



## Science Teachers' Perceptions of Integrating Cirebon Culture into Science Education: A Case Study

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### abstract

The Cirebon culture, a fusion of Sundanese, Javanese, and Islamic components, can be integrated into the science education curriculum. Nonetheless, research on how science teachers understand and utilize cultural integration in their teaching appears to be lacking. This research describes science teachers' understanding of integrating local culture into science education, the problems they face, and the possibilities these perspectives offer for the teaching and learning process. A case study was used, including interviews with science teachers and experts in Cirebon culture. NVivo software was used to analyze the data by coding responses concerning the role of Cirebon culture in science education. Findings from this study show that science teachers appreciate integrating culture into teaching, particularly the use of traditional, folklore, and environmental wisdom as contexts for teaching science concepts. Despite the glaring opportunities, challenges such as modernization, resource limitation, and institutional barriers negatively impact implementation. However, there is an opportunity to develop culture-based science education that responds to the local community, digital technology, and multidisciplinary approaches. This study demonstrates the need for curriculum change, emphasizing the integration of local cultural context without neglecting scientific standards. Integrating Cirebon cultural values allows students to simultaneously appreciate, comprehend, and integrate culture and environmental awareness with science.

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## 1. Introduction

Cirebon is well-known in its culture as the meeting point of Sundanese and Javanese (Hakim & Nabila, 2022). Cirebon's culture is unique. This mixture influences life in everything from language, art, and customs to daily routines. Cirebon's unique culture is the result of the blending of various ethnic groups, religions, and traditions that have interacted throughout history, which has become a fundamental factor in the identification of the people (Iryana et al., 2023). Culture is a dynamic

element that encompasses a people's history and traditions and shapes values, beliefs, and practices (Chibuye & Singh, 2024). This dynamic element influences culture, shaping perceptions and practices of education in value science, underscoring the need to investigate the role of culture in teaching and learning science.

The Indonesian Independent Curriculum also highlights the value of local culture in science education. To link information to students' cultural and environmental backgrounds, this curriculum promotes contextual and project-based learning. Within this approach, culturally responsive teaching and ethnoscience become crucial tools for achieving curriculum objectives. Teachers can create science lessons that are both locally relevant and nationally standardised by utilising local cultural practices as learning tools. Therefore, including Cirebon culture into science instruction is a clear fit with the Independent Curriculum's goal of helping students become more creative, critical thinkers, and culturally aware.

In education, culturally responsive teaching, which treats the local culture of the students as a focal point, has received much attention (Lightner et al., 2021). Unlike most subjects, which are often considered standardized science education, it benefits from incorporating culture because it makes learning relevant (Zidny et al., 2020). Teachers' knowledge is a primary holder of culture in education; therefore, their teaching methods and strategies must incorporate culture (Sotero et al., 2020). Integrating cultural aspects can help teachers better address their students' needs and make lessons more interactive. Similarly, integrating Cirebon cultural values into science education can help contextualize Science within local traditions, fostering increased understanding and appreciation of science and culture (Alghamdi & Malekan, 2020). Understanding teachers' perceptions of Cirebon culture can help them understand the role culture plays in teaching Science and how it can be strategically applied to facilitate learning.

Integrating local culture into science education is especially important in Indonesia, where it is often seen as abstract and disconnected from students' real-world experiences. Students may find it difficult to relate to and understand science if it is presented solely through global notions without referencing local knowledge. Local cultural contexts, such as the customs, art, and ecological practices of Cirebon, can offer students tangible examples that enhance their understanding of scientific concepts. Science becomes more interesting and meaningful as a result of this cultural foundation, which also improves understanding and promotes a sense of identity and pride in regional heritage.

Research on Cirebon culture has focused on ethnographic, artistic, or sociological approaches, even as interest in ethnoscience and culturally relevant approaches to teaching science intensifies (Pratama et al., 2023). Various studies have documented traditional Cirebon art. Examples include the Batik pattern, *Wayang Kulit* (shadow puppetry), and Cirebonese *Gamelan*, which show the culture's rich and diverse history (Dienaputra et al., 2021). Sociological studies have also explored the role of Cirebon culture in identity and social relations (Jihannita et al., 2024). However, few studies have examined science teachers' perceptions of Cirebon culture. This study seeks to answer that by examining how science teachers perceive Cirebon culture when teaching Science. Comprehending how science teachers engage with cultural norms fosters innovative strategies for developing culturally relevant science education frameworks for students in Cirebon, making Science more attainable and enjoyable (Zidny et al., 2021).

The literature lacks studies on the relationship between Cirebon culture and science education. Previous research has extensively analyzed the cultural attributes of Cirebon from historical and sociological lenses. Still, there is a lack of attention regarding science teachers' perceptions of these cultural elements and their instructional approaches. This research aims to provide a glimpse of the

actual practices of science teachers in integrating Cirebon culture by exploring how they construct, reconstruct, and perceive it in their teaching. This focused inquiry underscores the under-explored issue of local cultures in science education, thus advancing teaching practice and theory toward culturally responsive teaching (Sumarni et al., 2022).

Furthermore, this study aims to determine how teachers understand the role of Cirebon cultural knowledge in explaining scientific concepts and if they integrate it into their instructional delivery. This will illustrate the balance between local cultural traditions and scientific instruction, which is recognized as culturally responsive teaching. This study will enable a comprehensive understanding of the factors that shape the learning of Science by identifying the cultural elements brought into the lessons. This study explores Cirebon culture and its relevance in science instruction through the lens of science teachers. This study attempts to fill the gap of integrating culture with ethnoscience pedagogy. To fill this study gap, an exploratory qualitative methodology was deemed most appropriate, as it facilitates a comprehensive knowledge of teachers' perceptions and implementations of cultural integration in their classrooms. The case study design emphasises a small participant group, typical in exploratory educational research, yet offers profound contextual insights into the interplay between local culture and science instruction. The employment of NVivo software enhances analytical rigour through the methodical coding and categorisation of participants' responses. Furthermore, methodological trustworthiness is crucial for ensuring validity and reliability in qualitative research. Methods include triangulation among cultural specialists and scientific educators, member verification of interview transcripts, and the preservation of an audit trail for coding judgements were utilised to bolster trustworthiness. The study adhered to ethical standards by securing informed consent from all participants, guaranteeing anonymity, and emphasising voluntary involvement. These measures underscore the study's dedication to upholding integrity while examining the effective integration of Cirebon culture into science education. Instead of looking into an anthropological or art-oriented survey of culture, this study looks at culture and its relevance for scaffolding ethnoscience curricula.

There are further ramifications for educational justice and sustainability when local culture is emphasised in science instruction. When correctly utilised, Indonesia's cultural variety may be a great educational resource that supports inclusive education for students from different backgrounds. In the instance of Cirebon, integrating traditional ecological knowledge, culinary techniques, and artistic expression into science classes promotes environmental stewardship and cultural identity preservation in addition to academic success. The dual goals of scientific literacy and cultural resilience envisioned by the Independent Curriculum are thus fulfilled by this integration, which guarantees that students are equipped to confront global challenges while remaining grounded in their cultural values.

The study seeks to achieve several objectives: (1) understand Cirebon culture holistically, (2) explore the perception and understanding of Cirebon culture by Cirebon cultural experts and science teachers, (3) study the cultural impact regarding science education, and (4) investigate the problem and prospect of culture in teaching Science in Cirebon. Resolving the research objectives discussed above may help develop culturally appropriate science education that considers the students' backgrounds and experiences. To fulfill these goals, the study will seek to answer the following research question: What are the perceptions and understandings of Cirebon culture among science teachers in education? What is the impact of Cirebon cultural values on teaching Science in the schools? What are the possible problems in teaching Science from the perspective of the Cirebon culture concerning integration? What are the possible Cirebon cultural values that can be integrated into the teaching curriculum and science instruction? The study will collect data from

cultural experts and science teachers in Cirebon. Their perspectives will help explain how Cirebon culture features in the teaching of Science and what can be done to improve the infusion of culture into teaching, including Science.

Consultation with cultural experts will advance the understanding of how Cirebon cultural values and knowledge systems relate to scientific ideas and concepts. Perspectives from other science teachers will demonstrate how other cultural ideas can be integrated into classroom teaching and learning (Parmin et al., 2022). Addressing these concerns will help address the gap in research on ethno-science and education that responds to the culture, thereby broadening the scope of teaching Science in Cirebon and other places. Moreover, the study's results could affect the implications of science education in other ethnically diverse parts of the world, serving as a prototype for incorporating indigenous knowledge systems into science teaching around the globe. This study analyzes factors of science teaching and its specific practices to bring positive changes to science educational policies with culturally relevant frameworks, including local knowledge systems, while advancing students' understanding of science concepts (Wiyarsi et al., 2023).

## **2. Method**

A case study design is used in this research to investigate the perceptions and integrations of Cirebon culture among science teachers and cultural experts (Permana & Sriyati, 2021). The case study approach is the best design option for examining intricate social issues because it enables the researcher to comprehend the relationship between cultural principles and science education deeply (Tauhid et al., 2024). The study aims to provide detailed descriptions useful in practical situations by concentrating on a particular region and a limited number of participants. The participants in this study are selected using purposive sampling to include only individuals who have firsthand knowledge and understanding of Cirebon culture and science education (Hidayanti et al., 2018). To ensure validity and reliability, this study employed triangulation by comparing data from cultural experts and science teachers. Member checking was conducted by returning transcripts to participants for confirmation, and an audit trail of coding and analysis decisions was maintained to enhance transparency and rigor.

This study is conducted with six participants, including three cultural experts who are well-versed in the traditions, values, and practices of Cirebon and three science teachers who employ culture in their teaching. The science teachers were in their early thirties to early forties, with teaching experience ranging from 7 to 15 years. They represented schools located in urban, suburban, and rural areas of Cirebon, allowing diverse perspectives from different teaching contexts. The cultural experts, aged between their mid-forties and early sixties, included individuals involved in cultural preservation, local history, and traditional arts, all of whom had long-standing engagement with Cirebon cultural practices. Cultural experts are selected based on their involvement in cultural preservation, academic research, or community work concerning Cirebon culture. Besides, the focus science teachers are those aware of culturally responsive pedagogy or have attempted to use culturally relevant materials in teaching science. This pedagogical approach to the discipline assists with developing a constructive understanding of the research. There are no gaps in the sample selection because all methods will provide relevant and valuable information that meets the study's objective. The science teachers ranged in age from their early thirties to early forties, with 7–15 years of teaching experience, and represented schools in urban, suburban, and rural areas. The cultural experts ranged from their mid-forties to early sixties and had backgrounds in cultural preservation, local history, and community art.

The rich qualitative data is attained through semi-structured interviews with each participant, conducted personally (Siegener & Stapert, 2020). The interview guide was semi-structured, consisting of open-ended questions that allowed participants to share detailed perspectives while giving the interviewer flexibility to explore emerging themes. The guide was developed based on previous studies in ethnoscience and culturally responsive teaching (Zidny et al., 2020; Pinneo & Benton, 2023), and then adapted to the specific context of Cirebon culture and science education. This method provides the needed versatility by allowing the researcher to develop additional relevant questions beyond what was initially captured in the interview guide. The interview guide was developed based on previous ethnoscience and culturally responsive teaching studies and then adapted to the Cirebon context. The discussion guide consisted of questions that aimed at understanding participants' perceptions of Cirebon culture, its significance in the context of science education, the methods of culturally responsive pedagogy they attempt to implement, and the obstacles encountered in the process. This approach enables participants to share detailed accounts of how cultural aspects influence their teaching practice, thereby capturing the essence of their narratives.

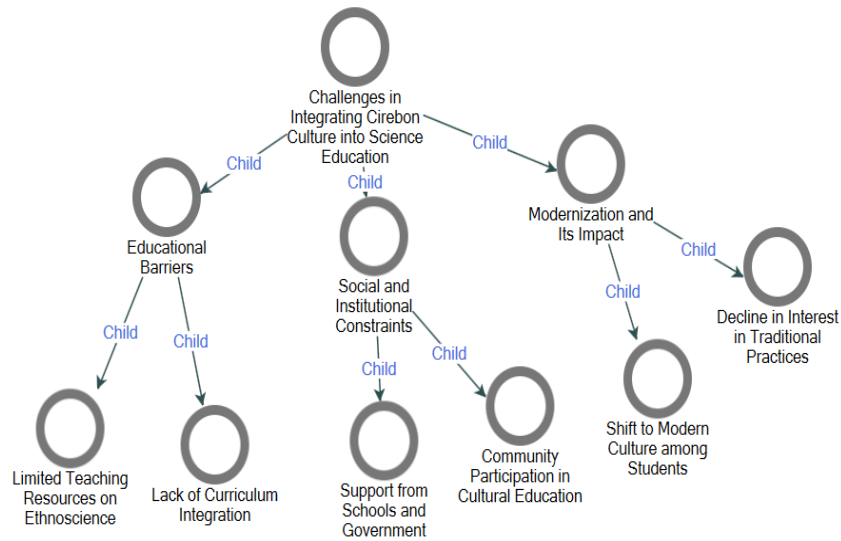
All interviews are conducted one-on-one, digitally recorded with the participant's permission, and transcribed verbatim for analytical purposes (Creswell & Poth, 2016). Data were analyzed thematically using NVivo 15 to code and categorize interview transcripts. The study was divided into many stages, including data familiarisation, initial coding, category identification, and the formulation of overarching themes about teachers' attitudes and practices. To improve the credibility of the findings, triangulation was used to compare data from both scientific teachers and cultural experts, ensuring that themes were not dependent on a single source of information. In addition, member verification was carried out by sending transcripts and tentative interpretations to participants for confirmation. To ensure consistency in coding and interpretation, a second researcher reviewed the coding system, thereby increasing inter-rater reliability. An audit trail recording coding decisions and analytical procedures was kept to ensure transparency throughout the analysis process.

Utilizing this methodology, the research undertakes a detailed and comprehensive analysis of Cirebon culture in the context of science education. The case study approach captures the phenomenon within its context, while purposeful sampling guarantees the inclusion of participants with adequate specialized knowledge. The semi-structured interviews provide an exploration of participants' perceptions, whilst NVIVO15, as a qualitative data analysis tool, improves the credibility of the research (Fahmi et al., 2022). Within this framework, the research seeks to respond to the local framework instructional model focus on science education, culture integration, and significant teaching difficulties. Ethical clearance was obtained from [insert institution], and informed consent was collected from all participants. Participation was voluntary, and participants used pseudonyms to ensure confidentiality.

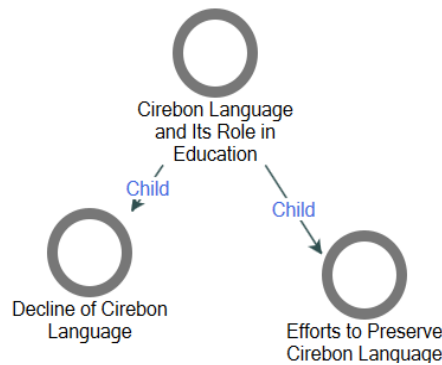
### **3. Result and Discussion**

Integrating Cirebon culture into science teaching poses opportunities and challenges for cultural experts and science teachers. In this part, an analysis and description of how cultural values from Cirebon, its history, and local wisdom inform science education through the lens of cultural experts and Science teachers interviewed for the research. The discussion initially focuses on cultural experts' views, as they explain Cirebon's culture in detail, its educational value, and the difficulties associated with preserving traditional knowledge systems. Following this, the analysis shifts to the science teachers' perspective to examine how these cultural aspects operate in practice, the





**Figure 2a.** Project Map of cultural challenge



**Figure 2b.** Project Map of Cirebon language

The project map from NVIVO illustrates the key themes and child codes that emerged from the cultural expert interviews. These themes provide valuable insights into the role of Cirebon cultural values, particularly in the context of education and science teaching. Figure 2a. Visualizes the key challenges in integrating Cirebon culture into science education, categorized into initial codes and their corresponding child codes. The principal initial codes identified are Educational Barriers, Social and Institutional Constraints, and Modernization and Its Impact, each with its own set of child codes representing specific issues within these broader themes. Generally, the project map illustrates that incorporating Cirebon culture into science teaching frameworks is mainly affected by resource gaps, organizational barriers, and modern influences. Solving these problems is the duty of teachers, decision-makers, and society. One of the primary initial codes is Educational Barriers, which includes two child codes: Limited Teaching Resources on Ethnoscience and Lack of Curriculum Integration. These barriers highlight educators' difficulties in incorporating Cirebon's cultural knowledge into science education (Gandolfi, 2024). Teachers may struggle to deliver lessons that effectively integrate ethnoscience concepts without adequate teaching materials. Additionally, the absence of structured curriculum integration limits students' systematic and meaningful exposure to traditional knowledge, making it harder to bridge the gap between Indigenous Science and modern scientific principles (Pinneo & Benton, 2023). The findings suggest that modernization has led to a gradual disengagement of students from traditional practices.

The project map Figure 2b. NVIVO clearly represents the relationships between primary and child codes related to the "Cirebon Language and Its Role in Education" project. The initial codes, or parent nodes, include Cirebon Language and Its Role in Education, Decline of Cirebon Language, and Efforts to Preserve Cirebon Language. In the analysis, the Cirebon Language and Its Role in Education node functions as the overarching theme connecting the issues of language decline and preservation efforts. These findings suggest a need for more structured educational strategies and community involvement to maintain the vitality of the language for future generations. The connections between decline and preservation efforts further underline the challenges and potential solutions in this ongoing cultural preservation endeavor (Marosi et al., 2021).

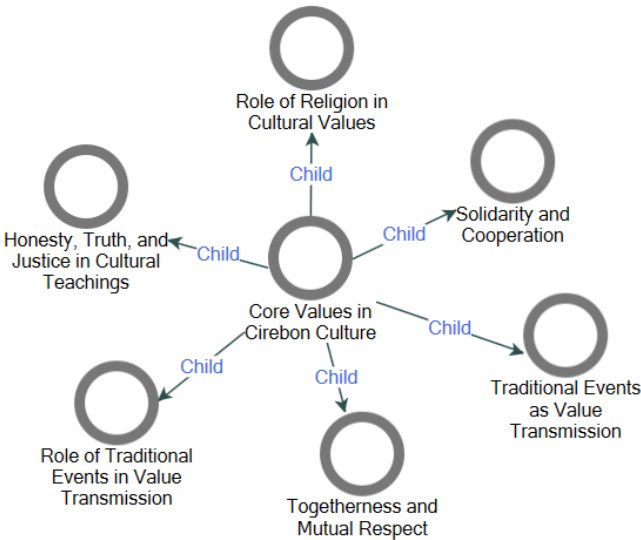


Figure 3a. Project Map of core value

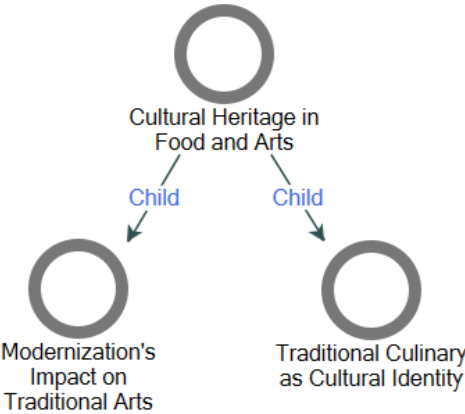


Figure 3b. Project Map of cultural heritage

Figure 3a. the central node, Role of Religion in Cultural Values, represents the fundamental connection between Cirebon culture and the religious teachings that influence it. Religion plays a significant role in shaping cultural values and is often intertwined with moral and ethical teachings. This node is subdivided into child codes such as Honesty, Truth, and Justice in Cultural Teachings,

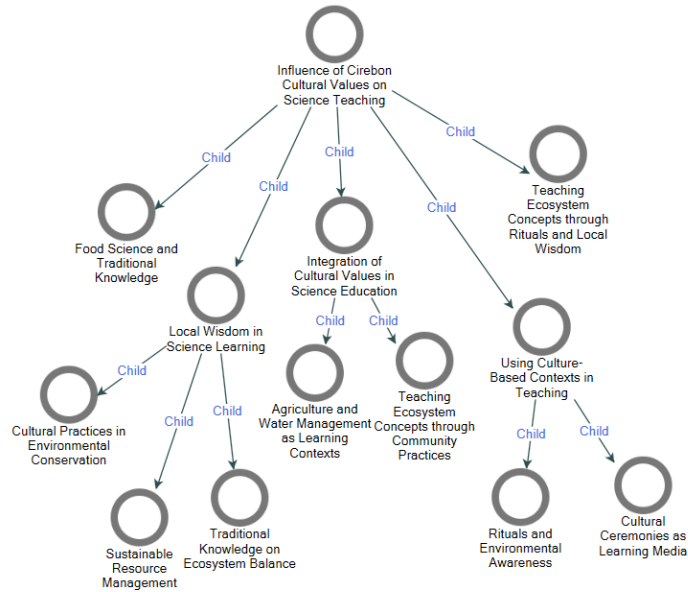
which reflect the moral values rooted in Cirebon culture that guide the actions and behavior of individuals within the community. Science teachers noted that these cultural values, influenced by religious teachings, could be integrated into the science curriculum to foster a more holistic approach to education (Macdonald et al., 2024).

Another child node emphasizes the importance of communal values and collaboration in Cirebon society. These values are highly regarded and seen as a source of strength for the community, fostering teamwork and mutual support. Science teachers mentioned that incorporating these values into science education could enhance collaborative learning environments, where students work together to solve problems and share knowledge. The node Core Values in Cirebon Culture delves deeper into the central values that define Cirebon culture. This node includes child codes such as Togetherness and Mutual Respect, reflecting the profound unity within Cirebon society. Science teachers highlighted that these values could significantly create a respectful and inclusive classroom learning environment. By promoting mutual respect and togetherness, science teachers can help foster a more harmonious and conducive atmosphere for learning (Vita et al., 2024).

These results correspond with the first and second research questions; the analysis shows that science teachers consider Cirebon cultural values central to students' character formation and behaviors, influencing the teaching and learning process. Values of honesty, respect, cooperation, and others can be integrated into the curriculum to ensure that students appreciate Science as a discipline and cultural heritage. To sum up, the NVIVO project map displays how Cirebon cultural values impact the teaching of Science and is a helpful tool for navigating the relevance of these values.

The NVIVO project map is shown in Figure 3b. presented here highlights key themes related to the cultural heritage of Cirebon, explicitly focusing on Cultural Heritage in Food and Arts. These themes are particularly relevant to the research title as they provide insight into how Cirebon's cultural values, particularly its traditional food and arts, are perceived by cultural experts and science teachers in Cirebon. The initial node, Cultural Heritage in Food and Arts, captures how Cirebon's traditional cultural elements, such as food and arts, shape local identity. This theme is essential for understanding the broader cultural framework science teachers may seek to integrate into education. Two key child nodes under this central theme are Modernization's Impact on Traditional Arts and Traditional Culinary as Cultural Identity.

Science teachers recognized that traditional Cirebon cuisine could be an engaging tool to introduce students to local culture, as it embodies cultural stories, practices, and values. This aligns with the second research question, as traditional culinary practices can be a creative and effective way to integrate cultural values into science education, particularly in subjects related to biology, chemistry, or environmental Science. In conclusion, the NVIVO project map highlights the intricate relationship between Cirebon's cultural heritage in food and arts and its implications for science education. The challenges posed by modernization and the need to preserve traditional arts emphasize the difficulties in integrating cultural elements into the curriculum, as explored in the third research question.



**Figure 4.** Project Map of Influence of Cirebon Cultural Values

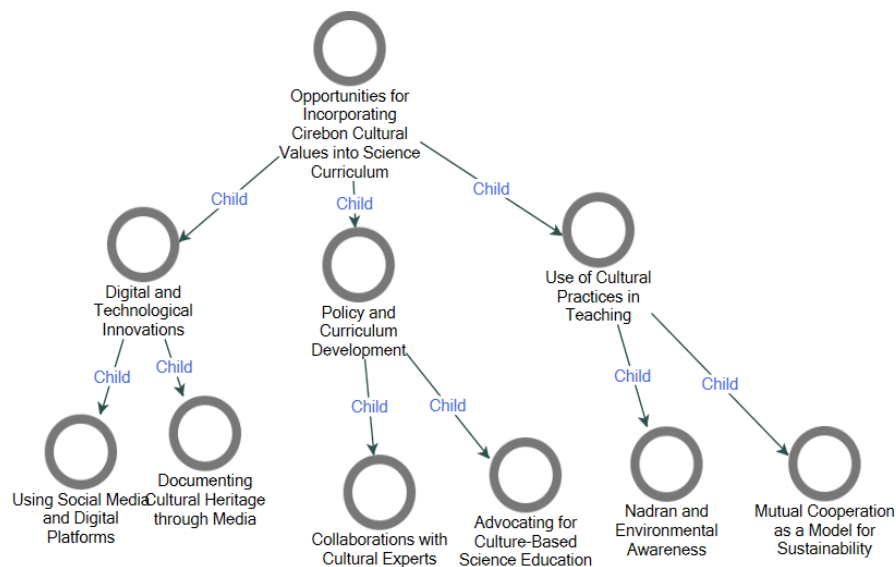
The NVIVO project map in Figure 4. presents a thorough breakdown of how Cirebon Cultural Values influence science teaching, explicitly focusing on food science, local wisdom, and environmental conservation. These insights are essential to understanding the integration of Cirebon culture into science education, which aligns with the research. This analysis also responds to the research questions, particularly the second, third, and fourth questions, which explore how cultural values influence science teaching, the challenges science teachers face in integrating Cirebon cultural perspectives, and the opportunities for incorporating these values into the curriculum.

The first child node, Food Science and Traditional Knowledge focuses on the knowledge that Cirebon people have traditionally used in food science and agricultural practices. Cultural experts and science teachers noted that traditional knowledge about food preservation, local ingredients, and cooking methods could be valuable in teaching scientific principles such as chemistry, biology, and nutrition. This is a direct opportunity to enrich science education with culturally relevant examples, making Science more relatable and grounded in local practices (Lloyd & Paige, 2022). This links to the second research question: "How do Cirebon cultural values influence science teaching in schools?" Science teachers can use traditional food science to demonstrate scientific concepts while preserving cultural heritage.

The second child node under this central theme is the Integration of Cultural Values in Science Education. This node discusses how Cirebon cultural values can effectively integrate into the broader science curriculum. It suggests that teachers can draw upon local wisdom in science learning, emphasizing the knowledge and practices passed down by generations. This local wisdom, such as understanding natural cycles, plant use, and ecological balance, can be integrated into environmental science lessons (Khery et al., 2025). Furthermore, Agriculture and Water Management as Learning Contexts emphasizes incorporating sustainable practices traditionally used in Cirebon, like local farming and water management systems, into science lessons (Fitria et al., 2025). Teachers identified these cultural contexts as necessary for teaching sustainable practices, such as eco-friendly farming techniques, water conservation, and resource management.

Additionally, the child node teaching ecosystem concepts through rituals and local wisdom highlights how local rituals, deeply embedded in Cirebon culture, can be utilized to teach ecosystem concepts. For instance, certain cultural practices related to rituals, such as those related to agricultural cycles or environmental stewardship, can be linked to science topics like ecology, conservation, and biodiversity (Nyblade et al., 2024). This presents a unique opportunity for integrating Cirebon culture into environmental science education by using rituals and ecological awareness as learning media. Teachers mentioned that using local cultural ceremonies as part of the curriculum could spark students' interest in Science by framing it in a context they can relate to personally and culturally.

Finally, using culture-based contexts in teaching and the child node cultural ceremonies as learning media emphasizes the educational value of local cultural ceremonies and practices (Tegegne et al., 2025). Science teachers noted that these ceremonies, often associated with significant cultural events, can be used as teaching tools to explain broader environmental or scientific concepts. For example, ceremonies that involve seasonal agricultural practices or community gatherings tied to nature can be explored to teach students about the cycles in nature, sustainability, and human-environment interactions. In conclusion, the NVIVO project map reveals that integrating Cirebon's cultural values into science education enriches students' learning experiences and helps preserve and promote local heritage. These findings are aligned with the third and fourth research questions, "What challenges do science teachers face in integrating Cirebon cultural perspectives into science education?" and "What opportunities can be utilized to incorporate Cirebon cultural values into the curriculum and science teaching?" Teachers face challenges finding appropriate resources and curricular support, but the opportunities to integrate food science, local wisdom, and cultural rituals into the science curriculum are substantial. By utilizing these cultural contexts, educators can enhance the relevance and engagement of science education while fostering a greater appreciation for local heritage and sustainability practices.



**Figure 5.** Project Map of opportunities for incorporating Cirebon Culture

The NVIVO project map is in Figure 5. focuses on the opportunities for incorporating Cirebon's cultural values into the science curriculum, which is a key component in understanding how Cirebon's cultural heritage can influence science education. This aligns with the research

examining how science teachers perceive and understand Cirebon culture in the context of education and how these cultural values can be integrated into teaching practices. This map also aligns with the research questions regarding the challenges and opportunities science teachers face in incorporating Cirebon cultural values into science teaching. The initial code opportunities for incorporating Cirebon cultural values into science curriculum is at the center of this analysis, which addresses how Cirebon culture can be woven into science lessons. The child nodes under this theme present several avenues for integration, and they reflect how cultural values can be adapted to modern teaching methodologies and how science education can be enriched by incorporating local culture. The first child node, digital, and technological innovations, illustrates the potential for using digital tools and platforms to document and promote Cirebon's cultural heritage. With the rise of technology, cultural experts and science teachers believe that digital platforms, such as social media, can effectively document and share Cirebon's cultural knowledge. This addresses the fourth research question: Can digital platforms offer innovative ways to share local knowledge and integrate cultural practices into the science curriculum? The second major child node, Policy, and Curriculum Development, emphasizes the need for institutional support in incorporating cultural values into the science curriculum.

Finally, the node use of cultural practices in teaching reflects how cultural practices can be used as learning tools in science education. The child nodes *Nadran* and environmental awareness and mutual cooperation as a model for sustainability which highlight specific examples of Cirebon cultural practices that can be integrated into science lessons. *Nadran*, a traditional Cirebon ceremony, is often centered around community participation and environmental conservation, which can be linked to lessons on ecosystem balance, sustainability, and environmental science. mutual cooperation, another key cultural value, promotes collaboration and collective responsibility, which can be translated into group work and community-based ecological education projects (Zidny & Sjöström, 2021). These cultural practices provide concrete examples of how Cirebon's cultural values can influence scientific thinking and sustainability education, offering unique opportunities to engage students with cultural heritage and scientific principles.

In conclusion, the NVIVO project map highlights several opportunities for integrating Cirebon cultural values into the science curriculum. Using digital platforms, collaborations with cultural experts, and incorporating local cultural practices into teaching can enrich the science education experience and promote a deeper connection between students' cultural identities and the scientific concepts they are learning (Johnson, 2024). These findings directly address the second, third, and fourth research questions by identifying the opportunities and challenges in integrating Cirebon culture into science teaching and offering pathways for teachers to incorporate local cultural values into their curriculum. By integrating Cirebon culture into science education, teachers can create a more holistic and contextually relevant learning environment that fosters academic and cultural growth (Lange et al., 2025).

**Table 1.** Cirebon's cultural content is related to the science content based on cultural expert interview

No	Science Content	Description
1	Chemical and biological processes in traditional foods	Traditional foods in Cirebon utilize local ingredients, linking the study of chemistry and biology to cultural practices.
2	Cultural practices as learning tools for environmental science	Rituals and community practices like <i>Nadran</i> and other ceremonies highlight environmental awareness and conservation.
3	Sustainable resource management	Traditional knowledge, including sustainable management of resources like water, land, and plants, exemplifies eco-friendly practices.
4	Chemical and biological processes in traditional foods	Traditional foods in Cirebon utilize local ingredients, linking the study of chemistry and biology to cultural practices.

As seen in Table 1, those project maps illustrate the interconnected relationship between Cirebon's cultural values and science education. The primary theme is the integration of Cirebon cultural values into the science curriculum, where cultural practices such as *Nadran* and cooperation serve as tools for teaching scientific concepts like sustainability and ecosystem balance. However, challenges such as limited resources and a lack of curriculum integration hinder the inclusion of local culture in science education. Despite these barriers, opportunities exist through digital platforms for documenting and sharing cultural heritage and collaborations with cultural experts to develop culturally relevant educational materials. These opportunities align with policy and curriculum development, advocating a system-wide embrace of culture-based science education (Terrell Shockley et al., 2024). Furthermore, Cirebon's traditional agriculture and water management practices can be leveraged to teach environmental Science, promoting sustainable resource management. The project maps highlight how Cirebon's cultural values can enrich science education, fostering a deeper connection between students' cultural identities and scientific knowledge.

### 3.2 Science Teacher Interview



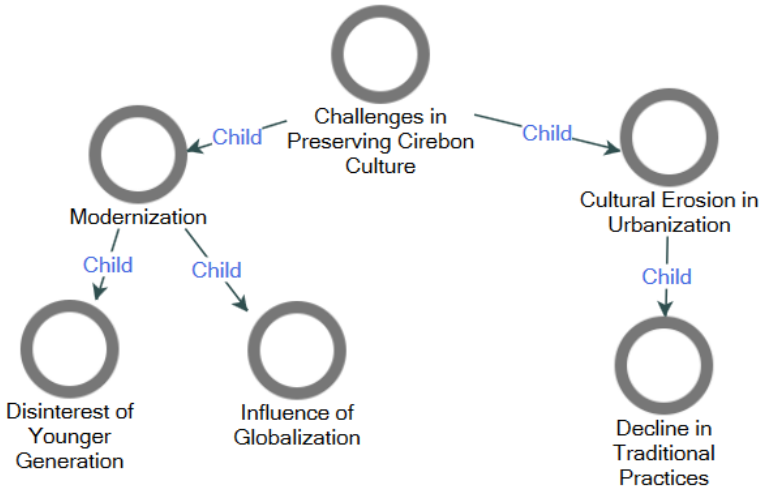
**Figure 6.** Word cloud of science teacher interview

The word cloud in Figure 6 derived from the science teacher interview data highlights key themes and concepts associated with integrating Cirebon culture into science education. The analysis shows that science teachers recognize the potential of incorporating Cirebon's cultural heritage into the science curriculum but face challenges. Cirebon's rich cultural knowledge of sustainability, ecosystem management, and community cooperation offers numerous opportunities for enriching science education. However, these opportunities must be integrated carefully alongside modernization and technological change pressures. The word cloud visually reinforces the importance of community-based learning and environmental awareness in shaping science education in Cirebon.

Prominent terms such as "knowledge," "community," "sustainability," "organic," "local," and "ecosystem" appear more significant in the word cloud, reflecting their significance in discussions about incorporating Cirebon cultural values into the curriculum. From the word cloud, it is clear that science teachers perceive Cirebon's culture as rich in knowledge and environmental wisdom, especially regarding sustainable practices and ecosystem management. The terms "community," "groups," and "cooperation" indicate the value placed on collective action and collaboration, which aligns with traditional practices in Cirebon, such as cooperation in community projects related to environmental conservation. These cultural practices are seen as teaching opportunities to highlight scientific concepts such as resource management and sustainability in science education (Idul & Fajardo, 2023).

Furthermore, the terms "local," "culture," and "content" emphasize the importance of integrating local cultural knowledge into science lessons, especially in subjects like agriculture, ecology, and environmental Science. Teachers indicated that using Cirebon's traditional practices, such as organic farming, water management, and conservation rituals, could provide a rich context for students to understand scientific principles in a culturally relevant way (Djosetro & Behagel, 2024). This aligns with the research question

that suggests cultural values effectively engage students and make science education more relatable to their everyday lives.

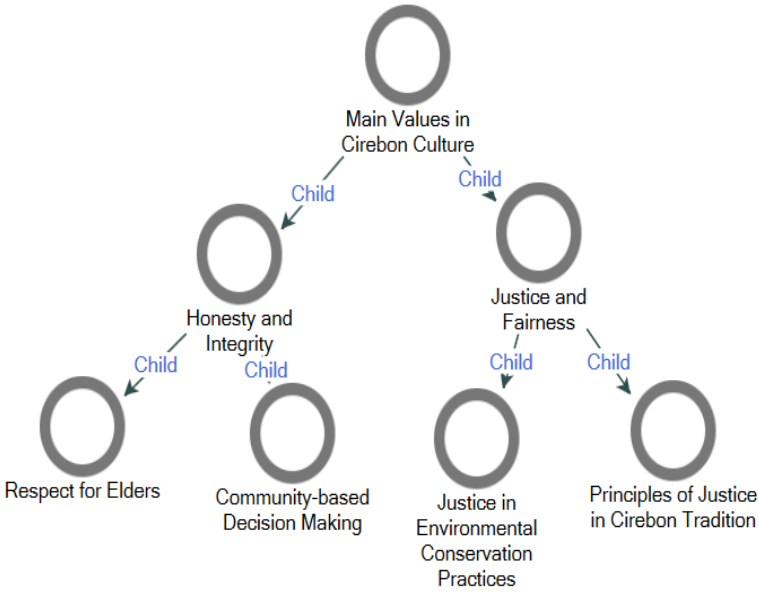


**Figure 7.** Project Map of challenges in preserving culture

Based on the science teacher interview, the project map in Figure 7 highlights several challenges in preserving Cirebon culture that directly impact integrating Cirebon cultural values into science education. This issue is a significant challenge for educators trying to instill cultural knowledge and

values within the science curriculum. Science teachers mentioned that such practices, which could be valuable teaching tools for science education (such as environmental conservation through community rituals), are slowly disappearing from urban settings (Zulirfan et al., 2023). These findings align with the research question about the challenges Science teachers face in integrating Cirebon cultural perspectives into science education. The interview responses suggest that modernization, globalization, and urbanization significantly hinder the integration of Cirebon's cultural values into science education.

However, the decline in traditional practices also highlights an opportunity to introduce these cultural values into the curriculum, using them as a context for teaching science concepts such as sustainability, ecosystem balance, and community-based environmental management. In conclusion, the project map underscores the challenges of preserving Cirebon culture in the face of modernization and globalization. These challenges, particularly the disinterest of younger generations and the decline of traditional practices, pose significant barriers to incorporating Cirebon cultural values into science teaching (Blackie, 2024). However, recognizing these challenges also allows science educators to promote cultural preservation actively, integrating Cirebon's traditions into the science curriculum to provide students with a broader and more culturally relevant educational experience.

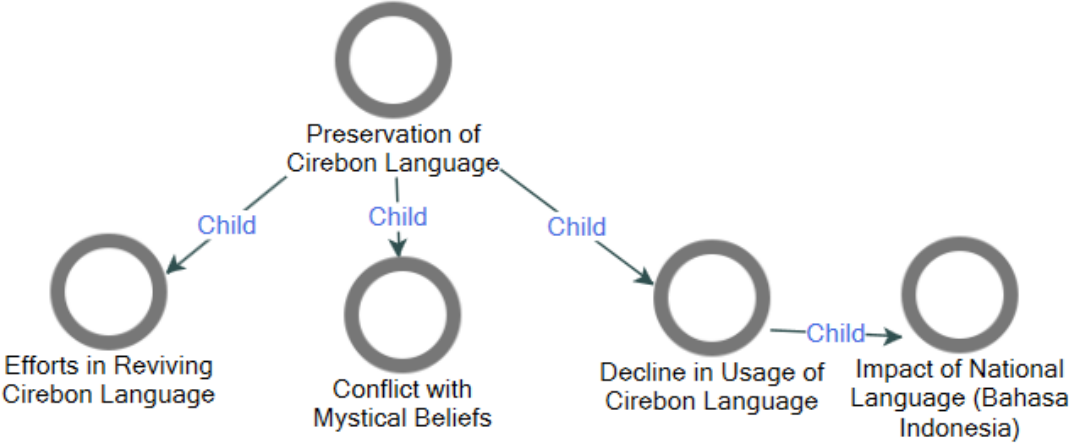


**Figure 8.** Project Map of central values in Cirebon culture

Based on the science teacher interview project map in Figure 8, the data reflects the key aspects of Cirebon's cultural values and how they can influence science education. The map focuses on the central values in Cirebon culture, all of which can be effectively integrated into the science curriculum. The initial code, Main Values in Cirebon Culture, is the central theme, which branches into several child codes. This value can be incorporated into lessons for science teachers by emphasizing the importance of knowledge transmission from older generations. This aligns with the research question about how science teachers perceive and understand Cirebon culture in the context of education, where teachers recognize that knowledge sharing, mainly traditional ecological knowledge, can serve as a valuable resource for teaching Science.

The second child node, Honesty and Integrity, is another core value in Cirebon culture. Science teachers noted that this principle can be applied in science education by emphasizing scientific integrity, such as honesty in research and data reliability. This aligns with the research question of how Cirebon cultural values influence school science teaching. Cirebon's cultural teachings about honesty and integrity can encourage ethical practices in scientific investigations, promoting truthfulness and transparency in the classroom. The third node, Community-based Decision Making, shows how decisions are made collectively in Cirebon culture. This principle can be incorporated into science education by adopting collaborative learning and group decision-making strategies (Mkhwebane, 2024). Teachers can use this value to promote teamwork and collective problem-solving, helping students collaborate on scientific projects and experiments. This connects to the research question. Opportunities can be utilized to incorporate Cirebon cultural values into the curriculum and science teaching, as it highlights the potential to integrate cultural values into Science through active, community-oriented learning strategies.

The Justice and Fairness child node reflects the value of equity and fairness in Cirebon culture. Science teachers noted that this principle could be applied in environmental Science, particularly when discussing sustainability and natural resource management topics. Teachers can integrate justice into environmental practices, teaching students how cultural values like justice align with scientific concepts such as environmental conservation. The sub-node Justice in Environmental Conservation Practices highlights the link between Cirebon's cultural views on justice and scientific sustainability practices, providing students with a real-world framework for understanding environmental ethics. Lastly, the Principles of Justice in Cirebon Tradition child node indicates how traditional Cirebon values of justice are deeply connected to environmental conservation practices. For science teachers, this provides an opportunity to incorporate cultural practices related to justice, such as water management and eco-friendly community rituals, into environmental science lessons. This connection underscores the potential for local knowledge and Science to complement each other, allowing students to see how cultural traditions contribute to sustainable environmental practices.



**Figure 9.** Project Map of preservation of Cirebon Language

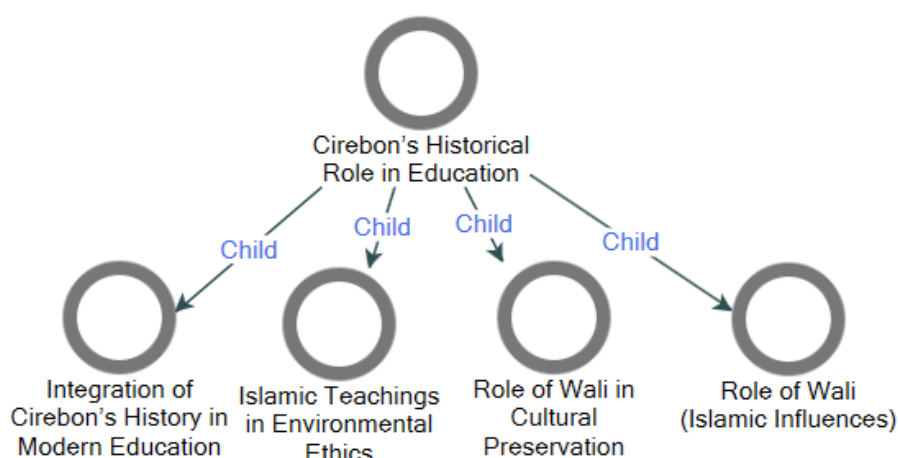
In conclusion, the science teacher interview project map emphasizes how Cirebon cultural values, such as honesty, integrity, justice, and respect for elders, can enhance the teaching of Science (Chen & Wu, 2024). These values offer meaningful opportunities to incorporate local

cultural knowledge into science education, helping students connect scientific concepts with their cultural heritage. While challenges exist due to the influence of modernization and globalization, these cultural values provide a foundation for creating a more engaging, ethical, and community-centered approach to science teaching in Cirebon.

The project map in Figure 9 from the science teacher interview illustrates the challenges and efforts of preserving the Cirebon language, a key aspect of Cirebon culture that directly influences integrating local values into education. The first child node, Efforts in Reviving Cirebon Language, highlights the initiatives and actions taken by local educators, cultural institutions, and the community to revitalize the language. These efforts may include teaching Cirebon in schools, encouraging its use in daily conversations, and creating educational materials that help younger generations learn the language. This aligns with the research question of how science teachers perceive and understand Cirebon culture in the context of education by emphasizing the role of language in cultural identity and how education systems can support language preservation as part of the cultural curriculum (Hidayati et al., 2015).

Finally, the child node impact of national language (*Bahasa Indonesia*) emphasizes the role of the Indonesian language as the national language and its dominance over local languages, including Cirebon. The widespread use of Bahasa Indonesia in schools, media, and public life has reduced the space for local languages like Cirebon. While *Bahasa Indonesia* plays a critical role in communication across the nation, it also marginalizes regional languages. This creates a dilemma for science teachers: how to respect and incorporate local language into the science curriculum while meeting the national educational standards prioritizing *Bahasa Indonesia*. This issue highlights the conflict between national language policies and the need for local cultural preservation in the education system.

In conclusion, the project map provides a clear view of the challenges and efforts surrounding preserving the Cirebon language and how it impacts science education. The decline in language usage, the conflict with mystical beliefs, and the dominance of *Bahasa Indonesia* present significant obstacles for educators. However, efforts to revive the Cirebon language offer opportunities to enrich science teaching by integrating local knowledge and cultural identity into the curriculum. These findings align with the research questions, offering both challenges and opportunities for science teachers to incorporate Cirebon's cultural values into education. Addressing these challenges can help create a more inclusive and culturally relevant science education that celebrates and preserves local heritage.



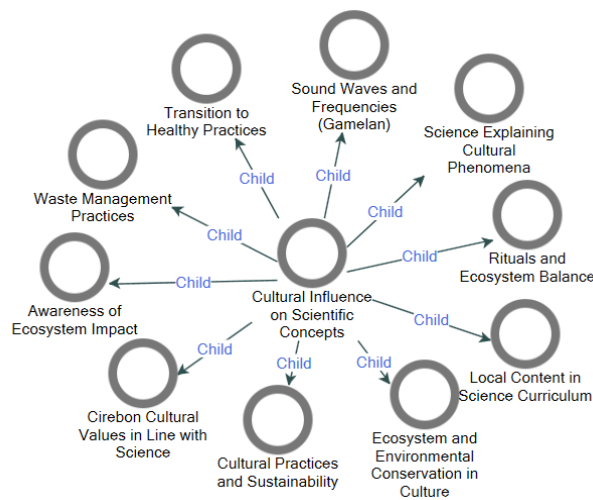
**Figure 10.** Project Map of Cirebon's historical role in education

The project map Figure 10 illustrates science teachers' perceptions regarding Cirebon's Historical Role in Education, which serves as the initial code. The findings align with the research questions by shedding light on how teachers view the role of Cirebon's culture in shaping educational practices, the challenges they face in integrating these perspectives, and the opportunities for incorporating cultural values into the curriculum. One key child code is Integration of Cirebon's History in Modern Education, which highlights how science teachers recognize the relevance of Cirebon's historical narratives in shaping contemporary education. Teachers see potential in incorporating local historical knowledge into science lessons, such as discussing traditional ecological practices or historical figures who contributed to scientific advancements (da Silva Ladislau et al., 2021). However, the challenge lies in the lack of structured materials integrating Cirebon's historical context with modern science education.

Another significant child code is Islamic teachings in environmental ethics, reflecting how teachers perceive the influence of Islamic values, particularly those introduced by Cirebon's scholars and saints (*Wali*), on environmental awareness. Many science teachers acknowledge that Islamic teachings emphasize environmental stewardship, sustainability, and ethical responsibility-values aligning with modern ecological principles. However, integrating these teachings into the formal science curriculum requires innovative approaches that bridge religious and scientific perspectives. The following child code, role of *Wali* in Cultural Preservation, explores the contributions of Islam in maintaining and transmitting traditional knowledge. Science teachers recognize that the *Wali* played an essential role in preserving local wisdom, including agriculture, medicine, and environmental conservation knowledge. This presents an opportunity to use historical narratives as teaching tools in science classes, helping students connect cultural heritage with scientific concepts.

The final child code, role of *Wali* (Islamic influences), emphasizes the broader impact of Islamic scholars in shaping Cirebon's educational landscape. Many teachers acknowledge that the *Wali* preserved cultural traditions and introduced knowledge systems that can complement modern science education. This perspective offers an avenue for integrating culturally responsive teaching methods that align with students' backgrounds and community values. Overall, the project map reveals that science teachers in Cirebon perceive the region's cultural and historical heritage as a valuable educational asset. However, challenges like the lack of curriculum integration and teaching resources hinder effective implementation. By leveraging the historical role of Cirebon's cultural figures and Islamic teachings in environmental ethics, there is potential to develop science education approaches that are both locally relevant and scientifically robust. These insights provide a foundation for further curriculum development, ensuring students gain a holistic understanding of science while appreciating their cultural heritage.

The project map in Figure 11 highlights the opportunities and challenges science teachers face when integrating local cultural values into science education. The child nodes under this theme, such as Cirebon Cultural Values in Line with Science, emphasize that local cultural values often align with scientific principles, particularly in environmental conservation, sustainability, and ecosystem balance. For example, Cultural Practices and Sustainability points to how practices rooted in local traditions can reinforce concepts such as resource conservation and eco-friendly living, directly linking cultural teachings to scientific sustainability (Pérez-Rodríguez et al., 2023).

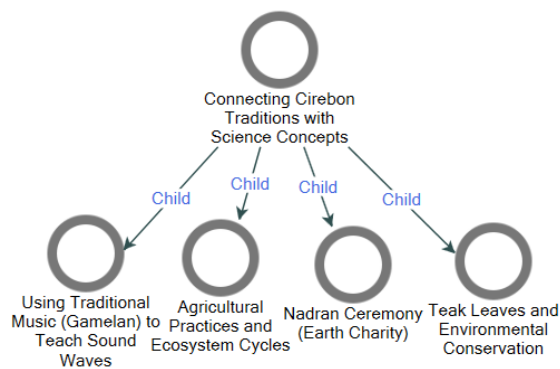


**Figure 11.** Project Map of opportunities for cultural influence on scientific concepts

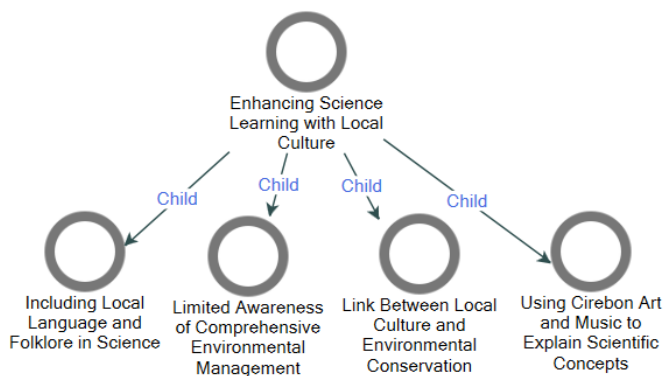
Another important child node is Ecosystem and Environmental Conservation in Culture, which shows how Cirebon cultural practices related to nature, such as community rituals and local customs, support environmental Science. For instance, rituals like *Nadran* (a traditional earth almsgiving ceremony) highlight community-based conservation efforts, teaching students the importance of ecosystem balance and sustainable resource management. These cultural rituals create a meaningful way to introduce scientific ideas about ecosystem dynamics and the human-nature relationship. The theme of Local Content in the Science Curriculum is also crucial, as it directly emphasizes integrating Cirebon culture into science lessons. Using local knowledge and cultural practices as examples, science teachers can make lessons more relevant and engaging for students. This relates to the research question of whether integrating local cultural content offers a unique opportunity to make science education more inclusive and culturally relevant.

Additionally, the Sound Waves and Frequencies (*Gamelan*) node suggests how Cirebon's traditional music, such as *Gamelan* (an Indonesian ensemble), can be used to explain scientific concepts like sound waves and frequencies. This cultural element provides a creative opportunity to teach science concepts through the arts, making science education more accessible and enjoyable for students. The Transition to Healthy Practices node links Cirebon's cultural traditions to science teaching by introducing topics like health and wellness. Teachers can connect traditional dietary practices and healthy lifestyle choices in Cirebon with scientific nutrition and human biology knowledge, creating cross-disciplinary lessons that enrich students' understanding of culture and Science.

Finally, the child node Rituals and Ecosystem Balance reinforce how cultural rituals serve as teaching tools for understanding ecological balance. Cirebon's traditional knowledge about maintaining ecosystem health can be taught alongside scientific lessons on biodiversity, conservation, and climate change, offering students real-world examples of how cultural practices promote sustainable living. In conclusion, the project map shows how Cirebon cultural values provide a rich context for science education, offering opportunities to integrate local wisdom and traditional practices into scientific teaching.



**Figure 12a.** Project Map of connection



**Figure 12b.** Project Map of Science and tradition of culture tradition and Science

The project map Figure 12a. from the science teacher interview highlights integrating Cirebon traditions with science concepts, focusing on how cultural practices can enhance science education. The central theme, Connecting Cirebon Traditions with Science Concepts, reflects the efforts to integrate local cultural values into the science curriculum, using traditional knowledge as a context for understanding scientific principles. This theme aligns with the research questions, particularly the ones asking how Cirebon cultural values influence science teaching in schools and what opportunities can be utilized to incorporate these values into the curriculum. The first initial code in the map is Using Traditional Music (*Gamelan*) to Teach Sound Waves, which connects Cirebon's traditional music, specifically the *Gamelan* ensemble, to the scientific concept of sound waves. Science teachers noted that *Gamelan*, with its distinct tones and frequencies, offers a hands-on approach to understanding how sound waves work. This approach helps students engage with the concept of sound in a culturally relevant way, making Science more relatable. This directly addresses the research question, how do Cirebon cultural values influence science teaching in schools, demonstrating how traditional cultural practices can serve as a teaching tool to explain complex scientific phenomena, such as sound waves (Majumdar & Chatterjee, 2021).

The second child node, Agricultural Practices, and Ecosystem Cycles, reflects the deep connection between Cirebon's agricultural traditions and scientific principles like ecosystem cycles and sustainability. Cirebon's traditional farming practices, including crop rotation, irrigation, and

sustainable land use, offer valuable lessons on ecological balance. Teachers discussed how these practices can be integrated into environmental science lessons to teach students about sustainable ecosystems and resource management, thus blending cultural knowledge with scientific concepts. This is particularly relevant to the research question about the opportunities to incorporate Cirebon cultural values into the curriculum, as it provides a practical example of how artistic practices can be used to teach key scientific ideas about ecology and environmental sustainability.

The third child node, *Nadran* Ceremony (Earth Charity), highlights the traditional Cirebon earth charity ceremony, a cultural ritual reflecting community values of environmental stewardship and mutual support. Science teachers pointed out that this ceremony, which is deeply tied to Cirebon's natural resource conservation practices, can teach students about the importance of ecosystem balance and community-driven environmental conservation efforts. This connects with the research question of how Cirebon cultural values influence science teaching in schools by showing how cultural rituals can be incorporated into science education to foster a deeper understanding of sustainability and environmental responsibility.

The final child node, Teak Leaves, and Environmental Conservation, reflects a traditional Cirebon practice of using teak leaves in environmental rituals. Teachers noted that protecting sacred trees and using teak leaves as symbols of conservation aligns with modern scientific principles of biodiversity conservation and forest management. This example illustrates how local cultural practices can be integrated into science lessons on environmental conservation, allowing students to connect traditional knowledge with scientific concepts. This again ties into the research question, "What opportunities can be utilized to incorporate Cirebon cultural values into the curriculum?" by offering specific examples of how local environmental practices can teach scientific concepts related to ecology and conservation.

In conclusion, the project map demonstrates the potential for integrating Cirebon cultural values into science teaching using traditional practices as learning tools. Integrating *Gamelan* music, agricultural practices, and environmental rituals enhances students' understanding of scientific concepts like sound waves, ecosystem cycles, and ecological conservation. It fosters a deeper connection between students' cultural heritage and modern Science. Despite challenges like modernization and globalization, these artistic elements offer unique opportunities to enrich science education and make it more relevant to students' lives, thereby addressing the need for more culturally inclusive and contextually relevant education.

The project map from Figure 12b, the science teacher interview, presents a comprehensive view of how local culture can be integrated into science education, focusing on Cirebon culture. The central theme, Enhancing Science Learning with Local Culture, is crucial for understanding how Cirebon's cultural values and practices can improve scientific concepts' learning. This theme is broken down into various child codes that explore how local culture can support science education and highlight the challenges science teachers face in integrating these cultural elements into their teaching. The first initial code, Including Local Language and Folklore in Science, focuses on how the Cirebon language and local folklore can enrich science education. Teachers noted that Cirebon's rich oral traditions and stories, which are deeply embedded in the community's history, can serve as practical teaching tools for explaining scientific concepts, particularly those related to natural phenomena and environmental processes. The local language allows for better communication with students, fostering a deeper understanding of Science and culture. This relates directly to the research question: how do science teachers perceive and understand Cirebon culture in the context of education? as teachers recognize the potential of integrating local language and

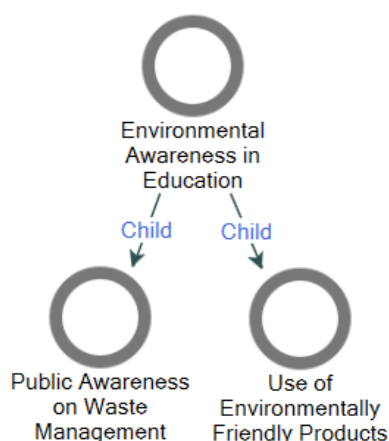
folklore into the science curriculum to make Science more relatable and grounded in students' everyday experiences.

The second child node, Limited Awareness of Comprehensive Environmental Management, reflects the challenges faced by science teachers in promoting a comprehensive understanding of environmental management within the context of Cirebon culture. Teachers expressed concern that traditional ecological practices are often not fully integrated into the formal education system. Despite Cirebon's strong cultural traditions of environmental conservation and sustainable resource management, there is often a lack of awareness about these practices in modern educational contexts. This links to the research question about challenges science teachers face in integrating Cirebon cultural perspectives into science education?", suggesting that while there are opportunities to incorporate cultural practices, there is a need for greater awareness and training for teachers to effectively integrate these practices into their science lessons (Hung & Min, 2020).

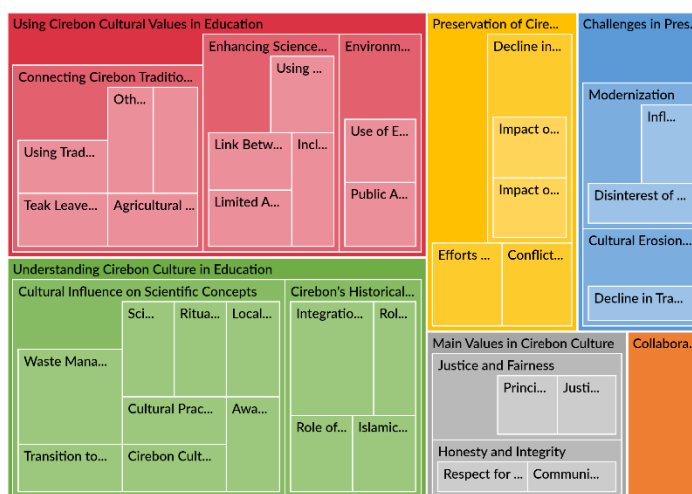
The third child node, Link Between Local Culture and Environmental Conservation, emphasizes the role of Cirebon culture in environmental conservation. Science teachers noted that cultural traditions, such as community-based resource management, sustainable agricultural practices, and rituals for environmental protection, are essential but often overlooked in formal education. These practices can offer valuable insights into how traditional knowledge can be applied to modern ecology and sustainability scientific principles. This connects to the research question how do Cirebon cultural values influence science teaching in schools?" as integrating these traditional practices into science education can provide students with real-world examples of environmental Science, promoting both cultural preservation and sustainability education.

The final child node, Using Cirebon Art and Music to Explain Scientific Concepts, explores how local art forms, especially music (such as *Gamelan*) and visual arts, can be used to teach scientific concepts. Science teachers suggested that traditional Cirebon music could teach concepts like sound waves and frequencies. At the same time, art could help students visualize abstract scientific phenomena, such as ecosystem cycles and environmental changes. This aligns with the research question about opportunities that can be utilized to incorporate Cirebon cultural values into the curriculum and science teaching, as using local art and music provides an innovative way to integrate culture into the science curriculum, enhancing students' engagement and understanding of scientific concepts.

In conclusion, the project map highlights how Cirebon cultural values can enhance science education, mainly through integrating local language, folklore, art, and traditional environmental practices. While there are significant opportunities to incorporate these cultural elements into the curriculum, there are also challenges, particularly related to awareness and training for teachers. By integrating local knowledge and scientific principles, educators can create a more holistic and culturally relevant science curriculum that enriches students' learning and helps preserve and promote Cirebon's cultural heritage.



**Figure 13a.** Project Map of environmental awareness



**Figure 13b.** Hierarchy chart

The project map Figure 13a derived from the science teacher interview illustrates the Environmental Awareness in Education theme, focusing on public awareness regarding waste management and environmentally friendly products. This theme highlights how environmental awareness can be integrated into science education, particularly in Cirebon's cultural context. It also reflects how Cirebon's cultural values inform how environmental topics are taught, aligning with the research questions, mainly how Cirebon cultural values influence science teaching and the opportunities for incorporating local values into the curriculum.

The initial code, Environmental Awareness in Education, emphasizes raising awareness about environmental issues within educational settings. Science teachers discussed how integrating ecological topics into the curriculum, especially in the context of Cirebon culture, can help students connect cultural values with scientific principles of environmental conservation and sustainable practices. This relates to the research question "How do Cirebon cultural values influence science teaching in schools?" showing that cultural values such as community-based environmental conservation and sustainable resource use can inform how environmental education is approached in Cirebon classrooms.

The first child node, Public Awareness on Waste Management, highlights the ongoing efforts to raise public consciousness about waste management practices. Teachers noted that traditional

Cirebon waste reduction and resourcefulness practices, such as using natural materials and recycling in local crafts, could serve as important examples for teaching students about waste management and eco-friendly practices. This also links to the research question "What opportunities can be utilized to incorporate Cirebon cultural values into the curriculum and science teaching?" as traditional cultural values can offer practical insights for teaching environmental Science through real-world examples that students can relate to.

The second child node, Use of Environmentally Friendly Products, focuses on promoting sustainable consumer choices. Science teachers discussed how introducing students to eco-friendly products, such as biodegradable materials or locally sourced, sustainable goods, can enhance their understanding of sustainability and environmental conservation. This connects with the idea of linking cultural practices to scientific principles, as Cirebon's traditional emphasis on local products and eco-friendly practices can reinforce the scientific concept of sustainability. Teachers suggested that these practices could be incorporated into the science curriculum to demonstrate how culture and Science can work together for environmental protection.

In conclusion, the project map demonstrates how Cirebon culture can enhance environmental education by integrating local practices and values into science lessons. Public awareness of waste management and using environmentally friendly products are areas where Cirebon's traditional knowledge aligns with modern scientific sustainability principles. These discussions highlight the opportunities for science teachers to use local cultural knowledge to teach critical environmental concepts, creating an engaging and contextually relevant curriculum. While there are challenges related to modernization and the shift toward more globalized educational content, the map illustrates how Cirebon cultural values offer a unique opportunity to enrich environmental science education by grounding it in the community's artistic practices and values.

The hierarchy chart Figure 13b from NVivo presents an overview of how science teachers perceive and understand Cirebon culture in education, categorizing their insights into initial and corresponding child codes. These findings align with the research questions, particularly in identifying how cultural values influence science teaching, the challenges in integrating cultural perspectives, and potential opportunities for curriculum development. One significant initial code is Using Cirebon Cultural Values in Education, which explores how teachers incorporate traditional knowledge into science learning. The child codes within this category include Connecting Cirebon Traditions to Science, which reflects efforts to integrate local wisdom, such as using teak leaves and agricultural practices, into science lessons. Another child code, Enhancing Science Education, highlights how teachers attempt to link traditional knowledge with scientific concepts, although they often face limitations in available resources and access to cultural references. Additionally, the Environmental Awareness child code reveals how Cirebon's environmental practices, such as waste management and local ecological knowledge, can be included in science education to foster sustainability.

Another primary initial code is Understanding Cirebon Culture in Education, which delves into how science teachers interpret cultural influences on scientific concepts. The child codes under this category include Cultural Influence on Scientific Concepts, where teachers recognize the role of rituals, local practices, and traditional ecological knowledge in shaping students' understanding of Science. Furthermore, Cirebon's Historical Role in Education emphasizes how historical narratives, particularly the influence of Islamic teachings and the role of Cirebon's religious leaders (wali), contribute to students' ethical and environmental awareness.

**Table 2.** Cirebon's cultural content is related to the science content based on the science teacher in Cirebon

No	Science Content	Description
1	Teak leaves and reforestation	The use of teak leaves in food packaging ties into discussions on environmental conservation and reforestation.
2	Cultural influence on scientific concepts	How Cirebon culture influences scientific understanding, particularly concerning environmental topics like waste management and ecosystem balance.
3	Local technology for sustainability	Traditional technologies, such as sand roasting and clay containers in cooking, support sustainability and eco-friendly practices.

Overall, the data show that science teachers understand the necessity of incorporating Cirebon culture into science instruction, although their approaches are limited and rely heavily on individual initiative. While cultural factors such as ancient rituals, local arts, and ecological knowledge offer numerous chances for contextualising science, obstacles such as modernisation, a lack of resources, and limited curriculum support impede systematic integration. This study makes a valuable contribution by demonstrating not only ethnoscience's potential for increasing culturally responsive teaching, but also the structural constraints that must be addressed at the governmental and institutional levels. By synthesising teachers' perceptions, practices, obstacles, and opportunities, the debate argues that cultural integration in science education should progress beyond isolated classroom activities to curriculum creation and teacher training that openly embrace local wisdom.

Despite these challenges, Opportunities for Cultural Integration in Science Education emerge as an essential theme in Table 2. This is closely related to the initial code Main Values in Cirebon Culture, where child codes such as Justice, Fairness, Honesty and Integrity suggest that Cirebon's ethical values can serve as foundational principles in education. Collaboration with Cultural Experts and Communities is also identified as a crucial factor in ensuring the successful integration of cultural perspectives into the curriculum. These findings suggest that while science teachers recognize the importance of incorporating Cirebon culture into science education, they face several barriers, including a lack of teaching resources, modernization pressures, and students' declining interest in traditional knowledge. However, leveraging historical narratives, local wisdom, and community engagement has significant potential to enrich science education with culturally relevant perspectives. These insights provide a foundation for further curriculum development and teacher training programs that promote culturally responsive science education. These cultural practices support scientific principles like sustainability, environmental conservation, and ecosystem balance and create engaging learning experiences that resonate with students (Tigist & Alemu, 2024).

Furthermore, to enhance the trustworthiness of the findings, data analysis was conducted via triangulation between scientific educators and cultural specialists, with results validated through member verification. Consistency in the coding process was achieved by engaging a second researcher to evaluate the coding framework, hence improving inter-rater reliability. The results of this study must also be understood within the wider external environment. National education systems, such as the Independent Curriculum, allow instructors the opportunity to incorporate local expertise into science instruction; yet, globalisation and curriculum standardisation frequently constrain teachers' freedom in utilising cultural settings.

The findings correspond with constructivist concepts, which assert that knowledge is developed via significant experiences, and with multicultural education philosophy, which underscores the

significance of cultural diversity in educational settings. Incorporating local culture into science enhances students' comprehension of scientific topics within a contextual framework and cultivates an appreciation for their cultural identity. Moreover, the culture-centric methodologies recognised in Cirebon may serve as exemplars for other Indonesian regions, each endowed with distinct traditions and indigenous knowledge. This work enhances culturally relevant scientific education in Cirebon and contributes to the broader dialogue on creating a science curriculum that addresses Indonesia's cultural diversity.

#### 4. Conclusion

This study discovered that science teachers see Cirebon culture as a rich resource for contextualising science instruction. Teachers have begun to incorporate cultural components such as local rituals, arts, and ecological practices into their classes, although these efforts are still restricted and rely heavily on individual initiative. The main issues mentioned include the impact of modernisation, a shortage of teaching resources, and insufficient curriculum support for culture-based learning. Simultaneously, the Independent Curriculum, project-based learning, and digital resources provide opportunity to improve the link between local knowledge and scientific principles.

Aside from these key discoveries, other practical ramifications arise. Local cultural elements could be strategically incorporated into the Independent Curriculum and related science materials to aid with curriculum implementation. Professional development programs for teachers should cover culturally sensitive pedagogy as well as techniques for incorporating ethnoscience into classroom practice. Teachers can use printed and digital resources to combine Cirebon cultural knowledge with scientific curriculum. These procedures would not only benefit teachers, but would also improve students' scientific literacy in ways that are relevant to their cultural context.

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