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Pre-service physical science teachers' perceptions of decolonizing the science curriculum in South Africa

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Abstract: This quantitative study explores the perceptions of 117 pre-service science teachers regarding decolonizing the science curriculum in South Africa. While national discourse increasingly emphasizes the importance of integrating Indigenous Knowledge Systems (IKS) into science education, limited research exists on how future teachers understand and engage with this goal. Using a quantitative survey and postcolonial theory as a framework, the study assesses participants' conceptual understanding of decolonization, their attitudes toward IKS, perceived readiness to implement change, and anticipated barriers. Participants generally recognized the benefits of IKS in enhancing learner engagement and promoting inclusivity. However, statistical analysis, including t-tests and chi-square tests, shows no significant differences based on gender, academic level, or program type. Most participants expressed limited confidence in practically applying these concepts in classroom settings. The findings suggest that despite ideological support for decolonization, structural challenges such as insufficient training, lack of resources, and limited institutional guidance hinder practical implementation. The study recommends that science teacher education programs strengthen pedagogical approaches to decolonization, incorporate experiential learning, and foster collaboration with local knowledge holders. Moving from theoretical discourse to practice-oriented preparation will better equip future educators to effect meaningful curriculum transformation in science education.

Keywords: *Curriculum reform, Decolonization, Indigenous knowledge systems, Pre-service teachers, Science education.*

1. Introduction

The discourse on decolonizing curricula has long been a central theme in educational reform worldwide, driven by the need to address historical inequalities and promote inclusivity in knowledge systems [1-7]. The consensus is that Eurocentric knowledge systems have historically marginalized and disempowered other knowledge systems [8]. Most scholars advocating for curriculum decolonization argue that the dominance of Western knowledge systems, to the exclusion of other ways of knowing, perpetuates colonial power dynamics. They see this imbalance as a form of cultural subjugation, where the Global North continues to assert epistemic authority, marginalizing contributions from other cultures and reinforcing unequal power relations in knowledge production [7]. The movement toward decolonization challenges the dominance of Eurocentric knowledge paradigms, promoting the integration of African Indigenous Knowledge Systems (AIKS) into curricula [8].

Thus, at its most basic level, decolonization means incorporating indigenous knowledge systems in the current knowledge structure as an attempt at increasing representation from diverse perspectives.

Efforts to decolonize curricula, while promising, face significant challenges. These include resistance to change, a lack of resources and training, and concerns about the compatibility of indigenous knowledge systems with global scientific standards [9]. The prospect of decolonizing the curriculum also offers opportunities to innovate teaching methods, enrich content, and foster a more inclusive educational environment. Moving beyond theoretical discourse to practical implementation requires

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addressing these barriers and leveraging the potential of pre-service science teachers to lead this change.

In South Africa, the discourse on the decolonization of education has emerged as a significant area of inquiry, as scholars seek to address historical imbalances and promote inclusivity in knowledge systems [4, 5, 8]. Movements such as #FeesMustFall and #RhodesMustFall brought issues of decolonization to the forefront as university students across South Africa engage in protests to challenge systemic inequality and advocate for addressing issues of poverty and exclusion, among other socioeconomic ills.

The call to decolonize the science curriculum at secondary and primary education levels should not be merely an academic exercise but a necessary step toward creating a more equitable and contextually relevant education system. Some of the conceptual foundations of decolonization in education include the integration of indigenous knowledge in science education, the role of teachers and teacher training institutions in this transformation, and the opportunities and challenges that characterize this process. In science education, the discourse on decolonization challenges the dominance of Western scientific paradigms, advocating for the inclusion of indigenous knowledge systems and local cultural perspectives [3, 8, 10].

1.1. Conceptual Foundations of Decolonization in Education

Decolonization in education is rooted in the recognition of "epistemic violence" perpetuated by colonial legacies, which positioned Western knowledge as universal while marginalizing other epistemologies [9, 11]. The argument is that if education systems were shaped and inherited from the colonial past, then their curricula have been complicit in perpetuating colonial domination. Furthermore, European conquests involved disregarding, discarding, and denigrating local indigenous knowledge systems existing at the time of the conquests [11]. Thus, discourse on decolonization of curricula cannot be divorced from power struggles in former colonies. Decolonizing curricula requires meaningful recognition of alternative perspectives embedded in analyses of power relations, including those of race, class, and gender [12].

In the South African context, decolonization aims to develop curricula that reflect local cultures, histories, and contexts, thereby addressing inequalities entrenched during the apartheid era [4]. In science education, this involves challenging the exclusivity of Western scientific paradigms and recognizing the value of indigenous knowledge systems [5]. Scholars argue that decolonization is not a rejection of Western science but an effort to create space for epistemological pluralism, where multiple ways of knowing can coexist and enrich the curriculum [8]. For Williams and Benjamin [7], one of the key aims of decolonising the curriculum is to ensure that all students can see themselves and their backgrounds reflected in the curriculum.

1.2. Postcolonial Theory as a Lens for Decolonising the Science Curriculum

This study employs Postcolonial Theory as a theoretical lens to examine pre-service science teachers' perceptions regarding the decolonization of the science curriculum in South Africa. Postcolonial Theory critiques the enduring legacies of colonialism in knowledge production, education systems, and cultural representations. It challenges Eurocentric epistemologies and advocates for the recognition and integration of indigenous and alternative knowledge systems in education [13, 14].

1.3. Defining Postcolonial Theory

Postcolonial Theory explores how colonial histories continue to influence contemporary societies, especially regarding knowledge, identity, and power relations. It critiques Western epistemologies, which have historically claimed universality and superiority while marginalizing indigenous ways of knowing. In education, Postcolonial Theory asserts that curricula are not neutral but are embedded within historical and ideological frameworks that often reflect colonial legacies [4].

In South Africa, the science curriculum has been largely influenced by Western scientific traditions, often at the expense of African Indigenous Knowledge Systems (IKS). Postcolonial theory offers a

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framework to examine how colonial narratives persist in science education, shaping the validation, transmission, and perception of knowledge. Applying this perspective enables a critical analysis of how power dynamics and historical legacies have influenced the exclusion or marginalization of African worldviews in science education.

A postcolonial approach to decolonizing the science curriculum does not call for the wholesale rejection of Western science. Instead, it promotes an inclusive epistemological framework that acknowledges and values the coexistence of multiple knowledge systems. Central to this approach is the recognition of indigenous scientific knowledge as both valid and relevant within contemporary scientific discourse. Rather than displacing Western science, the aim is to challenge the Eurocentric dominance that continues to shape curriculum content, pedagogical approaches, and assessment practices. This inclusive framework encourages meaningful dialogue between Western and indigenous knowledge systems, fostering a more comprehensive and culturally responsive understanding of science [15].

1.4. Decolonisation, Indigenous Knowledge Systems and Science Education

The integration of AIKS into the science curriculum has been identified as a critical step toward achieving decolonization [3, 4, 10]. Indigenous knowledge systems are contextually grounded, offering alternative perspectives and practical applications to scientific concepts [8]. For instance, the integration of IKS in STEM classrooms has been reported to enhance understanding of the nature of science itself [8]. Such integration not only enhances the relevance of the curriculum for students but also boosts cultural pride and identity among learners from marginalized communities [5, 10].

Despite these benefits, the process of integrating indigenous knowledge into science curricula remains contentious. Critics question the compatibility of indigenous knowledge with global scientific standards, while others argue that Western science and African IKS operate on fundamentally different epistemological bases [9]. Furthermore, the lack of comprehensive documentation of indigenous knowledge poses challenges for its systematic inclusion in formal education [8].

Decolonising the science curriculum should not be limited to integrating African Indigenous Knowledge systems. Decolonisation should also debunk the facade that the current body of science is solely a Western product. There are ample opportunities for classroom discussions on how other cultures have contributed to the present body of scientific knowledge through the present curriculum. Thus, at the implementation level, teachers may push the decolonisation discourse if equipped with the right knowledge and skills.

While the current government-mandated Curriculum Assessment Policy Statements (CAPS) recognize the importance of IKS, they often lack detailed guidelines for effective implementation. This ambiguity results in inconsistent application across institutions and provinces, undermining the stability and effectiveness of IKS integration.

1.5. The Role of Teacher Training Institutions in Decolonising the Curriculum

Teacher Training Institutions (TTIs) occupy a central role in the discourse on curriculum decolonization. While other academic disciplines, such as engineering, medicine, and finance, may engage with decolonization from sectoral perspectives, TTIs hold a unique responsibility. Their core mandate is to produce educators who become key agents in implementing curriculum transformation within classrooms. The success of any decolonization agenda in education is therefore inextricably linked to how well TTIs prepare their graduates to challenge dominant knowledge paradigms and embrace inclusive, contextually relevant epistemologies.

Despite the prominence of the decolonization discourse since the #RhodesMustFall movement, practical transformations within South African educational institutions remain minimal. Many educators report feeling unprepared to integrate Indigenous Knowledge Systems (IKS) into their teaching due to inadequate training, lack of curricular resources, and insufficient institutional support [8, 16]. Even when enthusiasm for IKS inclusion exists, this enthusiasm is often thwarted by systemic

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limitations. This underscores an urgent need for targeted professional development and dedicated resource allocation to bridge the gap between policy rhetoric and classroom realities.

Critiques of higher education institutions in South Africa suggest deeper structural inertia [17]. Scholars argue that these institutions have not only failed to actively promote curriculum decolonization but have also contributed to maintaining the notion that Western epistemologies are inherently superior to indigenous ways of knowing [9, 17, 18]. Such critiques highlight the paradox facing academia: scholars, often products of colonial education systems, are now expected to unlearn and critique the frameworks that shaped their intellectual formation.

Meda [19] expands on the above argument and offers a more compelling perspective by identifying the academics themselves as the 'Achilles' heel' of the decolonization process. The expectation that academics should decolonize a curriculum that forms the foundation of their own education is not only intellectually demanding but also emotionally and ideologically destabilizing. It requires a fundamental re-examination of their belief systems, identity, and scholarly allegiance, tasks that can only be accomplished through voluntary introspection and sustained critical engagement. Without such internal transformation among academics, efforts toward decolonization risk remaining discursive rather than practical.

Compounding the problem is a persistent lack of clarity regarding what decolonization truly entails within education. Many TTIs operate without clear, implementable policies guiding the integration of IKS into curricula. The result is often fragmented or symbolic initiatives that fail to produce systemic change. However, some progressive steps are noteworthy. At the University of KwaZulu-Natal, for example, a science module was redesigned to include indigenous gardening techniques, enabling pre-service teachers to engage directly with IKS experts. This approach not only enhanced participants' understanding of indigenous practices but also validated the epistemic authority of IKS within higher education. Despite these examples, such efforts remain isolated. Without explicit support from curriculum developers and education policymakers, TTIs face significant challenges in institutionalizing these innovations. The success of TTIs in promoting decolonized curricula depends not only on their internal willingness but also on systemic alignment with broader educational frameworks and policy imperatives.

While scholars such as Asea [17] view the inaction of higher education institutions as hypocritical, this paper takes a more nuanced stance. Drawing on Meda's [19] insights, it is evident that the challenges of curriculum decolonization are deeply entrenched in epistemological, institutional, and personal complexities. Rather than a matter of deliberate dishonesty, the inertia may reflect the magnitude of the task: decolonization, at its core, calls for the reconstitution of knowledge systems and the identities of those who teach them. It is, therefore, not merely a curriculum change; it is a paradigm shift.

1.6. The Role of Pre-service Teachers in Decolonising the Science Curriculum

Pre-service teachers occupy a critical position in the project of decolonising the science curriculum [6]. As both learners and future educators, they serve as conduits for shaping future classroom practices and pedagogical values [1, 5, 11]. Their beliefs, attitudes, and understandings significantly influence how educational reform is implemented, particularly reforms that challenge dominant epistemologies [6].

Given their ongoing academic training, pre-service teachers may be more receptive to critical engagement with Indigenous Knowledge Systems (IKS) and to questioning Eurocentric assumptions embedded in curricula. This positionality offers a unique opportunity to develop inclusive pedagogical practices rooted in diverse knowledge systems, not only Afrocentric but also globally representative [20]. For Gandolfi [21], preparing pre-service teachers to implement decolonisation would have far-reaching ramifications in the classrooms as it would 'challenge those university pedagogies-as-usual that translate legacies of coloniality, which further seep into schools…' (p 175–176).

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Despite this potential, teacher education programmes in South Africa have not fully equipped teachers to translate decolonisation principles into classroom practice [9, 11, 22]. Studies show limited emphasis on integrating IKS into teaching strategies, and many in-service and pre-service teachers lack confidence and practical experience [11, 23].

Pre-service teachers' perceptions, shaped by social context, prior knowledge, and institutional narratives, play a central role in the decolonization process. Research indicates that individuals who see IKS as complementary to Western science are more likely to embrace decolonized curricula, whereas those viewing it as inferior may resist change [24]. For Vandeyar [6], pre-service teachers' changes in beliefs, values, attitudes, and mindsets are prerequisites for meaningful educational change. Addressing these perceptions through reflective practice, experiential learning, and structured mentorship is essential for achieving significant curriculum transformation.

Despite increasing attention to curriculum decolonisation, few empirical studies focus on pre-service teachers' perceptions. For example, Creswell and Creswell [25] found UK university students more aligned with decolonial goals than faculty. In the South African context, a systematic review revealed limited evidence of similar studies, highlighting a significant gap in the literature.

1.7. Challenges and Opportunities

The most common challenge in decolonising the curriculum is that it is not a well-defined, one-size-fits-all concept. Without a clear understanding, there is an absence of institutional processes and sustainable policies [26, 27]. Additionally, institutional resistance to change, lack of resources and training for teachers, and concerns about losing scientific rigor pose significant barriers [5, 9].

On the other hand, the decolonization process offers significant opportunities to enrich science education. The inclusion of AIKS can make science more relatable and engaging for students, especially those from marginalized communities [4]. By enhancing epistemological diversity, decolonization can foster a more inclusive and equitable education system. For Ogunniyi and Iwuanyanwu [8], the decolonisation of the curriculum may enhance understanding of the nature of science.

1.8. Research Problem

While the discourse on decolonization has gained momentum in higher education, research on its application in secondary and primary education remains limited. Furthermore, the perspectives of pre-service science teachers, who will play a critical role in implementing decolonized curricula, are notably underexplored [5]. Addressing this gap is essential to move beyond theoretical discussions toward pragmatic implementation of decolonization efforts in science education.

The advocacy for decolonizing curricula has increased over the years. However, this advocacy has not been matched by policy development and implementation. At the same time, academic discourse has been limited to researchers. The voices of young people, including pre-service science teachers, remain underrepresented. This oversight is significant, as these individuals will play a pivotal role in shaping the science curriculum at secondary and primary education levels, where the foundations of scientific understanding are laid [4]. Little is known about how future teachers understand and engage with this imperative. Pre-service science teachers, as future educators, occupy a unique position to drive this transformation. Their perceptions and readiness to implement a decolonized science curriculum are critical, yet there is a noticeable gap in research exploring their perceptions [5]. Shifting the focus from higher education to basic education curricula acknowledges the continuity of knowledge and the need for a seamless transition in implementing decolonized content across all education levels [9].

1.9. Research Focus

This study focuses on pre-service teachers' perceptions of decolonization. We explored perceptions across six categories: understanding of decolonization, perceptions of the current curriculum, the role of teachers and training, practical implications, barriers and challenges, and attitudes and beliefs. Survey questionnaires are a widely used methodological tool for examining perceptions and attitudes, especially

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in educational research. They offer a systematic approach to collecting data from large populations, enabling researchers to identify trends and patterns quantitatively [25]. In this study, survey questionnaires facilitate exploring pre-service science teachers' perceptions of decolonization, emphasizing their understanding, challenges, and opportunities. This method also systematically includes pre-service teachers' voices in discussions traditionally dominated by academics and policymakers [4].

1.10. Research Aim and Research Questions

This study seeks to address the following research questions:

1. What are the perceptions of pre-service science teachers regarding the decolonization of the science curriculum in South Africa?
2. To what extent do pre-service science teachers feel prepared to integrate indigenous knowledge systems into their future teaching practices?
3. What challenges and opportunities do pre-service science teachers perceive in the process of decolonizing the science curriculum?

By exploring these questions, this quantitative study aims to contribute to the growing body of literature on decolonization and provide actionable insights for researchers, pre-service teachers, in-service teachers, policymakers, and curriculum developers.

2. Research Methodology

2.1. General Background

This study employs a quantitative survey research design to examine pre-service teachers' perceptions of the decolonization of the science curriculum at a South African university. The structured questionnaire ensures objective data collection, enabling statistical analysis of attitudes, beliefs, and challenges related to curriculum decolonization.

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2.2. Sample / Participants / Group

The study involved 117 pre-service teachers in their third and fourth years, ensuring they had substantial teaching practice (TP) experience. Participants were purposively selected based on their specialization in Physical Sciences, Life Sciences, or Natural Sciences to ensure familiarity with the current school science curriculum.

2.3. Instrument and Procedures

The Science Curriculum Decolonization Questionnaire was developed based on existing literature on curriculum decolonization, indigenous knowledge systems, and teacher training. To ensure content validity, the questionnaire was reviewed by five experts in science education and curriculum studies. Feedback from the reviewers was positive.

A pilot study was conducted with 15 pre-service teachers to assess clarity, reliability, and internal consistency. The instrument's reliability was evaluated using Cronbach's alpha coefficient, with a value above 0.8 indicating acceptable reliability for the Likert-scale items.

2.4. Questionnaire Structure

The instrument comprises two sections: Section A, Demographic Information, requiring participants to report on gender, teaching phase (PGCE, FET & SP, etc.), subject specialization, type of school attended during TP (rural, township, suburb), and the quintile classification of the school (1–5). Section B includes Likert-scale questions categorized into six areas: understanding of decolonization, perceptions of the current curriculum, role of teachers and training, practical implications, barriers and challenges, and attitudes and beliefs. Each category contains four statements. Responses were recorded on a 4-point Likert scale: (1) Strongly Disagree (SD), (2) Disagree (D), (3) Agree (A), and (4) Strongly Agree (SA).

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2.5. Data Collection Procedure

The questionnaire was administered electronically and in person. The electronic version was developed using Microsoft Forms and distributed via email, while hard copies were drafted in MS Word and printed before distribution. Participants were assured of anonymity and confidentiality, and their responses were stored securely.

2.6. Data Analysis

Data were analyzed using SPSS version 25.0 (Statistical Package for the Social Sciences), incorporating both descriptive and inferential statistical techniques to ensure a rigorous and comprehensive interpretation of the findings. Descriptive statistics included the use of frequencies and percentages to summarize demographic data, while visual representations such as bar charts were employed to depict demographic distributions. Histograms and stacked bar charts were used to present Likert-scale responses. Inferential statistics were applied to explore deeper relationships and differences within the dataset. Chi-square tests examined associations between categorical variables, such as subject specialization and perceptions of decolonization. Independent t-tests compared responses between groups, for example, between third- and fourth-year students. Ethical considerations were paramount throughout the study. Informed consent was obtained from all participants, and confidentiality and anonymity were strictly maintained. Ethical clearance was secured from the relevant institutional research ethics committee. This methodological approach was carefully designed to uphold validity, reliability, and analytical rigor in exploring pre-service science teachers' perceptions of the decolonization of the science curriculum in South Africa.

3. Research Results

3.1. Pre-service Teachers' Understanding of Decolonization

The four statements aimed at exploring pre-service teachers' understanding of 'decolonizing the science curriculum' elicited diverse and interesting responses. Figure 1 summarizes participants' responses to the statements regarding their understanding of decolonizing the curriculum, highlighting varied perspectives and insights.

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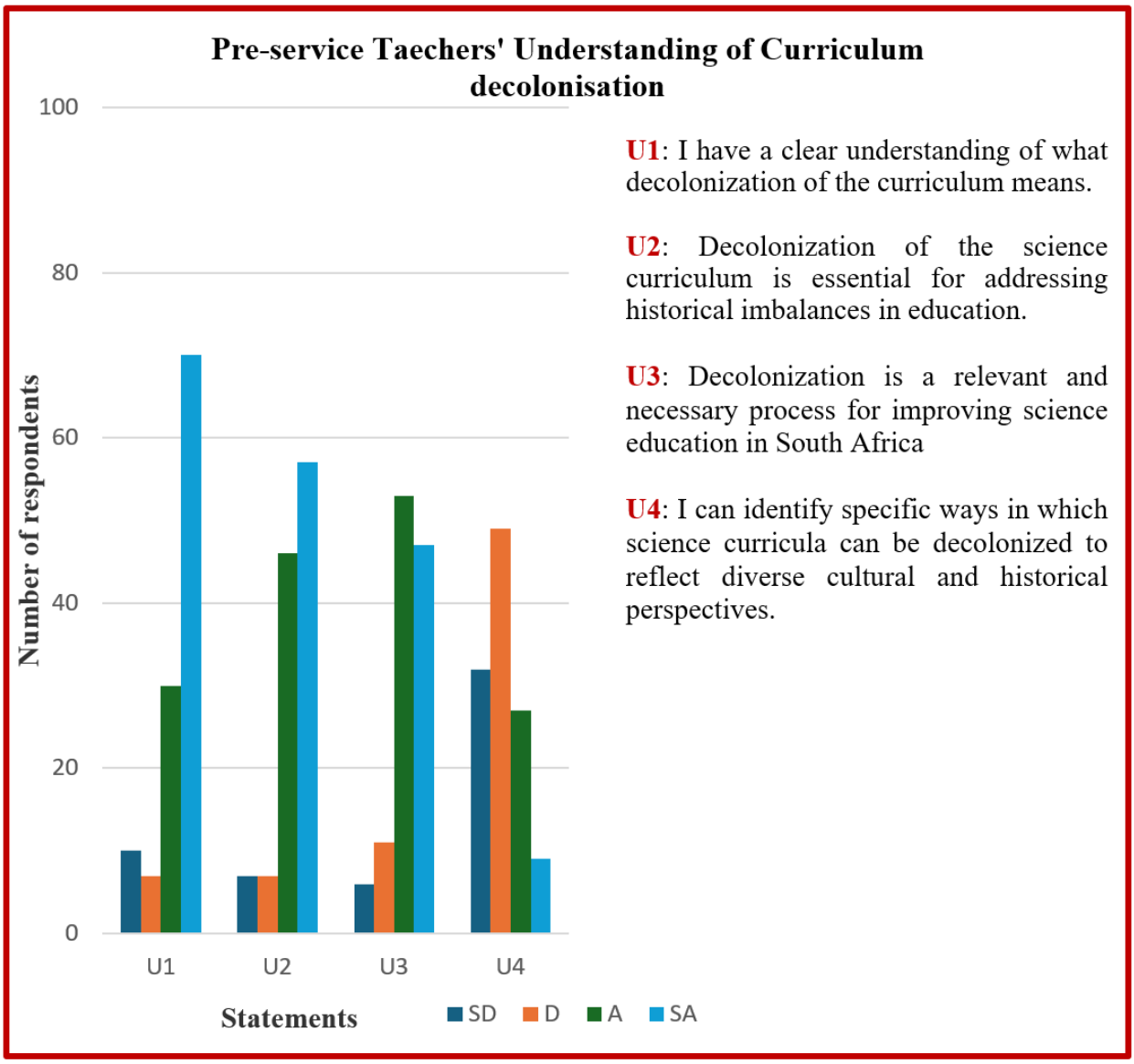

Figure 1.
Pre-service teachers' understanding of curriculum decolonisation.

Of the 117 students who completed the survey, 100 (85.5%) either agreed or strongly agreed that they had a good understanding of what 'decolonizing the science curriculum' meant. Most of the pre-service teachers (88.0%) strongly agreed or agreed with the statement that 'decolonization of the science curriculum is essential for addressing historical imbalances…' in the South African education system. Only 30% of respondents either strongly agreed or agreed that they could identify ways in which science curricula can be decolonized to reflect diverse cultural and historical perspectives.

3.2. Perceptions of Current Curriculum

There were four statements aimed at exploring teachers' perceptions of the current science curriculum concerning issues related to the 'colonized curriculum' or decolonization. Figure 2 provides a graphical summary of the responses from pre-service teachers.

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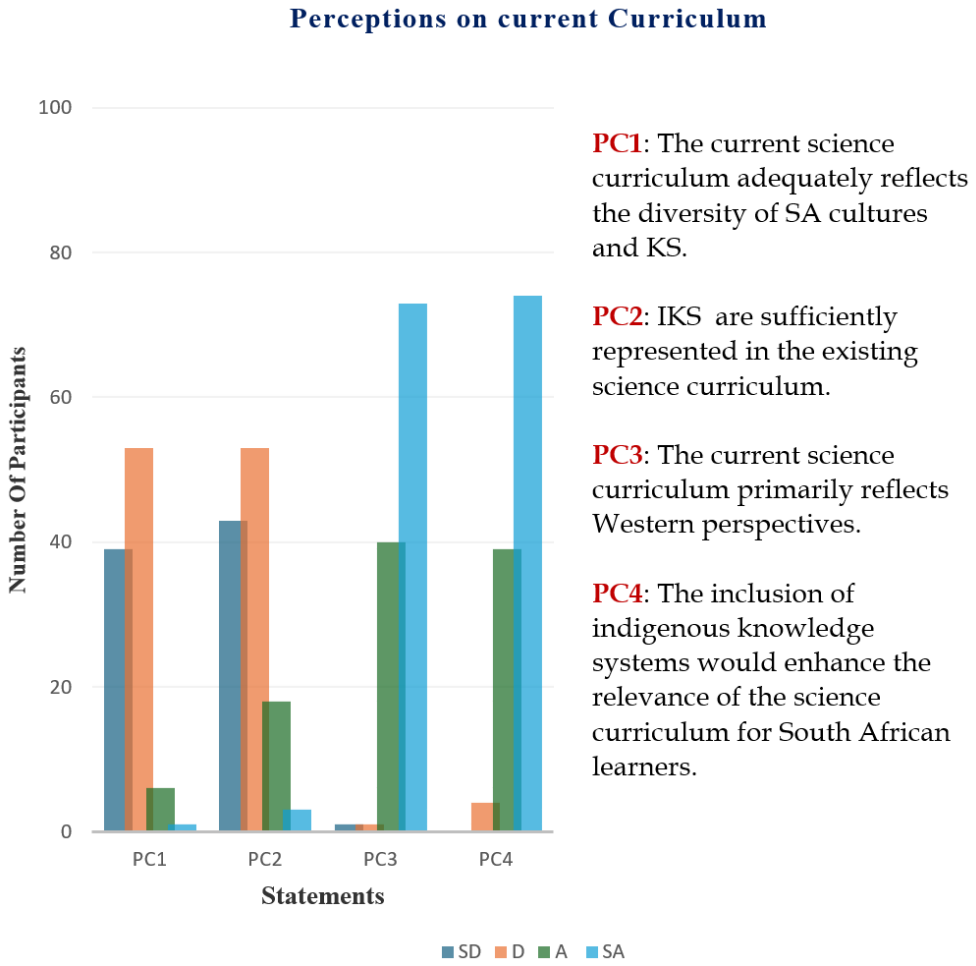

Figure 2.
Pre-service Teachers' perceptions on the current curriculum.

Most (78.6%) of the pre-service science teachers strongly disagreed or disagreed with the statement that the current science curriculum adequately reflects the diversity of South African cultures and knowledge systems. Only 17.9% perceived the curriculum as sufficiently representing indigenous knowledge systems. It was not surprising that 98.3% viewed the curriculum as predominantly Western in perspective. Additionally, 96.6% strongly agreed or agreed that including indigenous knowledge systems would enhance the relevance of the science curriculum for South African students.

3.3. Role of Teachers and Training

Teacher training institutions may be at the epicenter of issues of decoloniality and curriculum reforms. The survey questionnaire had four questions that sought to unpack how pre-service teachers perceive the role of teacher training institutions in terms of decolonization of the science curriculum. Figure 3 below summarizes pre-service teachers' responses.

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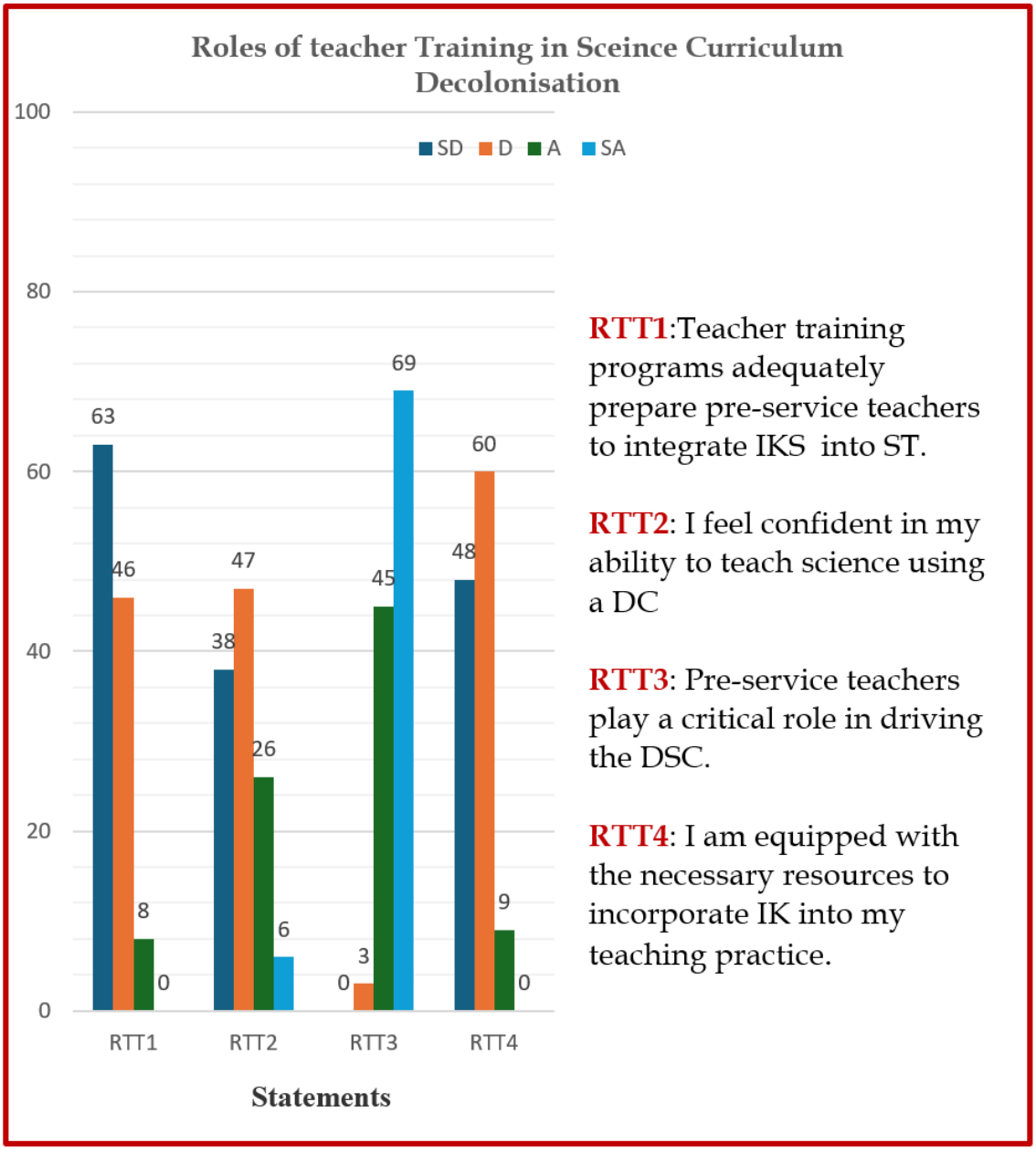

Figure 3.
Pre-service teachers' Perceptions on roles of Teacher Training in science curriculum decolonisation.

Only 6.8% of participants agreed or strongly agreed that teacher training programs adequately prepare pre-service teachers to integrate IKS into science teaching, with 53.8% strongly disagreeing. Most (72.6%) of the students did not feel confident in their ability to teach science using a decolonized curriculum. Despite these responses, most participants (97.4%) still perceived the role of pre-service teachers as critical in driving the decolonization of the science curriculum. Only 7.7% of pre-service teachers felt equipped with the necessary resources to incorporate indigenous knowledge into their teaching practice.

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3.4. Pre-Service Teachers' Perceptions on the Practical Implications of Decolonising the Science Curriculum

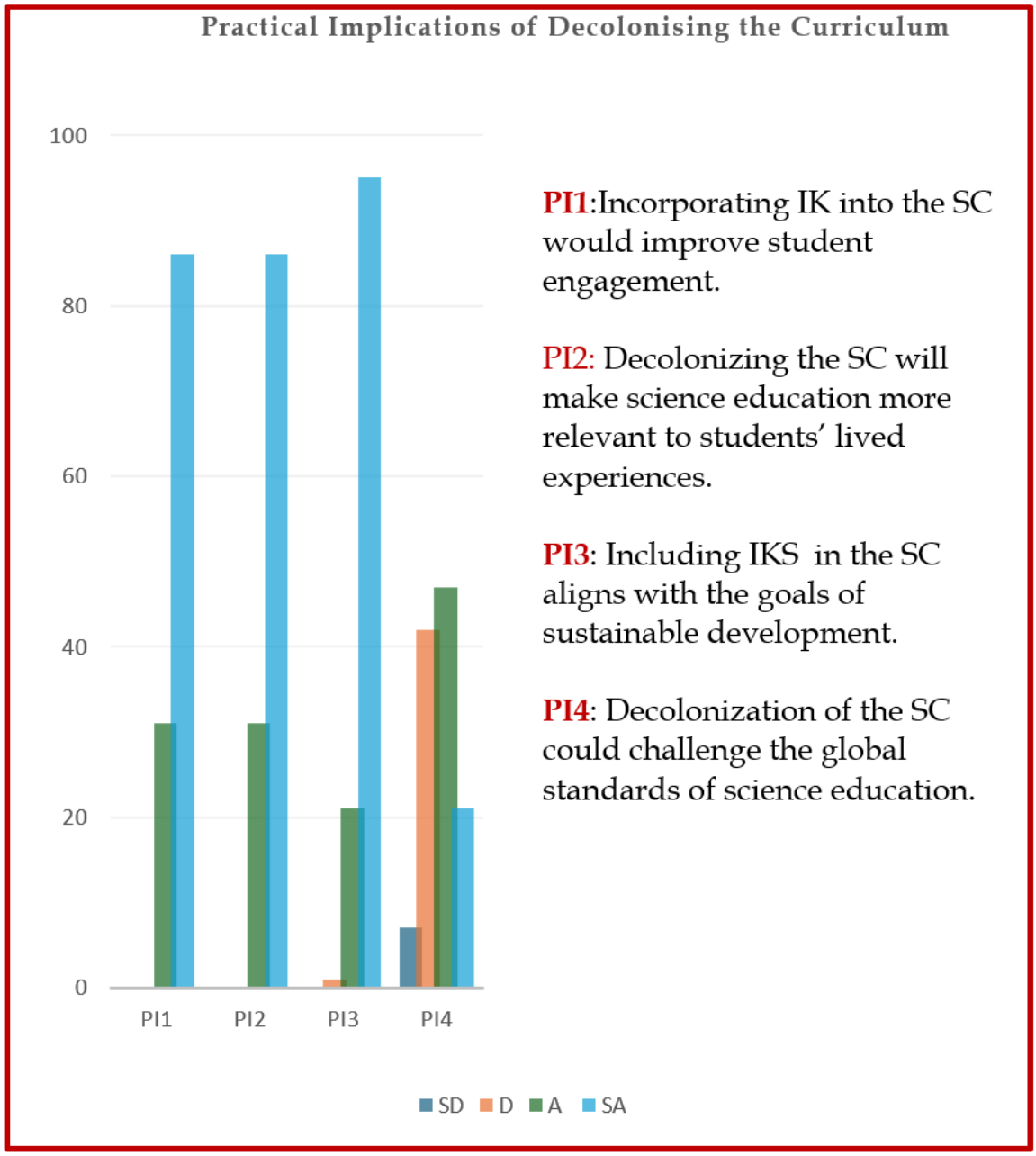

Figure 4.
Pre-service teachers' perceptions on the Practical implications of decolonising the science curriculum.

Most (80.3%) of the pre-service teachers either agreed or strongly agreed that incorporating Indigenous Knowledge (IK) into the science curriculum would improve student engagement. A slightly lower percentage (78.6%) agreed or strongly agreed that decolonizing the science curriculum would make science education more relevant to students' lived experiences. Participants overwhelmingly agreed that integrating Indigenous Knowledge Systems (IKS) would enhance engagement and relevance in science education.

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3.5. Preservice Teachers' Perceptions on Challenges in Decolonizing the Curriculum

Figure 5 below summarizes pre-service teachers' responses to four statements on challenges that efforts aimed at curriculum decolonization may confront.

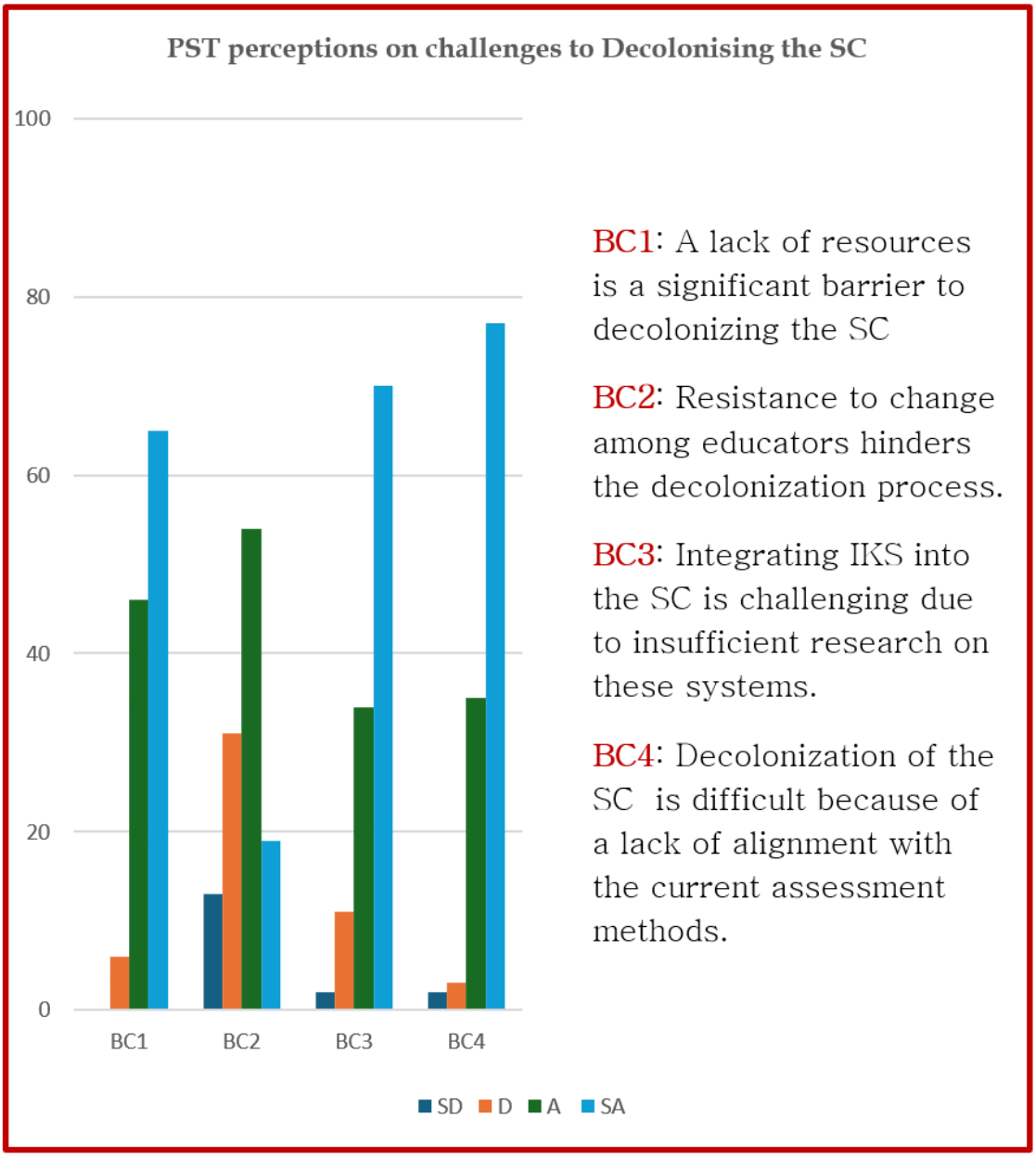

Figure 5.
Preservice teachers' perceptions of challenges in decolonizing the curriculum.

Most participants (94.9%) either strongly agreed or agreed that a lack of resources is a significant barrier to decolonizing the curriculum. A smaller percentage (62.4%) perceived resistance to change among educators as an obstacle to decolonization. The majority (88.9%) agreed or strongly agreed that integrating IKS into the science curriculum is challenging due to insufficient research on these systems.

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An even higher percentage (95.7%) viewed the challenges of decolonization as stemming from a lack of alignment with current assessment methods.

3.6. Attitudes and Beliefs

The media frenzy generated by protests around 'Fees Must Fall,' and the decolonization of curricula in South Africa may have influenced societal attitudes and beliefs. With a few statements, we aimed to unpack some of these perspectives. Figure 6 below provides a graphical representation of the participants' responses.

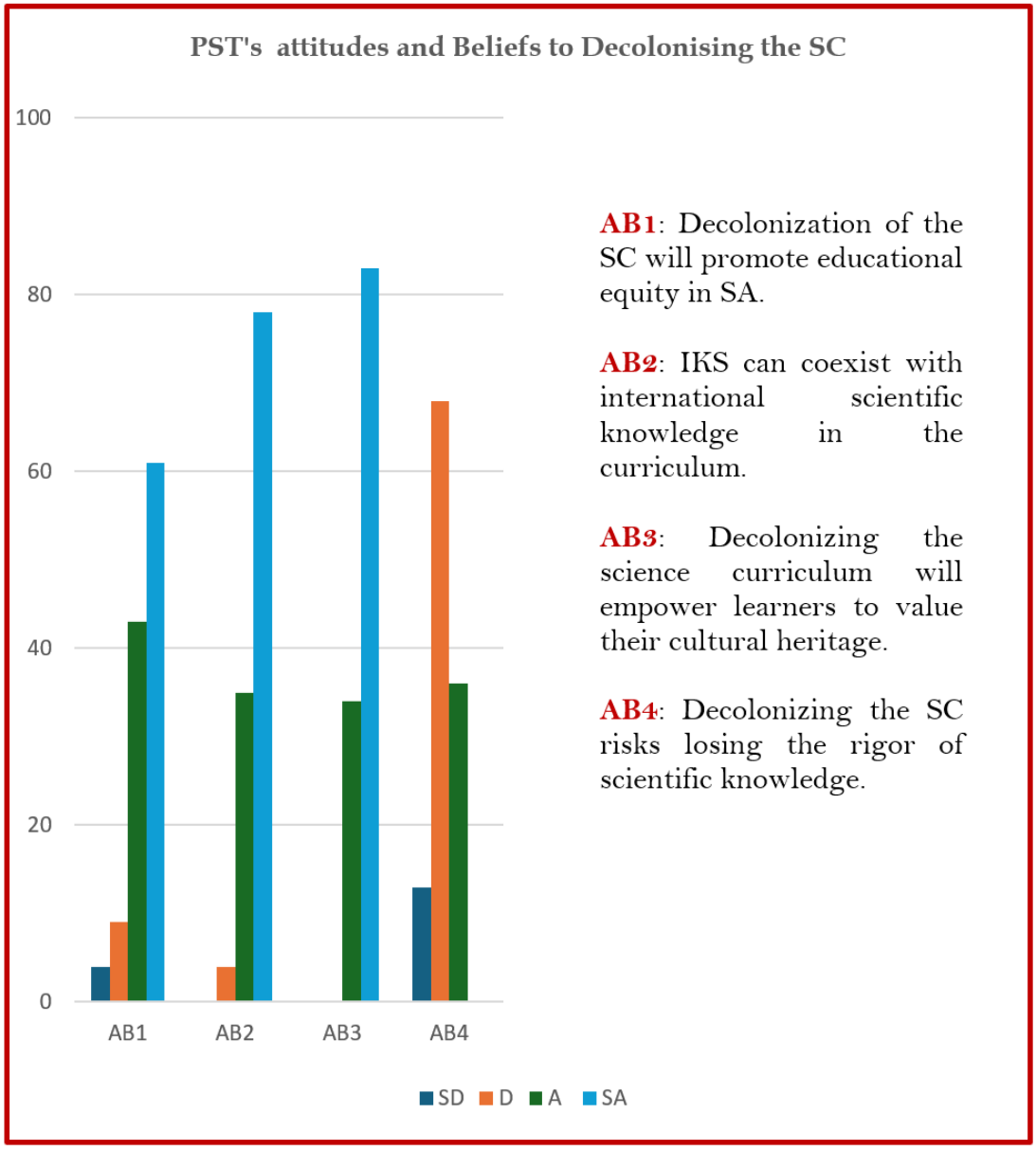

Figure 6.
Preservice Teachers' Attitudes and Beliefs on Decolonizing the Science Curriculum.

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Most participants viewed decolonization of the science curriculum as a means to promote equity in South Africa, with 86.3% either agreeing or strongly agreeing. Skeptics questioned the coexistence of Indigenous Knowledge Systems (IKS) with Western science. A majority (90.6%) agreed or strongly agreed that IKS can coexist with Western science. Additionally, 86.4% agreed or strongly agreed that decolonizing the curriculum would empower learners to value their cultural heritage. Opponents argued that integrating IKS into Western-centric curricula might weaken scientific rigor. However, 59.0% of participants believed that incorporating IKS would actually strengthen scientific rigor.

3.7. Key Insights from Pre-Service Teachers' Perceptions

Below is a summary of key insights on pre-service teachers' perceptions of decolonisation of the science curriculum.

Table 1.
Demographic Comparisons.

Figure	Focus	Key Insight
1	Understanding of decolonisation	Theoretical awareness is high, but specific pedagogical know-how is low.
2	Perception of the current curriculum	Curriculum is seen as Western-dominant and lacking IKS integration.
3	Role of teacher training	Teachers feel unprepared and under-resourced, despite understanding their importance.
4	Practical implications	Strong support for integrating IKS; concerns around global alignment are minimal.
5	Challenges	Resource gaps, teacher resistance, and assessment misalignment are major barriers.
6	Attitudes & beliefs	Pre-service teachers support decolonisation and reject claims that it weakens rigor.

To assess whether program type influenced beliefs, an independent samples t-test was conducted between PGCE and BEd students on the compatibility of IKS with Western science (AB2). Results indicated no significant difference, $t(df) = 0.93$, $p = .355$, with both groups showing strong agreement (PGCE: $M = 4.10$; BEd: $M = 3.92$). This suggests that openness to IKS is common across program types and not necessarily shaped by the teacher education pathway.

A Chi-square test was conducted to examine the association between gender and belief in IKS compatibility. No statistically significant relationship was found, $\chi^2(2, N = 115) = 1.81$, $p = .406$. Both males and females showed strong agreement that IKS can coexist with Western scientific paradigms, indicating broad acceptance of epistemological inclusivity among pre-service teachers regardless of gender.

From Figure 6, participants showed strong agreement that decolonization promotes equity and cultural identity, and that IKS can coexist with Western science. A Pearson correlation between understanding and attitudes (AB1–AB4) was again non-significant, $r = .019$, $p = .836$. This indicates that knowledge about decolonization does not automatically lead to stronger attitudinal alignment or commitment, highlighting the importance of reflective, values-based education [4].

4. Discussion

The results in the category of understanding indicate that most pre-service teachers comprehend what curriculum decolonization entails and strongly support its relevance for addressing historical imbalances and improving science education. However, fewer respondents (30%) expressed confidence in identifying practical implementation methods. This theoretical-practical divide is a recurring theme in curriculum reform [4, 9].

The results on pre-service teachers' perceptions suggest that, while they ideologically support decolonization, they feel hindered by systemic and institutional constraints. The strong endorsement of BC4 implies that assessment reform must accompany curricular change for decolonization efforts to

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succeed. This is consistent with findings from De Beer and Petersen [2] and Koch et al. [3] who argue that structural alignment, especially in assessments, is essential for sustainable curriculum transformation. Additionally, the emphasis on teacher resistance and the lack of IKS research align with previous studies highlighting gaps in educator preparedness and scholarly resources [5]. These insights reinforce the conclusion that meaningful decolonization in science education must be supported by comprehensive institutional reform, inclusive research development, and targeted professional development for educators.

Results displayed in Figure 3 highlight the institutional challenges perceived by participants. Only a small percentage felt their training programs prepared them to integrate IKS into science teaching. These findings support claims in the literature that teacher training institutions in South Africa have been slow to operationalize decolonization [16, 19].

Figure 5 highlights structural challenges perceived by participants. The majority cited a lack of resources, misalignment with assessment, and educator resistance as key barriers. These findings support claims in the literature that, despite consensus on the need to decolonize the science curriculum, numerous challenges remain regarding its implementation in science classrooms [16, 17].

5. Conclusions and Implications

This study examined pre-service science teachers' perceptions of the decolonization of the science curriculum in South Africa. The findings reveal a generation of pre-service teachers who are ideologically aligned with decolonization goals but lack the training, tools, and institutional support to implement these visions in pedagogical practice. The results echo Luckett [5] and Onwu and Mosimege [27], who stress the need for epistemological transformation supported by structural changes in curriculum design, teacher preparation, and assessment.

The lack of statistically significant correlations between understanding and either attitudes or practical implications highlights the need for deeper pedagogical engagement, not just conceptual knowledge. Training programs must evolve to bridge this gap, including collaborations with IKS experts and the development of context-sensitive teaching resources.

The findings reveal widespread support for integrating indigenous knowledge systems (IKS) into science education, with participants recognizing its potential to promote equity, cultural relevance, and learner engagement. Most respondents agreed that decolonization is essential for redressing historical imbalances and enriching the curriculum through diverse epistemologies. Despite this strong conceptual support, the study highlights a significant gap in practice. Many pre-service teachers reported feeling underprepared to implement a decolonized curriculum, citing inadequate training, limited resources, and unclear guidance on integrating IKS into existing science content. The findings also indicate systemic barriers, such as resistance from educators and poor alignment between decolonized content and current assessment methods. Importantly, participants rejected the notion that decolonization compromises scientific rigor. Instead, they viewed IKS and Western science as potentially complementary, affirming the value of epistemological diversity in teaching and learning. This suggests a readiness among future teachers to embrace a more inclusive, locally grounded science education. To make decolonization a practical reality, teacher education institutions must strengthen their programs by embedding IKS more meaningfully, providing clearer implementation frameworks, and collaborating with indigenous knowledge holders. Without these structural supports, the aspirations of a decolonized curriculum will remain largely theoretical. By centering the voices of pre-service teachers, this study contributes to the broader discourse on curriculum transformation. It underscores the need to bridge the gap between policy ideals and classroom realities and to empower future educators as agents of meaningful and sustainable change in science education.

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study, with no vital features omitted. Any discrepancies from the planned study have been explained. This study adhered to all ethical practices during writing.

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