional teaching, public and private schools.*

Introduction

Teachers play a pivotal role in the successful implementation of curriculum in schools. Their pedagogical beliefs and teaching practices largely determine the quality of the teaching-learning process within classrooms. Both pedagogical knowledge and pedagogical skills are critical factors that directly influence student learning outcomes.

In this context, teacher education emerges as a cornerstone in the development and strengthening of a country's education system. The effectiveness of teacher education, however, depends on the competence and quality of teacher educators, who shape future teachers' professional identities and practices (Flores, 2020). Globally, the quality of teacher education remains a widely debated issue, as it is recognized that effective teacher preparation requires a balanced integration of teaching skills, sound pedagogical theory, and professional competencies (Hoban, 2004; Zeichner, 2021). A meaningful amalgamation of these dimensions equips teachers with the knowledge, attitudes, and skills necessary to ensure holistic student development. Furthermore, the quality of pedagogical inputs in teacher education programs, along with their practical application, is crucial for preparing prospective teachers. This effectiveness largely hinges on the professional competence of teacher educators and the strategies employed in utilizing these inputs for strengthening teacher education (Aspfors & Fransson, 2021). Recent studies emphasize that improving teacher education is vital for promoting innovative pedagogical practices, enhancing student engagement, and fostering lifelong learning skills (Darling-Hammond & Hyler, 2020; OECD, 2022). In the context of rapidly changing educational landscapes, teacher education must also adapt to incorporate digital pedagogy, inclusive teaching practices, and competency-based approaches that prepare teachers for the diverse challenges of 21st century classrooms (Tondeur et al., 2020).

Traditional and Constructivist Ideas for Teaching and Learning Science

Traditional and constructivist ideas of teaching and learning science have been taken from the National Curriculum for General Science Grades IV-VIII 2006. The major focus of this curriculum is on inquiry based teaching and learning. The main goals of teaching inquiry based curriculum are to enrich the students as scientifically literate and encourage positive attitudes towards science and science subject among individuals. Through this effort it was also emphasized to produce the scientists that are capable to bring and accept change in the world of science and technology.

Major focus of this curriculum is to enable the learner to discover the content while using inquiry methodologies. These inquiry approaches facilitate the students in learning of multiple concepts and facts and also students learn how facts and concepts are related to each other. In this way students will understand about world and add great body of information which we call knowledge. Inquiry-based methodologies to science education focus on learner centered learning as opposed to teacher-centered. These inquiry approaches enabled the students to think critically, scientifically, and creatively. Therefore, this Curriculum presents a paradigm shift from the characteristics of traditional approaches to inquiry-based approaches in the following manner.

Traditional	→	**Inquiry based**
Behaviorism	**Principle Learning Theory**	Constructivism
Passive	**Student's Participation**	Active

Decreased Responsibility	**Student's Involvement in Outcomes**	Increased Responsibility
Direction Follower	**Student's Role**	Problem Solver
Output Oriented	**Curriculum Goals**	Process Oriented
Director/Transmitter	**Teacher's Role**	Guide/Facilitator

Classroom Teaching Strategies

The *National Curriculum for General Science Grades IV-VIII (2006)*, developed by the Government of Pakistan, Ministry of Education (MoE), Islamabad, outlines a range of recommended teaching strategies for science instruction at the elementary level. These include the inquiry method, questioning and discussion, investigation and problem solving, demonstration, and laboratory work. The curriculum further emphasizes the importance of employing a variety of instructional approaches, such as whole-class teaching, group work, and individual tasks, while also integrating literacy skills-reading, writing, speaking, and listening into science lessons. Moreover, it encourages teachers to use student work as feedback for informing instruction, ensuring that teaching practices remain responsive to learners' needs.

Despite these curriculum directives, the actual implementation of science teaching at the elementary level has faced structural challenges. Traditionally, there were no designated posts for specialized science teachers at the elementary level. Science was typically taught by general teachers, which often limited the quality and depth of science instruction. It is only in recent years, following the *Recruitment Policy for Educators (2013)*, that science graduates holding professional teaching degrees have started to be appointed as Secondary School Teachers (SST) or Secondary School Educators (SSE.Sc) and assigned to teach science at the elementary level. While this development has helped address the shortage of qualified science teachers, it also represents a relatively new phenomenon in the education system of Punjab.

Given this historical context, concerns persist regarding the effectiveness of science teaching at the elementary level. The absence of specialized science teachers in earlier years suggests that teaching practices may not have been aligned with curriculum expectations, potentially limiting opportunities for inquiry-based and learner-centered approaches. This situation underscores the need for empirical research to examine the pedagogical practices of elementary school science teachers, particularly in terms of how closely they adhere to the curriculum's prescribed strategies and how their practices differ across public and private schools.

Therefore, the present study was designed to investigate science teaching practices at the elementary level in public and registered private schools of Lahore and Kasur. Specifically, it aimed to explore whether teachers' pedagogical practices reflect curriculum recommendations, the extent to which constructivist approaches are implemented, and how teaching practices vary across different school types and teacher demographics. This inquiry was deemed essential for understanding the gaps between policy intentions and classroom realities, and for providing insights into strengthening science education at the foundational level.

Research Objectives

The objectives of this study were to:

1. Ascertain the science teachers' teaching practices at the elementary level.
2. Compare the science teachers' and students' responses about prevalence of science teaching practices in the classrooms.
3. Compare the science teaching practices in public and registered private schools at the elementary level.
4. Compare the science teaching practices of male and female science teachers in public schools as reported by students

Methodology

This study was conducted within the **positivist paradigm**, which emphasizes objective measurement, quantification, and the search for observable patterns in human behavior (Creswell & Creswell, 2018). The research employed a **descriptive quantitative design**, focusing on teachers' classroom practices as perceived by students. The population included all elementary school (Grades VI-VIII) teachers and students from public and registered private schools in Punjab, with the study delimited to Lahore and Kasur districts. A **two-stage random sampling technique** was used: schools were first randomly selected from public and private sectors, followed by the selection of teachers and students from these schools. From a total population of 357 public and 1,840 private schools, 104 schools were sampled (64 public and 40 private) with representation from urban, rural, male, and female schools. The final sample comprised **299 teachers and 2,351 students**. Data were collected through two researcher-developed instruments: the **Science Teaching Practices Questionnaire (STPQ) for teachers** and the **STPQ for students**, both based on traditional and constructivist teaching approaches. The teacher questionnaire contained 36 items rated on a five-point Likert scale (from *always* to *never*). Teachers' responses reflected their claimed practices, while students' responses served as verification of observed practices. Validity was established through expert review, while reliability was confirmed with Cronbach's alpha values of **.94 (teachers)** and **.92 (students)**. Data analysis involved cross-tabulation of teacher and student responses to examine the prevalence of pedagogical practices. Mean values were also computed to determine the overall degree of traditional versus constructivist practices in science classrooms.

Most Prevailing Science Teaching Practices as Reported by Teachers and Students are as below;

Table 1:

Most common science teaching practice as reported by teachers' and students'

Pedagogical Practices	Std. MRV	Std. Rank	Teach. MRV	Teach. Rank	Theoretical Orientation
ask students to memorize science definitions	4.49	1	4.35	2	Traditional
provides science information and explains it through lecture	4.42	2	4.21	5	Traditional
ask questions to promote scientific thinking among all students	4.31	3	4.08	8	Constructivist
encourage students to learn from other fellows during experiments	4.23	4	3.9	12	Constructivist
respond to students question	4.15	5	4.23	4	Constructivist
encourage students to ask questions	4.01	6	4.29	3	Constructivist
uses black boards to explain science concepts	3.95	7	4.47	1	Traditional
assigning home work to students to understand science concepts	3.92	8	3.9	13	Traditional
give examples from daily life to explain science concept	3.84	9	4.15	6	Traditional
read the textbook himself/herself and explain the concepts where necessary	3.77	10	3.77	15	Traditional

The above table illustrates the most prevailing science teaching practices, arranged in descending order based on students' mean response values. It shows that most of the traditional pedagogical practices, i.e., asking students to memorize science definitions and providing science information through lectures, were frequently employed by teachers. The table also indicates the presence of some learner-centered practices, such as asking questions to promote scientific thinking among all students, encouraging students to learn from their peers during experiments, and responding to students' questions, which teachers reported practicing in class.

Least Prevailing Science Teaching Practices as Reported by Teachers and Students

Table 2:

Least common science teaching practices as reported by teachers' and students'

Pedagogical Practices	Std. MRV	Std. Rank	Teach. MRV	Teach. Rank	Theoretical Orientation
assign works to students individually in order to enable them to understand science concepts	3.00	27	3.57	23	Constructivist

use charts, pictures and models to help students to understand science information	2.99	28	3.71	17	Traditional
requiring students to record data into diagrams, tables and graphs	2.85	29	3.51	24	Constructivist
engages students in learning from teacher, others fellows, guest speakers and audio cassettes	2.79	30	3.29	34	Constructivist
teach the use of science apparatus/equipment through demonstration	2.69	31	3.4	31	Traditional
invites resource person(doctors, engineers etc.) to provide science information to students	2.44	32	2.68	36	Constructivist
encourage student to use computer to gather science information	2.41	33	3.5	26	Constructivist
provide science equipment's (microscope, balance, glass apparatus etc.) to perform experiments practically	2.24	34	3.38	32	Traditional
takes the students to outside visits (park, schoolyard, museum, science labs, industry etc.) relevant to their topic for observation	2.23	35	2.81	35	Constructivist
take students to lab to perform experiments to understand science concept	2.15	36	3.36	33	Traditional

The above table illustrates the least prevailing science teaching practices, arranged in descending order according to students' mean response values. It shows that most of the learner-centered pedagogical practices, i.e., assigning work to students individually to enable them to understand science concepts and engaging students in learning from teachers, peers, guest speakers, and audio cassettes, were employed by teachers with low frequency. It also indicates the presence of some traditional practices, such as taking students to the laboratory to perform experiments for understanding science concepts, which teachers reported practicing in class.

Prevalence of Traditional Methodology as Reported by Teachers and Students

Teachers and students' responses were elicited on prevalence of traditional pedagogies i.e. lecture method for teaching science. Teachers and students' responses were compared by computing χ^2 test. Summary of χ^2 test is given below.

Table 3:

Comparisons of teachers' and students' perception about prevalence of pedagogies for traditional methods i.e. lecture method

Pedagogical practices	Respondent	N	% of Responses					χ^2	Sig. value	Cramer's V
			Always	Often	Sometime	Rarely	Never			
	Tch	299	50.2	29.1	13.4	6.0	1.3	66.19	.000	.158

provides science information	Std	235	69.2	15.3	6.1	7.6	1.9			
uses black boards to explain science concepts	Tch	299	63.5	25.8	6.4	2.7	1.7			
	Std	235	52.2	17.9	9.2	14.0	6.6	54.97	.000	.144
use charts, pictures and models to help students to understand	Tch	299	29.1	32.4	25.1	6.7	6.7			
	Std	235	20.8	21.7	16.1	20.1	21.3	95.86	.000	.190
ask students to memorize science definitions	Tch	299	52.2	33.8	11.4	2.0	0.7			
	Std	235	72.9	12.7	6.2	6.6	1.6	116.0	.000	.209
give examples from daily life to explain science concept	Tch	299	45.8	30.4	17.7	5.4	0.7			
	Std	235	41.3	23.9	16.8	13.5	4.5	29.59	.000	.106
assigning home work to students to understand science	Tch	299	36.1	35.8	14.7	8.7	4.7			
	Std	235	54.8	13.7	11.5	9.1	10.9	110.3	.000	.204
read the textbook himself/herself and explain the concepts	Tch	299	32.4	35.8	15.4	9.0	7.4			
	Std	235	49.0	16.0	10.5	11.6	12.9	86.26	.000	.180
ask students to textbook reading and explain difficult terms	Tch	299	36.8	20.4	21.1	14.0	7.7			
	Std	235	25.2	21.3	18.9	19.2	15.4	28.99	.000	.105

$p < 0.05$

The summary of the χ^2 test in the above table revealed that teachers' and students' opinions differed regarding the use of the lecture method in teaching science, as the χ^2 values were significant at the 0.05 level of significance. Significant differences were observed for practices such as providing science information and explaining it through lectures, using blackboards, charts, pictures, and models to facilitate understanding, asking students to memorize science definitions, giving examples from daily life, assigning homework, reading the textbook aloud, and asking students to read and explain difficult terms from the textbook. Students reported that their teachers provided science information through lectures, asked them to memorize science concepts, and assigned homework more frequently than teachers themselves claimed. Conversely, teachers reported higher percentages for practices such as using blackboards, charts, and pictures, giving examples from daily life, and assigning homework to explain science concepts, which were less strongly endorsed by students. This discrepancy indicates that students did not fully support teachers' claims regarding these practices. For these data, the minimum value of Cramer's V was .105 and the maximum value was .204 (out of a possible maximum of 1), representing a small association between respondents (teachers and students) and traditional methods (lecture method). Notably, 85% of teachers and 84% of students reported that teachers asked students to memorize science definitions.

Prevalence of Traditional Methodology as Reported by Teachers and Students

Teachers and students responses were elicited on prevalence of traditional pedagogies i.e. demonstration method and laboratory work for teaching science. Teachers and students' responses were compared by computing χ^2 test. Summary of χ^2 test is given below.

Table 4:
Comparisons of teachers' and students' perception about prevalence of pedagogies for traditional methods i.e. demonstration method and laboratory work

Pedagogical practices	Respondents	N	% of Responses					χ^2	Sig. Value	Cramer's V
			Always	Often	Sometime	Rarely	Never			
demonstrate the experiment themselves in order to	Tch	299	20.1	35.8	24.4	13.4	6.4	62.76	.000	.154
	Std	235 1	24.8	19.4	19.7	19.4	16.8			
teach the use of science apparatus/equipment	Tch	299	22.1	28.9	24.5	16.1	8.40	107.9	.000	.202
	Std	235	18.9	13.1	15.4	23.4	29.2			
take students to lab to perform experiments to understand science	Tch	299	26.1	24.4	22.4	14.0	13.0	200.6	.000	.275
	Std	235 1	11.4	9.3	12.1	17.1	50.1			
provide science equipment's to perform experiments	Tch	299	28.1	20.1	26.1	13.4	12.4	178.3	.000	.259
	Std	235	11.8	11.7	12.3	17.6	46.6			

$p < 0.05$

The summary of the χ^2 test in the above table revealed that teachers' and students' opinions differed regarding the use of the demonstration method and laboratory work for teaching science, as the χ^2 values were significant at the 0.05 level of significance. Significant differences were identified for practices such as demonstrating experiments themselves, teaching the use of science apparatus, taking students to the laboratory, and providing scientific equipment to perform experiments practically in order to understand science concepts. Teachers reported higher percentages for these practices—demonstrating experiments, teaching apparatus usage, taking students to the laboratory, and providing equipment—than did students. This indicates that students did not fully endorse the teachers' claims regarding the prevalence of these practices in science classrooms. For these data, the minimum value of Cramer's V was .154 and the maximum value was .275 (out of a possible maximum of 1), representing a small association between respondents (teachers and students) and traditional methods (demonstration method and laboratory work). Notably, 55% of teachers and 43% of students reported that teachers demonstrated experiments themselves to facilitate students' understanding of science concepts.

Prevalence of Constructivist Methodology as Reported by Teachers and Students

Teachers and students responses were elicited on prevalence of constructivist pedagogies i.e. scientific inquiry and group work for teaching science. Teachers and students' responses were compared by computing χ^2 test. Summary of χ^2 test is given below.

Table 5:
Comparisons of teachers' and students' perception about prevalence of pedagogies for constructivist methods i.e. scientific inquiry and group work

Pedagogical practices	Respondents	N	% of Responses					χ^2	Sig. Value	Cramer's V
			Always	Often	Sometime	Seldom	Never			
ask students to think and talks about science concepts	Tch	299	40.1	28.1	17.1	12.0	2.7	34.9	.000	.115
	Std	235	36.7	18.3	18.0	16.2	10.8			
admire students to participate in science activities	Tch	299	44.8	31.1	15.1	5.4	3.7	44.1	.000	.129
	Std	235	40.6	20.7	13.9	11.4	13.4			
requiring students to record data into diagrams, tables and graphs	Tch	299	30.4	33.4	19.4	8.7	8.0	7.47	.000	.127
	Std	235 1	25.5	17.1	17.4	17.1	22.9			
encourage students to use computer to gather science	Tch	299	27.1	27.4	20.4	13.0	11.4	17.9	.000	.259
	Std	235	17.8	12.0	.80	13.7	46.6			
require students to interpret the collected data in their own	Tch	299	31.1	37.1	17.4	7.0	7.4	42.7	.000	.151
	Std	235 1	37.5	21.7	15.9	13.4	11.4			
provides feedback to students on their performance	Tch	299	39.1	30.1	17.7	7.7	5.4	37.2	.000	.119
	Std	235 1	37.3	20.3	14.4	14.7	13.3			
make groups of students to learn science concepts and	Tch	299	23.7	36.1	27.1	8.4	4.7	12.0	.000	.219
	Std	235 1	31.8	18.2	13.7	13.1	23.2			
encourage students to learn from their peers within their	Tch	299	18.7	44.1	21.7	12.4	3.0	11.8	.000	.209
	Std	235	32.9	20.2	17.0	14.8	15.1			

$p < 0.05$

The summary of the χ² test in the above table revealed that teachers' and students' opinions differed regarding the use of the scientific inquiry and group work methods of teaching science, as the χ² values were significant at the 0.05 level of significance. Significant differences were observed for practices such as asking students to think and talk about science concepts, encouraging students to participate in science activities, using computers, recording data in graphs and tables, interpreting data, providing feedback to students, forming student groups, asking students to work collaboratively within groups, and promoting peer learning. Both teachers and students reported the prevalence of scientific inquiry and group work practices in science classrooms. However, teachers reported these practices more strongly than students, indicating that students did not fully endorse teachers' claims about the extent of these methods being applied in classrooms. For these data, the minimum value of Cramer's V was .115 and the maximum value was .259 (out of a possible maximum of 1), representing a small association between respondents (teachers and students) and constructivist methods (scientific inquiry and group work). Notably, 74%

of teachers and 60% of students reported that teachers encouraged students to participate in science activities.

Prevalence of Constructivist Methodology as Reported by Teachers and Students

Teachers and students responses were elicited on prevalence of constructivist pedagogies i.e. problem solving and individual work for teaching science. Teachers and students' responses were compared by computing χ^2 test. Summary of χ^2 test is given below.

Table 6:

Comparisons of teachers' and students' perception about prevalence of pedagogies for constructivist methods i.e. problem solving and individual work

Pedagogical practices	Respondents	N	% of Responses					χ^2	Sig. value	Cramer's V
			Always	Often	Sometime	Rarely	Never			
ask students to discuss their own ideas of problem-solving	Tch	299	16.7	36.1	30.4	7.7	9.0	127.6	.000	.220
	Std	235	29.7	19.3	14.1	17.4	19.6			
ask students to work on scientific plans in groups to understand science	Tch	299	17.4	37.1	28.4	11.0	6.0	125.1	.000	.217
	Std	235	24.4	18.0	15.5	20.2	22.0			
encourage students to learn from other fellows during experiments	Tch	299	36.2	38.9	11.1	5.7	8.1	116.4	.000	.209
	Std	235	61.5	16.0	9.9	8.6	4.0			
ask students to explain with their fellows what they have learnt during	Tch	299	29.8	32.1	24.7	10.7	2.7	73.57	.000	.167
	Std	235	44.2	18.3	14.4	12.8	10.3			
ask students to give examples from routine life to explain science	Tch	299	42.8	32.8	16.4	7.4	0.7	63.71	.000	.174
	Std	235	34.0	22.2	15.4	17.4	11.0			
assign works to students individually in order to enable them to	Tch	299	21.4	36.1	26.1	10.7	5.7	127.5	.000	.219
	Std	235	25.9	18.4	13.1	15.2	27.3			
help students to perform experiment individually to	Tch	299	30.4	31.8	19.1	9.7	9.0	67.81	.000	.160
	Std	235	25.3	19.0	13.4	18.1	24.2			
allow students to explain science concept individually	Tch	299	30.4	33.4	19.4	8.7	8.0	79.47	.000	.173
	Std	235	25.5	17.1	17.4	17.1	22.9			

$p < 0.05$

The summary of the χ² test in the above table revealed that teachers' and students' opinions differed regarding the use of problem-solving and individual work methods of teaching science, as the χ² values were significant at the 0.05 level of significance. Significant differences were observed for practices such as asking students to discuss their own ideas of problem-solving, working on a scientific plan in groups, encouraging students to share learning experiences, giving examples from daily life to explain science concepts, assigning work to students, performing experiments, and providing individual support to explain science concepts. Both teachers' and students' responses indicated the prevalence of these practices in science classrooms. Practices such as asking students to discuss their own problem-solving ideas, working on a scientific plan in groups, sharing and explaining learning with peers, giving examples from daily life, assigning work to students, performing experiments, and providing individual help were reported more strongly by teachers than by students. The only exception was encouraging students to learn from peers during experiments, which was reported as more prevalent by students. For these data, the minimum value of Cramer's V was .160 and the maximum value was .220 (out of a possible maximum of 1), indicating a small association between respondents (teachers and students) and constructivist methods (problem solving and individual work). Notably, 74% of teachers and 76% of students reported that teachers encouraged students to learn from peers during experiments.

Prevalence of Constructivist Methodology as Reported by Teachers and Students

Teachers and students responses were elicited on prevalence of constructivist pedagogies i.e. field trips & guest speaker, questioning and incorporating literacy strategies for teaching science. Teachers and students' responses were compared by computing χ^2 test. Summary of χ^2 test is given below.

Table 7:

Comparisons of teachers' and students' perception about prevalence of pedagogies for constructivist methods i.e. field trips & guest speaker, questioning and incorporating science literacy strategies

Pedagogical practices	Respondent	N	% of Responses: Always	Often	Sometime	Seldom	Never	χ^2	Sig. value	Cramer's V
takes the students to outside visits relevant to their topic	Tch	299	13.0	17.4	28.4	19.7	21.4	135.2	.000	.226
	Std	2351	14.3	10.4	10.8	13.0	51.5			
invites resource person to provide science information	Tch	299	15.1	16.7	19.1	19.1	30.1	49.57	.000	.137
	Std	235	19.2	10.8	11.1	12.4	46.5			
ask questions to promote scientific thinking among all	Tch	299	40.6	36.9	15.4	4.4	2.7	122.9	.000	.215
	Std	2351	65.5	14.5	8.6	8.0	3.4			
encourage students to ask questions	Tch	299	60.9	21.1	9.0	4.0	5.0	25.11	.000	.097
	Std	235	50.8	19.4	14.0	11.6	4.0			
respond to students question	Tch	299	54.8	25.4	11.0	5.7	3.0	12.99	.000	.070
	Std	2351	57.1	18.5	10.3	10.0	4.1			
engages students in learning from teacher, others fellows, guest	Tch	299	17.7	35.1	17.4	18.1	11.7	105.5	.000	.200
	Std	2351	22.2	14.9	15.0	15.4	32.5			
ask students to communicate their work to class through	Tch	299	22.7	28.4	29.4	12.7	6.7	64.33	.000	.156
	Std	2351	26.1	21.4	15.7	16.7	20.1			

engage students in writing about their science experiment	Tch	299	24.4	32.8	21.7	10.7	10.4	57.95	.000	.148
	Std	235	35.4	17.1	16.4	14.2	16.8			

$p < 0.05$

The summary of the χ^2 test in the above table revealed that teachers' and students' opinions differed regarding constructivist pedagogies of teaching science, including field trips and inviting guest speakers, questioning, and incorporating science literacy strategies, as the χ^2 values were significant at the 0.05 level of significance. Significant differences were found for practices such as arranging field trips for students, inviting resource persons, asking questions to promote scientific thinking, responding to students' questions, engaging students in learning from teachers, peers, guest speakers, and audio cassettes, asking students to communicate their work to the class through pictures, charts, or posters, and engaging students in writing about their science experiments. Both teachers and students reported the prevalence of these pedagogical practices in classrooms; however, teachers claimed their use more strongly than students, except in the case of asking questions to promote scientific thinking, which was reported as more prevalent by students. For these data, the minimum value of Cramer's V was .070 and the maximum value was .226 (out of a possible maximum of 1), indicating a small association between respondents (teachers and students) and constructivist teaching methods (field trips, guest speakers, questioning, and literacy strategies). Notably, 80% of teachers and 75% of students reported that teachers respond to students' questions during science lessons.

Findings

1. The most prevailing traditional science teaching practices, as reported by students, included asking students to memorize science definitions, providing science information and explaining it through lectures, using blackboards to explain science concepts, assigning homework to reinforce understanding, giving examples from daily life, and reading the textbook aloud while explaining concepts where necessary.

2. The most prevailing constructivist science teaching practices, as reported by students, were asking questions to promote scientific thinking among all students, encouraging students to learn from their peers during experiments, responding to students' questions, and motivating students to ask questions.

3. A noticeable gap emerged between teachers' and students' perceptions of the lecture method. Most students stated that their teachers often delivered science content through lectures and required them to memorize facts, whereas teachers themselves reported using this approach less frequently.

4. Divergences also appeared in responses concerning demonstrations and laboratory activities. Teachers indicated they regularly performed experiments, engaged students in lab-based learning, and utilized equipment, but students observed these practices to a lesser extent.

5. Differences were further evident in views on scientific inquiry and group-based tasks. Teachers highlighted their efforts to appreciate student involvement in science-related activities, while students noted such recognition less commonly.

6. In relation to problem-solving and individual tasks, perspectives again diverged. Students expressed that peer-to-peer learning during experiments was more encouraged than teachers acknowledged in their own accounts.

7. Variations also emerged regarding field trips, guest lectures, questioning strategies, and science literacy practices. Teachers emphasized promoting questioning skills more strongly, yet students reported experiencing such encouragement less often.

Discussion

The findings of this study revealed that science teachers were not confined to a single pedagogical orientation but rather employed a mix of traditional and constructivist practices. While constructivist approaches such as questioning, peer collaboration, and problem-solving were evident, traditional methods such as lecturing, textbook reading, and rote memorization continued to dominate classroom practices. This duality highlights a transitional phase in science pedagogy where teachers are attempting to integrate learner-centered approaches but remain largely reliant on conventional strategies. Existing literature reinforces the importance of constructivist approaches in science teaching, particularly the use of hands-on and inquiry-based instruction to foster deeper conceptual understanding and scientific reasoning skills. Research has consistently demonstrated that students engaged in inquiry-based and activity-oriented classrooms show higher levels of motivation and learning gains compared to those in traditional textbook-driven settings (Hmelo-Silver & Reigeluth, 2021; Jalil et al., 2022). However, as Halverson and Jita (2001) noted, implementing inquiry and hands-on practices consistently is challenging due to contextual constraints such as time, resources, and assessment pressures. Teachers' pedagogical orientations are also closely linked to their epistemological beliefs. Teachers who view knowledge as individually constructed are more likely to foster dialogue, collaborative learning, and discovery-based pedagogies, thereby positioning students as active contributors to the learning process. In contrast, teachers who adopt a transmissionist perspective, grounded in behaviorist traditions, often rely on direct instruction where the teacher is the sole authority transmitting knowledge to passive learners (Davis & Andrzejewski, 2009). More recent studies affirm that teacher beliefs about knowledge and learning strongly predict classroom practice, particularly in science education (Akyol & Garrison, 2019; Varpio & Ellaway, 2021). The present study further highlighted significant differences between teachers' and students' perceptions of pedagogical practices. Students reported that providing scientific information through lectures and requiring memorization were the most common strategies, whereas teachers perceived the use of blackboards and other explanatory aids as dominant practices. This discrepancy points to the perception gap between teaching claims and classroom realities. Such gaps have also been documented in other contexts, where teachers' self-reported practices differ significantly from students' actual classroom experiences (OECD, 2021; Tsai et al., 2022). Overall, the findings suggest that although teachers in this study demonstrated some awareness of constructivist pedagogies, their classroom enactment remained predominantly teacher-centered. Similar patterns are observed in many developing education systems where curricular reforms promote learner-centered teaching, but traditional pedagogies persist due to examination-driven cultures, resource constraints, and inadequate teacher professional development (Ali et al., 2020; Darling-Hammond & Hyler, 2020). As Seifried (2012) argued, transmission-oriented teachers often emphasize content coverage and classroom control, whereas constructivist-oriented teachers adopt process-based approaches to encourage active and meaningful learning. The limited prevalence of constructivist strategies in this study suggests that teachers are struggling to move beyond traditional practices, indicating the need for systemic interventions.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

Professional Development for Teachers: To ensure the effective implementation of learner-centered pedagogies (LCP) as emphasized in the curriculum, there is a need to organize professional development workshops and seminars for in-service teachers. Such training initiatives would help teachers become reflective and self-directed practitioners, thereby enabling them to create engaging and effective learning environments where students are more actively involved in the learning process.

Appointment of Qualified Science Educators: The recruitment and placement of highly qualified science educators are essential for the successful application of learner-centered pedagogies. These educators can serve as role models in adopting innovative teaching strategies and supporting colleagues in pedagogical shifts.

Monitoring and Support Mechanisms: Proper monitoring systems for both teachers and students should be established to ensure the faithful implementation of constructivist teaching approaches. Continuous feedback, mentoring, and classroom support can further enhance the quality of science teaching.

Further Research: Future studies should incorporate classroom observations and interviews as data collection tools to gain deeper insights into actual classroom practices and teacher-student interactions. This will provide a more comprehensive understanding of the dynamics of science teaching and learning.

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