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Science Teachers' Perceptions of Instructional Skills Used in the Teaching of Science Subjects: A Self-Evaluation Study

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Abstract: *This paper will examine the perceptions of the teachers of science subjects in secondary schools in Tehsil Dargai, District Malakand on the instructional skills required in teaching science subjects in schools. The quantitative survey design employed was descriptive, and 50 selected out of 1,458 teachers of science were used to collect the data using a well-designed and professionally validated Likert-scale questionnaire. The description analysis which was done with the SPSS on descriptive statistics showed that the self perceived competence of teachers was always high. Respondents said they had high confidence in the knowledge of their subjects, lesson planning, student motivation, and application of interactive instructional techniques like questions and clarification of concepts. The classroom management practices were also rated very well with a greater emphasis on being able to uphold the discipline and actively engage the student. Although these findings are encouraging, the rather reduced focus on the strategies of reinforcement identify an aspect that needs additional professional focus. Also, the prominent gender inequality of the sample indicates that the findings should be interpreted with caution. Although the study regards a very confident and professionally active community of teachers, it also does not ignore the shortcomings of self-reported data, which could also result in inflated images of reality. The paper emphasizes the significance of a continuous professional growth and suggests that more objective assessment procedures be integrated into future research so that one should obtain more comprehensive and balanced insight on the instructional efficacy in the area of science education.*

Keywords: the instructional skills, science teachers, self-perception, classroom interaction, classroom management, secondary education, Likert scale, Tehsil Dargai

Introduction

In the modern environment of rapid development of educational institutions, the science education is important in fostering scientific literacy, critical thinking, and problem-solving skills of the students. The quality of teaching science content depends on the ability of teachers to master the teaching skills like inquiry-based learning, hands on experimentation, integration of technology and adaptive strategies that can respond to the diversity in the classroom. Such skills do not only lead to higher student engagement but also follow the current trends where constructivist methods and learner-centred methods are prioritised (Mafugu et al., 2023; Neubauer-Hametner et al., 2025). Classroom practices and teacher professional development

are heavily dependent on the teachers themselves and their personal views of their teaching competencies. The studies show that when positive self-perceptions of science teaching process have been maintained (even after professional development intervention) they result in permanent changes in the instructional quality and student outcomes (Dailey & Robinson, 2017). Likewise, pedagogical content knowledge (PCK) is a self-reported knowledge that includes orientations to teaching science, knowledge about teaching methods and knowledge about assessment that facilitate teachers to critically assess their strengths and weaknesses. In-service elementary science teachers, in particular, may have a high rating of PCK in instructional strategies but find an area to be in need of some support in the area of understanding the student misconceptions (Siemoh et al., 2025). New teachers, especially, often view science teaching through the constructivist approach, where discovery learning, project-based learning and concrete lessons are highly regarded to fulfill the demands of modern learning standards including the Next Generation Science Standards (Harrell, 2014). Innovative tools are also perceived; education computer games are seen by many science teachers as important in student motivation and building 21 st century skills, but time and resource issues as well as classroom distractions influence their intentions to use them (An et al., 2016). Additionally, the attitudes of teachers towards classroom composition including achievements, motivation and language performance directly influence their decision-making and use of inquiry-based instructions, which implies the adaptability of effective science teaching (Neubauer-Hametner et al., 2025). Although the importance of such dynamics is increasingly gaining momentum, there has been very little empirical interest in how practising teachers of science engage in systematic self-evaluation of their instruction skills and how they represent their perceptions in actual classroom situations. This is a gap that is particularly applicable in the different learning environments whereby professional growth has to be based on self-perceived needs of teachers. This has been addressed in the present study through identifying perceptions of the science teachers concerning the aspects of instructional skills in the teaching of science subjects based on a structured self-evaluation approach. The results should be used in teacher training, curriculum development, and policy proposals that would help to improve the quality of science teaching and promote the ongoing professional reflex.

LITERATURE REVIEW

Theoretical Framework

The self-assessment of instructional abilities of science teachers is based mainly on two supplementary theories, namely the pedagogical content knowledge (PCK) and the self-efficacy theory seen by Bandura (1997). PCK is the professional integration of content

knowledge and pedagogy that allows teachers to bring subject matter into clarity and significance to the learners. In science learning, PCK involves orientations to teaching science, knowledge about teaching strategies, concepts representation, knowledge about student misconceptions, knowledge about curriculum, and assessment practice (Chaitidou and Peikos, 2026; Gess-Newsome et al., 2019). Recent applications focus more on the dynamic, enacted nature of PCK in the process of instruction, in which teachers change knowledge by way of planning, teaching, and reflecting cycles on the process (Hartmuth, 2025). The self-efficacy theory by Bandura states that when teachers believe that they are competent to plan and implement instructional activities, they become motivated, work hard, and persevere especially in problematic science situations that entail inquiry, experimentation, or a heterogenous group of learners. Self-efficacy encourages new student-centered practices at high levels, whereas at low levels, it contributes to the use of conventional ones (Dailey and Robinson, 2017; Sari and Balkas-Yasar, 2024). These models conceptualize the process of self-evaluation as a form of reflection with perception of PCK components and efficacy belief as serving as diagnostic resources to professional growth and instructional effectiveness.

Science Teachers' Perceptions of Pedagogical Knowledge and Pedagogical Content Knowledge

The studies that have been conducted continuously indicate that pre-service and in-service science teachers regard themselves as average to highly qualified in pedagogical knowledge (PK) and PCK. Guler-Nalbantoglu and Aksu (2021) surveyed 176 pre-service science teachers in Turkey and indicated high self-perception of PK (overall M = 4.14/5), in particular, in lesson planning (M = 4.20), assessment (M = 4.24), and learners/learning (M = 4.16). In the case of PCK, instructional strategies were considered the most important (M = 4.15), and misconceptions were the least important (M = 3.77) and did not alter significantly by level of achievement. Among the in-service teachers, the same tendencies can be noticed. According to Siemoh et al. (2025), Ghanaian elementary science teachers scored high on their PCK on instructional strategies, but there were misconception knowledge gaps. In beginner situations, Harrell (2014) emphasized constructivist perceptions of U.S. elementary teachers that supported hands-on discovery that was in line with such standards as NGSS. The perceptions show overall confidence in the basic instructional competencies, however, with ongoing difficulties in learning how to adjust to learner diversity and misunderstandings.

Self-Efficacy Beliefs and Instructional Skills in Science Teaching

The self-efficacy has a great influence on teachers' self-evaluated instructional competence. Dailey and Robinson (2017) demonstrated a continued positive attitude to the skills of science

processes after the intervention, improving the quality of instruction. According to Bergman and Novacek (2021), preservice teachers enrolled in an online course based on 5E/NGSS gained large gains in personal science teaching efficacy ($\eta 2 = .51$) as a result of lesson planning and inquiry activities. Question-based training enhances effectiveness. Sen and Vekli (2016) discovered that there were significant increases in laboratory self-efficacy and process skills ($p < .01$) in preservice Turkish biology teachers. According to Sari and Balkas-Yasar (2024), self-efficacy in 21 st -century skill development ($M = 4.14$) was high in 50 Turkish science teachers, and it was moderately correlated with positive STEM attitudes ($r = .465$, $p < .01$). Recent research supports the fact that focused experiences enhance the subjective view of the competence to provide effective and creative science education.

Perceptions of Specific Instructional Approaches

The approaches differ in perceptions. Haatainen et al. (2021) concluded that Finnish science teachers perceived integrated science education (ISE) as inspiring, though low self-efficacy to implement it at school, particularly at secondary levels, and collaborative experience enhanced self-efficacy. According to Mafugu et al. (2023), preservice opinions on STEM-based teaching with a focus on projects and technology were positive. The technology perceptions are optimistic but wary: An et al. (2016) showed the perceived advantages of educational games in motivation and 21 st century skills, but with time and management worries. Neubauer-Hametner et al. (2025) associated the perceptions of heterogeneity in the classroom (e.g., achievement, language) with the frequency of inquiry strategies, which highlights the adaptive self-evaluation.

Factors Influencing Perceptions and Self-Evaluation

The perceptions are moderated by contextual factors. Sari and Balkas-Yasar (2024) determined that there were no gender/seniority variations in self-efficacy in the 21st century, whereas there were positive STEM attitudes toward females. Haatainen et al. (2021) observed that ISE self-efficacy was higher in primary teachers compared to secondary teachers, and collaboration was one of the predictors. The recent studies (e.g., Karakaya et al., 2023) on online assessment self-efficacy show disparities based on the level of education, school type, and technological competence, yet not necessarily gender or experience.

Gaps in the Literature and Rationale for the Present Study

Although studies can shed light on individual perceptions of PCK, self-efficacy, and particular methods, there are limited studies that study in-service science teachers holistically with their self-assessment of overall instructional ability in real-life situations of ongoing and authentic

classrooms especially in developing nations such as Pakistan. The majority of them concentrate on preservice groups, individual interventions, or Western contexts, owing to which there are insufficient gaps in the way perceptions are used to implement long-term changes or specialized professional growth. This work fills this gap by identifying the perceptions of effective instructional skills among science teachers using structured self-assessment, which will provide information that can be used in teacher education, education curriculum and policy in other learning institutions or organizations.

Objective of the study

1. To determine science teachers perception about instructional skills used in the teaching of science subjects

Research Question

1. What are the science teachers perception about the instructional skills used in the teaching of science subjects?

RESEARCH METHODOLOGY

Research Design

In this research descriptive quantitative survey design was adopted to examine the perceptions of science teachers on instructional skills applied in teaching science subjects in Tehsil Dargai, District Malakand, Khyber Pakhtunkhwa, Pakistan.

Population and Sample

The population of interest was all science teachers in Tehsil Dargai and the District Malakand in secondary schools. Educational statistics and departmental records show that there were a total of 1,458 science teachers in the secondary schools in District Malakand (including Tehsil Dargai). The sample was picked using a simple random sampling method where all the members of the population would have an equal chance of being included. The sample was finalized by taking 50 science teachers (male and female) who were selected out of 110 secondary schools in the district.

Research Instrument

The structured questionnaire used in this study was to collect data with a specially designed questionnaire. The instrument was developed with the help of an expert panel, to ascertain the content validity and respondence to the research objective. It was comprised of variables that measured the perceptions of teachers towards the instructional skills that they used in teaching science on a five-point Likert scale (Strongly Disagree/Strongly Agree).

Data Collection

The researcher went to the secondary schools personally in Tehsil Dargai to administer the questionnaire. The participants were given the aim of the study, guaranteed of anonymity and confidentiality, and requested to give out their honest and in-depth answers. The research was carried out in a systematic way, thereby reducing the occurrence of bias and ensuring respect to the research ethics.

Data Analysis

The responses were collected, and the analysis was conducted with the help of descriptive statistical methods. The perceptions of the teachers were summarized and interpreted as frequency distributions, percentages, means, and standard deviations. The SPSS software was used to perform data entry, data cleaning and statistical computations.

Table 4.1: demographic information of science teachers

Groups	Frequency	Percent Valid	percent	cumulative percent
Male	39	78.0	78.0	78.0
Female	11	22.0	22.0	100.0
Total	50	100.0	100.0	

The percentage analysis and the frequency distribution of the gender of the respondents according to the sample size of 50 secondary school science teachers in Tehsil Dargai reveal that there is a dominant participation of males. Of all the respondents, 39 (78.0) were men, 11 (22.0) were women. The valid percent and cumulative percent are equal to the raw percentages, which proves that no data is missing in the population variable. This distribution shows that the sample is strongly biased towards male teachers, which is reflected in greater extent in science teaching positions at the secondary level in most parts of Khyber Pakhtunkhwa, with male teachers frequently outweighing female teacher because of historical, cultural and occupational trends in teaching in government and non-government secondary schools. Gender population should be taken into consideration when making interpretations of the results concerning the perceptions of instructional skills because it is possible that gender differences in terms of teaching strategies, classroom control, or self-efficacy might be involved in the results, but no serious gender distinctions were presumed or tested in the descriptive study.

Table 4.2: Preparation skills used by teachers in the teaching of science subjects

Items statements	Mean	Std. deviation
I go through the lesson or topic carefully before going to class.	4.54	.706
I prepare teaching materials in advance.	4.44	.733

I set the objectives of teaching a class in advance and prepare lesson and materials accordingly.	4.50	.814
I plan lesson taking into consideration the level of understanding of the class.	4.56	.705
I discuss the topics and concepts which I am doubtful with other teachers.	4.54	.579
I see to it that all apparatus and materials are ready and accessible to students before the commencement of the experiment.	4.36	.631
I try to keep pace with new methodology in science teaching by constant interaction with other professionals in the field.	4.48	.814
I know the subject's content very well.	4.62	.697
I am very much interested in my student's conceptual development.	4.64	.693
I motivate students and make them interested to learn before starting a lesson.	4.64	.598

The descriptive statistics of the 5-point Likert-scale questionnaire (1 = Strongly Disagree to 5 = Strongly Agree) with the answers of 50 secondary school science teachers in Tehsil Dargai indicate high levels of self-perceived competence with all the practices of the instructional preparation, content knowledge, professional collaboration, and student motivation. Means of all items were between 4.36 and 4.64, which are contained within the scope of Agree and Strongly Agree, with the standard deviations of the items being relatively low (0.579 to 0.814) the respondents agreed on the statement fairly well. The teachers indicated especially high agreement on the they were highly interested in the conceptual growth of students (M = 4.64, SD = 0.693) and active encouragement of students to develop interest prior to initiating a lesson (M = 4.64, SD = 0.598), as well as on the aspect of their knowledge of the subject content (M = 4.62, SD = 0.697). On the same note, they viewed themselves as very keen in pre-class preparation, including; taking a close review of lessons (M = 4.54, SD = 0.706), having clear goals and matching the materials to those goals (M = 4.50, SD = 0.814) and thinking over the lessons and carefully considering the understanding level of the students (M = 4.56, SD = 0.705). Another attribute that was rated very positively is collaborative behaviors with teachers often discussing questionable ideas with their colleagues (M = 4.54, SD = 0.579) and keeping themselves informed about new science instruction methods through professional interaction (M = 4.48, SD = 0.814). Practical aspects, including having the equipment and materials prepared and available prior to experiments, were minimally less but highly rated (M = 4.36, SD = 0.631). On the whole, these findings depict the instructors of secondary schools in the research location as having very favorable self-assessments of their teaching effectiveness, showing high perceptions of readiness, mastery of the subject, student-centered focus, and professional involvement in teaching.

Table 4.3 Presentation skills used by teachers in the teaching of science subjects

Statements	Mean	Std. deviation
I test previous knowledge of students properly.	4.44	.733
I properly instruct students what to do before starting a demonstration and experiment, and before assigning them assignments.	4.46	.706
I clarify doubts raised by students to their satisfaction.	4.74	.664
I encourage students to ask question and give responses.	4.72	.671
I formulate and ask questions properly so that every student of the class gets the question once it is posed to them.	4.40	.670
I simplify questions for the benefits of slow learners.	4.54	.788
I give ample time to students for thinking and responding to questions asked.	4.40	.728
I use several types of activities during a class to explain complex concepts properly.	4.42	.673
I personally supervise students to see whether they are doing the right things.	4.48	.707
I always guide those students who are not sure of what they are doing.	4.44	.577

The mean of the 5-point Likert-scale questionnaire (1 = Strongly Disagree to 5 = Strongly Agree) on the 50 secondary school science teachers in Tehsil Dargai showed very positive portrayals of self-perceptions with regard to the interaction with teachers during the science lesson, the methods of questioning, explaining the concepts, and supporting different learners. All items means were found to be in the range of 4.40 to 4.74 that is either in the range of Agree or Strongly Agree with fairly low standard deviations (0.577 to 0.788) that indicated high consistency and agreement by respondents. The highest scores in the levels of confidence were reported by teachers when they clarified the doubts of students as far as they are satisfied (M = 4.74, SD = 0.664) and provided active encouragement to students to ask questions and give answers (M = 4.72, SD = 0.671), which demonstrates the high focus on the creation of an open, interactive, and doubt-solving classroom environment. There was also high rating on simplifying questions to favor slow learners (M = 4.54, SD = 0.788) and personally supervising the students to make them do their work correctly (M = 4.48, SD = 0.707). Teachers considered themselves to be effective in giving clear pre-activity instructions to demonstrate, experiment and assignment (M = 4.46, SD = 0.706), instructing doubtful students (M = 4.44, SD = 0.577) and testing prior knowledge of students in an appropriate manner (M = 4.44, SD = 0.733). Greater redundancy, but overall quite high means were achieved in formulating and questioning in the way that gets all students on board (M = 4.40, SD = 0.670), providing them with enough time to think over the answers (M = 4.40, SD = 0.728), and using a variety of classroom activities to clarify complex statements (M = 4.42, SD = 0.673). Altogether, the results indicate that the studied science teachers have rather positive self-assessments of their

capability to make the students actively involved, respond to the individual needs of students, explain the material clearly, and promote effective interaction and comprehension during science classes, although the perceived strengths in the areas of doubt resolution and question encouragement are outstanding.

Post Presentation skills used by teachers in the teaching of science subjects

Statements	Mean	Std. deviation
I give opportunity to students to work independently.	4.44	.787
I take care of individual differences and give equal attention to all students.	4.54	.578
I always teach the correct concepts.	4.58	.810
I ask questions to lead my students to formulate generalization of their findings.	4.26	.777
I use reinforcement properly.	3.94	.956
My blackboard work is well organized, neat and clean.	4.46	.838
I give students plenty of opportunities to develop their thinking skills.	4.48	.646
I give students plenty of opportunities to develop their creativity.	4.30	.909
My laboratory work is well-planned and organized.	4.56	.644
I maintain discipline in the class.	4.68	.768
I have a good rapport with the students.	4.56	.733

The table 4.4 above is comprised of 10 items and each item has five choices basing on five points Likert scale. I keep the order in the classroom. Was found to have maximum mean score 4.68 meaning that this statement has the mean level of observance among ten statements. Conversely, it was found that I use reinforcement properly has a minimum mean 3.94. It represents the least observance of all the ten items. It is correct to add reinforcement. Was seen to have maximum standard deviation.956 and observed to have minimum standard deviation.578 through I take care of individual differences and pay equal attention to all students. The mean and standard deviation were 48.8000 and 5.92470 respectively.

Findings

A high female-male dominance was found in a sample of 50 secondary school science teachers in Tehsil Dargai where male dominated (78), and female dominated (22). This gender imbalance just like most parts of Khyber Pakhtunkhwa, should be remembered when reading on the results of instructional skills as gender could be a factor in the teaching styles or perceptions.

The self-rated instructional skills on a 5-point Likert scale, 50 secondary science teachers of Tehsil Dargai had very high self-rated instructional skills with all means of 4.36 to 4.64, strong

means indicating high levels of consensus.

The teachers were particularly sure about the ability to motivate the students, master the concepts, knowledge of the subject (M = 4.624.64), detailed lesson planning and professional cooperation with other colleagues.

On the whole, the findings are a very positive self-report of readiness, content mastery, student-focused instruction, and continuous professional involvement in these teachers.

Self-reported skills in instructional interaction, questioning, clarification of concepts, and support of diverse learners received exceptionally high ratings on a 5-point Likert scale in a survey of 50 secondary school science teachers in Tehsil Dargai, and the means of all items are all between 4.40 and 4.74 (Agree to Strongly Agree) with low standard deviations (0.577-0.788) indicating a high level of consensus.

The most confidence was revealed by the teachers in completely clearing any issues of students (M = 4.74) and in a proactive attitude to questions and answers (M = 4.72), which indicates a strong emphasis on open and productive communication in the classroom, with no doubts.

They also scored themselves high in simplifying the slow learners, task supervising, clear instructions, guiding the confused students, and testing prior knowledge, and the results as a whole described very positive self-reported engagement with the students, personalized teaching in science classes, and competent delivery of the concepts.

On 10 questions on a 5-point Likert scale adjusted to classroom management and interaction with the students, 50 secondary school science teachers in Tehsil Dargai responded with a grand mean of 48.80 (average item). The overall perceived practice of high standard was 5-high, with a grand standard deviation of 5.925.

The most rated statement was I maintain discipline in the class (M = 4.68), indicating the greatest self-reported discipline adherence, and the least one, which is I use reinforcement properly (M = 3.94), indicating the relatively weak use of positive reinforcement.

The reinforcement use had the highest variability (SD = 0.956) and the lowest variability was found in I take care of individual differences and give equal attention to all students (SD = 0.578) and this indicates a more consistent response to equitable attention but less uniform to the self-perceptions of the reinforcement strategies.

Discussion

The results of the present research show that the perception of the secondary school science teachers in Tehsil Dargai is positive in the aspects of mastery of subjects taught, lesson planning, student motivation, and interactive teaching style. The high mean scores all indicate the high sense of self-efficacy which can be generally related to effective teaching and enhanced student learning (Bandura, 1997). The confidence of teachers with regard to questioning, clarifying concepts, and dealing with different learners is a characteristic of the correspondence with the student-centered methods of teaching science in the modern education (Hattie, 2009). Nevertheless, the relative low score on the use of reinforcement implies a possible disparity in the application of behavior management techniques that promote student motivation (Emmer & Sabornie, 2015). Moreover, it could be the dominance of male participants that can affect these perceptions, which is why it is necessary to take a cautious generalization. Although the findings represent a very competent teaching force, the self-evaluation could also result in the overestimation of the skills as it has been observed in previous literature on teacher self-assessment (Dunning et al., 2004).

Conclusion

Conclusively, this paper points out that science teachers in the secondary schools in Tehsil Dargai believe they are very proficient in the area of teaching skills, classroom interaction and

classroom management procedures. The high degree of self-reported confidence in the knowledge of the subject, student engagement, and delivery of the concepts is a positive attitude to the profession and indicates the willingness to introduce effective teaching methods. Nevertheless, the relatively low frequency of reinforcement strategies use and gender difference in the sample suggest the aspects that they should address. Besides, since the results are self-evaluated there is a risk of exaggerating what is being really practiced in the classrooms. Thus, the studies conducted in the future need to include more objective data collection methods in the form of classroom observations and student feedback to obtain a more refined view of instructional efficiency of teachers.

Recommendations

It is suggested that focused training activities should be arranged to enhance the application of positive reinforcement methods by teachers in the classroom as it was found to be a relatively weaker point in spite of the relatively high self-perceived competence. This kind of training can contribute to a situation where teachers can be more useful in motivating students and controlling their behavior. Secondary research needs to include a combination of data sets, including classroom observations, student feedback, and self-evaluation to help present a more balanced and accurate evaluation of the instructional methods of teachers and eliminate the risk of the self-report bias.

They should work to make the future research and professional environment more gender-balanced since the existing male dominance might affect the results; inclusiveness can give a more detailed description of the instructional practice among various sets of teachers.

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