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Fostering Critical Thinking in Pakistani Secondary School Science: A Teacher's Viewpoint

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Abstract: *This qualitative narrative study explored a science teacher's perceptions and lived experiences regarding developing critical thinking skills among secondary school students in Pakistan. An in-depth interview was conducted with a 45-year-old physics teacher with 18 years of teaching experience. The findings revealed that although the teacher recognized the importance of developing Critical Thinking (CT) skills for quality education and lifelong learning, the current teaching practices and examination system focused more on rote learning and passing exams. The teacher suggested using questioning techniques, relating concepts to daily life examples, group work, and hands-on practical activities to promote CT skills. However, large class sizes, lack of training, and pressure to produce good exam results were barriers. The study recommends revamping the exam system to assess CT skills, providing quality teacher training, and creating a supportive school environment. The findings contribute to understanding grassroots-level issues in developing CT skills in Pakistan.*

Key Words: Critical Thinking, Science Education, Teaching Methods, Pakistan, Secondary School

Introduction

It is impossible Critical thinking skills are essential for developing students' logical reasoning, reflective thinking, metacognition, and problem-solving abilities (Cottrell, 2017). These skills empower students to analyze complex information, evaluate evidence, challenge assumptions, make informed decisions, and effectively apply knowledge in real-world contexts (Abrami, 2015). Given the rapid pace of technological change and information explosion in the 21st century, nurturing CT skills has become imperative to prepare students for future success (Jamil, Muhammad, & Qureshi, 2021b). However, research indicates that many secondary school graduates lack the CT skills needed for college and career readiness (Moore, 2013).

In the context of science education, CT skills are particularly important to develop scientific inquiry, logical argumentation, and evidence-based reasoning among students (Susilowati, Sajidan, & Ramli, 2017). Science subjects provide an optimal avenue to cultivate

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CT skills through hands-on activities, open-ended investigations, analysis of experimental data, and emphasis on the scientific method (Jamil, Muhammad, & Qureshi, 2021a; Pervez, Muhammad, & Waqar, 2022). However, science instruction in many developing countries continues to focus predominantly on rote memorization of facts from textbooks rather than meaningful learning and CT skills development (Jamil, Muhammad, Masood, & Habib, 2020; UNESCO, 2016).

In Pakistan's education system, teaching practices at the secondary school level have been criticized for their over-reliance on lecture methods, teacher-centred pedagogy, and focus on summative assessments, resulting in the lack of CT skills among graduates (Halai, 2013; Siddiqui, 2017). Pakistan's national curriculum and education policies have acknowledged the need to reform science education and instructional practices to foster CT skills (NC, 2006; NEP, 2009). However, classroom practices seem to lag behind the vision propagated in policy documents (Jamil & Muhammad, 2019). Recent research also indicates that most science teachers in Pakistan may not have the pedagogical capacity to effectively cultivate CT skills in students during classroom instruction (Ullah, 2017).

Hence, this study aims to bridge an important knowledge gap by exploring science teachers' perspectives, experiences, and challenges regarding CT skills development in secondary school students in Pakistan. Understanding teachers' views will provide critical insights into grassroots-level issues that can inform policy and practice focused on enhancing CT skills through science education in Pakistan's schools.

A significant body of research has examined CT skills development among science students worldwide, yielding important insights into instructional strategies that promote CT skills such as inquiry-based learning, collaborative group work, questioning techniques, concept mapping, and reflective writing practices (Abdi, 2014; Quitadamo & Kurtz, 2007; Tsui, 2002). Researchers have also explored science teachers' attitudes, perceptions, and barriers regarding teaching CT skills (Barak, 2008; Stapleton, 2011). However, most studies have been situated in Western or developed country contexts, while research from developing countries has been underrepresented (Jamil, 2022).

In the Pakistani context, national curriculum documents and education policies have highlighted the importance of cultivating CT and problem-solving abilities among students (NC, 2006). However, few empirical studies have actually examined how secondary science teachers view CT skills development and integrate CT pedagogies into classroom practices. While factors like overcrowded classrooms, lack of facilities, and exam pressures have been identified as barriers to student-centred teaching approaches in Pakistan (Halai, 2013), science teachers' firsthand experiences, perceptions, and proposed strategies regarding CT skills teaching remained underexplored.

Since the empirical gap is significant, exploring indigenous teachers' perspectives can help identify contextually relevant solutions and recommendations that have higher chances of successful implementation (Khan, Hasan, & Clement, 2012). Hence, giving voice to science teachers' views and narratives will provide crucial bottom-up insights to inform policies and practices aimed at enhancing CT skills through reforming science instruction in Pakistan's secondary schools.

This qualitative study aims to bridge this research gap by examining secondary school science teachers' perceptions regarding CT skills development in Pakistan. It explores the following key questions:

1. How do the teachers view the need for and importance of teaching CT skills to secondary students?
2. What pedagogical practices do the teacher currently employ for developing CT skills?
3. What challenges hinder him from fostering CT skills in students effectively?

4. What strategies and recommendations do he propose to integrate CT skill development in science instruction?

An in-depth interview was conducted with a 45-year-old Physics teacher, Muhammad Naveed (pseudonym), at a public secondary school in Pakistan. Naveed has 18 years of experience teaching Physics at the higher secondary level. The detailed interview transcript provided rich, descriptive insights into his perspectives, classroom practices, challenges faced, and suggested solutions regarding CT skills teaching.

The study is situated within the interpretive paradigm, which portrays reality as subjective, constructed through lived experiences, and interpreted within particular social, cultural, and historical contexts (Creswell & Poth, 2018; Crotty, 1998; Thanh, 2015). Hence, the purpose was not to make sweeping generalizations but to holistically and contextually understand how one experienced science teacher makes sense of CT skills development in his particular professional role and school setting (Creswell & Creswell, 2022; Silverman, 2018). The findings provide "thick descriptions" (Geertz, 2008) of the teacher's emic perspectives, practices, and recommendations grounded in his insider viewpoint.

The study makes two key contributions. Firstly, it addresses the empirical research gap by providing in-depth insights into a Pakistani science teacher's perspectives and practices related to CT skills, which have been lacking in existing literature. Secondly, it informs education policy and curriculum development focused on integrating CT skills in science subjects at the secondary level. The teacher's suggestions helped identify contextually suitable strategies, while the challenges highlighted areas for reform efforts to enhance science pedagogy.

Theoretical Positioning of the Research

The study is underpinned by social constructivist learning theories, which posit that meaningful learning occurs when learners are actively involved in constructing knowledge within social contexts rather than passively absorbing it (Vygotsky, 1978). Social constructivism highlights the importance of pedagogical scaffolding, guided participation, discovery learning, and collaborative construction of knowledge (Orlich, Harder, Callahan, Trevisan, & Brown, 2010; Schunk, 2012). These processes align closely with the development of CT skills, which include active reasoning, inquiry, analyzing perspectives, and social negotiation of meaning (Yang, 2008).

The study also draws upon sceptical, pragmatic epistemology, which sees knowledge as arising from practice and direct real-world experience rather than abstract principles (Corbett, 2007). This lens fits aptly because the teacher's knowledge and perspectives about effective CT teaching are derived from his accumulated practical experience in real classroom contexts. As an experienced practitioner, his recommendations can provide contextually relevant solutions.

Moreover, the study applies an advocacy/participatory lens by giving voice to an indigenous teacher's perspectives and practices (Burns, Howard, & Ospina, 2021; Creswell & Poth, 2018). This aligns with the paradigm's emphasis on constructing knowledge by engaging and collaborating with research participants rather than treating them as passive subjects (Creswell & Poth, 2018). Enabling teachers to share their narratives as insiders provide crucial insights often missed in top-down policies and reforms (Burns, Howard, & Ospina, 2021).

Therefore, this study's theoretical positioning enables eliciting a science teacher's knowledge and recommendations grounded in his professional practice and lived experience to inform bottom-up, contextually suitable policies for integrating CT skills in Pakistan's secondary science education.

The study's limitations include a small sample size of one teacher at one school (Yin, 2018). However, the in-depth, information-rich interview elicited perspectives and practices that may resonate with other science teachers in similar public school contexts (Brinkmann &

Kvale, 2015). As an exploratory study, it sets the stage for larger multi-case studies across more schools. Participation was voluntary, and the teacher could have provided socially desirable responses (Miles, Huberman, & Saldaña, 2020). The teacher's narratives, which are rich in nuances and critiques, indicate that he was willing to share his perspectives openly (Marshall, Rossman, & Blanco, 2022).

Overall, the study gathered meaningful insights into indigenous perspectives, often missing in existing literature.

Research Methods

This study utilized a qualitative narrative inquiry approach to gain in-depth insights into a secondary school science teacher's perspectives and experiences regarding CT skills development (Kim, 2015). Narrative inquiry is the process of gathering and analyzing people's stories and narratives to understand how they construct meaning from their lived experiences (Clandinin, 2022). It is effective for understanding teachers' knowledge derived from practical experience in school contexts (Kim, 2015). The teacher's detailed personal and professional narratives provided rich insights into his beliefs, practices, challenges, and recommendations concerning CT skills development.

Participant Selection

Purposeful, criterion-based sampling (Patton, 2015) was used to select an information-rich case that could best illuminate the research questions. The participant chosen was Muhammad Naveed (pseudonym), a 45-year-old Physics teacher with 18 years of experience teaching secondary students at GHS Garh, a public school in Faisalabad district. Naveed's substantial experience enabled him to provide meaningful perspectives grounded in his professional journey. As Clandinin (2022) notes, narrative inquiry benefits from participant stories that offer breadth and depth. Initial access was gained through the researcher's personal contacts. The study's purpose was explained to Naveed, and his voluntary written consent was acquired prior to participation (Wiles, 2012).

Data Collection

In keeping with narrative inquiry methodology (Kim, 2016), data was collected primarily through an intensive one-on-one interview with Naveed, guided by open-ended questions focused on the research objectives. The 90-minute semi-structured interview was conducted in Urdu by the researcher based on an interview guide. It took place at the teacher's school site and was scheduled at his convenience after school hours. The conversational interview centred on eliciting Naveed's personal narratives and experiences regarding a) the significance of critical thinking skills, b) current teaching practices employed, c) challenges faced in skill development, and d) suggested strategies and reforms.

The interview sought to uncover not just factual responses but detailed descriptions of Naveed's beliefs, professional journey, classroom experiences, struggles, and insights related to critical thinking, guided by probes to expand on his narratives (Brinkmann & Kvale, 2018). With the teacher's consent, the interview was audio-recorded and transcribed verbatim in Urdu to retain original meanings before translating relevant portions into English for reporting.

Data Analysis

The interview transcript was analyzed using thematic narrative analysis, which involves identifying key narrative threads, themes, and structures that shape how the experiences are told (Kim, 2016). An iterative process of repeated reading of the transcript was undertaken to immerse in the data and identify salient narrative segments related to the research questions (Clandinin, 2022). These segments were coded into thematic categories using the qualitative data analysis software ATLAS.ti. For example, narrative codes included: "developing conceptual understanding," "activity-based learning practices," "large classes as a barrier" etc. Codes

were compared, contrasted, and refined to uncover connecting threads and patterns in the teacher's narrated experiences, perspectives, and recommendations concerning critical thinking teaching.

Networks and memos were created in ATLAS.ti to explore relationships between thematic codes and extract meaning from the coded narratives (Flick, 2022a; Friese, 2014). Key narrative segments were translated into English and incorporated as illuminating quotes in the findings. The analysis aimed to construct a holistic narrative account or "restorying" (Kim, 2016, p. 196) of Naveed's central experiences, beliefs, challenges, and suggestions concerning CT skill development as a secondary science teacher. Authenticity and trustworthiness of findings were strengthened through reflective journaling, member-checking of the interview transcript, and rich, thick descriptions of the narrated experiences (Clandinin, 2022; Flick, 2022a, 2022b).

Positionality and Ethics

In narrative inquiry, the researcher plays an active role in co-constructing participant's narratives through a relationship of trust (Kim, 2016). At the time of data collection, the first author was positioned as an insider - a science educator from Pakistan has been granted easier access and rapport with Naveed, enabling him to share his experiences openly. Their shared cultural background facilitated mutual understanding. However, being cognizant of researchers' subjectivities was important so their assumptions did not override the participant's voice (Flick, 2022b). Researchers aimed to approach the interview with an open, listening stance, allowing Naveed's narratives to come forth.

Ethical considerations were duly addressed. The study obtained clearance from the Institutional Review Board (Cohen, Manion, & Morrison, 2018; Silverman, 2018). Informed written consent emphasizing voluntary participation and confidentiality was taken from the teacher (Silverman, 2018). Pseudonyms protect the participant's identity (Flick, 2022a). Member-checking of the interview transcript was done to ensure an accurate representation of the teacher's perspectives. Data has been securely stored and will be destroyed after a stipulated time. Close adherence to ethical guidelines was critical for building a relationship of trust integral to eliciting detailed personal narratives from the teacher (Thomas, 2021).

Adopting a qualitative narrative inquiry provided rich insights into an experienced science teacher's perspectives grounded in his professional journey. The findings highlighted important implications for both research and practice focused on enhancing critical thinking through reforming science instruction in Pakistan's schools.

Findings

Thematic narrative analysis of Muhammad Naveed's interview generated rich insights into his perspectives and experiences related to developing critical thinking skills among secondary school science students in Pakistan. Three major thematic categories emerged from his detailed narratives: 1) Significance of critical thinking skills, 2) Current teaching practices, and 3) Barriers and suggested solutions. Relevant quotes from the teacher are incorporated to substantiate the themes.

Significance of Critical Thinking Skills

Naveed's narratives revealed his strong appreciation for the value of critical thinking skills in science education. He defined critical thinking as:

"To me, critical thinking is about developing students' ability to think and analyze independently, beyond just absorbing textbook knowledge. It's cultivating skills to question ideas, draw connections, and create novel solutions. In science specifically, critical thinking means gaining a deeper understanding of concepts rather than memorizing facts. It's the capacity to make inferences, evaluate evidence, and apply the scientific method to new problems. Rather than just recalling definitions, students should learn

the scientific reasoning skills to critically evaluate information and design their own experiments. Critical thinking transforms textbook science into an active process of discovery and logical thinking. It's the difference between students who simply remember scientific facts and ones who can think critically about scientific concepts."

He elaborated that critical thinking enables students to gain knowledge beyond rote learning from textbooks, apply conceptual understanding, think creatively, and develop their own insights.

When asked if critical thinking should be an objective in science education, Naveed asserted: "Yes, it should be. Studying with complete understanding should be the focus. Education should produce thinkers, so the aim of education must be to develop critical thinking."

He believed critical thinking skills are essential to create thinkers rather than passive learners, which should be an aim of quality education. Reflecting on how these skills can be useful, he explained:

"Critical thinking in students helps them make decisions by themselves. Books only have some examples whereas by using daily life examples, teachers can make students focus on creativity and improve understanding of the subject matter."

Naveed highlighted that critical thinking empowers students to apply knowledge for self-directed decision-making beyond textbook examples by relating concepts to real-life situations.

Regarding the need to develop critical thinking in secondary school science students, he asserted:

"Definitely. I believe these types of skills are really important for science students to learn before they graduate. Teachers have an important role to play in helping students develop things like the ability to make decisions and continue learning on their own beyond the classroom. Science in particular is a subject where students need to be able to apply their knowledge in practical ways in their daily lives. So, giving them the tools to keep learning and problem-solve is crucial. I would say there is a considerable need to make critical thinking a priority for science students at the secondary level."

He believed teachers have a key role in fostering critical thinking skills at the secondary stage, which can enable students to engage in lifelong learning and informed decision-making. Discussing its relevance for students' lives, Naveed explained:

"I think if students are just memorizing scientific concepts without seeing how they apply practically, it really limits the benefit of their learning. For example, they might study something like Newton's laws of motion in a textbook, but if they can't then take that knowledge and apply it to things like riding a bike or hitting a baseball, then they aren't getting the full value out of it. The concepts need to be taught in an interactive, hands-on way so students learn how they work in everyday scenarios. That ability to apply science will help them so much more in their daily lives than just memorizing formulas. I want them to really learn the material in a practical, useful way so they can actually use it outside of the classroom."

Naveed stressed that students should be able to apply scientific concepts like laws of motion to real-life situations rather than confining knowledge to textbooks. Being able to think critically about scientific principles can make education relevant and beneficial for students' practical lives.

When asked about the link between critical thinking and quality education in science, Naveed reflected:

"I believe critical thinking skills are vital for quality education, especially if we define quality as deep understanding rather than just memorization. Students at the secondary level are at an age where they need to learn how to make decisions and approach their work with real comprehension. So, there is definitely a dire need to incorporate deliberate critical thinking skill development into science classes

for high schoolers. If students can analyze information, question ideas, and draw conclusions, they'll have a much richer educational experience and really internalize the material versus just memorizing facts. This age group is primed to learn these higher-order skills that are crucial for decision-making down the road. Critical thinking lays the foundation for true quality education."

In his view, meaningful learning with deep conceptual understanding constitutes quality education, for which cultivating CT is essential, especially at the secondary level, as students are developing decision-making abilities.

Overall, Naveed's narratives revealed his strong perceived value of CT as enabling students to achieve conceptual clarity, apply scientific knowledge meaningfully, think creatively beyond textbooks, and develop skills for lifelong learning and informed decision-making. He considered critical thinking abilities to be a vital component of quality education in science.

Current Teaching Practices

Analysing Naveed's described experiences in his physics classroom uncovered some pedagogical practices he employs to promote critical thinking among students, as well as challenges faced in skill development.

When asked how critical thinking can be developed in science classrooms, Naveed responded:

"I think using methods that focus on conceptual understanding rather than just rote memorization is key. Teachers should apply techniques that get students thinking for themselves. For example, after teaching a lesson on energy and work, give students time to reflect on what the commonalities and differences are between those two concepts. Have them think through it and vocalize their thoughts, maybe in a pair or small group discussion. Then ask relevant questions that get them to explain their thinking. This allows them to start differentiating concepts on their own rather than just being told the answers. Over time, with approaches like this that really engage their critical thinking, the students will become independent, skilful thinkers and learners. The goal is to move beyond recitation of facts and have them develop deeper understanding."

He emphasized that teaching should focus on building conceptual foundations. Relevant questioning can trigger students' thinking, for instance, asking them to reflect on similarities and differences between physics concepts like energy and work. Naveed believes this self-directed thinking equips students to identify positive and negative facets of phenomena.

Elaborating further, he explained:

"I really like to use participatory and inquiry-based methods. For example, when introducing a new topic, I'll have students generate their own questions that they have about that concept. This gets them engaged and curious to learn more. I require them to come up with questions from different angles and perspectives - some questions might identify the positives of a phenomenon, others the negatives. This process of articulating their own questions forces them to start critically analyzing the topic. And by having them inquire in an active way, they identify gaps in their knowledge that they want to fill rather than just passively receiving information. I find these participatory, question-driven techniques really effective at activating students' critical thinking and having them engage with the material."

Naveed engages students through participatory techniques like question-answer sessions tailored to the topic being studied, which arouses their curiosity. When probed about an example activity tried with students, he described:

"One activity I like to do is divide the class into two teams and have them complete chapters by asking and answering questions. For example, I'll assign each team a different chapter to read and prepare. Then we'll go back and forth with each team asking questions about the content, and the other team has to answer. If they get the question right, they get a point. This friendly competition really

motivates the students to read closely and think critically about the information so they can win. It engages them in productive analysis of the material in an interactive, game-like way. The students have fun while also sharpening their critical thinking skills by formulating meaningful questions and explaining their knowledge. It's been a great activity to get them actively thinking and learning."

He has students work in teams to prepare chapters and then organize a quiz competition, making learning interactive. Such gamified questioning techniques motivate students positively.

Reflecting on the usefulness of inquiry-based learning, Naveed shared:

"I'd say there is a need for these kinds of approaches in most situations, though not all. As I mentioned before, I regularly use questioning techniques in my own classroom because I find it improves student comprehension and engagement. Asking them to articulate questions and explain their knowledge forces deeper thinking. But of course, certain settings like standardized testing may require more traditional teaching to cover a wide range of content knowledge in a limited time. So while inquiry is incredibly valuable for normal classroom learning, in my opinion, there may be some scenarios where other methods are necessary to achieve specific goals. But in general, I believe techniques like questioning that activate critical thought are of great importance for education. The interactive process sticks with students so much more than passive lecturing. There are few situations where inquiry-based teaching wouldn't be beneficial if implemented well."

While Naveed recognized the merits of inquiry-based approaches, he admitted to using questioning techniques only "in some situations when there is need." This indicates it is not a regular practice.

Regarding hands-on activities, he remarked: "I use few of them. Practicals are conducted in labs to teach the students with hands-on experience, but due to insufficient lab apparatus, all the practicals are not possible in our science laboratory."

Naveed acknowledged the value of activity-based learning "to make the students teach with hands-on experience." However, inadequate lab facilities and apparatus hindered regular practical work. Still, he tries to incorporate some hands-on practicals, sharing:

"Yes, we have dedicated lab sections in our school curriculum. The students are able to actively apply the scientific concepts they've learned through practical experiments. First, the teachers demonstrate and explain the lab techniques and principles. Then the students are able to carry out the labs themselves, with guidance as needed. This "learning by doing" approach through hands-on work really enhances the students' educational outcomes. They gain so much more comprehension and scientific skills from direct experience compared to just passive studying. The practical application cements their knowledge and abilities in a very positive way. Being able to investigate concepts for themselves in the lab, rather than just being told facts, is hugely beneficial for their scientific learning and critical thinking. The labs are an impactful part of our curriculum."

This depicts Naveed's efforts to engage students in laboratory work to facilitate learning by doing despite resource constraints. He also mentioned using diagrams and charts at times as visual aids to explain concepts.

Overall, Naveed's main teaching strategies focused on questioning students to stimulate thinking, relating concepts to everyday examples, team activities like quizzes to promote interactivity, and conducting some practical work despite limited facilities. However, student-centred, inquiry-based pedagogies were not regularly integrated into his practice.

Barriers and Suggested Solutions

Naveed's narratives shed light on multiple challenges confronting his efforts to foster critical thinking skills among students. The

biggest barrier highlighted was the examination system:

"I don't think our current exam system always works in the students' favour, unfortunately. I remember an instance where a physics exam was graded incorrectly, and it really jeopardized the students' academic careers. The examiner had marked the students' correct answers wrong in the board exam when going over the test. It wasn't until the students submitted regrade requests that they realized the right solutions had been unfairly marked incorrect. Situations like this, where exam mistakes can severely hurt students, really need to change. The system needs proper checks and balances to ensure grading is accurate and students are evaluated fairly. Exams are meant to assess true knowledge, but flawed grading practices defeat that purpose. It's so disheartening when a student is wrongfully penalized due to examiner errors. The system needs reform to better support student learning and create an evaluation process that students can trust."

He critiqued the practice of deducting marks for student responses that are unconventional yet logically correct. This compelled students to reproduce model answers rather than apply critical thinking. Naveed felt such flawed exam practices actively impede the development of creative thinking skills.

Another challenge was large classes, as he explained:

"While cultivating critical thinking is crucial, our classes are just too big to implement certain effective techniques. When you have around 100 students in a classroom, it's incredibly difficult to use discussion-based or hands-on activities that promote the analysis and inquiry skills we want. Things like group debates, experiments, or Socratic questioning are just not feasible with so many kids. The large class size really limits how interactive and focused on higher-order objectives we can make the lessons. To enable the kind of teaching that develops strong critical thinkers, we need smaller, more manageable class sizes. With fewer students, I could really target critical analysis and have the time to assess these high-level skills. But in the current environment, we end up focusing on rote memorization just to keep up. For the sake of both students and teachers, class strength should be reduced. It would really open up opportunities to teach the way we know is most effective for growth."

He noted that in classes with over 100 students, techniques like collaborative learning could not be implemented, hindering skills development.

Additionally, pressure from school administration to focus solely on completing the syllabus and securing high pass percentages was a hurdle:

"From my experience, the administration really emphasizes the wrong things - they focus narrowly on metrics like cleanliness, attendance, enrollment, and pass rates. Their concept of "good results" just means getting the maximum number of students to pass exams, even if it's through shallow rote learning rather than meaningful concept building. There's no focus on the quality of education or students' actual understanding. Just having full classrooms and good pass percentages is prioritized over real learning. Critical thinking skills, hands-on learning, deep comprehension - those higher-level goals take a back seat. The administration's attention is completely on those surface-level variables. For them, it's quantity over quality, and deep learning falls through the cracks. I wish they would broaden their focus to see that real "results" mean students who have developed strong foundations in analytical thinking and genuine subject mastery. Those are the outcomes we should be striving for."

The administration's academic focus was on non-educational issues and exam scores rather than meaningful learning. He lamented rote learning being encouraged to obtain high pass rates.

Naveed also described the lack of training for teachers specific to critical thinking strategies as an impediment:

"No, unfortunately not. In my years of service, no officer has ever motivated or promoted cultivating those skills when they visit. Their focus is always on other matters, never on furthering this crucial area. They've never encouraged practices to enhance critical thought or even discussed it. It's simply not been a priority or area of encouragement from the officers I've encountered."

"There was one relevant training back in 2003 that I attended in Lahore run by the Directorate of Staff Development. It was a month-long science teaching course. However, the focus was more on English language instruction rather than explicitly developing critical thinking. Beyond that, in my years of service, there hasn't been any training targeting this concept specifically. Everything has revolved around content knowledge and curriculum, without time spent on how to actively teach thinking skills. I wish we had professional development on best practices for cultivating analysis, inquiry, and problem-solving in students. But so far, the pieces of training have not emphasized critical thinking as a primary theme or given me many tools to purposefully develop those abilities in the classroom. It's an area I'd love to get more guidance on through focused training opportunities."

He had received no guidance from education officers on incorporating CT nor attended any professional training focused on CT pedagogies except one general science workshop in 2003. To address these barriers, Naveed proposed solutions like:

"I've found that just elaborating on textbook content doesn't lead to effective learning. Simply restating the written words from the page is limited in value for students. What's more effective is taking that content and presenting it in my own words and style. Bringing textbook knowledge to life through real-world examples, class discussions, experiments, and open-ended questioning. Engaging students in the material in an interactive way, rather than just verbatim repetition, makes for much richer learning."

This indicates going beyond textbook content transmission through discussion and higher-order questioning. He also recommended:

"I believe teachers need to make use of effective teaching methods that go beyond rote learning. And the school education departments should expand their definition of "good results" beyond just marks and pass rates. They need policies that actively promote critical thinking skills. Because critical thinking is so connected to creativity - it's almost creativity's second name. When students learn to think independently and creatively, they develop the ability to analyze and problem-solve on their own. So the focus needs to shift to teaching in ways that spark students' self-thinking capacities, rather than only preparing them to pass exams. Teachers play a key role in employing creativity-driven methods. And the administration needs to reshape policies to support teaching critical thinking as a crucial goal, not just scoring well on tests. With changes in both pedagogy and policies, we can equip students with the lifelong thinking skills they need to truly excel both in academics and in life."

Here, he advises teachers to use effective pedagogies for critical thinking while the education department should implement policies and assessments supporting creative thinking over rote exam performance.

Naveed's narratives revealed key barriers like flaws in the examination system, large classes, administrative pressures, and lack of professional training in critical thinking instructional approaches. He suggested solutions focused on higher-order questioning techniques, conceptual teaching, and reforms in policies and teacher training to create an enabling environment for critical thinking skills to thrive in science classrooms.

Discussion

This study offered important insights into a Pakistani secondary school science teacher's perspectives and experiences regarding CT skills development. The findings align with

social constructivist principles valuing active construction of knowledge and critical thinking (Vygotsky, 1978). Naveed emphasized promoting conceptual understanding rather than rote learning, relating concepts to students' lives, and using questioning to activate thinking. This resonates with literature highlighting similar instructional strategies to foster critical thinking in science (Abdi, 2014; Zohar, 2003).

However, Naveed's challenges mirrored systematic issues plaguing Pakistan's education system, including flawed examinations encouraging rote memorization, large classes, lack of facilities, and inadequate teacher training (Halai, 2013; Ullah, 2017). The tensions between vision and reality must be addressed to transform classroom practices. Nevertheless, Naveed's efforts to employ interactive questioning, collaborative activities, and hands-on practical work within the limitations indicate his commitment to CT skill development.

As Laursen (2019) notes, teacher-driven initiatives are key to activating successful educational change. Naveed's proposed solutions – higher-order questioning techniques, relating concepts to students' lives, activity-based methods, demonstrative experiments, reforming assessments and providing professional training – can guide context-specific interventions leveraging teachers' insider knowledge.

The study makes key contributions. Firstly, Naveed's perspectives address the empirical knowledge gap concerning secondary science teachers' views on critical thinking teaching in Pakistan. His narratives provide much-needed indigenous insights to complement and complicate policy mandates. Secondly, the findings have important implications for practice and research. For praxis, Naveed's voiced challenges and suggestions can inform context-relevant in-service teacher training, instructional resources, and policy reforms focused on enhancing critical thinking skills through science education.

For research, his lived experiences build an understanding of on-ground realities shaping pedagogical choices, highlighting areas for further inquiry. As Creswell and Poth (2016) note, qualitative studies offer depth and complexity to advance knowledge. Further narrative studies should examine the stories of teachers in differing contexts. Quantitative surveys could also measure the prevalence of critical thinking instructional practices. Longitudinal observations are needed to directly study implementation.

There were some limitations. As a small-scale narrative case study, findings are not generalizable but provide context-rich insights. Using a government school teacher constrained diversity; private schools may differ. However, the in-depth interview elicited a wealth of perspectives, and the study makes valuable contributions within its scope. Overall, engaging with indigenous teachers' knowledge and lived experiences is vital for evolving relevant, context-sensitive reforms to develop critical thinking skills effectively in Pakistan's education system.

Conclusion

This study explored a Pakistani secondary school science teacher's perspectives on developing critical thinking skills among students. The findings provide insights into the teacher's valued beliefs, instructional practices, challenges confronted, and suggested solutions regarding critical thinking teaching and learning.

The study reveals the teacher's strong perceived importance of critical thinking for promoting conceptual understanding, applying knowledge meaningfully, thinking creatively, lifelong learning, and informed decision-making. He considers critical thinking vital for quality science education. However, his narratives uncover gaps between vision and actual practices constrained by systemic challenges like the rote learning-focused examination system, large classes, resource limitations, and lack of teacher training.

Nevertheless, the teacher's proposed solutions offer insights into contextually suitable strategies to bridge this policy-practice disconnect. Recommendations like higher-order questioning, demonstration experiments, in-service training on critical thinking pedagogies, and reforms in policies and assessments can guide practical interventions leveraging teachers' insider knowledge. Teacher-driven, context-sensitive initiatives are key to activating meaningful educational change.

In conclusion, this study makes important contributions by providing rich insights into a Pakistani science teacher's perspectives and experiences regarding critical thinking teaching, addressing a significant empirical gap in existing literature. More such narrative inquiries engaging teachers' voices are needed to inform context-specific reforms. The teacher's narratives also uncover systemic challenges hampering critical thinking instruction, as well as pragmatic solutions, thereby making vital contributions to scholarship and practice focused on enhancing critical thinking through science education in Pakistan's schools.

This small-scale narrative case study is only a starting point. Further qualitative studies should examine teacher narratives across multiple contexts and school types. Larger surveys are needed to determine the prevalence of critical thinking teaching practices. Longitudinal observations can elucidate how policies and training shape classroom behaviours. Nevertheless, listening to indigenous teachers' voices provides crucial insights often missed in policy formulation. Their knowledge and recommendations grounded in practical experience are invaluable for developing context-sensitive interventions and transformative reforms that can bridge the gap between vision and implementation. This is imperative for realizing the aim of developing reflective, creative, and critical thinking abilities among students in Pakistani schools.

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