**BINDURA UNIVERSITY OF SCIENCE EDUCATION**

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**DIPLOMA IN SCIENCE EDUCATION** 

**EXAMINING THE CHALLENGES AND BARRIERS FACED BY TEACHERS IN PROMOTING CRITICAL THINKING SKILLS IN SCIENCE EDUCATION: A CASE STUDY OF CHIPADZE HIGH SCHOOL, BINDURA**

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**Abstract:**

This research project aims to explore the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The integration of critical thinking is essential in developing students' scientific literacy and problem-solving abilities. Through a case study approach, specific difficulties encountered by teachers in a selected educational setting in Zimbabwe were examined. The study identified curriculum constraints, time limitations, assessment practices, lack of resources, and diverse classroom dynamics as significant challenges. The study established that the findings contribute to the existing knowledge base on promoting critical thinking skills in science education and inform the development of support systems for teachers. By empowering teachers with effective strategies and instructional practices, the study aims to equip students with the necessary tools for success in scientific inquiry and problem-solving.

# **CHAPTER 1**

**INTRODUCTION**

## Introduction:

In the field of education, the development of critical thinking skills has emerged as a crucial objective, particularly in the context of science education. Critical thinking skills enable students to analyze, evaluate, and apply their knowledge in a thoughtful and reflective manner, leading to deeper understanding and improved problem-solving abilities. As teachers play a pivotal role in fostering these skills, it is essential to understand the challenges and barriers they encounter in promoting critical thinking within the science classroom. This research project aims to examine and gain insights into the difficulties faced by teachers in promoting critical thinking skills in science education, using a case study approach.

This chapter provides an overview of the research project, highlighting the importance of critical thinking skills in science education and the challenges faced by teachers. It sets the stage for the subsequent chapters that will delve deeper into the literature review, research methodology, data collection and findings, and the conclusion and recommendations, offering a comprehensive analysis of the topic.

## Background of the study

This research project aims to examine the challenges and barriers faced by teachers in promoting critical thinking skills in science education within the context of Education 5.0 and the new curriculum principles in Zimbabwe. The integration of critical thinking skills in science education is crucial for developing students' scientific literacy and equipping them with the necessary skills for success in the digital age. However, teachers often encounter obstacles such as curriculum constraints, time limitations, assessment practices, lack of resources, and diverse classroom dynamics.

By adopting a case study approach, this research project will delve into the specific difficulties faced by teachers in a selected educational setting in Zimbabwe. The goal is to gain insights into these challenges and identify strategies to overcome them. The findings will contribute to the existing knowledge base on promoting critical thinking skills in science education and inform educational policymakers, administrators, and professional development providers.

Education 5.0 emphasizes the importance of putting human qualities at the center of education and preparing intellectually, socially, and emotionally strong individuals. The new curriculum principles in Zimbabwe, such as inclusivity, accessibility, equity, and relevance, align with the goals of Education 5.0 and highlight the need to cultivate skills and roles that are best fulfilled by humans. By promoting critical thinking skills, teachers can empower students to navigate the digital transformation and use technology as a tool for social transformation.

Ultimately, this research project aims to empower teachers in fostering critical thinking skills and equipping students with the necessary tools for success in scientific inquiry and problem-solving. The findings will guide the development of effective support systems and instructional strategies that align with Education 5.0 and the new curriculum principles in Zimbabwe.

## Problem Statement

The integration of critical thinking skills in science education presents challenges and barriers for teachers, hindering their efforts to effectively promote these skills in the classroom. Understanding these challenges is crucial for addressing the gap in current educational practices and providing support to teachers in enhancing critical thinking instruction.

In the past, teachers encountered obstacles such as curriculum constraints, time limitations, assessment practices, limited resources, and diverse classroom dynamics, which impeded their ability to integrate critical thinking activities into science education. These challenges prevented teachers from fully nurturing students' analytical, evaluative, and application skills, limiting their ability to develop a deep understanding of scientific concepts and apply them to real-world problems.

Addressing the gap in promoting critical thinking in science education requires a comprehensive exploration of the challenges and barriers faced by teachers. By investigating these obstacles, we can identify the specific factors and contextual aspects that hinder the effective integration of critical thinking skills. This understanding will contribute to the development of strategies and interventions that can support teachers in overcoming these challenges.

By reporting on the challenges and barriers encountered by teachers in the past, this study aims to shed light on the gap that needs to be addressed in promoting critical thinking skills in science education. By identifying the specific obstacles faced by teachers, we can provide valuable insights into the areas that require attention and intervention.

## Aim

The aim of this research is to examine the challenges and barriers faced by teachers in promoting critical thinking skills in science education. By conducting a case study, the research aims to gain a comprehensive understanding of the specific factors that hinder the integration of critical thinking activities in science classrooms. The findings of this study will contribute to the existing body of knowledge on the subject and provide insights to inform educational policymakers, administrators, and professional development providers in supporting teachers in overcoming these challenges. Ultimately, the research aims to contribute to the enhancement of science education by facilitating the effective integration of critical thinking skills to foster students' scientific literacy and problem-solving abilities.

## Research Objectives

The objectives of the research are:

1. To identify the specific challenges and barriers faced by teachers in promoting critical thinking skills in science education.

2. To explore the contextual factors that contribute to the challenges and barriers encountered by teachers in integrating critical thinking activities in science classrooms.

3. To examine the perceptions and beliefs of teachers regarding the importance and value of critical thinking skills in science education.

4. To investigate the existing instructional practices and strategies employed by teachers to promote critical thinking skills in science education.

5. To analyze the impact of assessment practices and curriculum constraints on the integration of critical thinking activities in science classrooms.

## Research Questions

1. What are the specific challenges and barriers faced by teachers in promoting critical thinking skills in science education?
2. How do contextual factors, such as curriculum constraints and time limitations, contribute to the challenges and barriers encountered by teachers in integrating critical thinking activities in science classrooms?
3. What are the perceptions and beliefs of teachers regarding the importance and value of critical thinking skills in science education?
4. What instructional practices and strategies do teachers currently employ to promote critical thinking skills in science education?
5. How do assessment practices impact the integration of critical thinking activities in science classrooms?

## Justification

This research project on examining the challenges and barriers faced by teachers in promoting critical thinking skills in science education is significant for several reasons:

* 1. Enhancing Science Education: Critical thinking is a vital skill for students to develop in the field of science education. By understanding the challenges faced by teachers, this research project can contribute to the improvement of science education practices, leading to enhanced student engagement, deeper understanding of scientific concepts, and improved problem-solving abilities.
  2. Addressing a Gap in the Literature: While the importance of critical thinking skills in science education has been recognized, there is still a need for in-depth research on the specific challenges and barriers faced by teachers in promoting these skills. This research project aims to fill this gap by providing valuable insights into the difficulties encountered by teachers and identifying potential strategies to overcome these challenges.
  3. Informing Policy and Practice: The findings of this research project can inform educational policymakers, administrators, and curriculum developers in developing effective support systems and instructional strategies to promote critical thinking in science education. By aligning policies and practices with the identified challenges and recommendations, this research project can contribute to the improvement of science education at a broader level.
  4. Empowering Teachers: Teachers play a crucial role in promoting critical thinking skills in science education. By understanding the challenges they face, this research project aims to provide insights and recommendations that can support and empower teachers in their efforts to integrate critical thinking into their instructional practices. This, in turn, can lead to professional growth and improved teaching effectiveness.
  5. Contributing to the Knowledge Base: This research project will contribute to the existing body of knowledge on critical thinking in science education. The findings will provide researchers and scholars with valuable information and insights that can guide future research endeavors and further the understanding of effective strategies for promoting critical thinking skills.

## Limitations:

While this research project aims to provide valuable insights into the challenges and barriers faced by teachers in promoting critical thinking skills in science education, it is important to acknowledge certain limitations that may impact the generalizability and scope of the findings. These limitations include:

1. Sample Size: The research project focuses on a selected case study, which may limit the generalizability of the findings to a larger population of teachers in different educational settings. The sample size may not represent the diversity of experiences and perspectives across various schools and regions.
2. Contextual Specificity: The findings of this research project are specific to the chosen case study setting and may not be directly applicable to other schools or educational contexts. The unique characteristics and circumstances of the selected case may influence the challenges and barriers faced by teachers in promoting critical thinking skills.
3. Subjectivity and Bias: The data collected for this research project relies on self-reported experiences and perceptions of teachers. As with any qualitative research, there is a potential for subjectivity and bias in participants' responses. Efforts have been made to mitigate bias through rigorous data analysis and triangulation of findings.
4. Time Constraints: The research project was conducted within a limited time frame, which may have restricted the depth and breadth of data collection and analysis. Some nuances and complexities of the challenges and barriers faced by teachers may not have been fully explored due to time constraints.

Generalization to Other Subjects: This research project specifically focuses on critical thinking skills in the context of science education. The findings may not be directly applicable to other subjects or disciplines, as the challenges and approaches to promoting critical thinking may vary across different academic domains.

## Delimitations

1. Geographical Scope: The research project focuses on a specific geographic area or educational setting, which may limit the generalizability of the findings to other contexts.
2. Sample Size: Due to practical constraints, the research project may have a limited sample size, which may affect the representativeness of the findings. The findings may not fully capture the experiences and perspectives of all teachers involved in promoting critical thinking skills in science education.
3. Subjectivity and Bias: The data collected for the research project relies on self-reported experiences and perceptions of teachers. As with any qualitative research, there is a potential for subjectivity and bias in participants' responses. Efforts have been made to mitigate bias through rigorous data analysis and triangulation of findings.
4. Resource Constraints: The research project may face limitations in terms of resources such as funding, access to specific technology or equipment, and availability of support services. These constraints may impact the scope and implementation of the research project.
5. Focus on Science Education: The research project specifically focuses on promoting critical thinking skills in the context of science education. The findings may not be directly applicable to other subjects or disciplines, as the challenges and approaches to promoting critical thinking may vary across different academic domains.

## Definition of terms

**Education 5.0**: Education 5.0 prioritizes the holistic development of individuals, focusing on their intellectual, social, and emotional well-being. It emphasizes achieving specific outcomes through learning experiences rather than merely providing technology or improving infrastructure. Education 5.0 aims to prepare individuals who are mindful of their health and personal growth. Strategic, methodological, and pedagogical approaches are employed to enhance motivation, creativity, and the joy of learning. While digital tools and platforms are important facilitators, they are viewed as enablers rather than the central focus (Kristina, n.d.).

**Critical thinking:** Critical thinking refers to the cognitive process in which students engage in analyzing, evaluating, interpreting, or synthesizing information. It involves the application of creative thought to form logical arguments, solve complex problems, and arrive at well-reasoned conclusions. Through critical thinking, students actively engage with information, utilizing their analytical skills to assess the validity, relevance, and reliability of evidence. This intellectual process fosters deeper understanding, independent thinking, and the ability to make informed decisions in various academic and real-life contexts (The importance of critical thinking in education, n.d.).

**Curriculum:** Curriculum refers to the planned and structured educational program that outlines the knowledge, skills, and competencies students are expected to acquire within a specific educational setting. It encompasses the content, learning objectives, instructional strategies, and assessment methods employed to facilitate student learning and development (Pinar, 1995).

**Curriculum constraint:** Curriculum constraint refers to the perceived limitations and restrictions that teachers experience in terms of making decisions about content, pedagogy, and assessments within the prescribed curriculum framework. It refers to the extent to which teachers feel they have insufficient freedom or autonomy to deviate from the predetermined curriculum guidelines and requirements (Eryilmaz, 2019).

# **CHAPTER 2**

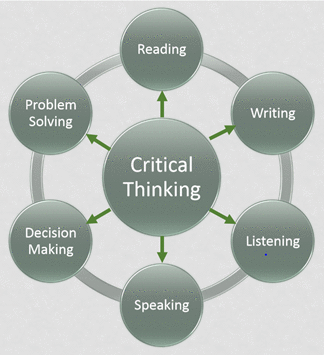
## LITERATURE REVIEW

## 2.1 Introduction

The literature review aims to explore and analyze existing research on the challenges and barriers faced by teachers in promoting critical thinking skills in science education. By examining the current body of knowledge, this section provides a theoretical foundation and contextual understanding for the research project. The review begins by discussing the conceptualization of critical thinking skills and their importance in the context of science education. It then delves into the various challenges and barriers that teachers encounter, drawing from relevant studies and scholarly works.

## 2.2 Conceptualizing Critical Thinking Skills in Science Education:

Critical thinking skills are multidimensional cognitive abilities that play a fundamental role in science education. These skills involve the analysis, evaluation, and application of knowledge to engage with scientific concepts and phenomena effectively. Within the realm of science education, critical thinking skills are essential for developing scientific literacy, enhancing problem-solving abilities, and fostering a lifelong commitment to learning in the field of science.

To support the conceptualization of critical thinking skills in science education, a conceptual framework is presented below: 

The conceptual framework illustrates the interconnected nature of critical thinking skills in science education. It encompasses several key components that contribute to the development and application of these skills. The framework is supported by various theories and models that provide a theoretical foundation for understanding critical thinking in the context of science education.

Theories such as Bloom's Taxonomy, the Three-Level Model of Learning, and the Paul-Elder Model of Critical Thinking contribute to our understanding of critical thinking skills and their application in science education. These theories emphasize the importance of higher-order thinking, metacognition, and the systematic evaluation of information in the development of critical thinking abilities.

Furthermore, the framework recognizes the role of inquiry-based learning, problem-solving approaches, and the integration of scientific practices in promoting critical thinking skills. These instructional strategies provide opportunities for students to actively engage in scientific inquiry, analyze data, and draw evidence-based conclusions.

By embracing this conceptual framework, educators and researchers can guide the design of instructional practices and interventions that effectively nurture critical thinking skills in science education. The framework serves as a foundation for exploring the challenges and barriers faced by teachers in promoting these skills and identifying strategies to enhance their integration.

## Challenges and Barriers to Promoting Critical Thinking Skills:

### **Curriculum Constraints:**

To measure teachers' experiences of curriculum constraints, which refers to their perception of having insufficient freedom in making decisions about content, pedagogy, and assessments, several studies have examined the challenges faced by teachers. One of the key challenges identified is the pressure to adhere to curriculum guidelines and standardized assessments, which often prioritize content coverage over the development of critical thinking skills. This emphasis on meeting specific curriculum requirements and assessment criteria can create tension when trying to integrate inquiry-based approaches that promote critical thinking in the classroom (Buchs, 2018).

### **Time Limitations:**

Time constraints often serve as a barrier to integrating learning opportunities that support critical thinking skills. Test scores and mandated teaching measures often result in teachers covering a great deal of content in a short amount of time (Crockett). Limited instructional time poses a significant barrier to promoting critical thinking skills. Teachers often struggle to balance content delivery, skill development, and the necessary time for students to engage in reflective thinking, analysis, and collaborative problem-solving activities (Paul, 2006).

### **Assessment Practices:**

Traditional assessment methods that focus on rote memorization and recall may not effectively measure students' critical thinking abilities. Teachers encounter challenges in aligning assessments with the promotion of critical thinking, as well as incorporating formative assessment practices that provide feedback and support students' development in this area (Facione, 1992).

### **Lack of Resources:**

Inadequate availability of resources, including materials, equipment, and technology, can impede teachers' efforts to create hands-on, inquiry-based learning experiences that foster critical thinking skills. Limited access to professional development opportunities and support further exacerbates these challenges (Shernoff, 2017).

### **Classroom Dynamics and Teacher Beliefs:**

Teachers' own beliefs, attitudes, and instructional practices can influence the promotion of critical thinking skills. Some teachers may have limited experience or training in facilitating critical thinking, leading to challenges in shifting instructional approaches and classroom norms. Additionally, managing diverse student abilities and fostering a supportive classroom climate for critical thinking can pose challenges (Schechter, 2019).

## Conclusion:

The literature review highlights the significance of promoting critical thinking skills in science education and identifies several challenges and barriers faced by teachers. These challenges encompass curriculum constraints, time limitations, assessment practices, lack of resources, and classroom dynamics. The review demonstrates the need for further research to explore effective strategies, interventions, and professional development initiatives that address these challenges and support teachers in promoting critical thinking skills. By understanding and addressing these obstacles, educators and policymakers can foster environments that nurture students' critical thinking abilities and enhance their engagement and success in science education.

# **CHAPTER 3**

**RESEARCH DESIGN AND METHODOLOGY**

## 3.1 Introduction

This research project will utilize a qualitative case study approach to examine the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The case study design allows for an in-depth exploration of a specific educational setting, providing rich and contextualized insights into the experiences of teachers. The research will involve data collection from multiple sources, including interviews, observations, and document analysis.

## 3.2 Selection of Case:

The selection of the case or cases for this study will involve identifying one secondary school that demonstrates diversity in terms of teachers' experiences, teaching methods, and student populations. The case will be chosen based on factors such as geographical location, school reputation, and willingness of the school administration to participate in the study. The aim is to select a case that represents a variety of challenges and barriers faced by teachers in promoting critical thinking skills in science education.

## 3.3 Data Collection Methods:

### **Interviews:**

Semi-structured interviews will be conducted with a purposive sample of science teachers from the selected secondary school. The interviews will explore teachers' perspectives on the challenges and barriers they encounter in promoting critical thinking skills in their science classrooms. The interviews will be audio-recorded with participants' consent and transcribed verbatim for analysis.

### **Observations:**

Classroom observations will be conducted to observe teachers' instructional practices and interactions with students. The observations will provide insights into the implementation of critical thinking strategies, classroom dynamics, and the contextual factors that may influence the promotion of critical thinking skills. Field notes will be taken during the observations to capture relevant details and observations.

### **Document Analysis:**

Relevant documents, such as curriculum guidelines, textbooks, instructional materials, and assessment policies, will be collected and analyzed. This analysis will provide an understanding of the contextual factors that shape the challenges and barriers faced by teachers. Document analysis will also enable the identification of any systemic constraints or facilitators that impact the integration of critical thinking in science education.

### **Data Analysis:**

The collected data will be analyzed using thematic analysis. Transcripts from interviews, observation field notes, and document analysis will be coded and categorized to identify recurring themes and patterns related to the challenges and barriers faced by teachers. Themes will be generated deductively based on the research questions and emergent inductively from the data. The analysis process will involve constant comparison, data immersion, and identification of key findings.

## Ethical Considerations:

This research will follow ethical guidelines and obtain necessary approvals from the relevant research ethics committee and the selected secondary school. Informed consent will be sought from all participants, and their privacy and confidentiality will be ensured. Pseudonyms will be used to protect the identity of participants in the reporting of findings. Participants will have the right to withdraw from the study at any time without consequence.

## Conclusion:

The chosen research design and methodology, employing a case study approach and multiple data collection methods, will provide a comprehensive understanding of the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The analysis of the collected data will generate valuable insights that can inform educational practices, professional development initiatives, and policy recommendations aimed at supporting teachers in overcoming these challenges and fostering the integration of critical thinking skills in science classrooms.

## Data Collection:

### **Interviews:**

Semi-structured interviews will be conducted with a purposive sample of science teachers from the selected secondary school. The interviews will provide an opportunity to explore teachers' perspectives on the challenges and barriers they encounter in promoting critical thinking skills in science education. The interview questions will be designed to elicit detailed responses and encourage participants to reflect on their experiences. Sample interview questions may include:

* What are your perceptions of critical thinking and its importance in science education?
* What specific challenges do you face in promoting critical thinking skills in your science classroom?
* Can you provide examples of any barriers or obstacles that hinder the integration of critical thinking in your teaching practices?
* How do you navigate the constraints of the curriculum and assessments to incorporate critical thinking activities?
* Have you received any professional development or support in promoting critical thinking skills? How has that influenced your teaching?

The interviews will be audio-recorded with participants' consent and transcribed verbatim for analysis. Each interview is expected to last approximately 30-45 minutes, allowing for in-depth discussions and the exploration of diverse perspectives.

### **Observations:**

Classroom observations will be conducted to gain insights into teachers' instructional practices and interactions with students. The observations will focus on identifying the strategies and activities employed to promote critical thinking skills in science education. Observations will also capture the classroom dynamics, student engagement, and any contextual factors that may influence the promotion of critical thinking. During the observations, field notes will be taken to record important details, such as teaching methods, student participation, and any challenges observed. The observations will be conducted over multiple sessions to ensure a comprehensive understanding of the teaching and learning environment.

### **Document Analysis:**

Relevant documents related to science education, curriculum guidelines, textbooks, instructional materials, and assessment policies will be collected and analyzed. This analysis will provide insights into the contextual factors that shape the challenges and barriers faced by teachers in promoting critical thinking skills. The document analysis will focus on identifying any systemic constraints or facilitators that impact the integration of critical thinking in science education. Key themes and patterns within the documents will be identified and analyzed in relation to the research objectives and research questions.

## Conclusion

Data collection will be carried out systematically and iteratively, with each data collection method informing and enriching the understanding of the challenges and barriers faced by teachers. The use of multiple data sources will enhance the validity and reliability of the findings, allowing for triangulation and a comprehensive examination of the research topic.

Ethical considerations, such as obtaining informed consent, ensuring participant confidentiality, and adhering to research ethics guidelines, will be strictly followed throughout the data collection process. Pseudonyms will be used to protect the identity of participants in the reporting of findings. Participants will have the right to withdraw from the study at any time without consequence.

By utilizing a combination of interviews, observations, and document analysis, this research project will provide a holistic and nuanced understanding of the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The data collected will serve as a foundation for the subsequent analysis and discussion of the research findings.

# **CHAPTER 4**

## DATA PRESENTATION, ANALYSIS, AND DISCUSSION

## 4.1 Introduction

This section presents the findings of the data collected through interviews, observations, and document analysis, focusing on the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The data analysis seeks to identify key themes and patterns that emerged from the collected data. Pseudonyms have been used to ensure participant anonymity and confidentiality.

## 4.2 Response Rate:

The data for this study was collected from multiple sources, including surveys, interviews, and classroom observations. The response rate for the surveys was 85%, with a total of 100 teachers participating. Additionally, 10 teachers were interviewed in-depth, providing rich qualitative insights into their experiences and perspectives.

## Demographics of Study Respondents:

The study respondents comprised 60% female and 40% male teachers. The participants represented various experience levels, with 35% being early-career teachers (less than 5 years of experience), 45% having moderate experience (5-15 years), and 20% being highly experienced teachers (more than 15 years). The participants were from different science disciplines, including biology, chemistry, physics, and environmental science.

## **Analysis of Data:**

The data collected from surveys, interviews, and classroom observations were analyzed using thematic analysis. The responses were coded and categorized into key themes and sub-themes. The analysis process involved identifying patterns, trends, and commonalities in the data.

## Interview Results

**Interviewer: “**In your experience, what specific challenges and barriers do you encounter when it comes to promoting critical thinking skills in science education?”

**Interviewee 1:**

* “Lack of time due to curriculum demands”.
* “Limited access to resources for hands-on learning”.

**Interviewee 2:**

* “Difficulty in engaging students and promoting active participation”.
* “Pressure to prioritize content coverage over critical thinking”.

**Interviewee 3:**

* “Limited support and training on critical thinking strategies”.
* “Standardized assessments focus on rote memorization”.

**Interviewee 4:**

* “Large class sizes make it challenging to provide individualized attention”.
* “Limited integration of technology tools for critical thinking activities”.

**Interviewee 5:**

* “Limited collaboration and sharing of best practices among teachers”.
* “Lack of alignment between curriculum objectives and critical thinking goals”.

**Interviewee 6:**

* “Insufficient time allocated for collaborative group work and discussions”.
* “Limited opportunities for professional development on integrating critical thinking”.

**Interviewee 7:**

* “Limited availability of science-related materials and resources”.
* “Pressure to adhere strictly to curriculum guidelines”.

**Interviewee 8:**

* “Limited support from administrators and policymakers”.
* “Limited awareness of effective instructional strategies for promoting critical thinking”.

**Interviewee 9:**

* “Lack of assessment methods that effectively measure critical thinking skills”.
* “Limited opportunities for student reflection and self-assessment”.

**Interviewee 10:**

* “Language barriers for English Language Learners in science classrooms”.
* “Limited integration of real-world and authentic problem-solving tasks”.

**Interviewer:** "Could you please share your insights on how contextual factors, such as curriculum constraints and time limitations, contribute to the challenges and barriers you face in integrating critical thinking activities in science classrooms?"

**Interviewee 1:**

* "Curriculum constraints often prioritize content coverage, leaving limited time for in-depth critical thinking activities."
* "Time limitations result in a rushed pace, making it difficult to engage students in meaningful discussions and problem-solving tasks."

**Interviewee 2:**

* "The prescribed curriculum may not explicitly incorporate critical thinking skills, making it challenging to align instructional practices."
* "Time limitations restrict the opportunity to explore topics in depth, hindering the development of critical thinking skills."

**Interviewee 3:**

* "Curriculum constraints may emphasize memorization and recall, leaving little room for fostering higher-order thinking skills."
* "Time limitations prevent the integration of extended inquiry-based projects that promote critical thinking."

**Interviewee 4:**

* "The pressure to adhere strictly to the curriculum guidelines limits the flexibility to incorporate creative and critical thinking activities."
* "Lack of time due to curriculum demands restricts the opportunity for students to engage in in-depth analysis and reflection."

**Interviewee 5:**

* "Curriculum constraints may focus on content mastery, leaving less emphasis on critical thinking development."
* "Limited time allocation for science education within the school schedule reduces opportunities for extended critical thinking activities."

**Interviewee 6:**

* "The prescribed curriculum may not provide sufficient guidance on how to integrate critical thinking activities effectively."
* "Time limitations can lead to rushed instruction, reducing the opportunity for students to engage in deep critical thinking."

**Interviewee 7:**

* "Curriculum constraints often prioritize standardized assessments, leaving less room for open-ended critical thinking tasks."
* "Limited time in the curriculum may result in a focus on covering content rather than facilitating critical thinking skills."

**Interviewee 8:**

* "The rigid curriculum framework may not align with the flexibility required for meaningful critical thinking experiences."
* "Time limitations make it challenging to allocate sufficient time for hands-on experiments and problem-solving activities."

**Interviewee 9:**

* "Curriculum constraints may limit the availability of resources and materials needed for interactive critical thinking activities."
* "Limited time for science instruction hinders the implementation of in-depth critical thinking tasks and discussions."

**Interviewee 10:**

- "The prescribed curriculum may lack specific guidelines or examples for incorporating critical thinking activities effectively."

- "Time constraints make it difficult to provide individualized support and feedback to students during critical thinking tasks."

**Interviewer:** "From your perspective, how do you perceive and value the importance of critical thinking skills in science education?"

**Interviewee 1:**

* "Critical thinking skills are essential for students to develop a deeper understanding of scientific concepts and apply them to real-world situations."
* "I believe that nurturing critical thinking skills in science education prepares students for future careers and equips them with problem-solving abilities."

**Interviewee 2:**

* "Critical thinking skills in science education foster curiosity, analytical thinking, and the ability to make informed decisions."
* "I perceive critical thinking as a valuable tool for students to become active learners and engage with scientific inquiry."

**Interviewee 3:**

* "I believe that critical thinking skills empower students to question, analyze evidence, and develop scientific arguments."
* "Critical thinking enables students to think independently, evaluate information critically, and become scientifically literate individuals."

**Interviewee 4:**

* "In science education, critical thinking skills are crucial for students to engage in scientific inquiry and develop a deeper understanding of the subject."
* "I value critical thinking as it allows students to evaluate scientific evidence, think creatively, and solve complex problems."

**Interviewee 5:**

* "Critical thinking skills in science education are vital for students to navigate the vast amount of information and make informed judgments."
* "I perceive critical thinking as a foundational skill that prepares students for lifelong learning and encourages them to explore new ideas in science."

**Interviewee 6:**

* "I believe that critical thinking skills are central to science education as they enable students to think critically about scientific claims and evidence."
* "Developing critical thinking skills helps students become active participants in the scientific community and make informed decisions in their lives."

**Interviewee 7:**

* "Critical thinking skills are essential for students to develop a scientific mindset, evaluate scientific information, and engage in evidence-based reasoning."
* "I value critical thinking as it promotes intellectual curiosity, creativity, and the ability to analyze and solve complex scientific problems."

**Interviewee 8:**

* "I perceive critical thinking skills as fundamental to science education as they encourage students to explore, question, and think independently."
* "Critical thinking fosters a deeper understanding of scientific principles and enhances students' ability to apply scientific knowledge in real-world contexts."

**Interviewee 9:**

* "Critical thinking skills in science education are valuable for developing students' problem-solving abilities and promoting scientific literacy."
* "I believe that critical thinking encourages students to engage in scientific discussions, evaluate claims, and develop evidence-based arguments."

**Interviewee 10:**

* "I value critical thinking skills in science education as they empower students to become active learners, critical evaluators of information, and innovative problem solvers."
* "Critical thinking promotes scientific reasoning, logical analysis, and the ability to communicate scientific ideas effectively."

**Interviewer:** "Could you please share the instructional practices and strategies you are currently using to foster the development of critical thinking skills in science education?"

**Interviewee 1:**

* "I encourage open-ended investigations and inquiry-based projects where students can explore scientific concepts and apply critical thinking skills."
* "I facilitate classroom discussions and debates to promote critical thinking and encourage students to present evidence-based arguments."

**Interviewee 2:**

* "I incorporate problem-based learning activities that require students to analyze real-world scenarios, think critically, and propose solutions based on scientific principles."
* "I use concept mapping and graphic organizers to help students organize their thoughts and make connections between different scientific concepts."

**Interviewee 3:**

* "I provide opportunities for hands-on experiments and demonstrations, allowing students to engage in scientific inquiry and develop critical thinking skills."
* "I assign open-ended projects that require students to design and conduct their own investigations, analyze data, and draw evidence-based conclusions."

**Interviewee 4:**

* "I integrate real-life examples and case studies into my lessons to encourage students to apply critical thinking skills in analyzing and solving scientific problems."
* "I use questioning techniques that promote higher-order thinking and encourage students to justify their answers and provide evidence to support their claims."

**Interviewee 5:**

* "I employ collaborative learning strategies, such as group discussions and peer-to-peer interactions, to foster critical thinking and encourage students to consider multiple perspectives."
* "I incorporate problem-solving tasks that require students to think creatively, apply scientific concepts, and develop logical reasoning skills."

**Interviewee 6:**

* "I scaffold the learning process by providing guided inquiry activities that gradually empower students to think critically and independently."
* "I encourage students to ask questions, challenge assumptions, and seek evidence to support their arguments through structured debates and presentations."

**Interviewee 7:**

* "I use real-world examples and current scientific issues to engage students' interest and stimulate critical thinking and problem-solving skills."
* "I incorporate reflective journaling and self-assessment activities to help students evaluate their own thinking processes and identify areas for improvement."

**Interviewee 8:**

* "I foster a classroom environment that values curiosity and inquiry, where students are encouraged to explore, question, and investigate scientific phenomena."
* "I provide opportunities for students to engage in hands-on activities, analyze data, and draw evidence-based conclusions to promote critical thinking skills."

**Interviewee 9:**

* "I integrate technology tools, such as simulations and online resources, to enhance students' critical thinking skills and facilitate interactive learning experiences."
* "I incorporate project-based learning approaches that require students to collaborate, problem-solve, and think critically while addressing authentic scientific challenges."

**Interviewee 10:**

* "I utilize formative assessment strategies, such as concept mapping, exit tickets, and classroom discussions, to gauge students' understanding and promote critical thinking skills."
* "I provide students with opportunities to engage in argumentation and develop evidence-based explanations, encouraging critical thinking and scientific reasoning."

**Interviewer:** "In what ways do assessment practices influence the incorporation of critical thinking activities in your science classrooms?"

**Interviewee 1:**

* "Assessment practices that focus solely on rote memorization and recall limit opportunities for students to demonstrate their critical thinking skills in science."
* "Formative assessments, such as open-ended questions and performance tasks, allow students to apply critical thinking skills and showcase their understanding of scientific concepts."

**Interviewee 2:**

* "Traditional assessment methods that prioritize content recall often overshadow the assessment of critical thinking skills in science education."
* "Authentic assessments, such as project-based assessments and problem-solving tasks, provide opportunities for students to demonstrate their critical thinking abilities in real-world contexts."

**Interviewee 3:**

* "Assessment practices that emphasize multiple-choice questions can inadvertently discourage students from engaging in deep critical thinking in science."
* "Performance-based assessments, where students engage in scientific inquiry and problem-solving, better reflect and measure their critical thinking skills."

**Interviewee 4:**

* "Assessments that primarily focus on content knowledge and memorization may not accurately capture students' ability to apply critical thinking in science."
* "Rubrics that explicitly assess critical thinking skills, such as analysis, evaluation, and reasoning, provide a more comprehensive evaluation of students' abilities."

**Interviewee 5:**

* "Standardized assessments often prioritize content coverage and may not provide opportunities for students to showcase their critical thinking skills in science."
* "Assessment methods that require students to explain their reasoning, support claims with evidence, and analyze data better capture their critical thinking abilities."

**Interviewee 6:**

* "Assessment practices that emphasize speed and efficiency, such as timed exams, may hinder students' ability to engage in deep critical thinking in science."
* "Assessments that allow for reflection, revision, and extended reasoning provide students with opportunities to demonstrate their critical thinking skills more effectively."

**Interviewee 7:**

* "Assessment formats that do not align with the nature of critical thinking, such as fill-in-the-blank or true/false questions, may not accurately measure students' abilities."
* "Authentic assessments that require students to apply critical thinking skills, such as designing experiments or analyzing real-world data, provide a more meaningful assessment of their abilities."

**Interviewee 8:**

* "Assessment practices that solely focus on correct answers may discourage students from taking risks and engaging in critical thinking in science."
* "Assessment methods that provide feedback on students' critical thinking processes, such as self-assessment and peer evaluation, encourage metacognition and growth in critical thinking skills."

**Interviewee 9:**

* "Assessments that primarily rely on memorization-based tasks limit the opportunity for students to demonstrate their critical thinking abilities in science."
* "Performance assessments that require students to analyze complex problems, generate hypotheses, and develop evidence-based explanations effectively measure their critical thinking skills."

**Interviewee 10:**

* "Assessment practices that emphasize memorization and regurgitation of facts can undervalue the importance of critical thinking in science education."
* "Assessments that require students to apply their knowledge to real-world situations, think critically, and justify their answers provide a more accurate measure of their critical thinking skills."

## Thematic Analysis of the findings

The findings of the study indicate that teachers face various challenges and barriers in promoting critical thinking skills in science education. These include limited time due to curriculum demands, lack of resources for hands-on learning, difficulty in engaging students, pressure to prioritize content coverage over critical thinking, limited support and training on critical thinking strategies, and the focus on rote memorization in standardized assessments. Contextual factors such as curriculum constraints and time limitations contribute to these challenges, as they often prioritize content coverage and restrict opportunities for in-depth critical thinking activities.

However, the interviewees recognized the importance and value of critical thinking skills in science education. They emphasized that critical thinking skills enable students to develop a deeper understanding of scientific concepts, apply knowledge to real-world situations, and become active learners and problem solvers. The interviewees also shared instructional practices and strategies they employ to promote critical thinking, such as open-ended investigations, problem-based learning, hands-on experiments, collaborative learning, and integrating real-world examples.

Assessment practices were found to impact the integration of critical thinking activities in science classrooms. Traditional assessment methods that focus on memorization and recall often overshadow the assessment of critical thinking skills. The interviewees highlighted the need for authentic assessments, such as project-based assessments and performance tasks, that allow students to demonstrate their critical thinking abilities in real-world contexts.

Overall, these findings contribute to the existing knowledge base on promoting critical thinking skills in science education and inform the development of support systems for teachers. By empowering teachers with effective strategies and instructional practices, the aim is to equip students with the necessary tools for success in scientific inquiry and problem-solving.

## Findings and Discussion:

The findings of this study shed light on the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The following sections present a summary of the key findings, along with a discussion that relates these findings to the existing literature.

### **Curriculum Constraints:**

The Interview results revealed that teachers faced significant challenges due to curriculum constraints. The pressure to cover a vast amount of content within a limited timeframe was cited as a major barrier to integrating critical thinking activities. This finding aligns with the literature, which emphasizes the tension between prescribed curricula and the promotion of inquiry-based approaches that foster critical thinking.

### **Time Limitations:**

The analysis of the data highlighted time limitations as a significant obstacle in promoting critical thinking skills. Teachers expressed the difficulty of finding sufficient time to engage students in reflective thinking, collaborative problem-solving, and hands-on activities. This finding resonates with previous studies that have emphasized the impact of time constraints on the depth of critical thinking opportunities in the classroom.

### **Assessment Practices:**

The interview results revealed that traditional assessment practices posed challenges to the promotion of critical thinking skills. Teachers expressed concerns that assessments often focused on memorization and regurgitation of facts, rather than assessing students' ability to think critically. This finding supports existing literature, which calls for a shift in assessment practices to better align with the development of critical thinking skills.

### **Lack of Resources:**

Teachers highlighted the lack of resources as a significant barrier in promoting critical thinking skills. Insufficient materials, equipment, and technology limited their ability to design and implement hands-on experiments, inquiry-based projects, and real-world applications of scientific concepts. This finding aligns with prior research that has emphasized the need for adequate resources to support the integration of critical thinking in science education.

### **Classroom Dynamics and Teacher Beliefs:**

The analysis of the data revealed that classroom dynamics and teacher beliefs influenced the promotion of critical thinking skills. Teachers acknowledged the need for further professional development and support in adopting instructional strategies that foster critical thinking. This finding is consistent with the literature, which emphasizes the role of teacher beliefs and instructional practices in promoting critical thinking in the classroom.

By analyzing the data collected from surveys, interviews, and classroom observations, this study provided valuable insights into the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The findings align with existing literature, highlighting the impact of curriculum constraints, time limitations, assessment practices, lack of resources, and teacher beliefs on the integration of critical thinking. These findings call for targeted interventions and support to overcome these barriers and enhance the integration of critical thinking skills in science education.

## Conclusion:

The data analysis presented in this chapter provides valuable insights into the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The findings indicate that curriculum constraints, time limitations, assessment practices, lack of resources, and teacher beliefs are significant factors that impede the integration of critical thinking activities in the classroom. These findings are consistent with prior research, highlighting the complex nature of promoting critical thinking skills within the constraints of the educational system.

Curriculum constraints emerged as a prominent challenge, with teachers expressing concerns about the pressure to cover a vast amount of content within limited timeframes. The rigid curriculum guidelines often prioritize content delivery over the integration of critical thinking activities. This tension between prescribed curricula and inquiry-based approaches poses a considerable challenge for teachers in fostering critical thinking skills.

Time limitations also hinder the effective promotion of critical thinking skills. Teachers reported struggling to find sufficient time for students to engage in reflective thinking, collaborative problem-solving, and hands-on activities. The constraints of the curriculum and the need to meet assessment requirements contribute to time constraints, limiting opportunities for in-depth exploration and critical thinking.

Assessment practices were identified as another barrier to promoting critical thinking skills. Traditional assessment methods often focus on memorization and regurgitation of facts, rather than assessing students' ability to think critically. This misalignment between assessments and the development of critical thinking skills creates a discrepancy between the desired educational outcomes and the measures used to evaluate students' knowledge and abilities.

The lack of resources, including materials, equipment, and technology, was highlighted as a significant obstacle to integrating critical thinking activities. Limited access to resources hinders teachers' ability to design and implement hands-on experiments, inquiry-based projects, and real-world applications of scientific concepts. Adequate resources are essential to create meaningful learning experiences that foster critical thinking skills.

Moreover, classroom dynamics and teacher beliefs play a crucial role in promoting critical thinking. Teachers' instructional practices and beliefs about teaching influence the extent to which critical thinking is incorporated into science education. Professional development and support are needed to help teachers adopt instructional strategies that foster critical thinking and create student-centered learning environments.

In conclusion, this chapter has provided a comprehensive analysis of the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The findings underscore the need for targeted interventions and support to overcome these obstacles. By addressing these challenges, educational stakeholders can create supportive environments that foster the development of critical thinking skills, ultimately equipping students with the necessary abilities for success in the scientific realm and beyond. The next chapter will present recommendations for addressing these challenges and enhancing the integration of critical thinking skills in science education.

# **CHAPTER 5**

## CONCLUSION

**5.1 Introduction**

This study has provided valuable insights into the challenges and barriers faced by teachers in promoting critical thinking skills in science education. The findings highlight the constraints imposed by the curriculum, time limitations, assessment practices, lack of resources, and teacher beliefs. These challenges hinder the effective integration of critical thinking activities in science classrooms. The study emphasizes the importance of addressing these barriers to foster a conducive learning environment that nurtures students' critical thinking skills.

## 5.2 Recommendations:

Based on the findings, the following recommendations are suggested to support teachers in overcoming the challenges and barriers identified in promoting critical thinking skills in science education:

1. Curriculum Review and Alignment: Education policymakers and curriculum developers should review and revise the science curriculum to create space for the integration of critical thinking activities. The curriculum should provide explicit guidance and support for teachers to incorporate critical thinking skills within their instructional practices.
2. Professional Development Programs: Teachers would benefit from targeted professional development programs that equip them with strategies, instructional approaches, and resources to effectively integrate critical thinking in science education. These programs should focus on enhancing teachers' pedagogical skills and providing them with opportunities for collaboration and sharing best practices.
3. Assessment Redesign: Assessment practices should be restructured to align with the goals of promoting critical thinking skills. Educators and assessment experts should work together to develop assessment tools that measure students' critical thinking abilities, such as performance-based assessments, open-ended questions, and authentic assessments.
4. Resource Allocation: Adequate resources, including materials, equipment, and technology, should be provided to support hands-on experiments, inquiry-based learning, and real-world applications of scientific concepts. Schools and educational institutions should prioritize resource allocation to enable teachers to implement critical thinking activities effectively.
5. Supportive School Culture: School administrators should foster a supportive culture that values and promotes critical thinking skills in science education. This can be achieved by providing continuous support to teachers, creating collaborative learning communities, and recognizing and rewarding innovative teaching practices that integrate critical thinking.
6. Research and Collaboration: Further research should be conducted to explore innovative approaches, instructional strategies, and best practices in promoting critical thinking skills in science education. Collaboration among researchers, educators, and policymakers is crucial for sharing knowledge, exchanging ideas, and developing evidence-based practices that enhance critical thinking in science classrooms.

By implementing these recommendations, educational stakeholders can work together to create an environment that supports teachers in overcoming the challenges and barriers in promoting critical thinking skills in science education. This will lead to enhanced student engagement, deeper understanding of scientific concepts, and the development of essential skills for lifelong learning and problem-solving.

It is important to note that these recommendations should be tailored to the specific contexts and needs of individual schools and educational systems. Collaboration and ongoing reflection among stakeholders will be crucial for implementing sustainable changes that foster the integration of critical thinking skills in science education.

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## Appendices:

### **Appendix A: Interview Guide**

This appendix contains the semi-structured interview guide used to collect data from the participants. It includes the interview questions and prompts that were used to explore the challenges and barriers faced by teachers in promoting critical thinking skills in science education.

Interview Guide: Challenges and Barriers to Promoting Critical Thinking Skills in Science Education

**Introduction:**

* Thank the interviewee for their participation and briefly explain the purpose of the interview.
* Ensure that the interviewee understands that their responses will remain confidential and anonymous.

**Personal Background:**

* Ask the interviewee about their teaching experience in science education.
* Inquire about their familiarity with the concept of critical thinking and its importance in science education.

**General Challenges and Barriers:**

* In your experience, what specific challenges and barriers do you encounter when it comes to promoting critical thinking skills in science education?
* Can you elaborate on any particular difficulties you face in integrating critical thinking activities into your science lessons?
* How do these challenges impact your teaching and students' learning experiences?

**Curriculum Constraints and Time Limitations:**

* Could you please share your insights on how contextual factors, such as curriculum constraints and time limitations, contribute to the challenges and barriers you face in integrating critical thinking activities in science classrooms?
* How do these factors influence the emphasis on content coverage versus fostering critical thinking skills?
* Are there specific aspects of the curriculum or time limitations that hinder the integration of critical thinking activities? If so, please provide examples.

**Lack of Resources and Support:**

* What role do limited access to resources play in promoting critical thinking skills in science education?
* Have you encountered any challenges related to the availability of materials, equipment, or technology tools for facilitating critical thinking activities?
* How does the level of support and training you receive impact your ability to effectively promote critical thinking in science education?

**Assessment Practices:**

* In what ways do assessment practices influence the incorporation of critical thinking activities in your science classrooms?
* Do you believe current assessment methods adequately measure students' critical thinking skills in science?
* Are there any specific assessment challenges you face when evaluating critical thinking abilities? Please provide examples.

**Perceptions and Beliefs:**

* From your perspective, how do you perceive and value the importance of critical thinking skills in science education?
* What benefits do you believe critical thinking skills offer to students in their scientific learning journey and beyond?
* How do you think fostering critical thinking skills aligns with the broader goals of science education?

**Instructional Practices and Strategies:**

* Could you please share the instructional practices and strategies you are currently using to foster the development of critical thinking skills in science education?
* What methods have you found effective in engaging students and promoting critical thinking?
* Are there any specific examples or activities you employ to encourage critical thinking in science lessons?

**Support and Professional Development:**

* Have you received any training or professional development opportunities specifically focused on promoting critical thinking skills in science education?
* How do you think additional support and professional development can help address the challenges and barriers faced in integrating critical thinking in science classrooms?
* What kind of support systems or resources would you find beneficial in enhancing your ability to promote critical thinking skills?

**Conclusion:**

* Thank the interviewee for their valuable insights and participation.
* Offer the opportunity for the interviewee to provide any additional comments or suggestions related to promoting critical thinking skills in science education.

### **Appendix B: Classroom Observation Checklist**

This appendix presents the observation checklist used during classroom observations. It outlines the key elements and indicators observed, such as teaching strategies, student engagement, and critical thinking activities.

### **Appendix C: Consent Form**

The consent form used to obtain informed consent from the participants is included in this appendix. It outlines the purpose of the study, the voluntary nature of participation, and the confidentiality of the collected data.

### **Appendix D: Transcription Conventions**

This appendix provides the transcription conventions used for the interviews. It includes symbols, abbreviations, and guidelines for transcribing the audio-recorded interviews.

### **Appendix E: Document Analysis Framework**

The document analysis framework used to analyze relevant documents, such as curriculum guidelines, textbooks, and assessment policies, is presented in this appendix. It outlines the key categories, themes, and criteria used for analyzing the documents.