CriSTaL
CRITICAL STUDIES IN TEACHING & LEARNING

2021, Volume 9, Special Issue
DOI: 10.14426/cristal.v9iSI.339

A translanguage pedagogy to promote Biotechnology concept engagement and academic literacy in a linguistically-diverse university context

Muhammad Nakhooda[1] & Moragh Paxton[2]
[1]*Cape Peninsula University of Technology*
[2]*University of Cape Town*
Corresponding Author: nakhoodam@cput.ac.za

(Submitted: 6 October 2020; Accepted: 9 September 2021)

Abstract

Following the call for transformation, higher education institutions in South Africa were required to promote and implement indigenous languages in teaching and learning. This has led to various strategies and resources being explored and implemented, multilingual glossaries among them. In science, where English remains the global means of communication, our experience has been that such interventions are often underutilized. A more inclusive, holistic pedagogy is required to adequately prepare students, especially non-English speakers, for international scientific engagement. One such pedagogy is presently proposed and tested. Its purpose is to harness the dominant language - that which is most active in the learners' minds - to first promote epistemological access to difficult scientific concepts, and after concept acquisition, develop the required English, scientific, and academic literacy. Biotechnology undergraduate students at Cape Peninsula University of Technology (CPUT) - many of whom are international - reported enhancing their learning experience and recognised the significance of their dominant language in deep learning as a result of this translanguage pedagogy. Such a pedagogy demonstrates that multilingualism, far from being viewed as an impediment to teaching and learning, should be seen as a rich resource that needs to be harnessed to facilitate epistemic access, cognitive development, transformation, social cohesion, and respect for all languages.

Keywords: Agency, Cognitive, Communication, Literacy, Science, Translanguaging

Introduction

Democratic South Africa inherited an unequal education system, and myriad challenges were, and are, currently faced to correct such historical heterogeneity. Academics and students alike have taken up the mantle to advance the goal of social justice. Various university programs sought to initiate conversations and explore topics around student identity, and their spaces and voices in higher education. Inextricably linked to discussions of identity were discussions centred on language. De Kadt (2005) observed that language and identity are related to each other in various ways, and that South Africa has a history of associating language with identity or ethnicity.

As a result, any kind of transformation agenda in higher education was incomplete without the inclusion of a Language Policy, and the case for some sort of language integration, as a mechanism to enhance teaching and learning was recognised as an imperative (Wildsmith-Cromarty and Gordon, 2009; Ouane and Glanz, 2010).

Meaningful aims towards addressing the subject of language transformation in education – primary, secondary, and higher – were formulated soon after the birth of Democracy in 1994. The topics around language integration and multilingualism in education were reflected in the Education White Paper 3: *A Programme for the Transformation of Higher Education* (1997), and the Department of Education's *'Language in Education Policy (1997)'*. With these nascent attempts, the stage was set for linguistic diversity in South African education to be seen as a prime objective towards transformation and integration. A number of policy documents then followed: the Council for Higher Education's (CHE) Language Policy Framework for South African Higher Education (2001), the Department of Arts and Culture's National Language Policy Framework (2002), and the Department of Education's 'Development of indigenous languages as mediums of instruction in higher education' (2003). The promotion, development, cultivation and respect for all official languages in a post-apartheid South Africa, was a focus of these national policy documents. Certainly, the most recent Draft Language Policy for Higher Education (2017) carries this theme forward, recognising that language continues to act as a barrier to education access and success, and sets out a policy to guide higher education institutions to develop and implement plans aimed at strengthening indigenous languages into modes of instruction for teaching, learning, research, innovation and science, among other directives. Importantly, a key value that guides the 2017 Draft Language Policy for Higher Education is that multilingualism should not be considered an impediment to teaching and learning, but rather as a resource to 'facilitate cognitive development, epistemic access, inclusiveness, transformation, social cohesion and respect for all languages'.

All South African universities have since focussed on institutionalising plans that addressed the directives of the Ministry. At the Cape Peninsula University of Technology (CPUT), the 'Language Implementation Plan 2020-2025 and beyond' outlines the institution's vision, mission, and role in promoting multilingualism in the teaching and learning space. For example, the Plan aims to contribute to the development of the official languages of the Western Cape, namely Afrikaans and isiXhosa, into academic and scientific languages, to ensure that the existing language of instruction supports student learning. Importantly, this policy is informed by several value principles, amongst which is the affirmation and celebration of diversity, and a commitment to positive transformation. Such principles together with global student mobility, have resulted in students from various countries and linguistic backgrounds registering for qualifications at CPUT. Consequently, this requires novel teaching and learning approaches that not only recognises and nurtures linguistic, ethnic, and cultural diversity, but also support students to be proficient in the primary language of instruction, English. However, several teaching and learning challenges accompany this diversity, particularly in the science curriculum, which is characterised as being English-dominated and conceptually weighty.

The reasons for English dominance in the sciences and in fact most academic curricula, have their roots in British colonisation of the New World during the 17th and 18th centuries (Oliver and Oliver, 2017). The effects of this colonisation have been far-reaching and remain deeply ensconced in university curricula in South Africa (Nyoni, 2019), and in most parts of the world. In addition, the hegemonic status of a language like English has inevitably had an impact on culture and identity (De Kadt, 2005), resulting in the marginalisation of indigenous languages and local culture, such as the oral traditions (Canagarajah, 2003).

As a scientific field, Biotechnology is multidisciplinary, and encompasses a combination of concepts from various fields in the 'hard sciences': Biology, Physics, Chemistry and Mathematics, along with conversations in the Humanities and allied disciplines, such as Bioethics, Intellectual Property, etc. The knowledge journey through the biotechnology curriculum is therefore accompanied by the concomitant acquisition of trans-disciplinary academic language. Yet, this language of instruction may be significantly epistemologically enriched through imagery, symbolism, numeracy and urban vernacular, diverse linguistic experiences, and various available semiotic resources, leading to a deeper understanding and grasp of threshold concepts. Hence, a more holistic and integrated pedagogy becomes necessary, one that takes cognisance of existing linguistic backgrounds that students bring to the classroom, and uses this knowledge as a scaffold onto which scientific English and literacy can be built, is likely to better acclimatise students to the linguistic and cognitive demands of the Biotechnology curriculum.

Problem identification

The Biotechnology programme at the CPUT attracts students from a broad diaspora, with multiple language backgrounds. A recent survey in a typical first year classroom indicated that approximately 45% of students have an isiXhosa language background, 10% of the class have an Afrikaans background, a further 10% may comprise French and/or Portuguese-speaking students, and the balance constitutes students from various other language backgrounds, either from the South African indigenous languages, or internationally. As a result, the language of teaching and learning - English - may limit their understanding of scientific concepts, and may not, without the appropriate interventions, provide epistemological access to the content of the curriculum. As it stands, most students are in the early stages of the process of acquiring the requisite English literacy skills to engage with scientific content in the official language of instruction.

The problem of linguistic access to content has been variously addressed over the years. One approach has been to develop subject-specific glossaries in the hope of explaining complex terminologies in the home language. However, this approach has been met with some concern. Mesthrie (2008) acknowledges the need for glossaries, but clarifies that such interventions are insufficient at the university level. A similar sentiment is echoed by Madiba (2010), who proposed that definitions, such as those in glossaries, do not explore the deeper meanings of scientific concepts, and suggests a corpus-based, contextualised approach to glossary development.

Some authors, such as Mesthrie (2008) believe that terminology development should be done by practitioners and experts in that respective field, and mere translations of English equivalents is likely to be deficient. That author identifies linguistic inclusivity as being among the key challenges facing higher education in South Africa. Hence, validating as many indigenous languages as possible is central to the many language policies that have emerged in the democratic South Africa. Nevertheless, English is the dominant language of the international scientific community, and almost all new knowledge is generated in English. This presents both challenges and opportunities to non-English-speaking student cohorts.

It has emerged, from the diverse linguistic backgrounds that characterise the student cohort in higher education in the Western Cape, that switching to the predominant languages of the province, i.e., isiXhosa and Afrikaans, as the medium of instruction, will not sufficiently accommodate student needs, particularly in the sciences. Furthermore, the fact that global scientific knowledge is presented in English should remain a primary consideration. A mechanism that harnesses existing linguistic knowledge, that uses this resource to enhance epistemological access to scientific knowledge, and simultaneously construct and develop English literacy skills, towards scientific and academic proficiency, is more likely to support student learning, by providing practical and long-lasting opportunities for students to navigate the Biotechnology curriculum, and progress through the outcomes stipulated at their respective level of study.

Conceptual Framework

It is already a common practice for English second language students to code-switch between their home language and English for conceptual engagement (Addendorf, 1993; Paxton, 2009). On the basis of a well-developed first (dominant) language, Cummins (1979) argues that conceptual understanding can then be enhanced in the second language (English), as concepts can be variously represented. As such, language is central to the integration of biological threshold concepts which, through the paradigm of scientific thinking, demonstrates a transformed, sophisticated understanding of complex biological systems (Taylor and Meyer, 2010). The abstract nature of these biological systems, dealing with microorganisms, biomolecules, and biochemical pathways towards a physiologically-functional organism, means that the Biotechnology syllabus is replete with threshold concepts. Such concepts are necessary conduits to student understanding of biology. As Meyer and Land (2003; 2005) explain, these concepts are transformative, irreversible, and integrative. It is also important that students construct their own understanding by using what they already know, in order to make sense of new information so that a learner's transformed understanding is a 'personal reconstruction' and is accommodated within the student's emerging identity. Then the transformed understanding will reflect an appropriation of meaning (Wells, 1999; Paxton, 2009).

Neuner (2004) explains that the pedagogy that underpins multilingualism should be considered as a set of principles, rather than an integrated methodology. As a result, depending on the teaching and learning context, the student cohort, or the curriculum, appropriate principles of language are used to varying degrees. Languages, far from being discretely positioned in the brain, are in fact connected in multiple and dynamic ways in the mind, constantly influencing each other (Cook, 1992; Bialystok, 2001). For these reasons, pedagogy needs to be sensitive to the false notion of named languages, and be cognisant of multiple social and linguistic contexts in simultaneous operation, as knowledge is created independently of ideological constructs (Guzula, et al., 2016; McKinney and Tyler, 2018; Guzula, 2019). It thus follows that learners would draw on previous experiences of language learning, and transfer those strategies to the learning of new language, and in the context in which the new language operates, i.e. academic science in the present example. Hence, teachers have the responsibility to guide learners to become aware of their existing knowledge of the dominant language, allowing them to disinvent named languages (McKinney and Tyler 2018) in order to reconstruct a 'scientific English toolkit' required for success in the Biotechnology Program. Furthermore, this practice of translanguaging – constant adaptation of linguistic resources for meaning making (García and Sylvan, 2011) – affords students and teachers alike, the agency to shift power relations in the construction of meaning and identity (Wei, 2018).

At present, students of this program have access to multilingual glossaries (for the major Biotechnological terms) that specifically cater to the regional languages, i.e., isiXhosa and Afrikaans, where terminology has been developed on the basis of the English equivalent. Similar glossaries are to be found online for most of the other languages represented in the class (e.g., isiZulu, French, Portuguese, and Swahili). Although Mesthrie (2008) and Wildsmith-Cromarty (2008) raised certain concerns regarding 'terminological development' and the 'translatability' of technical and scientific terms from English into indigenous languages of South Africa, these glossaries serve to familiarise students, through the medium of the home language, with abstract concepts that are presented in English in the literature. The goal, therefore, is to use the 'home', or dominant language as a vehicle to augment and reinforce access to scientific knowledge of the Biotechnology curriculum, whilst concurrently developing professional scientific literacy skills (Figure 1), in a scheme similar to that presented by Setati (2002) for mathematics education.

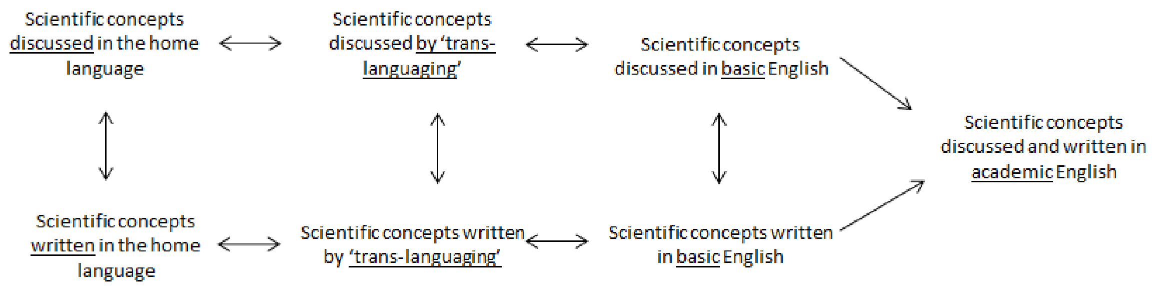

Figure 1: Using the dominant language to enhance epistemological access, and subsequently develop scientific and academic literacy

The translanguage pedagogical process captured in Figure 1 expounds on the values of the South African Language Policy, in that multilingualism is seen as 'capital', which, through guided transformation, can be converted to cognitive capital, and into academic capital, which the learner can then use to advance through the curriculum. The model can be implemented in various ways for the same outcome, one of which is detailed in the present study. It encourages multi-modal learning, through the engagement of different learning pathways, and grants agency to students, as they navigate their learning of the science curriculum presented here.

Research question

The study sets out to answer the question:
"In a linguistically-diverse classroom, what is the value of a translanguaging pedagogy in promoting student engagement with biotechnological concepts, and concomitantly developing the requisite academic literacy skills?"

Data collection

The study was undertaken in a level 2, Diploma in Biotechnology program, in the subject 'Microbiology 2A', which typically enrols 60 students in a semester. The subject content builds upon basic Microbiology from level 1 and covers areas such as bacterial identification using various biochemical approaches, bacterial taxonomy and classification, bacterial metabolism, and some important metabolic genes in bacteria.

The study was designed to take a qualitative, action research approach, drawing on data from assessments, student reflections, surveys and focus group discussions conducted in and outside of the classroom. Students were introduced to a usually complex threshold concept related to the course content in Microbiology. This represented a concept relating to the molecular biology of bacteria, and applications thereof to identify unknown bacteria. The aim was for students to distribute themselves into the major language groups represented in the classroom and engage with the concept first in their dominant language(s) (using translanguaging) – Stage 1.

Stage 2 required students to write down their understanding of the presented concepts, leaving aside the demands of academic and scientific literacy, and in the home language if necessary. This was to allow them to clarify their understanding and start to formally articulate the concept. Students were encouraged to make use of dictionaries, glossaries, or any other resource they would find useful. At CPUT, online multilingual glossaries had been developed for the major terms used in Biotechnology, available in the dominant indigenous languages of the Western Cape – isiXhosa and Afrikaans. The terms were selected from an English Biotechnology glossary that was developed at CPUT, and routinely used in the classroom.

Upon completion of Stages 1 and 2, students were tasked with building upon their conceptual understanding and the written narrative framework, to enhance their understanding by transferring those concepts into academic English - Stage 3. This pedagogy follows the model outlined in Figure 1. It describes one way to implement the practice, potentially allowing for the deep cognitive development of threshold concepts first, in whatever language or semiotic form that may be dominant in the students' minds. Such an approach may also nurture not only the concept in question, but also the scientific context around which this concept rests, as it allows the learner to create meaning without this being prescribed in a language that isn't their dominant one.

The classroom exercise required students to submit all work done in the three Stages as assignments, and as evidence of engagement.

Once the assignments were completed, and after feedback was given on their performance, focus group discussions were held. Here, students reflected on their learning experience through the translanguage pedagogy in question. In order to guide the focus group discussions, questions such as the following were presented:

- How were you taught English in school? Was it via the medium of the home language?
- To what extent do you think your knowledge of the home language is useful when learning scientific concepts that are presented in English?
- To what extent do you draw on your home language to understand scientific concepts?
- How do you feel about the fact that English appears to be the international language of science, and English proficiency is part of the Biotechnology curriculum?
- To what extent do you feel that scientific concepts may be better represented in your home language?

The overall aim was to build knowledge in the curriculum upon strong conceptual and cognitive foundations, by allowing students to explore concepts with the range of linguistic and semiotic resources at their disposal, rather than by prescribing their learning journey.

Data analysis

The student cohort under study represented various home language groups. Among these were, in order of largest to smallest group: isiXhosa, Afrikaans, Sepedi, isiZulu, French, Setswana, English, Portuguese, and isiNdebele. In implementing the translanguage pedagogy model outlined in Figure 1, students were first divided into their various language groups, which comprised approximately 2-4 members each. In those cases where a single student represented a language, it was suggested that they join the English group/s, or a group with a closely-related language.

After the scientific concept was delivered to the class, the learning process, according to the model (Figure 1), was divided into 3 steps:

- Stage 1: Group discussions in the chosen language,
- Stage 2: A written piece using informal language that they were most familiar with, to establish understanding of the concept, based on the group discussion, and
- Stage 3: A formal and final written submission in English, where the concepts from Stage 2 are interpreted and represented in academic and scientific English.

Stage 1: Group discussions

A salient feature of the student group discussion recordings was the conversational manner with which the concepts were engaged. Through this process of peer-learning, using the mental resources that the home or dominant languages provide, students created meaning of the concept, corrected each other, and arrived at a common understanding of what the scientific concept meant. Here is an excerpt of a typical conversation that occurred in an isiXhosa-speaking group, recorded by the students, and then transcribed by the researcher:

> Student 1: So *ke ngoku* after *ufake la* antigen *neh uzofaka i-antibody, i-antibody* er… er… *i-antibody esele yenziwe uyayibona*? and then *kengoku to… izaku… izaku.. lo antibody izobinder* to that specific antigen and then *izosibonisa xa sele si-adde le-enzyme*. When there is a colour change then *sizakubona ukuba ok kukho i-enzyme*, I mean, *kukho* (interjection by student 3: antibody) *i-antigen ekhoyo apha*.
> Student 2: Oh…
> Student 3: Oh… So *ezi antibodies zenziwa ecaleni*?
> Student 1: Eh… .eh, *ii-antibodies sele zenziwe zona*,then *thina kula i-antigen siyifumeneyo siye sithathe i-antibody le thina sinayo* to determine *ukuba yeyiphi i-antigen ephaya* cause *asiyazi ukuba yeyiphi la antigen*.
> Student 3: Ok
> Student 2: Oh….
> Student 3: So basically *kuproduswa ii-antibodies* using imonoclonal and *i-polyclonal* and then *ke ngoku usebenzise ii-antibodies kwi* process *yalento*.
> Student 1: Mhhh
> Student 2: Mhhhh
> Student 3: Ok…

A significant amount of translanguaging was evident during Stage 1, as students took turns debating the concept to their peers, in their home or dominant language. The conversations were often quite animated as the speaker sought to find the words in order to create meaning for the group. Where terms did not exist in the home language, students tended to appropriate from English, but took ownership of the term by converting it into the linguistic style of the language or vernacular, as in 'iantibody', for example. In this way, students tended to adopt terms from English and embed them into their dominant language, from which the terms could be reinvented in the context of the dominant language, before being transferred back to English, with fresh, created, and rediscovered meaning.

Stages 2 and 3: From conceptual to academically-appropriate understanding

Presented here, are excerpts from Stage 2 and Stage 3 exercises. As mentioned above, the teacher or researcher is not required to understand all the languages represented in the classroom. Through peer-led learning, groups of students construct meaning for themselves. By writing their understanding of the concept, in a translanguage manner (Stage 2), and through reciprocal confirmation, the actual scientific meaning of the concept is built. The value of this approach is evident in the accurate interpretation of the concept as it is eventually presented in scientific and academic English, in Stage 3.

Example 1 – isiXhosa

Stage 2: "And then *sizifake kwi* wells and if *eza* antigen *zibindile kula* primary antibodies *ubuyifake kuqala sizofaka isecondary* antibodies (inaudible) antigens *zizo* bind *isecondary* antibodies *zihamba ne-enzyme sizo galela* substrate *kuzo kwenzeka ienzyme*-substrate reaction for colour change."

Stage 3: If these antigens found in the sample binds to the primary antibodies that were initially inoculated from the diagnosed patient, then the secondary antibody will bind to this complex. Secondary antibodies contain enzymes which are responsible for the enzyme-substrate reaction for colour change, this reaction of a substrate with the enzyme produces a coloured product thus indicating a positive reaction."

Example 2 – isiXhosa

Stage 2: "As it moves down the electrophoresis gel it encounters an increase kwi concentration of denaturing agent (urea) iDNA ezi weak zizo unwind kuqala meaning it will get bigger. Ezo species ezino AT rich region zizo bankulu kuqala and stop moving down the gel. And ezo species ezino GC rich regions will denature last."

Stage 3: "After the inoculation, the denaturing agent (urea) is added. As the DNA moves down the gel it encounters an increase in concentration of the denaturing agent, thus resulting in the AT rich DNA regions to unwind first meaning they get bigger and stop moving down the gel. The GC rich DNA regions denatures last, because of the stronger triple bonds (hydrogen bonds) between their nucleotides."

Example 3 – French

Stage 2: "It is a technique called Restriction fragment length polymorphism. It is a technique that uses restriction enzymes e.g. EcoR1 to cut the DNA at specific sites. *Il faut avoir un organisme inconnu á partir duquel nos devons avoir extraire l'ADN. L'ADN va être coupé en utilisant un* enzyme *de* restriction. Thus, it then runs through an Agarose gel electrophoresis with a marker. From there the (DNA of) known and unknown microorganism that are being cut by the same restriction enzyme are inserted into the gel."

Stage 3: "It is a technique called Restriction Fragment Length Polymorphism. It utilizes restriction enzymes to compare base sequences of different organisms. Restriction Enzymes cut a molecule (of) DNA wherever a specific base sequence occurs, producing restriction fragments. Thus, DNA from two microorganisms is digested with the same restriction enzyme and the restriction fragments produced are separated by electrophoresis, producing DNA Fingerprint."

Example 4 – seSotho

Stage 2: "DNA *ke molekhule ho boloka* genetic information *ho di* species *a le nakong. E nale di* arrangements *tsadi* chemicals tsebitswang *di* nucleotides *tse bontshang kapo tsebitswang* (A,T, C le G). Di arrangements *tsena dirijwetsa hore di* organism *ledi* organism *tse ding dinale* code *kepo tsela eo disebedisang* code *kateng hade sebedisi* code *elengwe engwe le engwe* organism *inali yayona*."

Stage 3: "DNA is a molecule responsible for preserving genetic information across species and across time. It consists of a meaningful arrangement of nucleotides that are symbolised by A, T, C, and G. Those arrangements tell a story of each organism or individual in that the code they produce represents a detailed instruction book for that particular organism or individual."

The extent of translanguaging differed among groups, which may be due to the command of the dominant language/s by students in the various groups. It was evident that students weren't translating directly from the dominant language to English. Instead, the knowledge was being transferred from Stage 2, represented, and reinterpreted to a more complete and deeper understanding of the concept in English, in Stage 3. Importantly, however, was the finding that the final English version in Stage 3 was a correct interpretation of the question posed, and the meaning that was created through the translanguaging exercise, irrespective of the extent of translanguaging in the process, was sufficiently accurate at this level of study.

The lecturer was not required to understand the various languages represented in the classroom. Rather, using this pedagogy, the lecturer facilitated understanding by drawing on linguistic resources already present, possibly dominant, and active in the students' minds. This resource was harnessed to engender understanding (the first cognitive step), upon which the correct scientific and academic language was built, in the subsequent communicative step. In this way, students were afforded the agency to develop deep understanding, but guided by prescribed material.

Feedback from focus group discussions

The focus group discussions revealed that most English Second Language Learners were taught English through the medium of the 'home language'. In most cases, the instructions were delivered in a trans-languaged manner, or learners were given the instructions in the home language, with the expectation that they answer in English,

> "…*when they explain it, they have to explain the things sometimes in isiXhosa for us to understand and then we write that thing in English"*.

Those students who went to an English-medium school felt that they had an advantage over the students who attended a school where the home language was the dominant medium of instruction.

The question was posed to the discussion group regarding the dominance of English in the Biotechnology curriculum, and in science in general. One student answered

> "*I think it's beneficial in English because we study Biotechnology, so we're going to have to go to other countries and we won't be able to speak our own languages. So, English as the medium of instruction I think is ok. It's alright*".

Another student added:

> "*I think English is ok because of, if I was to do a research and then I write it in my own language, will the next generation know what I've written? Maybe from China, they will not understand it and my research won't be public as it was going to be if it was in English. So, I don't mind.*"

Despite an agreement that English is presently the most useful means of instruction and scientific communication, students did lament the effect of its dominance on the home language

> "*It's overshadowing our other languages*", and

> "*Like over time, I think people who speak isiXhosa, they're going to be like few people. Even if we go to Eastern Cape now, people they're from Cape Town and Johannesburg from whatever, so they speak English. So, I think our value of our original (language) is decreasing because people now are communicating with their English, which is a bad thing for me because like I would like people to speak my language*".

Such sentiments were common among the focus group participants.

Nevertheless, students agreed that English is the most viable means of scientific instruction in higher education, but raised concerns over their understanding of concepts presented in English, as one student responded:

> "*Like English is ok but we need our home language at least for understanding*".

We then asked the group whether lectures or discussions should be in the home language. One response was:

> "*…we can discuss both but when it comes to writing a report, we cannot like write in our home language because it's a disadvantage with some other way because other places from another country cannot read your report with your home language. So, I think English*

is ok but when it comes to explaining, if you can find someone who can explain for you with your own language then it's ok".

This was the idea behind grouping the students into their home languages, so that peer-led learning may emerge within groups. About this practice, one student felt:

"*I think that it is the best because we get to understand because if he knows it in isiXhosa and he can explain to me better than English then I can get it better. I think group discussions whereby we discuss a certain topic using our own languages, it's even better than using English because we understand better. Then it's easy for us to translate it to…*".

Most students were in agreement with this sentiment, echoing

"You speaking about something that you know, then when you speak it you become confident when you know something in your own language because you know…", and

"*…like that assignment, we got to understand the processes, like the DGGE* [denaturing gradient gel electrophoresis] *and everything else. We got to understand that because we discussed it using our own language and it was like you were not forced because sometimes it happens that you read something and we'd just, we'd cram it for the sake of talking in English but we don't understand it*".

This highlighted the fact that students often rote learn concepts, with little or no understanding of the concept itself. This approach has implications for the learners' progression through a curriculum, especially when subsequent learning depends upon a deep understanding of previously-presented concepts. It is imperative that this worrying practice be effectively addressed, and to foster engagement and enthusiasm from students, so that they become fully involved in their learning journey. By constructing understanding using their own language and what they already know to make sense will result in a more effective appropriation of meaning as Paxton (2009) and Wells (1999) indicate. Recognising the capital that the student brings to the classroom may well be an effective means of realising this aim.

A translanguaging pedagogy is not the same as a simple translation from the home language into English, or vice versa. Instead, meaning and understanding is created using multiple linguistic and/or semiotic means, whichever is useful for a particular time and concept. It represents a dynamic approach to teaching and learning and draws on the many linguistic tools available in a diverse classroom, all of which draw on and inform each other as they are presented in the minds of learners, to eventually accrete towards a common understanding of a presented concept.

Students were asked whether translations were useful in enhancing their understanding of learning of presented material:

"*I tried to translate English to French and then French to English, it doesn't work*".

Students then explained that conversational language to them is often quite different to the way they write. This difference guided the practice in the present work to get students to discuss a concept, orally, in a group setting, before attempting to write down their understanding. Based on the language group, or peer-learning exercise, students were asked whether the practice helped them to better understand the scientific concept presented to them. One student responded that:

> "*It's better in my own language, because explaining with your own language and someone explaining to me with my own language I could understand better than if you tell me in English because I just liked that*".

To which another student responded:

> "*I agree with her what she said because when you learn something in English you actually cram what they told you. You don't actually understand. You don't get to analyse what they're trying to say. But then when you speak in your home language, you get what they're saying and you understand it better...*".

A key advantage of this approach is that with deep conceptual understanding, students are better equipped to then present the knowledge in English, or in the wider applicability of the multilingual pedagogical model, in whatever the medium of instruction happens to be. This is evidenced in the feeling expressed by one student,

> "*Oh, when someone explains in your own language you understand it and then you get to put it into French ways because you understand it*".

When pressed a little further, students explained that if they understand a concept (based on cognitive assistance in the home language), they are then able to present the concept in different ways. This acquisition is vital, and can be enhanced through the pedagogy currently presented. One student's response was

> "*Yes, you can put it in a different way but think the same thing*".

This is a key indicator of learning advancement in the Constructivist Paradigm (reviewed by Dagar and Yadav, 2016). Once the understanding of a concept has been realised, the next step is to transfer this knowledge such that it can be accurately represented in the medium of instruction, English in the present case. Students were all too aware that this transfer is not a simple linguistic translation:

> "*(This way of) doing things only helps in understanding, but when it comes to writing, 'ja', it's difficult because you have to write in English.*"

However, the practice presented here encourages students to first write or present their understanding in the home language, to solidify their understanding of the concept. Once this is in place, the English is developed therefrom, and in doing this, students are again made to engage with the concepts to deepen their understanding enough to present it in English. One student explains,

> "*Like in my own language I write a page because I know what I am writing. But when it comes to English [...] I have to try like step by step to like get it to English*", and

> "...*if I understand it in my home language then I will be able to put it in English*", and

> "*I got to understand the processes through discussions in my own language. So I think the understanding is better than cramming because if I cram the whole thing then I'll forget them next year*".

This sentiment shows a deliberate, systematic effort to transfer deep cognitive understanding of the presented concepts from the dominant language to English. Swain (2006) and Swain and Lapkin (2002) describe this process as a means to mediate cognition, in deeply understanding and making meaning through shaping knowledge and experience. In so doing, learning is directed towards the apex of Bloom's taxonomic model, where students start creating cognitive links between what they understand in their dominant language, and what they are required to communicate in the language of teaching and learning, English. As a result, deep learning percolates, which serves as a basis upon which further concepts can be built, rather than superficial learning that is typified by 'memorising' or 'cramming', as students have described the rote learning approach. In the process of creating meaning through translanguaging, therefore, knowledge is more creatively constructed by virtue of student agency, giving them confidence to use, think, understand, and create meaning for themselves, as described by Li (2018), and by Swain and Lapkin (2002) as 'coming to know while speaking'.

Wider applicability of the translanguage pedagogy model

Meaning can be constructed in myriad ways and varies among disciplines. The translanguage pedagogical model presented here can therefore be tailored and implemented for a range of teaching and learning applications. The method is also amenable to blended learning. As students and institutional needs change, alternative teaching and learning practice must necessarily be developed alongside, in order to maintain the alignment between learner needs, curriculum outcomes and institutional duties. In the Biotechnology classroom presently described, students were allowed to create meaning from scientific concepts in the form of digital story narratives, from which the 'script' is further developed and converted to academic English and submitted for assessment. Such an interpretation of the model can be more widely implemented, as students increasingly develop computer literacy, and as programs and apps make individual and/or group narratives easier to create.

As mentioned earlier, the translanguage pedagogy model described in this paper also impacted on student identity. Because language and identity are so closely linked, students felt affirmed when they realised that their languages had status and were being valued in the classroom. They also gained more overt appreciation for, and confidence in using their home languages to assist them in developing conceptual understanding.

In those disciplines that lend themselves to semiotic modes of developing understanding, the multilingual pedagogy model is still relevant. It grants agency to students to use whatever cultural, linguistic, or other resources they may possess, and harness this to create meaning as part of the cognitive grasp of concepts presented. With assistance from teachers and tutors, this model, however varied and for whichever discipline, can then be refined, corrected, and used to develop academically-acceptable meaning, in whatever language of instruction the instructor is familiar with, or the institution subscribes to.

Acknowledgements

The authors are grateful to Zakeera Docrat and Ntombizethu Nyakambi from the Department of African Language Studies, University of the Western Cape (UWC), Cape Town, South Africa, for assistance with isiXhosa orthography.

Author Biographies

Muhammad Nakhooda is a Biotechnologist and serves also as the Curriculum and Academic Development coordinator for the Faculty of Applied Sciences at CPUT. His academic interests span Plant Biology and Biotechnology, Language, Curriculum Development, and Teaching and Learning in Higher Education.

Moragh Paxton worked for the Language Development Group in CHED at UCT for more than 25 years. Her research interests are academic literacy, multilingualism and translanguaging. Latterly she has focussed on collaboration between universities through courses/ programmes like the CHEC courses and TAU (Teaching Advancement at Universities), amongst others.

References

Addendorf, R. 1993. Code-switching amongst Zulu-speaking teachers and their pupils: its functions and implication for teacher education. *Southern African Journal of Applied Languages Studies*, 7(3): 141-162.

Bialystok, E. 2001. *Bilingualism in Development: Language, Literacy and Cognition*. New York: Cambridge University Press.

Canagarajah, A.S. 2003. *Resisting Linguistic Imperialism in English Teaching*. Oxford: Oxford University Press.

Cook, V.J. 1992. Evidence for multicompetence. *Language Learning*, 42: 557-591.

Council on Higher Education (CHE). 2001. Pretoria: Council on Higher Education. Available at: https://www.gov.za/sites/default/files/gcis_document/201409/langframe0.pdf (Accessed: 14 September 2021).

Cummins, J. 1979. Linguistic interdependence and the educational development of bilingual children. *Review of Educational Research*, 49(2): 222-251.

Dagar, V. & Yadav, A. 2016. Constructivism: A paradigm for teaching and learning. *Arts and Social Science Journal*, 7(4): 1000200.

De Kadt, E. 2005. English, language shift and identities: a comparison between 'Zulu-dominant' and 'multicultural' students on a South African university campus. *Southern African Linguistics and Applied Language Studies*, 23(1): 19-37.

Department of Arts and Culture. 2002. National Language Policy Framework, Republic of South Africa.

Department of Education. 1997. Education White Paper 3 - A Programme for Higher Education Transformation. Pretoria: Government Printers.

Department of Education. 2003. Development of indigenous languages as mediums of instruction in higher education (Report compiled by the Ministerial Committee appointed by the Ministry of Education). Pretoria, Republic of South Africa, Government Printers.

García, O. & Sylvan, C.E. 2011. Pedagogies and practices in multilingual classrooms: Singularities and pluralities. *The Modern Language Journal*, 95(3): 385-400.

Guzula, X., McKinney, C. & Tyler, R. 2016. Languaging for learning: Legitimising translanguaing and enabling multimodal practices in third spaces. *South African Linguistics and Applied Language Studies*, 34(3): 211-226.

Guzula, X. 2019. Moving beyond artificial linguistic binaries in the education of African Language speaking children: A case for simultaneous biliteracy development. *Perspectives in Education*, 36(2): 1-14.

Madiba M. 2010. Fast tracking concept learning to English as an additional language students through corpus-based multilingual glossaries. *Alternation*, 17(1): 225-248.

McKinney, C. & Tyler, R. 2018. Disinventing and reconstructing language for learning in school science. *Language and Education*, 33(2): 141-158.

Mesthrie, R. 2008. Necessary versus sufficient conditions for using new languages in South African higher education: A linguistic appraisal. *Journal of Multilingual and Multicultural Development*, 29(4): 325-340.

Meyer, J.H.F. & Land, R. 2003. Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practising within the disciplines. In Rust, C. (ed.) *Improving Student*

Learning: Improving Student Learning Theory and Practice – Ten Years On. Oxford: Oxford Centre for Staff and Learning Development.

Meyer, J.H.F. & Land, R. 2005. Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. *Higher Education*, 49: 373-388.

Neuner, G. 2004. The concept of plurilingualism and tertiary language didactics. In Hufeisen, B. & Neuner, G. (eds.) The plurilingualism project: tertiary language learning – German after English, Strasbourg: Council of Europe, 13-34.

Nyoni, J. 2019. Decolonising the higher education curriculum: An analysis of African intellectual readiness to break the chains of a colonial caged mentality. *Transformation in Higher Education*, 4(1).

Oliver, E. & Oliver W.H. 2017. The colonisation of South Africa: A unique case. *HTS Theological Studies*, 73(3): a4498.

Ouane, A. & Glanz, C. 2010. Why and how Africa should invest in African languages and multilingual education. An evidence- and practice-based policy advocacy brief. UNESCO Institute for Lifelong Learning, in collaboration with the Association for the Development of Education in Africa (ADEA), Hamberg, Germany.

Paxton, M.I.J. 2009. 'It's easy to learn when you're using your home language but with English you need to start learning language before you get to the concept': Bilingual concept development in an English medium university in South Africa. *Journal of Multilingual and Multicultural Development*, 30(4): 345-359.

Setati, M. 2002. Researching mathematics education and language in multilingual South Africa. *The Mathematics Educator*, 12(2): 6-20.

Swain, M. 2006. Languaging, agecy and collaboration in advanced second language learning. In Barnes, H. (ed.) *Advanced Language Learning: The Contributions of Halliday and Vygotsky.* London: Continuum, 95-108.

Swain, M. & Lapkin, S. 2002. Talking it through: Two French immersion learners' response to reformulation. *International Journal of Educational Research*, 37: 285-304.

Taylor, C.E. & Meyer, J.H.F. 2010. The testable hypothesis as a threshold concept for biology students. In Meyer, J.H.F., Land, R. & Baillie, C. (eds.) *Threshold Concepts and Transformational Learning. Educational Futures: Rethinking Theory and Practice*, 42. Rotterdam: Sense Publishers, 179-192.

Wei, L. 2018. Translanguaging as a practical theory of language. *Applied Linguistics,* 39(1): 9-30.

Wells, G. 1999. *Dialogic Inquiry: Towards a Sociocultural Practice and Theory of Education*. Cambridge University Press: Cambridge.

Wildsmith-Cromarty, R. 2008. Can academic/scientific discourse really be translated across English and African languages? *Southern African Linguistics and Applied Language Studies*, 26(1): 147-169.

Wildsmith-Cromarty, R & Gordon, M. 2009. Policy versus practice: the role of the home language in learning mathematics and science in English-medium classrooms. *Language and Learning Journal*, 37(3): 359-370.