

# Decolonising Teaching and Learning in Engineering Education in a South African university

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## Abstract

Teaching and learning is the crux of most educational programs, especially at the undergraduate level where it is the principal tool through which meaning is constructed and reconstructed by students and lecturers. In the bid to explore pathways to decolonising teaching and learning in engineering education, this paper was designed as a qualitative case study of a South African university of technology. The paper was driven by a key research question: how can teaching and learning in engineering education be decolonised? To answer this question, data was generated using open-ended questionnaires. A total of 162 participants completed the questionnaire. The data generated from the questionnaire was coded and categorised into four themes: pedagogical approaches; facilitators of teaching and learning; teaching and learning resources; and assessment practices. These themes reveal that to begin to decolonise teaching and learning, one must be cognisant of how teaching and learning is enacted; what is used to facilitate the enactment of the same; who facilitates it; and how what is facilitated is accessed. The paper concludes that a thorough engagement with these four angles will not only reveal the complexities of decolonising teaching and learning in engineering education, but would also provide a pathway for critical engagement and consciousness in the bid to produce more engineers in South Africa.

**Keywords:** decolonisation, engineering education, South African higher education, teaching and learning

## INTRODUCTION AND PROBLEMATIC

Teaching and learning is the most fundamental part of any higher education institution or university. Any organisation can conduct research (research organisations) or engage in community engagement, both of which constitute two of the three operational missions of a university, but what distinguishes a higher education institution or university from other research organisations is teaching and learning (Holz-Clause, Guntuku, Koundinya, Clause, & Singh, 2015). Holz-Clause et al. (2015) define teaching and learning as real action time or period of imparting knowledge, skills and attitude to students by an adult facilitator – this means that teaching and learning is all about imparting knowledge. Fomunyam (2016a)

avers that teaching and learning is a process of imparting skills required to master a subject area, and is about constructing knowledge, stimulating, directing, guiding the learner or student and evaluating the learning outcomes of the process. Teaching and learning therefore is a vital part of the higher education system especially since assessment is ferried through it. Fomunyam and Mnisi (2017) argue that assessment is part of teaching and learning in engineering education and since all higher education institutions or universities conduct one form of assessment or another, and that the higher education system cannot fully function without teaching and learning. Fomunyam (2015), Fomunyam (2017a) and Fomunyam (2017b) all argue that teaching and learning is goal-oriented with change being the ultimate end. Lecturers in engineering education help shape these experiences for students through their teaching rational and reflective process (Fomunyam, 2015). As such, teaching and learning can be used to enhance the decolonisation movement in engineering education, but for this to happen, the process itself (that is teaching and learning) needs to be decolonised so that through it, other parts of the engineering program curriculum, language assessment etc. can be decolonised. This paper therefore explores the decolonisation of teaching and learning in engineering education in a South African university. The paper sets out to answer the question: how can teaching and learning in engineering education be decolonised? To explore this question, it is vital to theorise the notion of decolonisation as well as the methodology used in generating data for the paper.

Since 2015, the calls from academics and students for decolonisation is critical in advancing the higher education discourse. These calls have increased the demands to address the effects of colonialism on higher education, ranging from knowledge, curriculum, pedagogy, institutional culture, institutional architecture and teaching and learning. Brock-Utne (2017) argues that the higher system, especially teaching and learning (since it is the primary way of instruction in the higher education sector), is failing the majority of the students in the country, and it does so by refusing to acknowledge the persistent inequalities in education. The failure to recognise the ways in which colonialism, and the inherited system of education, disempowers students and ensures the continuous disempowerment of students in South Africa has forced students to take to the streets to demand the decolonisation of

the education system. Adebisi (2016) adds that the decolonisation movement in South Africa took another turn when a student in the University of Cape Town desecrated with faeces the statue of Cecil John Rhodes – a central figure in Apartheid South Africa – located at the centre of the university. Students at other institutions took their cue from the University of Cape Town, according to Pather (2015), and spread the movement. In Rhodes University, students called for the name of the university to be changed. Students at the University of KwaZulu-Natal covered a statue of King George V with white paint and students at University of Witwatersrand held transformation talks (Pather, 2015).

Heleta (2016, p. 1) argues that in the decolonisation movement, students are calling for the end of domination by “white, male, Western, capitalist, European worldviews in South African higher education and the incorporation of other South Africans, African and a global perspectives, experiences and epistemologies as the central tenets of the curriculum, teaching, learning and research in the country”. This quote means the decolonisation project is about the survival of a people as a whole, championed by the university. In calling for the end of undue privileges and the subjugation of one group of people by the other, the movement seems to be following the footsteps of the rise of African nationalism in the 1950s and 60s which led to the independence of countries in Africa, the eventual collapse of colonialism in most of Africa and the departure of Europeans, which marked a new dawn for Africa.

Mgqwashu (2016) argues that decolonising higher education is about knowledge and how knowledge or the curriculum in South Africa is constructed, who constitutes the knower and how what is known is known. This statement means that knowledge in this context is colonised, especially because knowledge from colonial centres is treated as powerful. Knowledge from colonial centres is powerful in that it produces accrues privilege to the powerful, which is then used to dominate, often subtly and silently. Mgqwashu goes further to ponder on alternative meanings of decolonisation and what it means in the higher education sector; to him there is no clarity on what decolonisation means and whose responsibility it is to decolonise education. This belief is supported by Netswera and Mathabe (2006) who argue that most academics in general, and students in particular, have no theoretical understanding of decolonisation, especially the decolonisation of teaching and learning and the curriculum. They further argue that decolonisation is about agency and the reshaping of one's own higher education path and this can only happen when those in the higher education sector take responsibility and refuse to occupy the position of violence-absorbing passive victims. Adding to this, Higgs (2012) argues that decolonising higher education in South Africa means a further dismantling of western-centred institutions, systems, symbolism, and standards within the higher education system. Such a view goes beyond numbers or replacing white staff with black staff, to empowering marginalised bodies through teaching and learning.

Hendricks and Leibowitz (2016) argue that decolonising would mean answering the following questions: what is meant by decolonisation in South Africa's current context? What should the process entail? While there is a general consensus that there is need for decolonisation, there is a general lack of understanding what exactly decolonisation means. Essop (2016, p. 1), aiming to provide clarity on the subject, argues that decolonisation of South African higher education is “about inclusion, recognition and affirmation. It seeks to affirm African knowledge and cultural traditions in universities, which remain dominated by western traditions”. Although this definition echoes general demand for the end of domination over Africans, it fails to articulate who or what should be included and to what. The mere recognition and inclusion of an African knowledge system into the curriculum cannot be considered decolonisation because the processes within the universities which necessitated the call for decolonisation are yet to be dealt with. Mgqwashu (2015, p. 1) offers an alternative definition by arguing that “decolonising education will mean exposure to opportunities that will ensure that students learn more about other fellow South Africans who might be different to them”. To this end, Mgqwashu sees decolonisation as appreciating difference and not as addressing the numerous issues raised by students that require decolonising within South African universities, like the curriculum, teaching and learning, institutional culture, architecture and language, amongst others (Heleta, 2016). From the definitions, it is clear that there are several issues within the higher education sector that require decolonisation, and teaching and learning is one of them. This paper therefore seeks to explore the decolonisation of teaching and learning in engineering education in a South African higher education institution in the bid to enhance the discourse on decolonisation.

Kapoor (2007) argues that colonialism or colonisation was not just the political occupation of one nation or territory by another, it could be understood as a formation of discourse. As discourse, colonialism is the interpolation of a people by incorporating them in a system of representation. This system, which is far-ranging, might be ideological, cultural, educational, formal or informal, amongst others. Colonisation provides specific ways of seeing or representing things which leaves the people confined to particular worldviews. Kapoor (2007, p. 4) adds that “the attempt to reshape the structures of knowledge and the active subjugation and devaluation of local knowledges meant that several branches of learning were touched by the colonial experience”. More than twenty years after the advent of democracy in South Africa, there are calls for decolonisation within the higher education sector. It therefore means that although a nation has gained independence and now rules itself, certain aspects of the society might still be colonised. Tamburro (2013) argues that decolonisation helps to create an awareness on the effects of colonisation and create less or non-oppressive approaches to dealing with societal issues. Tamburro adds that any approach to education that includes the perspectives of indigenous, non-

western people and their worldviews will help articulate local experiences and decolonise the process of knowing. In South Africa, the call for decolonisation is predominantly in the higher education sector. Kapoor continues that embedded in the decolonisation movement or facets of society requiring decolonisation are agents who constrain possibilities for change, not in the bid to deter the process but because scholars are still historicising subjects with a capacity to know, act on and change oppressive realities. There is need therefore to question the teaching and learning mechanisms used in engineering education in particular, and higher education institutions in general, to ensure the process of decolonisation unfolds. Smith (2012) argues that decolonisation involves deconstructing western scholarship, which goes beyond foregrounding indigenous experiences to teaching and learning, enacting teaching and learning in ways that directly benefits indigenous peoples, rather than subject them to different levels of epistemic violence.

Higgs (2012) argues that decolonising higher education in Africa is about Africans seeing themselves clearly in relationship with themselves and others in the universe. Ngugi (2004, p.84) calls this “a quest for relevance” that can only be established if African universities succeed in decolonising the mind through teaching and learning. Mbembe (2016) points out that, decolonisation is not simply about eradicating European worldviews and introducing African worldviews, but about making Africa the centre in African universities. Laenui (2011), enhanced by (Chilisa, 2012), articulates several stages for decolonisation: rediscovery and recovery; mourning; dreaming; commitment; and action. Rediscovery and recovery sets the pace for eventual decolonisation and it involves the rediscovery of one’s self, history, culture, language, and identity. Rediscovery and recovery can principally be championed through teaching and learning, but when the process of teaching and learning is yet to be decolonised it becomes difficult for rediscovery and recovery to take place. Coming to a full understanding of who one is and what one has lost is the first step to decolonising. Rediscovery and recovery, through teaching and learning, leads to the second stage of mourning, where the colonised lament on their victimisation. Mourning is vital for decolonisation, and it can be expressed in different forms. Teaching and learning can also play a vital role in this because through it, both students and lecturers negotiate meaning and express their emotions. Expressing the pain of what has been lost creates the desire for change and this leads to the third stage of decolonisation which is dreaming. Dreaming is the most fundamental stage of decolonisation. It is at this stage that the colonised plan, debate, consult and build dreams about their future and what better way to do this than through teaching and learning. Dreaming is about the re-evaluation of the political, social, economic, educational and judicial structures and the development of new structures if need be, which can house the new values of the colonised. Once a vision has been established, the next stage is commitment which entails committing to see this vision made manifest. This

stage gives rise to the last stage, action, which is about pursuing the direction for the society developed through teaching and learning. These phases are vital for decolonisation in any sector of human endeavour and the application of the same would go a long way to enhance the decolonisation movement in higher education. Having explored the discourse of decolonisation in higher education, the research design and methodology used in the paper is discussed below.

## METHODOLOGICAL CONSTELLATIONS

This paper aims at answering the question: how can teaching and learning in engineering education be decolonised? This paper is a qualitative case study of decolonising teaching and learning in a university program. Denzin and Lincoln (2012) define qualitative research as research which studies and generates detailed empirical data from questionnaires, introspection, personal experience, interviews, documents and artefacts which describe, in detail, problematic situations or phenomena. As such, qualitative research is a research approach which seeks to go further than any other research approach in order to glean all information possible about the phenomenon being studied so as to generate new knowledge. Yin (2009, p. 18) on the other hand defines case study research as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident and relies on multiple sources of evidence”. This definition highlights several hallmarks of case study research by emphasising the nature of the problem which should be contemporary within the natural setting. It also points out that case study comes in handy when the difference between the phenomenon and context is not quite clear, as is the case with many real-life situations or human relationships. Therefore, this paper is justifiably a qualitative case study and this approach is employed to theorise the decolonisation of teaching and learning in engineering education. The case under study is the engineering program in a South African university and the unit of exploration is teaching and learning. The qualitative data for this paper was generated using open-ended questionnaires. This questionnaire had two basic questions:

1. Do you think teaching and learning in your department is decolonised?
2. How do you think teaching and learning can be decolonised?

This paper adopts critical theory as a lens for meaning making within the context of decolonising teaching and learning in engineering education. Creswell (2008) argues that research which aims to emancipate should be intertwined with politics, which is what most theories fail to do. He adds that critical theory believes that inquiry should change the lives of the participants, the institutions in which individuals work or live, and the researcher’s life. Decolonising teaching and learning is all about breathing change both for the individual and the

system as a whole. Critical theory gears towards individual or group emancipation from imbalanced power relations and attempts to deconstruct different accounts of reality that ensure oppression, and rather to generate a version which would empower people and subsequently lead to emancipation. This focus on balance is because power relations in the world are always unbalanced such that one group (colonised) is always disadvantaged. Some people within society often enjoy higher status than others just as certain intellectual agency or currency is often considered more worthy than others. Deconstructing such a perspective, and creating a balanced society (decolonisation) can only be done using the critical theory. Powell (20110, p. 108) adds that critical researchers must awaken the consciousness of the people and help break down “institutional structures and arrangements that reproduce oppressive ideologies, and the social inequalities that are produced, maintained and reproduced by these social structures and ideologies.” Such a view can be reflected in the fact that governments and political parties do all in their power to ensure that they remain in power, but since power is a double-edged sword which can be both oppressive and liberating, research has to go beyond criticising unequal power relations, to ensure a shift in the balance of power. A critical evaluation of such a society, according to Chavez (2006), would reveal that the powerful and privileged will do all in their power to manipulate and maintain their power and privilege. Since knowledge can be contested at different points in time due to differing values, beliefs and interests which all overlap, political processes and power will be the only thing that gives it legitimacy. The creation of an equal balance of power in society is the ultimate goal of the critical theory. The utilisation critical theory was therefore employed to ensure the process of decolonisation and give meaning to the experiences and constructions of decolonisation, as understood by students.

## DATA ANALYSIS AND DISCUSSION

The open-ended questionnaires were circulated amongst engineering students and staff in the university under study. In total, 890 questionnaires were circulated and 162 completed the questionnaire. Amongst the 162, 103 were male and 59 were female. Of the 162 participants, 18 were members of staff, 23 were first year students, 26 were second year students, 40 were third year students, 33 were fourth year and 22 were postgraduate students. The data generated was categorised and coded into themes. These themes were used for the analysis and discussion. The paper adopted grounded analysis as an approach wherein the researcher lets the data speak for itself and themes develop from the data through different processes of coding and categorisation; the resultant themes inform the analysis, with direct quotations from participants used to substantiate every theme (Fomunyan, 2016b). From the coding and categorisation of the data, four themes emerged in answering the main research question ‘how can teaching and learning in engineering education be decolonised?’ These

themes are pedagogical approaches, teaching and learning resources, facilitators of teaching and learning and assessment practices. Literature and the theory is also used to support and expatiate upon the claims of the participants.

### Pedagogical Approaches

Fomunyan (2013) defines pedagogy as the art and science of how teaching and learning is practiced, or how it unfolds, and how students learn what is taught. Pedagogical practices therefore include the manner in which teaching and learning takes place, the teaching and learning approach, the diverse ways through which content is taught and what students take home from the teaching and learning process. Cogill (2008) adds that pedagogy is the act of teaching and learning, combined with its associated discourse. Teaching and learning is what a teacher or lecturer should know, and the skills the lecturer has to command so as to make and justify the numerous different kinds of decisions that constitute teaching and learning. Pedagogical approaches used by lecturers therefore surpass how teaching and learning is enacted in the classroom, to the more rigorous work of how it is experienced and the decision making associated with such experiences. To the participants, decolonising teaching and learning in engineering education was all about the pedagogical approaches used by the lecturers in teaching and learning. Decolonising the pedagogical approaches would be one way of ensuring that teaching and learning is decolonised. To this end, one of the participants stated that:

Lecturers still teach us in ways that we don’t understand. Since we started talking about decolonisation, nothing has changed. They still teach us the same like before. For teaching and learning to be decolonised, lecturers need to change the way they teach. They need to use teaching approaches which would be able to relate to. They need to go back and develop African ways of teaching, the one used by our forefathers before formal education started. It is part of our heritage, so it should be developed and used to ensure decolonisation.

Heleta (2016) argues that decolonisation is about the incorporation of South Africans, and African perspectives, experiences and epistemologies as the central tenets of the curriculum, teaching, learning and research in the country. Going back to African epistemological and ontological practices to develop the pedagogical approaches used in communicating knowledge would be one way of ensuring that African perspectives and experiences reach the forefront in higher education in general and engineering education in particular. Shillington (2012) argues that African history has shown that engineering education on the African continent dates back about 500 years ago and the University of Timbuktu was famous for its engineering prowess and this attracted more foreign students from all over the world than modern day New York University. The pedagogical approaches used by such institutions, as well as those used before the advent of

colonisation need to be revisited and developed to ensure the decolonisation of teaching and learning.

Expatriating on this, another participant stated that “Africa before colonisation had engineers who worked for its development on several ways. We need to look at how these engineers were taught whether formally or informally and develop these approaches to make sure that students are able to fully understand what is being taught in classroom”. Mäki (2013), writing about engineers in South Africa, argues that as far back as the early 1800, engineers were trained in South Africa and these people moved on to work for municipalities as well as other engineering firms. How these engineers were trained can be revisited to develop African perspectives on the practice of teaching and learning which can be used in engineering education to ensure decolonisation.

Other participants saw decolonising teaching and learning in engineering education as contextualising the foreign, or giving foreign pedagogical approaches an African orientation or perspective to make it more suitable for African students. One of the participants stated that “decolonising teaching and learning in engineering education would be about teaching students in ways that do not alienate them. It would be about Africanising all the foreign ways of teaching way are using to make sure it represent us and who we are”. Chilisa (2012) argues that decolonising higher education is all about dismantling western-centred approaches within the higher education system, which go beyond numbers to empowering marginalised bodies through teaching and learning. This belief is supported by Mbembe (2016) who says that decolonisation is not simply about eradicating European worldviews and introducing African worldviews, but about making Africa the centre in African universities. By giving European world views and pedagogical approaches an African touch, lecturers would be ensuring that teaching and learning is decolonised. Adding to this, another participant stated that:

Lecturers within our department still use methodologies which leave most students confused. This explains why we still have shortage of engineers in this country. They need to develop methodologies that speak to the South African people. In Canada they took to decolonised the pedagogical approaches used in the education system and today they are enjoying indigenous approaches to teaching and learning. We also need to follow this example and forget pedagogical practices that doesn't speak to the African reality. Students are suffering, that is why they are demanding for decolonisation and developing African approaches to teaching and learning would be the major way to decolonise teaching and learning in engineering education in particular and the South African higher education in general.

McGregor (2012) argues that decolonising pedagogy is all about developing and using approaches that would help students come to the understanding that structures of colonisation still exist and be able to navigate or dismantle such structures. Decolonising pedagogy is also about developing and

employing strategies and approaches which disrupt those structures at an individual and collective level, resulting in the re-centring of indigenous or African ways of knowing or teaching and learning, being and doing and facilitate engagement with possibilities for making change using the learning experienced. Pedagogical approaches therefore are key in the decolonisation of teaching and learning in engineering education and until this is done, decolonisation would still be a foreign term in engineering education.

### **Teaching and Learning Resources**

Benjamin and Orodho (2014) define teaching and learning resources as any support material required or available for use by the lecturer or teacher in the classroom in enhancing the teaching and learning experience. These resources could range from wall pictures, blackboards, audio-visual aids, globes, maps, atlases, concrete objects, computers and the classroom environment. Such a view is supported by Yara and Otieno (2010) who argue that teaching and learning resources are a spectrum of educational materials that teachers use in the classroom to support specific learning objectives. The resources used by a lecturer are defined by his or her learning objectives or how he or she wants to drive the lecture. One way of decolonising teaching and learning in engineering education would be through the teaching and learning resources used. The materials brought to class by the lecturer to facilitate teaching and learning, as well as the fittings and fixtures within the classroom can either aid the decolonising of teaching and learning or not. Expounding on this, one of the participants stated that:

The way the classrooms are decorated hear for teaching and learning still smell of colonisation. Some of the pictures in the classroom, the designs and drawings as well as architectural representations are all foreign as if we don't have African engineers who have done similar things. Making sure that their work is showcase and students familiarise themselves with it in the teaching and learning environment would go a long way in decolonising teaching and learning in engineering education.

This idea was supported and enhanced by another participant who stated that:

Lecturers come to class with different designs everyday as well as case studies and models for use to explore. But all these models they bring and use for teaching and learning are foreign. We hardly know what other Africans have done. By just bring charts and other examples of from African would help boost our moral in what we are doing and how we can get better. We are already dominated by western innovations like the computer internet phones amongst others. Showcasing what other Africans have done as learning resources is the only way I think teaching and learning can be decolonised.

McGregor (2012) argues that teaching and learning resources go a long way in the decolonisation process, as well as

decolonising pedagogies, because disrupting taken-for-granted assumptions or symbols (resources) about where and how 'legitimate' teaching and learning takes place has helped sustained colonialism till date. Engaging teaching and learning resources that speak to the African people and showcase who they are and their heritage is one way of decolonising teaching and learning. Phillips (2005) adds that the lived experiences of indigenous people which has precedence to become a resource for teaching and learning (just like those of the colonisers) require recognition and acknowledgment if decolonisation is the goal. Tapping into these resources for teaching and learning would ensure the decolonisation of teaching and learning, not only in engineering education but in the South African higher education system as a whole.

Another participant added that;

Even the books used as resources in teaching and learning are all from the west and nothing from African. African lecturers and students are writing books and articles which can be used as resources in teaching and learning. If these resources are not used by lecturers as resources for teaching and learning, who are we expecting to use it? To talk about the decolonising of teaching and learning whether in engineering or in the higher education system as a whole is to begin with the utilisation of these materials in teaching and learning to aid student understanding. These materials and resources are produced from a context that is familiar to them and it showcases the African continent and intellect. The utilisation of these resources are paramount in decolonising teaching and learning in engineering education.

Munroe, Borden, Murray Orr, Toney, and Meader (2013) argue that publications are an important contribution to development of indigenous understandings and perspectives and the utilisation of the same as resources in teaching and learning would not only ensure that teaching and learning is decolonisation, but also that this important contribution is adding value to the African people. Munroe et al. (2013) add that this recognition of agency has far reaching implications in the decolonisation process, especially because these resources shape and control the ultimate understandings of the knowledge systems and the values the people hold dear, as well as what to showcase to the rest of the world. Engaging teaching and learning resources that speak to the African context, and that have been produced by Africans, would go a long way in ensuring the decolonisation of teaching and learning in engineering education.

### **Facilitators of Teaching and Learning**

Noroozi, Teasley, Biemans, Weinberger, and Mulder (2013) argue that facilitating teaching and learning is all about an educational vision which explores and invests in innovative practices and coaches students through challenges. The

facilitator provides an educational atmosphere where students have the opportunity to fulfil their potential for intellectual, emotional, physical and psychological growth. This view means that facilitating teaching and learning goes beyond going into the classroom to speak to students, and encompasses an understanding of who they are and takes their needs into consideration in the teaching and learning process. Yoshida (2017) argues that facilitating teaching and learning is about making learning effective and bringing out the inner values, beliefs and feelings possessed by students. Teaching and learning is also about creating a culture that builds and supports student relationships in the spirit of a community that inspires learning within the classroom using the tools, strategies, and processes you employ to teach. Cathcart, Greer, and Neale (2014) add that facilitating learning involves coaching, mentoring and training. Mentoring entails that facilitators engage students one-on-one. Mentoring is all about teaching what you have been doing successfully. Training, on the other hand, requires experts who would train students to masters certain skills. Coaching is typically a one-on-one relationship where the coach helps the student to focus on and achieve their objectives faster than if they worked alone. A coach is an adept facilitator who is goal-oriented and produces results. Every facilitator of teaching and learning in engineering education must therefore ensure that he or she is a mentor, a coach and a trainer. To the participants, for lecturers to successfully facilitate teaching and learning in engineering education, they have to understand the background and experiences of the majority of the students. The participants were of the opinion that decolonised teaching and learning should be facilitated by lecturers who are black because they are more predisposed to understanding the experiences of black students who make up the majority of the student population. Expatriating on this, one of the participants pointed out that "we cannot be talking about decolonising teaching and learning when we are still being taught by whites who do not even understand our experiences or who we are as a people. Many of us are simply trying to express ourselves effectively in English. We need people who can coach and mentor us in a language we understand better". This statement means that decolonising teaching and learning in engineering education is about having black lecturers to facilitate teaching and learning. Another participant stated:

Facilitating teaching and learning is about mentorship. I cannot be mentored by somebody who doesn't understand what it means to be poor or who has never gone hungry to be once in his or her live. To be mentored by people who have no understanding of the socio economic and structural challenges black students' face is reimagining colonialism. If not all, a majority of those who facilitated teaching and learning should be black people whom the students and relate with. And not only blacks, but black South Africans who have been through similar challenges and succeeded, so they can mentor and train upcoming engineers to do the same and take their place in the society. To decolonise teaching and learning is about ensuring that those facilitating it are blacks who those who have hard

first-hand experience of what it means to be considered not good enough.

Cathcart et al. (2014) and Yoshida (2017) argue that facilitating teaching and learning is not simply about transmitting knowledge in the classroom but taking personal interest in the person of students and mentoring and well as training them to acquire relevant skills which they would otherwise not be predisposed to. Decolonising teaching and learning therefore is about ensuring that people who facilitate it, have both the contextual understanding as well as the experience and willingness to not only see students as objects who must be taught but as people who must be nurtured to develop and fulfil their potentials. Fomunyam (2017c) and Munroe et al. (2013) add that decolonising education in particular, and teaching and learning in general, should seek to heal and transcend the effects of colonisation, and these can best be done by those who have experienced the same and have been able to heal. They continue that decolonising education cannot ignore the reality of colonisation but rather must address the issue directly, especially since decolonisation can be understood as a process of deconstruction and reconstruction at multiple levels, one of which is teaching and learning (Fomunyam, 2017c; Munroe et al., 2013). Decolonising education therefore demands the critical examination of the hegemonic structures of mainstream education and to the participants, this in engineering education can only be done by lecturers who are black.

### Assessment Practices

Fomunyam and Mnisi (2017) argue that assessment is a process which lecturers use to generate data, using a variety of tools and strategies to ascertain whether what students know, are able to do, and identify gaps in understanding so as to plan future teaching and learning to address the gaps. This belief means that assessment goes beyond simply determining competence to understand individual gaps and differences to ensure that these gaps can be engaged with in the future. Pinchok and Brandt (2009), adding to this, argue that assessment is the process of ensuring that the learning program or syllabus has been understood so grades and degrees can be conferred. In engineering education, assessment would involve tools which are directly linked to current lessons and are geared towards developing particular skills in students. The lecturers engages these tools to gather information so as to use it to enhance teaching and learning. Kanjee and Sayed (2013) argue that there are two major types of assessment. Formative assessment and summative assessment and these two types of assessment serve different purposes in the higher education system. While formative assessment is often used to improve teaching and learning, summative assessment is often used to test comprehension and confer grades or qualification. Roth and Sanford (2016) argue that assessment in engineering education would be different from assessment in most disciplines because the target in this discipline is critical and practical skills which the student must possess to succeed in the work place upon

graduation. Participants therefore believed that assessment practices used by lecturers while facilitating teaching and learning should be one that aims at developing students and empowering them to improve their skills rather than test for accuracy. Alluding to this, one of the participants stated that “assessment practices used by lecturers in the classroom should not be rigid, but should consider empathy and the developing trend of the learners. Their performance should be used as data for target intervention so that students can improve and not for disgracing them as some lecturers do”. Roth and Sanford (2016) argue that assessment in engineering education should be a collaborative experience in which the students are involved in the development of the rubric for assessing certain concepts; they add that the assessment itself should generate a discussion and the ensuing discussion should be a valuable tool for stimulating thinking about each of the modules and practices, comparing changes in student understanding across modules. By doing this, lecturers would ensure that assessment is primarily targeted at improving learning and the development of the students.

Another participant, adding to this, went further to state that:

Lecturers use assessment to privilege a few as well as to empower certain students while ensuring that others remain underdeveloped. Some students are sent on placement to places that would help their development effectively, while others are sent to places that have little or no value in the industry but at the end all of them are assessed using the same criteria. This is not right and require decolonisation. Students need to be assessed using mechanisms that ensures that their abilities are accurately tested and this should be premised on the fact that all of them were provided with equal opportunities so that assessment can be fair.

This statement means that assessment practices, as well as the exercises leading to these practices, should be fair and practiced in ways that certain students are not privileged over others. Another participant stated that “assessment practices of lecturers should be open, fair and calibrated in ways that all students would understand the rubric which would be used for grading so they can equally assess themselves and compare it with that of the teacher, since they are both creators of knowledge in the classroom”. Roth and Sanford (2016) concur with this when they argue that assessment should create the basis for meaningful discussion of how the different learning outcomes and associated course activities lead to differences in student understanding and how these understandings were tested. Munroe et al. (2013, p. 332) adds that decolonising education and assessment practices and approaches can enable indigenous “peoples and all peoples to be educated in a way that honours identity and culture as we become responsible and productive citizens guided by such values as love, respect, honesty, humility, courage, wisdom, and compassion in order to live in harmony”. Decolonising teaching and learning in engineering education therefore is also about engaging assessment practices that move beyond stringent testing to

engaging empathy and the development of the individual. Douglas and Purzer (2015) conclude that engineering education and research requires sound practices for development and use of assessment instruments, and this can be done through the engagement of more researchers and students in dialogue on ways to improve such practices and performance. Furthermore, lecturers must be leaders in research to create methods of assessment that can be used to measure constructs essential or valued in ensuring the development of engineering students.

## CONCLUSION

Decolonising teaching and learning in engineering education is a complex process which requires a complex mix of ideas and processes to ensure that teaching and learning, which is considered the principal tool for education, empowers students the way that it should. In the attempt to theorise a pathway for decolonising teaching and learning in engineering education, this paper engaged in a complex process. This paper was driven by the research question: how can teaching and learning in engineering education be decolonised? Data to answer this question was generated using open-ended questionnaires, and a total of 162 participants completed the questionnaire. The data generated was coded and categorised into four themes: pedagogical approaches; facilitators of teaching and learning; teaching and learning resources; and assessment practices. These four themes were analysed and discussed using direct quotations from participants, as well as literature as a theoretical lens.

These four themes reveal that decolonising teaching and learning in engineering education centres on how teaching and learning is enacted, what is used to facilitate the enactment of the same, who facilitates it and how what is facilitated is accessed. A thorough engagement with these four aspects will not only reveal the complexities of decolonising teaching and learning in engineering education, but would also provide a pathway for critical engagement and consciousness in the bid to produce more engineers in South Africa. How teaching and learning is facilitated, as well as who facilitates it is of critical importance in the decolonisation project especially because it speaks not only to the context, but also to the experiences of the facilitator and the students whose learning he or she is facilitating. Furthermore, it is critical to determine what is used to facilitate teaching and learning, and how data is generated to determine whether the facilitation process was effective or not, since such experiences can either make or mar the consciousness of the students, as well as the idea of empathy and fairness in assessment.

From the findings of the paper, three key considerations can be made. First, decolonising teaching and learning in general, and in engineering education in particular, is a complex process which requires careful consideration to ensure that both the lecturers and students involved in the teaching and learning process are co-creators of knowledge which speaks to and

addresses local experiences and needs. This process should be engaged in ways that are liberating, with students being seen as equals and being given the opportunity to engage with all fairness and freedom. Secondly, teaching and learning in engineering education needs to tap into contextual experiences and methodologies in a bid to enhance the learning experience for students; this can be done by revisiting engineering education in Africa before the colonial era and developing the approaches and methodologies used in training engineers to ensure that teaching and learning is contextual and effective. Lastly, decolonising teaching and learning in engineering education is about putting African and South African experiences at the centre of engineering education and engaging engineering students in ways that ways that are emancipatory and empowering.

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