Chapter 7

Pre-Service Science Teachers' Perceptions Towards Developing Isizulu Vocabulary for Teaching and Learning

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Abstract

This study investigates pre-service teachers' perceptions towards developing an isiZulu vocabulary for teaching and learning chemistry in three rural FET schools in KwaZulu-Natal, South Africa. It contributes to the ongoing debates around curriculum decolonisation and code-switching in teaching and learning. The study adopts a qualitative interpretivist paradigm, utilizing individual interviews with six (6) isiZulu pre-service chemistry teachers who were purposively selected. The study found that pre-service teachers generally had a positive attitude towards curriculum decolonisation and code-switching for teaching and learning chemistry. This study also found that some pre-service teachers were not keen to develop isiZulu vocabulary, given the challenges and complexities of code-switching in real-life chemistry teaching and learning contexts.

Further, the findings indicate developing isiZulu vocabulary can enhance curriculum decolonisation and code-switching for effective teaching and learning of chemistry in this context. The study recommends the need for pre-service teachers to be conscientised about the value of developing isiZulu vocabulary for effective teaching and learning of chemistry lessons. Future

research must explore how to effectively empower pre-service teachers to manage code-switching in teaching chemistry in rural contexts.

Keywords: *decoloniality, Chemistry teaching, isiZulu, English, rural schools.*

Understanding curriculum decolonization in the African context

In the context of decolonisation struggles against colonial rule, curriculum decolonisation developed on the African continent in the 1950s and 1960s. Decolonisation is based on the renunciation of contemporary colonial education, which deprives the colonised of their humanity and potential while attempting to transform them into colonial subjects. According to Santos (2014), the suppression of the non-European and indigenous groups' knowledge resulted in a form of epistemicide from the canon of knowledge. Indigenous knowledge received little consideration from the (colonial) school of thought. The (colonial) school supported the Western canon, which was built on the idea that modern Western knowledge should be distinguished from its non-Western knowers and suggested that modern knowledge would aid in the instantiation of modern subjects.

Teaching modern subjects was the primary focus of colonial education, which sparked radical discussions amongst learners who demanded the decolonisation of education. They demanded that the Western canon of knowledge be revised and all formerly marginalised groups' sophisticated modes of knowing to be accepted. Intercultural education must consider all types of knowledge in order to encourage epistemic openness to the knowledge of all humans. Schools, colleges and universities are called to propagate respect for people and their cultural and knowledge systems. Different knowledge and science systems should be incorporated into university curricula to create dialogical platforms about the present and future. According to Fataar (2018), such incorporation must be discussed urgently by policymakers, designers of textbooks,

learning materials, and curriculum, but most importantly, by university lecturers and schoolteachers. In this light, this chapter reports on pre-service teachers' perceptions towards developing an isiZulu vocabulary for teaching and learning chemistry in three rural FET schools in KwaZulu-Natal, South Africa.

The need for curriculum change in South African Higher Education

The chapter contributes to the ongoing debates on curriculum decolonisation and code-switching in teaching and learning. The conceptual strength of curriculum, which suggests novelty and creates a variety of opportunities for pedagogical lives to emerge, may be viewed as the cornerstone of decolonisation (Deleuze & Guattari, 1994). For more perspectives on curriculum (see Le Grange, 2016; Fomunyam & Khoza, 2021a; Maistry, 2021). The higher education system in South Africa is highly intricate. Classrooms are filled with learners who suffer great inequality in terms of basic education, race and class. These learners also lack financial resources and other materials. Consequently, a curriculum that caters to the needs of the learners is required, as opposed to the currently pre-planned curriculum.

A growing body of literature in the field suggest that a pre-planned curriculum is rigid (Fisher-Ari et. al., 2015). However, because of how rapidly the economic, global market, and technological worlds are changing and how they affect day-to-day life, curricula must change to meet a global society's needs and interests. This would create a task force that is well-trained and prepared to handle the modern day opportunities and challenges. To achieve this goal and create a unique learning environment, an open-ended curriculum that encourages learners to pursue knowledge relevant to their backgrounds is recommended. Fomunyam and Khoza (2021a) adopt the concept of curriculum as explained by Aoki (1993). Also, the curriculum designed by educators as opposed to non-educators is likely to be effectively implemented as

educators have the knowledge to adapt the curriculum in light of their classroom experiences to best meet the learners' educational needs and interests. This view is supported by Rispel et. al., (2023), Arbuckle (2020) and Mittelmeier et. al., (2018), who posit that decolonisation of curriculum design should be adapted to address the socioeconomic needs of the learners. This was also supported by Fomunyam and Khosa (2021a) who advocate for a student-centered open curriculum that is locally relevant, enhance critical thinking abilities and promote learning across a wide range of disciplines. Hence, developing chemistry IsiZulu vocabulary for teaching and learning may meet socio-cultural needs of rural KwaZulu Natal learners.

Centrality of language and code-switching in curriculum decolonisation in South Africa

The June 16, student uprising of 1976 in South Africa, introduced the centrality of language in curriculum decolonisation. Learners suggested that the curriculum be decolonised because they felt that the use of Afrikaans in teaching African languages was the main reason for their alienation from the educational system. Based on that consciousness, a plethora of propositions that support educational access through language decolonisation being accentuated (Open Stellenbosch Collective, 2015; Thesnaar, 2017; Woods et. al., 2022; De Vos et. al., 2023) became dominant. In this regard, the literature focus more on the need for the university, school and colleges to implement curriculum decolonisation through conceptual and descriptive use of language, including code-switching as a teaching and learning instrument (Brock-Utne, 2005). The context of decolonising struggles against colonial rule calling for curriculum decolonisation emerged in Africa during the 1950s and 1960s. Decolonisation aims to reject contemporary colonial education, which dehumanizes the colonised and stifles their potential by trying to transform them into colonial subjects (Fanon, 1967; Fomunyam & Khosa, 2021b; Grosfoguel, 2013; Maistry, 2021; Maldonado Torres, 2007;

Ndlovu-Gatsheni, 2018). The suppression of non-European and indigenous knowledge led to epistemicide, as Santos (2014) noted, with indigenous knowledge receiving little consideration in the colonial school of thought. This school supported the Western canon, promoting modern Western knowledge while disregarding its non-Western sources, sparking radical discussions among learners demanding a decolonised curriculum that respects all cultural knowledge systems and promotes intercultural education. Fataar (2018) emphasizes the need for policymakers, educators, and curriculum designers to incorporate different knowledge systems into university curricula, fostering respect for diverse cultures and creating dialogical platforms for discussing present and future educational needs. Developing isiZulu chemistry vocabulary for teaching and learning will create opportunities to incorporate other knowledge systems into the curriculum.

Decolonisation of curriculum change in higher education is essential due to the diverse and unequal backgrounds of learners, many of whom lack financial and material resources. A pre-planned and rigid curriculum that does not take account of the local learners' culture and language cannot meet the rapidly changing demands of the global economy and technology.

The benefits of the decolonised curriculum which foregrounds the local languages and the use of code-switching for teaching and learning develop learners' for better life opportunities, and academia transformation into a more inclusive space as well as lifelong learning opportunities. Against this backdrop, Le Grange (2016) explored the decolonisation of the university curriculum. Le Grange (2016) emphasised the need to explore the decolonisation of the university curriculum, particularly the teacher education curriculum. Le Grange (2016) suggests that curriculum decolonisation should include the redefinition of the value we ascribe to the indigenous people in local contexts in ways that combine the dominant western epistemologies and the indigenous epistemologies. In order to achieve this imperative,

the use of local languages and code-switching is central to the teacher education curriculum decolonisation endevours. Hence, this chapter sets out to investigate pre-service teachers' perceptions towards curriculum decolonisation and the use of code-switching in teaching and learning.

Use of code-switching in teaching and learning in rural context

Code-switching is a pedagogical tool by which the teacher strategically moves from English language as a medium of instruction to a local indigenous language and vice versa to explain concepts using examples that are relevant to the real-life experience of the learners (Brock-Utne, 2005; Myers-Scotton, 1993). During code-switching, in rural context, chemistry concepts are initially described in English, followed by an explanation in isiZulu language and vice versa to help learners to grasp the conceptual and utility meaning of chemistry concepts. However, due to insufficient resources and paucity research providing insights on how best to adapt the curriculum and implement code-switching effectively, pre-service teachers are not well equipped to apply this concept in real-life classroom context. Given the centrality of code-switching in rural schooling contexts, this study set out to bridge the gap in the literature by providing insights on pre-service teachers' perceptions towards developing isiZulu chemistry vocabulary for teaching and learning. Language is often a barrier to effective teaching and learning (Mthiyane, 2016), mainly when pre-service teachers' English proficiency is below the required standard for classroom instruction (Kellerman, Evans & Graham, 2021).

Another factor relates to complex nature of the chemistry concepts and rural learners' lack of proficiency to comprehend these complex concepts which legitimise the imperative to use code-switching. Therefore, code-switching is employed to enhance communication, understanding, and clarity, creating a conducive learning environment where English language mastery is lacking (Almutairi & Alqarni,

2024; Jacinda, 2024; Maluleke, 2019; Nkosi, 2020; Syahrin, Zulfariati & Permata, 2024; Songxaba *et al.*, 2017; Uys, 2010) or in the absence of English terminology for the concept (Van Laren & Goba, 2013), hence, the need to develop chemistry isiZulu vocabulary for teaching and learning. Boughey and McKenna (2021) emphasise the value of language proficiency, culture and use of language (Fanon, 2017; Crossman, 2004; Greenstein, 2007; Mkhize & Balfour, 2017; Rodrigues-Seeger *et al.*, 2021). Code-switching is particularly suitable for teaching Chemistry, a subject often perceived as abstract and complex to grasp (Sözbilir, 2004). Chemistry concepts, frequently seen as a collection of formulas (Afonso, 2009), can be made more comprehensible through the use of culture-related scenarios and mother tongue, which helps learners recall what they were taught (Golding, 2017; Mumba *et al.*, 1997).

Teaching in mother tongue also increases learners' participation (Mwinsheikhe, 2001) and aligns with UNESCO's (2016) commitment to incorporating indigenous languages in education (Knagg & Mcllwraith, 2013). Policies on code-switching may be adopted to avert the historical inconsistency of requiring learners to be educated in unfamiliar languages (UNESCO, 2016). Maluleke (2019) and Uys (2010) emphasize the need for such policies to ensure uniformity across classrooms. Despite UNESCO's (2016) proposal to use both international and local languages as mediums of instruction, currently school policies are often silent on this matter. While starting code-switching during early childhood can be beneficial (Heugh, 2006), in South Africa, primary school learners face challenges transitioning from mother tongue to English in science education, resulting in poor performance due to unfamiliar scientific terminology (Kazeni & Maleka, 2020). On the other hand, Makanda (2020) and Mzizi (2022) expand on efforts to incorporate indigenous languages in education, such as the 2020 matric exams in the Eastern Cape Province using indigenous languages, which have shown improved results with the incorporation of indigenous languages (Mndende, 2020). Promoting code-switching through education aligns with the Department of Education's

(2002) recommendations and the Department of Higher Education and Training's commitment to decolonial education and accessible academic programs in South Africa. Use of indigenous languages in teaching and learning would enhance learners' success if communities would learn in the language spoken at home. Cowling (2023) expounds that majority of South Africans speak isiZulu at home (25.3%), followed by isiXhosa (14.8%), then Afrikaans (12%) and English (8%).

Theoretical underpinnings for understanding curriculum decolonisation

The study is guided by Le Grange (2016) theory of decolonisation, Shulman (1986) domains of teacher knowledge and Gee's (2014) multilingual language. According to Le Grange (2016), the five stages of decolonization are the rediscovery and recovery of history and identity, mourning the ongoing oppression, dreaming of new possibilities based on Indigenous knowledge, demonstrating commitment through activism, and translating these dreams and commitments into actions for social transformation. Action provide the curriculum transformation into developing isiZulu vocabulary for chemistry. Shulman (1986) teacher knowledge theory emphasizes that effective teaching requires a blend of content knowledge, pedagogical knowledge, and pedagogical content knowledge to understand how to teach specific subjects effectively. Shulman's (1986) theory helped us in understanding how chemistry curriculum may be decolonised through code-switching. Gee's (2014) multilingual theory posits that language learning is deeply rooted in social and cultural contexts, where individuals acquire multiple language practices through participation in various discourse communities. Through the use of an indigenous knowledge in the form of indigenous language, Gee's (2014) theory provided the basis for understanding a sense of belonging of the indigenous people to the curriculum decolonisation since language is located in a culture of indigenous people.

Le Grange's (2016) five stages of decolonisation firstly refer to: People who have been colonised rediscover and recover their history, culture, language, and identity. Secondly, mourning is the process of lamenting the ongoing assault on oppressed people's identities and social realities. Thirdly, dreaming is the process of invoking the history, worldviews, and indigenous knowledge systems of colonised people in order to theorise and imagine new alternative possibilities, such as a new curriculum. Fourthly, commitment is demonstrated when university students or academics become political activists in order to demonstrate their commitment to including the voices of the colonised, in this case, in the university curriculum. Finally, action occurs when dreams and commitment are translated into strategies for social transformation. I employ action, in this study. Action denotes developing chemistry isiZulu vocabulary for teaching and learning.

Shulman's (1986) theoretical framework consists of content knowledge and general pedagogical knowledge. The amount and organisation of knowledge of the subject in the teacher's mind is called content knowledge. The knowledge that goes beyond knowledge of the subject matter, including the dimension of subject matter knowledge for teaching, is general pedagogical knowledge. Pedagogical content knowledge refers to the topics taught in the subject, the vital depiction of the ideas, analogies, illustrations, examples, explanations, and demonstrations that make the subject intelligible to others.

Pedagogical content knowledge incorporates understanding what makes learning specific topics easy or difficult and the misconceptions that learners experience within the subject matter (Shulman, 1986). In addition, it allows the teacher to be acquainted with the most appropriate strategies for imparting knowledge in various topics for learners at different levels of study. Additionally, the content knowledge and general pedagogical knowledge receive amalgamation in pedagogical content knowledge to form the type of knowledge called knowledge of learners (Golding, 2017). This means that curriculum decoloniality and code-

switching should be made part of the formal plan in designing the pedagogical approach to teaching chemistry subjects. For instance, this must be fused in the learning designs, content knowledge and skills to the learners of chemistry subjects. Gee (2014) offers a different approach to discourse and describes the wield of language as incorporating information (saying), action (doing), and identity (being). In linguistics, 'discourse' names a part of the language that intimately relates to syntax. The structure of the language and the way the words and phrases combine into sentences is called 'syntax'. The context of language usage includes the operation of clues and cues (namely, syntax and discourse) to shape the interpretations and actions of listeners and readers. This means that in decolonising the curriculum, indigenous knowledge which are indigenous knowledge systems, which are mainly represented through language use bring inclusivity, sense of belonging and understanding; which are all essential elements of meaningful and effective learning and teaching of chemistry subjects.

Methodology

The study adopted a qualitative interpretivist research paradigm which explains the way people attribute meaning to their circumstances and develop rules that govern their behaviour (Thanh & Thanh, 2015). Thanh and Thanh (2015) describe interpretivist as a methodical approach that seeks experiences, understanding and perceptions of individuals for their data to uncover reality. This paradigm was used in this research to seek pre-service teachers' experiences in teaching Chemistry in isiZulu and how an isiZulu Chemistry vocabulary may be developed. The interpretivist paradigm uses qualitative methods (Willis, 2007), such as case studies. Qualitative methods provide rich data necessary for interpretivists to fully understand contexts. A case study was adopted for this research. Teachers' perceptions are the phenomenon, and developing isiZulu vocabulary is the unit of analysis. The case study is located in the class of 2019 Chemistry III: with six Zulu pre-service teachers during work integrated learning (WIL)

in rural schools of KwaZulu-Natal (KZN). This is a single case study where there is only one location.

In qualitative research, broad research questions are designed to explore, interpret, or understand the social context (Lodico, Spaulding & Voegtle, 2006). The selection of participants is determined by individuals' acquisition of information vital to the research questions in non-random methods. Data collection techniques included interviewing participants. The qualitative approach used in this study uses one technique for gathering data for interviews of pre-service teachers who teach Chemistry in isiZulu. Pre-service teachers were interviewed in my office after school. For accurate information capture, interviews were recorded. Each interview took 45 minutes.

The participants were recruited via the 'Class' WhatsApp group, as we discussed teaching Chemistry through English and isiZulu code-switching on WhatsApp. All 50 level-three Chemistry pre-service teachers consented to participate in the study through the 'Subject' WhatsApp group. Participants who were willing to teach in this manner, and who were Zulu and who were to be placed in rural KZN schools for WIL, were purposively sampled. This is common in rural KZN schools where isiZulu predominates as a language. These participants were placed in KZN rural schools in one district. They were willing to be interviewed (one-on-one) to understand their experiences and benefits of code-switching between English and isiZulu and how an isiZulu vocabulary may be developed for Chemistry. The schools are comprised of exclusively isiZulu-speaking mother tongue learners.

To represent each phase in the Further Education and Training (FET) band matching pre-service teachers' specialisation, two pre-service teachers per FET phase level (10, 11, or 12) per school participated in this study. The two first language (L1) Zulu pre-service teachers taught Chemistry in one of the grades 10, 11 or 12. This was an appropriate sample size due to expense and time constraints (Cohen et. al., 2007). The interview questions required the

participants to indicate their experiences, advantages, and disadvantages of code-switching between English and isiZulu when teaching Chemistry and how an isiZulu vocabulary may advance for Chemistry. Face-to-face interviews were held with each participant for approximately 45 minutes. To ensure anonymity, the participants were labelled P1 to P6.

Data findings and discussion

This study set out to investigate pre-service teachers' perceptions towards curriculum decolonisation and use of code-switching in teaching and learning. It also investigated the ways in which a chemistry isiZulu vocabulary could be developed.

Data analysis involved recording and transcription of data, using an inductive approach. Through an interpretive analysis of transcribed data; the following conceptually informed themes emanated: curriculum decolonisation through Code-switching as a mechanism of curriculum decolonisation in teaching Chemistry subjects; optimising on code-switching from English to isiZulu in teaching Chemistry; the challenges of teaching Chemistry with code-switching between isiZulu and English; and the development of an isiZulu vocabulary for Chemistry.

Code-switching as a mechanism of curriculum decolonisation in teaching Chemistry subjects

Chemistry is an abstract subject (Sözbilir, 2004) that is taught in abstract ways and continues to be a problem for learners. According to Shulman (1986), teachers of a specific subject should possess special understanding and abilities that integrate their knowledge of the content of the subject that they are teaching as well as having knowledge of the learners who are learning the content. To resonate with Shulman's (1986) framework, pre-service teachers in this chapter use culture-related scenarios that the learners are familiar with to teach Chemistry. This is in line with the literature (Golding,

2017). Moreover, P3 noted the introduction of contextual examples simplifying chemistry abstract theoretical notions for the learner: *"I make scenarios that are culture-related to enable learners to remember what was taught."* This story was consistent with the experiences of other participants:

> *… as you teach Chemistry, you make simple examples that they can relate from their homes, what they usually do, and what they usually do in their daily life experiences and then you built up on that (P5).*

The above narratives allude to cultural inclusiveness in the teaching and learning environment, which encourages identification while discussing Chemistry ideas. This demonstrates how learning is consolidated within the context of learners' daily situations and examples. Each human language, according to Gee (2014), has a grammar that is used, recruited, adapted, and altered differently by different users to complete certain tasks. P3's efforts to ensure learners' learning and retention of abstract topics exemplifies this adaptability. This is explained by Le Grange's (2016) decolonisation theory's first stage termed rediscovery and recovery to exemplify pre-service teachers' bringing culture into teaching and learning of chemistry concepts for learner concepts' retention.

As alluded to by P5, language is a prerequisite to qualifying in the education system. This agrees with Boughey and McKenna (2021), who report that knowing the language is a requirement for success in the educational system. Further, academic literacies must be mastered by the learners (Boughey & McKenna, 2021). In line with this notion, learners must comprehend the disciplinary principles, values, and norms from which the specific language practices emerge, to produce an effective laboratory report in Chemistry. According to Fanon (2017), language is critical to cultural regeneration and agency growth. Because language and identity are so intertwined, he suggested that being denied one's language would severely impact one's mental health. When learners' identities are unknown, they are subjected to testimonial

injustice. This means that indigenous languages need to be included as languages of instruction as described by Gee (2014).

When revisiting Le Grange's (2016) five stages of decolonisation: rediscovery and recovery referred to pre-service teachers employing cultural models in the indigenous language isiZulu in teaching Chemistry as already discussed under curriculum decolonisation through teaching Chemistry with code-switching between isiZulu and English. The legacy of apartheid and the South African Education system lagging comes to the fore during the assessment, which is called mourning. This is revisited under decolonising curriculum through optimising on code-switching from English to isiZulu in teaching Chemistry. Dreaming comes to the fore as we theorise our own isiZulu Chemistry vocabulary. Commitment is demonstrated during the #FeesMustFall and #RhodesMustFall campaigns for the implementation of inclusive education. In the case of language transformation, commitment came from black staff and students at a University that continued to employ Afrikaans as a language of instruction (Open Stellenbosch, 2015). This study demonstrates the importance of action in developing isiZulu vocabulary for chemistry teaching and learning, leveraging resources for effective code-switching.

Optimising on code-switching from English to isiZulu in teaching Chemistry

Pre-service teachers were familiar with their learners, thus they realised that using the mother tongue would help with long-term memory retention, as shown in the excerpts below:

> *... teaching in isiZulu is more enjoyable. Learners can even make the class or the atmosphere conducive to learning, they can even come up with jokes because they understand what you are talking about. (P4).*

> *Well, it has helped learners concentrate, it has helped them learn to relate to the subject content, and it helps enhance*

> *the learning process. Learners do not have to work hard to memorise because it is already in their system. That is the biggest benefit of teaching learners in a language they can relate to. …You can tell from their participation; you can tell from their very high concentration levels… (P5)*

As evident from the excerpts above, Shulman (1986) ascertains that a competent teacher uses the most powerful analogies, illustrations, examples, explanations, and demonstrations to help learners understand what they are learning. According to Mumba et. al. (1997), pre-service teachers use isiZulu, a mother tongue that allows learners to recall what they were taught. The mother tongue also realises UNESCO's (2016) commitment to including indigenous languages in learning and teaching (Knagg & Mcllwraith, 2013). The mother tongue also tackles a historical inconsistency in which nationals were required to learn in languages they could not understand (UNESCO, 2016).

Chemistry curriculum decolonisation may be achieved through the knowledge of the learner (Shulman, 1986) and the use of code-switching between an indigenous language and the English language. As shown from the excerpts from P4 and P5 above, pre-service teachers know their learners' historical backgrounds and use code-switching between English and isiZulu. They are aware that teaching exclusively in English will result in low learner participation, in line with a previous report (Mwinsheikhe, 2001). Pre-service teachers frequently believe that they are failing to meet the demands of the learners, as validated by P3: *"It becomes boring to teach in English only since only one or two learners will participate in class".*

The preceding narrative stresses class participation by the greater majority of learners; otherwise, communication will be limited to a select few. In addition, there is a desire to learn and teach Chemistry in isiZulu, since it involves the development of learner confidence and effective communication, as evidenced by the following: *"… upon code-switching between isiZulu and English, the learner develops confidence and understanding"* (P1).

The advantages of using code-switching are a preferred and powerful communication tool (Gee, 2014). P3 and P1 above suggested that code-switching promoted better communication between learner and teacher. This was also attested by Maluleke (2019), who demonstrated using code-switching as an empowerment strategy in teaching Mathematics to learners with limited proficiency in English in SA. Maluleke (2019) further insinuates that the DBE must have a policy on code-switching so that it is regulated. The usage could be uniform through different classrooms. Uys (2010) concurs with Maluleke (2019) on policy requisite and further ascertains that teachers code-switch mainly for academic, social, and classroom management purposes. In addition, teachers perceive code-switching as the best way to facilitate understanding (Songxaba et. al., 2017). While UNESCO (2016) has proposed using the international language and local language as the mediums of instruction, school policy is silent on the language policy.

Code-switching appears beneficial in teaching and learning, starting at a young age for the learners (Heugh, 2006). Kazeni and Maleka, (2020) point out that in SA, primary school learners debut with a Science subject and transition from learning, teaching, and assessment from mother tongue pedagogy to English at Grade four. Learners encounter challenges in line with decolonisation theory's (Le Grange, 2016) mourning stage during the assessments due to historic Afrikaans and English teaching and learning instruction, as these languages are second languages to majority of the learners in South Africa (Cowling, 2023). The challenges of learning a new subject in an unfamiliar language include the inability to understand the scientific terminology, resulting in poor performance in Science assessment as attested by P4: *"... the Matric learners fail Chemistry because they do not understand what is going on...."* Hence, code-switching is necessary to address this challenge. In addition, code-switching positively impacts the Grade 12 Physical Science examination results, as P3 and P5 remarked below.

> *Learners can answer what is asked if written in their mother tongue. An examination cannot determine what you know if you cannot write it down in English, which is a barrier for some learners. No learner has been found cheating when writing isiZulu composition. However, learners memorise chemistry concepts which is a problem when taught in English only (P3).*

> *... Even when you look at exam papers, they are asked in complex English; they fail to then decode the English (P5).*

Above, P3 and P5 note the obstacles in the examination process. In the next stage of the decolonisation theory, dreaming (Le Grange, 2016), an indigenous language is incorporated into teaching, learning and assessment by the DBE in South Africa in the 2020 matric exams in the Eastern Province (Makanda, 2020). The language policy is changing to incorporate indigenous languages (Mndende, 2020). Mother tongue in the examination was expected to produce the desired results. As expected, the outcomes of the 2020 and 2021 matric results improved due to the usage of indigenous languages (Mzizi, 2022). Perhaps such a pilot will offer the opportunity for isiZulu to be considered next in the province of KwaZulu-Natal, where this dialect predominates. In addition, the challenges of the language of learning and teaching start to emerge as learners cheat due to a language barrier, as P3 noted above. This points out to the need for the action stage of the decolonisation theory (Le Grange, 2016) to developing isiZulu chemistry vocabulary for teaching and learning, which are the objectives of this chapter.

The challenges of teaching Chemistry with code-switching between isiZulu and English

According to Greenstein (2007), the greatest challenge to the renewal of education in general, and curriculum policies in particular, is Africanisation. While this is true, it is crucial to recognise that the transformation of higher education institutions will not be complete unless the knowledge

generation and dissemination processes are congruent with the circumstances and cultural orientation of the people our universities serve. According to Crossman (2004), such a process would include changing external variables and internal principles and priorities that determine our universities' orientation, beliefs, and practices.

The language should be acknowledged as a right that needs to be practiced and a resource (Mkhize & Balfour, 2017) that needs to be developed and distributed for equality in participation. The issue of undervaluing indigenous languages is pertinent. P3 communicated on wider recognition and applicability as narrated below:

> *Great attention paid to an indigenous language like isiZulu will not be well received as other races undermine indigenous languages. Indigenous people must develop their businesses. This will enable them to learn in their indigenous languages, like isiZulu, without prejudice towards employability requiring English (P3).*

The broader ramifications of indigenous language devaluation are acknowledged by P3, who details the more comprehensive benefits of multilingualism. Other languages are not considered as important and worth investment, since English is valued as a prestigious language that offers international benefits for future studies and a sense of belonging into an international academic community (Rodrigues-Seeger *et al.*, 2021) - believing in the English language's superiority traces back to the coloniality era. Colonialism still prevails in South Africa since the country's emancipation from apartheid more than two decades ago. This occurs despite the Department of Education's (2002) suggestion to adopt language policies that encourage learning South African languages to promote unity. Further, the DHET recommended commitment to the practical implementation of the language policies that promote multilingualism for accessible academic programmes and decolonial education in SA. Multilingualism should thus be promoted through education.

Teaching formulas has always been a challenge, as alluded to by Afonso (2009). Participants describe difficulty in grasping Chemistry concepts. In this case, code-switching is necessary for describing chemical formulae, as P1 indicated: *"I use code-switching in teaching Chemistry for clarity purposes. Sometimes, language becomes a barrier for learner understanding".*

Clearly, from the narrative above, clarification is key to promoting understanding and comprehension of Chemistry formulae. as language hinders learning (Mthiyane , 2016). P1 demonstrated ambivalence about code-switching. Particular alerting to pertinent aspects of assessments and perhaps national examinations: *"For assessment and examinations, isiZulu is not used. That is why the usage of isiZulu should be limited".*

P1 is acutely aware of how the national examinations determine language use. The matric results of the Eastern Cape for 2020 and 2021 have been released, and school matric grades have improved dramatically in the last two years (Mzizi, 2022). Perhaps, examinations in isiZulu could be considered next. Pre-service teachers' challenges in teaching in a bilingual space stemmed from deciding what is to be taught because they cannot find an appropriate alternative to Chemistry in isiZulu as noted by P3: *"... Due to lack of isiZulu Chemistry vocabulary..."*. As already ascribed in this study, it may be critical to overcome these challenges by creating isiZulu vocabulary for Chemistry.

Development of an isiZulu vocabulary for Chemistry

Developing isiZulu vocabulary for teaching and learning Chemistry is essential to capitalise on the multiple benefits of code-switching fully. Developing an isiZulu Chemistry vocabulary will ensure that our curriculum is elevated to the same status as that of the Global North. Our Chemistry curriculum will be more nuanced, focused, and responsive, reflecting contextual relevance (Fomunyam & Khosa, 2021a). As P3 states below, it is critical to develop an isiZulu grammar

for Chemistry, in addition to English and Afrikaans, for equity in Chemistry examinations.

> *We will have to train our minds. It will be challenging to change from English to isiZulu with current learners. English and Afrikaans put some learners at a disadvantage. Learners from the English culture who are not good in Chemistry will perform better than an African learner who knows Chemistry better than English. IsiZulu-English code-switching will be important in isiZulu translation. We can hold workshops on how to impart information into isiZulu. Information can then be shared with teachers who will impart the information to learners. Department of Basic Education must fund this initiative (P3).*

From the above excerpt, P3 recognises the need to create an isiZulu grammar for Chemistry and focus on increasing capacity. Therefore, there is a necessity to write isiZulu workbooks, grammar, literature, etc, for Chemistry. The process will be strenuous, requiring time and resources. Further, township teachers would be capacitated to equip learners with accurate Chemistry concepts and rectify what Mumba et. al. (1997) described as 'incorrect Chemistry information conveyance' by those teachers.

Pre-service teachers in this study begin to consider developing enabling indigenous teaching resources. This is an example of pre-service teachers developing imaginative and problem-solving abilities through disciplinary responsiveness where pre-service teachers are elevated to the Chemistry discipline and community stakeholders (for more information, see Fomunyam & Khosa, 2021b). When applying one of Le Grange's (2016) five stages of decolonisation: Action is demonstrated towards developing isiZulu vocabulary, which is an indigenous enabling resources for teaching and learning.

The results suggest that code-switching allowed learners to recall what they had learned and felt more at ease and confident in class. During the class, the learners were motivated and actively participated due to this indigenous inclusion. There were no communication breakdowns amongst

the learners, as they followed what was being taught. Learners gained a sense of belonging to the educational system in this way. Furthermore, learners managed to identify with the education system when new knowledge and concepts were imparted in class due to pre-service teachers' structuring of culture-related situations and consolidation of new knowledge with learners' experiences. Grade 12 results may reveal the total impact of code-switching. Therefore, there is a pressing need to develop IsiZulu vocabulary for Chemistry.

Conclusion

In conclusion, the findings point that pre-service teachers had dynamic and mixed perceptions about curriculum decoloniality and the use of code-switching in teaching and learning. Many of those who had a positive attitude towards curriculum decoloniality seemed to understand the value and imperative of the need to consider learners' cultures and code-switching in teaching of chemistry subjects. However, the paucity of knowledge in how curriculum decoloniality and code-switching could be applied in real-life classroom contexts seemed to act as a deterrent to buy-in, for the implementation of chemistry isiZulu vocabulary for teaching and learning. Hence this chapter, strongly recommends that curriculum specialists and further research should be dedicated on understanding the pedagogical imperatives and applications of curriculum decoloniality and code-switching in real-life classroom context of teaching chemistry subjects, particularly in rural contexts.

Additionally, the availability of IsiZulu chemistry vocabulary may encourage pre-service teachers to code-switch during chemistry instruction.

It should be noted that these findings are solely applicable to the sites where research was conducted or similar contexts.

Measures to be taken in developing an isiZulu Chemistry vocabulary

Teacher training programmes need to include code-switching in their curriculum in order to empower pre-service teachers with the skill to teach across more languages. More research may be required to determine the indigenous people of KZN's language requirements. However, because there are no isiZulu Chemistry workbooks or textbooks available - except UKZN's isiZulu dictionaries - it is necessary to code-switch between English and isiZulu for effective teaching and, for example, to improve Grade 12 results. The creation of isiZulu Chemistry textbooks and the reform of policies to incorporate isiZulu as a language of learning, teaching, and evaluation would be a significant step towards the recognition of indigenous languages.

To create isiZulu Chemistry learning and teaching materials: Pre-service instructors can begin to write Chemistry textbooks, workbooks, and other materials in isiZulu. Then, in workshops, engage local schoolteachers to contribute to the written resources. Other topic teachers may be drawn to the same concept as the participating schoolteachers piloting these teaching and learning materials. DBE and school governing bodies may be driven to adopt teaching, learning, and assessment policies that acknowledge this initiative once the process is expanded to other school disciplines. Universities are likely to follow suit.

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