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Exploring Elementary School teachers' Pedagogical Content Knowledge: A Quantitative study

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Abstract

Pedagogical knowledge focuses on teachers' expertise regarding instructional methods and content knowledge for their subject area. This study explored elementary school teachers' perspectives on pedagogical knowledge. A quantitative survey was conducted with 100 elementary school teachers. The self-developed questionnaire measured five aspects of pedagogical knowledge on a 5-point Likert scale: pedagogy of inquiry, propositional knowledge, content knowledge, student-teacher interaction, and student-student interaction. Results showed teachers rated inquiry-based and student-centered practices very highly. They strongly agreed that they utilize students' prior knowledge, encourage investigation, focus on concept development, design engaging activities, build thinking through questioning, allow expression of student perspectives, etc. However, peer interaction practices are viewed as less common currently. The overall mean score for pedagogical knowledge was 104.93. Significant gender differences existed as female teachers (M=108.44) had more positive perceptions than male teachers (M=101.42) across all subscales. In conclusion, while teachers were very confident regarding their learner-centric instructional practices, scope exists for further improvement in student collaborative work. Greater emphasis on peer learning and group activities would enrich the classroom environment.

Keywords: *Pedagogical Knowledge, Inquiry-Based Learning, Teacher Practices, Elementary Level*

1. Introduction

Pedagogy refers to the methods and techniques used for teaching any academic subject. It involves teachers' instructional approaches to achieve educational goals and learning objectives. Pedagogical knowledge relates to teachers' understanding of effective ways to teach their subject matter and content area. High-quality teaching is important for student achievement (Guerriero, 2014). Pedagogical knowledge also encompasses teachers' professional competencies, expertise, and grasp of key facts, concepts, and ideas related to student learning. The term "pedagogical content knowledge" is often used synonymously in literature. As originally proposed by Shulman (1986) and further developed by his colleagues and students, teachers need to have specific

methods and skills for teaching any given subject. Subject matter content and pedagogy should be integrated for optimal outcomes. It represents the blending of teaching and learning perspectives. Pedagogical content knowledge also relies on how well teachers relate their pedagogical knowledge to their understanding of the subject matter in order to promote student academic achievement.

Traditionally, teachers have been the center of the educational process. However, modern philosophies focus more on student-centered learning. Students should build knowledge, skills, and attitudes to enable better achievement (Coetzer & Sitlington, 2014). Student success is evaluated not just on teachers' content knowledge and test scores but also on teachers' professional competencies, which play a key role.

Prior research shows teacher pedagogical knowledge positively correlates with student achievement. Teachers' pedagogy can facilitate learning at different grade levels. As Kunter et al. (2011) highlight, teachers with strong content knowledge, especially in mathematics, have a robust effect on academic outcomes. However, Ball and Bass (2000) note that even teachers with adequate pedagogical knowledge may lack the skills to address every student's learning needs in a classroom. While caring greatly for students, taking their perspectives seriously, and building understanding is crucial, professional knowledge also involves developing one's specialized role. Teachers' pedagogical knowledge and instruction are important in improving education (Blömeke & Delaney, 2012).

Researchers have discussed the link between teachers' professional knowledge and student achievement, accounting for factors like family background and prior learning. However, teachers' pedagogical knowledge receives less attention in examining teacher quality. Pedagogical knowledge represents teachers' specialized expertise. For example, Acharya et al. (2017) note that lack of connectivity between mathematical concepts, infrastructure issues, and management constraints were key difficulties in learning mathematics.

It is well-accepted that effective teaching requires a combination of pedagogy and content knowledge. The specific subject matter and curriculum content teachers impart and students learn play definite roles. Teachers skilled in pedagogy understand how students acquire abilities. Guerriero (2014) explains that pedagogical knowledge also necessitates a grasp of social, cognitive, and developmental learning theories and their classroom applications. Thereby, teachers can promote constructive dispositions and thinking patterns.

Research on the effects of teachers' pedagogical knowledge emphasizes that meaningful learning stems from activities and discourse to build conceptual understanding and link concepts to observable phenomena. Similarly, learning remains incomplete if based only on teachers' perspectives on instruction and learning. Teachers need to blend the scope and nature of the subject to achieve its goals. Ultimately, learner interests and capabilities directly impact teachers' content expertise and curriculum integration. Pedagogy and content are vital for quality education and teaching competence (Guerriero, 2014). Teachers' command of subject matter and pedagogical strategies is valuable for professional growth. Pedagogical content knowledge entails multifaceted teaching practices to represent the subject matter.

1.1.Research Objective

1. To explore the teachers' pedagogical content knowledge at the elementary level.

1.2.Research Question

1. What are the elementary teachers' perspectives on pedagogical content knowledge based on gender?

2. Literature Review

Pedagogical content knowledge (PCK) refers to blending content and pedagogy into an understanding of how particular aspects of subject matter are organized, adapted, and represented for instruction (Shulman, 1986). PCK is subject-specific and involves knowing what teaching approaches fit the content and how elements can be arranged for better teaching. Pedagogical content knowledge integrates subject matter expertise and teaching skills for a specific discipline. Various scholars have theorized this concept, but no consensus definition exists (Lowery, 2002; Shulman, 1986). Common ideas denote blending content and pedagogical knowledge, encompassing learning challenges linked to difficult and easy topics (Niess, 2005). Pedagogical knowledge emphasizes teachers' grasp of instructional methods and content for their subject area. Quality teaching enables student achievement (Guerriero, 2014). As Nilsson and Loughran (2012) discuss, pedagogical knowledge has a characteristic dimension built on individual experiences. Integrating content and pedagogy creates specialized understanding, helping teachers explain concepts diversely (Rozenszajn & Yarden, 2015).

Empirical studies assess pedagogical influences on achievement across educational settings using surveys, interviews, observations, and mixed methods (Baumert et al., 2010; Chick et al., 2006) examined student and teacher perceptions of tablets, noting technology impacts teaching practices. Teachers should adopt innovative learner-centered strategies. Pedagogical knowledge also connects to technology integration. He outlines support for teacher development with ICT infrastructure. Alongside, Schofield (2012) suggests pedagogical techniques linked to metacognitive development and student outcomes. Both sound content knowledge and pedagogy are critical for quality instruction per contemporary literature (Blömeke & Delaney, 2012; Guerriero, 2014). Shing et al. (2018) provided an overview of definitions of teaching, indicators, and knowledge bases required for good teaching. Olanoff et al. (2014) presented a research summary of prospective elementary teachers' mathematical content knowledge in fractions. Findings from this summary suggest the need for a broader study of fractions in both content and methods courses for teachers, as well as research into how teachers fraction content knowledge develops.

In Pakistan, teacher quality has gained increasing attention with the universal primary education goal. However, few studies have examined teachers' pedagogical content knowledge. Amirali and Halai (2010) explore patterns in teachers' knowledge about the nature of mathematics in public and private schools in Karachi, Pakistan. As per findings, teachers hold contradicting views about the nature of mathematics, i.e., mathematics as a discovered and invented body of knowledge. On the other hand, teachers expressed a progressive view of mathematics, stating that they considered mathematical knowledge useful for scientific invention and addressing societal issues. A study explored secondary school science teachers' perceptions and practices while teaching science subjects regarding pedagogy for critical thinking (Jamil & Muhammad, 2019; Jamil et al., 2021a, 2021b). Teachers' critical reflective practices were explored in a qualitative study regarding online teaching (Jamil et al., 2022). In the same way, another study explored teacher educators' reflective teaching practices in a multiple case study regarding a teacher training program in Lahore (Saif et al., 2021).

3. Methodology

The current study aimed to determine elementary school teachers' perspectives on pedagogical knowledge in public schools. A quantitative research design was utilized, with self-developed 5-point Likert scale questionnaires for elementary teachers. The target population comprised all 483 elementary teachers across public schools in a district of Punjab province. Using simple random

sampling, the sample included 100 respondents (N=100; 50 males, 50 females) from this teacher population (20%, meeting the 10% minimum (Creswell & Poth, 2016). These teachers were from public elementary schools. The questionnaire measured perceived pedagogical knowledge across five subscales: Pedagogy of Inquiry, Propositional Knowledge, Content Knowledge, Student-Teacher Interaction, and Student-to-Student Interaction, with 24 total items. The instrument demonstrated strong internal reliability ($\alpha = 0.890$).

Table 1: Demographic Information of the respondents

Demographics		Frequency	Percent.
Gender	Male	50	50%
	Female	50	50%
	Total	100	100%
Academic Qualification	F.A	8	8%
	B.A	11	11%
	M.A	67	67%
	Any Other	14	14%
	Total	100	100%
Teaching Experience (Years)	1-10	54	54%
	11-20	24	24%
	21-30	16	16%
	31-40	6	6%
	Total	100	100

The above table is about the demographic information of the respondents. The study had a total of 100 respondents who were teachers. The gender distribution shows an equal number of male (N=50, 50%) and female (N=50, 50%) participants. Most respondents were highly qualified - 67% (N=67) had a Masters degree. 11% (N=11) had a bachelor's degree, 8% (N=8) had completed their F.A., and 14% (N=14) had other qualifications. The sample was comprised mainly of teachers who were relatively new to the profession. Over half (N=54, 54%) had 1-10 years of teaching experience. 24% had 11-20 years, 16% had 21-30 years, while only 6% were experienced with 31-40 years on the job.

Data were analyzed through SPSS 21. Frequency distribution was used for the analysis of respondents' opinions. On the other hand, an independent sample t-test was used to compare respondents based on gender. Descriptive and inferential statistical techniques were used for data analysis. Frequency, mean, standard deviation, and regression were used to meet the study's objectives. To find out the difference based on gender, a t-test was used regarding teachers' and students' respondents.

4. Findings

Table 2: Analysis of Teachers' Pedagogical Practices

Indicator Statement	Mean	SD
Pedagogical inquiry		
Use instructional strategies based on student's prior knowledge	4.69	0.465
Encourage knowledge through investigation and problem solving	4.52	0.611
Focus on creation and exploration of new ideas	4.58	0.496
Design lessons to engage students	4.52	0.559
Clarify basic concepts	4.48	0.522

Pedagogical	Promote conceptual understanding	4.37	0.757
Propositional	Use A.V. aids for comprehension	4.34	0.655
Knowledge	Have a strong command of subject matter	4.46	0.717
Pedagogical	Use daily examples for conceptual understanding	4.52	0.463
Content:	Allow students to make predictions/hypotheses	4.30	0.759
Knowledge	Use varied strategies to involve students	4.35	0.757
Student Teacher	Allow students to reflect their viewpoints	4.42	0.669
Interaction	Accept constructive criticism from students	4.23	0.750
	Develop thinking through questioning	4.63	0.597
	Encourage problem-solving techniques	4.41	0.740
	Encourage active participation	4.55	0.557
	Remain calm and patient	4.43	0.685
	Encourage investigation skills	4.48	0.559
	Good listening skills	4.56	0.556
Student to Student	Students respect each other	4.06	0.930
Interaction	Students respect each other	4.06	0.930
	Students share ideas with peers	4.01	0.882
	Students participate in activities	4.25	0.687
	Students engage in group discussions	3.90	0.959
	Students describe prior knowledge to peers	3.87	0.981

According to the above table regarding pedagogy of Inquiry, teachers showed very high agreement (M>4.50) that they utilize students' prior knowledge to design instructional strategies and activities. They also strongly agreed that they focus on facilitating students' creation and exploration of new ideas during lessons. Encouraging knowledge construction through investigation and problem-solving also received high ratings (M=4.52). As did designing engaging lessons (M=4.52) and clarifying basic concepts (M=4.48). As per pedagogical propositional knowledge, agreement was high (M=4.37-4.46) but slightly lower that teachers promote conceptual understanding, use A.V. aids to improve comprehension, and have adequate command of subject matter knowledge. Accordingly, regarding pedagogical content knowledge, there was very high agreement (M=4.52) that teachers use simple daily examples to help students develop conceptual understanding. Teachers also agreed that they allow students to make predictions and hypotheses (M=4.30) and utilize different strategies to actively engage all students during class (M=4.35). Regarding student-teacher interaction, expressing student viewpoints and developing critical thinking via questioning elicited high agreement (M>4.50). Most other interaction practices, like encouraging participation, remaining patient, building investigation skills, and displaying good listening skills, had high mean ratings between 4.23 and 4.48. All five practices received the lowest agreement ratings among subscales for student-to-student interaction, although they were still moderately high (M=3.87-4.25). The highest means were found for students participating in class activities (M=4.25), respecting peers (M=4.06), and sharing ideas (M=4.01). Students engaging in group discussions (M=3.90) and describing prior knowledge to each other (M=3.87) had marginally lower means. In summary, teachers rated their inquiry-focused and student-centered pedagogical practices very highly. However, student peer interaction practices are viewed as comparatively less common currently.

Table 3: Mean and S.D. of Teachers' Pedagogical Knowledge

Factors	**All**	**Male**	**Female**
Overall			

	N	100	50	50
	Mean	104.93	101.42	108.44
	SD	8.890	9.287	6.949
1. Pedagogy of Inquiry				
	N	100	50	50
	Mean	22.79	22.42	23.16
	SD	1.578	1.458	1.621
2. Pedagogical Propositional Knowledge				
	N	100	50	50
	Mean	13.17	12.86	13.48
	SD	1.491	1.604	1.313
3. Pedagogical Content Knowledge				
	N	100	50	50
	Mean	13.17	12.58	13.76
	SD	1.767	2.091	1.117
4. Student-Teacher Interaction				
	N	100	50	50
	Mean	35.71	34.72	36.70
	SD	3.261	3.586	2.573
5. Student to Student Interaction				
	N	100	50	50
	Mean	20.09	18.84	21.34
	SD	3.373	3.378	2.413

The above table reflects the mean and S.D. of teachers' pedagogical knowledge for the whole, gender-wise sample. The mean value for the whole sample was measured (104.93) while for the male respondents, it was calculated as (101.42). On the other hand, it was measured as (108.44) for the female respondents.

Table 4: Comparison of Teachers' Pedagogical Knowledge based on gender

Gender	N	Mean	SD	Df	T	P
Over All						
Male	50	101.42	9.827	98	-4.280	.000
Female	50	108.44	6.949			
1. Pedagogy of Inquiry						
Male	50	22.42	1.458	98	-2.400	.018
Female	50	23.16	1.621			
2. Pedagogical Propositional Knowledge						
Male	50	12.86	1.604	98	-2.115	.037
Female	50	13.48	1.313			

3. Pedagogical Content Knowledge						
Male	50	12.58	2.091	98	-3.520	.001
Female	50	13.76	1.117			
4. Student-Teacher Interaction						
Male	50	34.72	3.586	98	-3.172	.002
Female	50	36.70	2.573			
5. Student to Student Interaction						
Male	50	18.84	3.738	98	-3.973	.000
Female	50	21.34	2.413			

$p<0.05$

According to the above table, it is clear that there was a significant difference between the t value (-4.280) and *df* (98) at $p<0.05$. It may have resulted in the female counterparts having more perception of pedagogical knowledge than the male respondents.

5. Conclusions

This study explored elementary school teachers' perspectives on pedagogical knowledge across five aspects - pedagogy of inquiry, propositional knowledge, content knowledge, student-teacher interaction, and student-to-student interaction. The self-developed questionnaire measured teachers' self-reported instructional beliefs and practices on a 5-point Likert scale. Regarding pedagogy of inquiry, teachers strongly agreed that they utilize students' prior knowledge to design lessons, encourage investigation and problem-solving, focus on facilitating idea creation, design engaging activities, clarify concepts, etc. However, propositional knowledge practices like promoting conceptual understanding, using audio-visual aids, and having strong content knowledge command elicited slightly lower agreement. Concerning pedagogical content knowledge, agreement was very high that teachers use daily examples and varied strategies to improve conceptual grasp and engage all students. Allowing students to make predictions and formulate hypotheses also received high ratings. For student-teacher interaction, the top-rated practices were developing critical thinking via questioning, encouraging expression of diverse viewpoints, ensuring active participation, displaying good listening skills, building investigatory skills, and remaining patient. Accepting criticism from students and using problem-solving techniques had marginally lower means. Peer interaction activities like respecting others, sharing ideas, participating in groups, and describing prior knowledge to classmates obtained moderately high ratings. However, these practices had the lowest comparative means among subscales. The results showed that teachers rated inquiry-based, student-centered practices highly, including utilizing prior knowledge, encouraging investigation, facilitating idea creation, designing engaging activities, clarifying concepts, etc. However, peer interaction practices received comparatively lower ratings, though still moderately positive. The overall sample mean score for pedagogical knowledge was 104.93 out of 120. Significant gender differences existed as female teachers (M=108.44) reported higher confidence in pedagogical capabilities across all aspects measured

versus males (M=101.42). In summary, while teachers viewed their instructional methods very affirmatively overall, particularly for critical thinking development and active participation facilitation, fostering more collaborative peer learning requires greater emphasis.

6. Discussions

The present study aimed to explore elementary school teachers' perspectives on pedagogical knowledge and practices across five key areas. Findings revealed positive orientations generally towards inquiry-based, student-focused instructional approaches. However, fostering peer collaboration is viewed as comparatively less prevalent currently. Aligning with conclusions of prior research (Guerriero, 2014; Kunter et al., 2011), teachers expressed confidence in their ability to actively engage students via questioning, facilitate conceptual understanding through examples, adapt strategies based on needs, etc. The high ratings for drawing on students' existing knowledge and allowing self-expression validate learner-centric models that emphasize building on prior schemas (Coetzer & Sitlington, 2014). Outcomes also concur with Acharya et al. (2017), confirming elementary teachers' perceived grasp of pedagogical capabilities and content required for quality instruction. However, the marginally lower emphasis on student-peer interaction corroborates the (Schofield, 2012) assertion regarding the lack of explicit focus on developing collaborative abilities. Schofield (2012) and Chick et al. (2006) discuss that adopting innovative learner-centered strategies necessitates students working cooperatively to co-construct knowledge. Integrating more group dialogue and collective meaning-making would enrich learning. The significantly higher pedagogical knowledge reported by female teachers supports Guerriero (2014) finding that female educators may adopt a more "care" oriented approach. Gender socialization inclines women towards facilitative roles valuing emotional bonds. It shapes more affirmative appraisals of relational, student-focused competencies, as observed here. Alternatively, the lower male ratings could stem from overconfidence bias, per Rozenszajn and Yarden (2015) study showing teachers' tacit overestimation of content abilities.

Nonetheless, the present data implies a perceived balance of teacher-directed activities and learner-driven exploration to spark enjoyment and motivation. The use of multimedia aids assists comprehension, though teachers felt equipped regarding content expertise. ICT infrastructure and e-learning can enable ongoing growth (Buabeng-Andoh, 2012). Conclusions underline teachers strongly believe their instructional practices develop critical thinking, leverage prior knowledge, and actively involve students. However, further qualitative research would provide greater insight into pedagogical choices and their reasons (Nilsson & Loughran, 2012). Comparing espoused versus enacted practices can highlight gaps between beliefs and reality. Exploring if contextual constraints like resources, policies, workload, etc., limit the implementation of constructivist approaches teachers ideally prefer would be worthwhile.

7. Recommendations

Based on the findings and conclusions, the following are recommendations of the study:

1. Teachers should receive ongoing training on new instructional strategies and technologies to enhance their pedagogical knowledge and practices.
2. School policies and resources should provide greater support for inquiry-based, constructivist learning approaches teachers prefer, including adequate digital infrastructure, conducive class sizes, flexibility in curriculum implementation, etc.
3. While teachers expressed confidence in content knowledge, opportunities to gain updated exposure to subject matter advancements through conferences, online courses, and peer exchanges should be facilitated to strengthen expertise.

4. Classroom layouts and schedules should allocate more time for collaborative group work, project-based tasks, and co-creation activities under teachers' guidance to underscore the importance of peer interaction.
5. Standardized assessments may need realignment to emphasize higher-order competencies developed through participative learning strategies rather than individual achievement measures.
6. Female teachers emerging as stronger pedagogical role models offer a compelling case for recruiting more women educators in leadership and mentoring roles to propagate affirmative, facilitative instructional cultures.

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