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Sustainable curriculum design

New paradigms in engineering education

The Role of Context in Decolonising Engineering Curriculums in Proudly South African Universities: A Cybernetic Perspective.

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Abstract

This paper addresses the epistemological challenges facing South African Public Universities in light of the *#FeesMustFall* campaign and the associated outcomes. Of particular interest are the academics who are to embrace the changes while they remain in the education system. The decolonisation of knowledge, which is still not clearly understood nor agreed upon, necessitates a rapid review of the status quo in the major universities and how they conduct their business. While transformation and decolonisation are not synonymous, the universities will be undergoing transformation to address the decolonisation needs of the majority of its students, which has already created dilemmas for the academics who have largely followed a Eurocentric approach, and are now to implement the changes addressing decolonisation. The immediate aspects facing the academics are the undefined curriculum changes, as well as the new teaching and learning strategies, which need to reflect the epistemology of the students addressing an Afrocentricity that has not been embraced in the past. A cybernetic perspective relying on Pask's Conversation Theory may be integral in allowing the academics the skill to contextualise the curriculum, embracing those who are the consumers of this new co-created locally generated knowledge.

Keywords:

Conversation theory, cybernetics, contextual approach, decolonisation of knowledge, South Africa

1.1 Contextualising the Paper

In October 2015 a student led campaign called *#FeesMustFall* formed as a response to tuition fee increases at South African public universities. These public universities account for 89% of all tertiary level enrolments [1]. The student demands also included the decolonisation of knowledge in these universities. This and earlier protest movements highlighted the inherited legacies of the apartheid regime and the need for transformation. The talk of decolonisation of knowledge is not new in South Africa though. Mahmood Mamdani [2] noted that without an Africa-focused Intelligentsia, the challenge facing South African universities will remain. Du Toit's [3, p94] view was that South African universities were facing grave challenges with "the enduring legacies of colonial dependence and the colonisation of consciousness", published more than 15 years ago. However, the urgency for change is now at the forefront of the universities' and government's agendas owing to the mass mobilisation of the students who seek out the changes. The responsibility on academics at South African Universities is probably higher than ever before. Firstly, with the successful *#FeesMustFall* campaign, cost cutting mechanisms have been implemented and are probably here to stay throughout 2016 and the election year of 2017. The additional financial burden has seen universities take frugal measures to curb spending, including reducing budgets for hardware, travel, staff hiring, and so forth. These challenges are to be dealt with by university management who need to plan for minor

increases for at least two years. However, the even bigger challenge facing academics rests on the probable revolution of how the curriculums are to be presented in terms of the decolonisation of knowledge that the students (and some parents, staff and other professional partners) would like to see. From the outset one should know that South African universities are not facing a top down governmentally organised re-curriculum agenda to replace the current worldview with a defined African world view. There is however political pressure to embrace transformation; however, the space is open for discourse and ideas amongst role players, but for the most part, this responsibility rests on the academics and students who share the conversation spaces in the classrooms.

Teaching and learning are obviously critical aspects of universities; however, in South Africa this area is often measured by management according to student intake size, throughput, and pass rates. The role of research is increasingly important in the public universities, especially since university rating agencies emphasise this when ranking the universities. Further, the funding model favours the research aspects of the public universities to such an extent that even the former Technikons, which were mostly geared for teaching and learning, have either been merged with universities or adapted to become research centres as well. Proof of this priority to increase research output is evident in the high growth in publication output that has more than quadrupled in South Africa from 1996 to 2014, with South Africa sitting in 34th place in the world journal publication rankings [4]. A problem has occurred in that teaching and learning tends to be less valued and acknowledged than research outputs, even in global spaces [5]. Thus, the shift from teaching to research

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has also resulted in shifts in the staff complement. This further defocusses the requirement for teaching excellence when the measurement of this core aspect is firstly, difficult to quantify, secondly, difficult to achieve, as many academics are specialists in their field but not necessarily specialists in teaching. Lastly, some academics who may prioritise teaching development spending much time on this aspect, do so at the expense of a lower research commitment, even at the risk of their career [6]. In keeping with international trends, improved student experiences in universities, including the new motivation for improved teaching practices, are also the buzz in the South African context. Faculties now need to show that they have a teaching and learning focus, which is especially true in the engineering faculties whose staff mostly have not had the same exposure to the humanities courses and the methodologies that are closer to this arena of teaching and learning.

The requirement for transformation in the university, especially at ground level—the classroom—leaves many lecturers in a challenging position. The new focus on teaching and learning impacted with the decolonisation of knowledge in the curriculums is a tall order to fulfil. Many lecturers are lost as they do not have the tools/skills to adapt to a new fluid approach in teaching, which itself has not yet been defined. This uneasiness in the academic circles is understandable, especially since this teaching shift has not been a requirement before. Further, this coincides with a perception change in the importance of the student as a customer, shifting the focus from the teacher to the learner and the learner's experiences.

The decolonisation theme is not a superficial requirement. Removing statues, changing the wording of the mission statement, re-compiling the university website and marketing material, are just the tip of the ice-berg. Decolonising the colonial legacy has a wide scope. For example, the faculty subdivisions, degree names, tuition languages, even the physical design and layout of the universities are colonial with many South African universities being over 100 years old. To enable the successful transformation, the staff need to embrace the transformation and in the end too need to transform. This is a daunting process as it relies on integrating new worldviews and methods into one's own way of seeing and experiencing the world. A cybernetic approach is presented as the means for change, allowing for a contextual approach to addressing transformation in teaching, learning, and curriculum design.

1.2 A Cybernetic Approach

This section was added for the reader who is not familiar with cybernetics. Cybernetics is not easily defined. There are at least two reasons for this. The first reason is that cybernetics does not have a home discipline. Pask [7, p11] states:

Cybernetics... like applied mathematics cuts across the entrenched departments of natural science; the sky, the

earth, the animals and plants. Its interdisciplinary character emerges when it considers economy not as an economist, biology not as a biologist, engines not as an engineer. In each case its theme remains the same, namely, how systems regulate themselves, reproduce themselves, evolve and learn. Its high spot is the question of how they organize themselves.

With such a diverse spread of cyberneticists and their subject areas, it is difficult to define the "what is..." to a simple question of what is cybernetics. The Greek word *Kybernetes* translated into English is *pilot* or *steersman*. The term cybernetics was coined by mathematician Norbert Wiener in 1948 and was described in his book *Communication and Control in the Animal and the Machine*. In Wiener's model, cybernetics adheres to the laws of physics. His view of cybernetics had limitations but from his coinage, the path had been laid for increased scope of cybernetic thinking, specifically at the Macy Conferences (1946 to 1953) where new themes were introduced, including patterns, regularity, and feedback, which translated into circular causality [8, p178]. With the awareness of the observer in systems, a new chapter of cybernetics emerged: second order cybernetics. This brought the observer into the system. The observer needs to be accounted for. For example, anthropologist, ethnographer, and cybernetician Margaret Mead [9], who studied people and their cultures realised that her mere presence in their company was impacting the behaviours she experienced. In Mead's case, whether it be that the cohort acted differently to impress her, please her or even anger her, her presence altered what she observed—the observer effect.

With the growth in constructivist narrations, observer dependent realities and recursive relationships, so too did cybernetics evolve. Many cyberneticians are also constructivists and vice versa as there is some overlap, particularly in Glasersfeld's [10] radical constructivism and the theme of reflexivity. Cybernetics is vested in principles that are used to formulate a cybernetic understanding of phenomena. One reason for introducing cybernetics in this paper is to frame the decolonisation as one that is not separate from those who view it, discuss it, and live it. This means that all role players under the university umbrella are connected to this issue of decolonisation. This addresses the cybernetic view of being an observer *in* the system. By acknowledging that transformation is a shared problem, the ideas of epistemology, mutual causality, and reflexivity arise. From the outset, one should know that it is easier to experience cybernetics as a worldview rather than as a model, for modelling something seeks to create the separation between the model and the person who invents it owing to the objective nature of the definitions of such model [11]. This relates to the second reason for why defining cybernetics is troubling. The definition of something is tied to the observer who punctuates the distinctions figure from ground. We are all inhabitants of different linguistic domains, which also have their own

way of knowing and understanding the world through the vast works of mythical thinkers, poets, and their canonical texts that are relevant to these respective linguistic domains [12]. From a biological perspective, Maturana and Varela [13] explain how our experiences are mapped in our neurology, which in turn relates to how our thoughts produce our epistemology. Observations arise out of neuronal activity, which is a function of past neuronal activity in how the connections in the brain have been wired, for neurons that fire together wire together. Thus, the repetition, acceptance, and linguistic expression of cohort behaviours is what separates different groups from each other. From each linguistic domain the use of language, logic, and the justification for actions relates to the socially accepted formalised standards for each society. If two cultures are brought together as MacIntyre [12] discusses in his analysis of the Spanish and the American Indians during the colonisation of the Americas, the two different linguistic communities exhibit vast misunderstandings when interfacing with each other. Misunderstandings do not only arise owing to the lack of translatability of the two languages, but also due to the lack of common cultural norms and beliefs that can be implemented as baselines between the two cultures. For example, the Spanish believed in property rights while the Native Indians did not accept this concept, as who could own shared land?

MacIntyre proposes that if a person could inhabit both linguistic systems, they could have a better chance at integrating the two different linguistic communities. This person would find him/herself between two worlds where each worldview has developed an acceptable social reality and consciousness. Even with these individuals who have had this opportunity to inhabit two linguistic domains, there are still challenges in seeking a common ground between these two cultures. MacIntyre has successfully set the stage for a person to have a rational relativist response of “seems right to this group because of such and such”, rather than being able to just dismiss the one group in favour of the other. Transcending this epistemological challenge for the role-players within the university will require tolerance, respect, and most of all, learning. Thus, it is an important step in the transformation process of the university and its staff, for people who are at least in part versed in both an African epistemology and a colonial one, to be actively involved. Obviously there is variety in African and colonial worldviews as they are not simply two items of uniformity. Ideally, if individuals could be identified who have lived in both a colonial and an Afrocentric culture, speaking and understanding the respective languages, these people could be instrumental in assisting in the new understandings that are needed for those whose ancestors are not African.

Being a South African but from Western origin who spends most of my time in shared linguistic spaces that comprise mostly of Black South Africans, I have realised that it is no longer acceptable to continue with the dominant discourse of a colonial legacy without at least the agreement of those who are mostly affected by it. In

embracing the transformation shift in my classes, I adopted a contextual approach to tackle, firstly, my lack of understanding of the linguistic systems of the students in my class, and secondly, for the co-creation of a “do what works best” pragmatic approach in order for the students to achieve their goals in a system that reflects *their* epistemology. Lastly, aiming for the overarching goal of sustainability of the public universities in South Africa.

1.3 Why a Contextual Approach?

The issue of decolonisation arises out of the lack of transformation in the university structures. Lack of transformation means the dominant discourse and activities in the university do not reflect the majority of people who are using the system to achieve their goals. This includes the design of the curriculums; the dominant teaching and assessment approaches and how they are implemented; the reliance on imported knowledge for the curriculum content; the focus on the exportation of research outputs published in foreign countries; the disconnect between many staff and students both in the classrooms, as well as in the management spaces; and the lack of integration of the epistemology of the students into the university.

The reverse of colonisation is to break from a European perspective and emerge with independence in thinking, embracing the local majority view, whether integrating this epistemology into a hybrid summation, or what seems most probable, a continuously evolving approach of recursive improvements resting on the continuous feedback from student groups along the way. The latter is favoured owing to the time required for role-players to adapt, which includes learning new skills in teaching and learning and integrating these into the learning systems. The degree of decolonisation in the universities will ultimately depend on the needs of the people who require the change, moderated by the economic forces in a largely capitalist South African economy. With the large public universities acknowledging that resisting the transformation will see the universities tear at the seams, large scale transformation is imminent. Thus, the question is not whether the universities must decolonise, it is how they can perform this task with minimal social unrest, while still serving industrial partners.

Decolonisation is counteracted by incorporating those that require the change into the system to reflect the epistemology of this group, thus changing the system itself. How will the university know which direction to make shifts if there is lack of understanding as to what the needs of the students are? By contextualising the problems, deeper understanding of the students can take place in a respectful manner where there is openness to learning for the educators, students, and professional partners. The umbrella of role-players is wide and other interested parties may seek to be part of the conversation including parents, politicians, and most importantly, the industrial partners who are the receivers of the students that the university graduates.

It is obvious that for the universities to remain significant in their mission for academic freedom, the betterment of society, and education for the masses, they need to address the very needs of the bulk of South Africans. Using a contextual approach of allowing the students' voices to be heard and integrated into the university status quo diffuses the need for social unrest. The primary shared spaces in the university are the classrooms. Thus, creating and integrating students into the university will see this area having a central role in addressing the decolonisation requirement. The academics themselves will have to re-think their approach, addressing social justice in the classroom, while also steering the students into a direction that they will be prepared for the work environment upon graduation. This is a challenging tight rope which can be mitigated by contextualising the students' backgrounds, embracing these backgrounds, and most importantly, using these backgrounds as the context and curriculum baselines, which now may reflect the students themselves. There is thus a requirement for the personalisation of the learning outcomes, making the outcomes in the modules significant to the learners, addressing the learners' perspectives, while also tackling local South African aspects. For example, some lecturers have allowed for crowdsourced (student and/or community generated) assignment topics that the students partake in addressing the challenges in communities that the students inhabit. Whether it be engineering projects solving problems in the local community, including creating solutions for a local *spaza* shop operating with solar electricity, or a rural clinic not having cellular or ADSL service for electronic patient file transmissions to the regional hospital, or entrepreneurial aspects such as marketing and business leadership to informal or even small businesses. Students learning through servicing of their community while led by the skill of the lecturers—who should be specialists in the content of the learning outcomes—, allows for several aspects of decolonisation to be dealt with at once. The students still achieve their educational goals; the community benefits seeing the university as an important partner; the academics have a ground level experience of the needs of South Africans and the diverse cultures who inhabit the community spaces; all while the university achieves its goals of improved teaching and learning in the service of humanity. For example, the electrical engineering courses have an industrial project which each student needs to complete prior to finalising their degree. Instead of students building projects that are shelved, if all the students had the opportunity to only undertake projects that have a community involvement servicing a local need, contextualised learning is achieved in terms of the community needs. The project is then provided to the community or to the community representative who requested the solution. The student/s would need to work with the beneficiary of the project along the way to fully integrate the engineering solution. The lecturer also gains further contextual understandings of the communities, also bridging the relationships between university and

community. Some of these projects have taken place with mostly good results; however, there are the social challenges of theft and so forth that do challenge the progress along the way. Additionally, the assessment methods can also be diversified while still meeting the local and international regulatory bodies' standards such as the Engineering Council of South Africa (ECSA), or the Association for Commonwealth Universities, who do not necessarily define the how of teaching and learning, rather they require the proof of the learning and the auditing security that the proof is indeed valid. There is already scope for community aspects in engineering, ECSA's exit level outcomes number 6 and 7 are intimately focussed on communication skills (outcome 6) and the wider social aspects of where these engineering solutions are implemented (outcome 7).

Interestingly, contextualised, socially based learning is not new. Lev Vygotsky's [14] central focus on learning was social, cultural, and historical, which form a complex system that one is part of. For Vygotsky, understanding learning, one must also look to the social processes from which a person's thinking is derived, while acknowledging the cognitive growth as a *collaborative* process as we learn through social interactions. It seems plausible to assume that if Vygotsky's points for learning were broadly incorporated in the universities embracing the social domains and allowing for multiple epistemologies to flourish under the university umbrella, there would be no requirement for decolonisation in the first place.

The next challenge is how to achieve contextual learning in the classrooms.

1.4 Ground Level: Perspective shifts in the classroom

The goal in contextualised learning is to allow the students an opportunity to add their own background into the learning system, thus contextualising the content. Cybernetics provides some principles that can assist the lecturer in taking a contextual approach with the students. For example, cybernetics is concerned with circularity and mutual causality. Glanville stated [15, pp.168-169]:

The Principle (or Law) of Mutual Reciprocity states that, if through drawing a distinction we are willing to give a certain quality to that we distinguish on one side of the distinction, we must also permit the possibility of the same quality being given to that which we distinguish on the other side of this distinction: If I distinguish myself from you and I consider I am intelligent, I must consider that you (which I distinguish from I) might also be intelligent...

This principle explains how qualities such as intelligence may be understood to belong to both participants in an interaction, shared *in the between* [15]. In the classroom

context, if the actors¹ (teachers) are to think of themselves as having knowledge, so too must they allow the other actors (students) to also have the option of having knowledge, for the teacher alone with knowledge is meaningless, unless this knowledge is being acknowledged by the co-learners in the shared classroom. There needs to be compliance/cooperation between the relational elements, with neither side thinking they are in control. Acknowledging that the students too have intelligence and are not just blank slates, is an important step. While the students are not yet specialists in the fields they study, they are specialists in the context of their lives, for they are the ones who are living it. Thus, if one is aiming to contextualise the curriculums and have these curriculums reflect the students' own epistemology to some extent, an enquiry of the students' way of knowing is essential. It is impractical to assert that the teachers must befriend their students to enable a closer relationship in understandings. This is fraught with ethical problems and I am sure most would not like this option of reduced personal boundaries. However, it is still possible to achieve a level of engagement that does not challenge the reasonable social gap in teacher learner groups. Conversation theory (CT) is a useful tool to engage the students in their learning, allowing for the contextualisation of knowledge to be introduced in the classroom. One technique is referred to as Teachback [17], [18]. In this method, after the teacher has presented to the learners the topics of the learning outcomes, the learner is invited to teach back his/her understanding of this material to the teacher and the classmates. When the learner teaches back their interpretation of the new concept/s, they are providing a glimpse into their world of understandings, but more importantly how they arrive at these understandings is a feature that the teacher can use to improve the learning process. During the Teachback, the teacher stresses the *how* of knowing. This implies that the learner tells of how they arrived at their understandings. By focussing on the *how* rather than the *what*, the student is invited to tell of their own story in how they understand the content in their own lives. The teacher hears the learner's ideas about the concepts and what meaning they have attached to this content. The role of the teacher is to then use the diverse contexts of the students to adjust the curriculum to the contexts of the learners, embracing the learner's contexts and every day aspects. Thus, the teacher becomes what I call a *Creative Contextualiser*: finding interesting ways of placing the important curriculum knowledge areas in the territory of the learner's backgrounds so they may integrate this new content and understand it in a personal way. For example, if the knowledge area is waves and resonance, topics that students find interesting can be used as the context. Music and audio equipment including speakers and room design are not traditional study areas,

yet still fall under the engineering branch of acoustics. Many engineering students are interested in audio, including car audio, disco setups and so forth. Contextualising waves and resonance in a student chosen context of music equipment, for instance, addressing student's questions in terms of speaker placement etc. allows for the students to have a personal experience with the topic. This in turn results in meaningful learning and better memory retention. This also means that the teacher learns about the students in terms of their way of knowing, as well as their interests and goals. This is in keeping with Vygotsky's [14] ideas about social learning in a collaborative manner.

According to Pask [19, p.45], learning begins with each student's aims or outcomes, which means that the teacher needs to work with the students' goals. This also means a new form of responsibility is created. New questions arise from this way of thinking and acting: how does the teacher take responsibility in the class? How do the learner's show their responsibilities? How do you know learning is taking place, and so forth? The answer to these questions rests on the mutually agreed upon roles and responsibilities that emerge in the classroom.

1.5 Limitations

Probably the most challenging aspect of contextual approaches is that there is a perspective shift that the teacher would need to embrace. While there are many methods to achieve this, cybernetics is not an easy option as cybernetics is not a theory, it's a way of being [20]. Teaching cybernetics to people has its own challenges including the shift from objectivity to personal relational meaning generation [11]. This means that one cannot simply think in terms of cybernetics without acting in a corresponding manner [20]. A level of authenticity is required, which arrives once the observer not only thinks cybernetically, but also lives it now in keeping with what Aristotle called the *sophia* and *phronesis* of knowledge. Thus, for inclusivity and circularity to be present within the classroom context, the learners truly need to feel part of the system. The lecturer has to create a context for the students to be responsible co-authors in the system. Removing the hierarchy from the traditional teacher learner roles is one example. Allowing the students to adjust the modules incorporating the learners' requests creates a more interesting class, but also increases the spontaneity, which also translates to the requirement of the teacher being good on their feet. For example, for each topic the learners can decide for themselves what aspects of the real world they would like to know; the teacher can steer the course in that direction still maintaining the course outcomes, while now increasing the learners' interest. The learners achieve a level of immediacy, which is

¹ The word actors is used based on Austin's [16, p.138] statement:

Once we realize that what we have to study is not the sentence but the issuing of an utterance in a speech

situation, there can hardly be any longer a possibility of not seeing that stating is performing an act.

advantageous through topics that are personally selected, but it does also rest on the creative abilities of the teacher.

Adopting a conversational method in the classroom such as the teachback may be challenging when the group size is large. Turn taking rules become important with large groups, including the additional time to manage the different inputs of the students. There are workarounds for such scenarios, including the pre work that the teacher can perform and place on the online university module's forum, where the students can have pre-knowledge and early discussion of their own selected topics for the class. One may postulate that the students will not take actively participate; however, when the learning becomes personal, the interest is heightened.

1.6 Conclusion

Mahmood Mamdani [2] noted that epistemological transformation is central in the decolonisation of knowledge in South African universities. A cybernetic approach was presented as one method of achieving the epistemological shifts in the university. The Greek word *Kybernetes* which translated into English is *pilot* or *steersman*, illustrates the role of the teacher in the new face of proudly South African Universities. The steering of the curriculum content into the diverse contexts that the students brings forth can allow for the contextualisation of knowledge, and thus the growth in a South African knowledge that has local meaning and benefit. Teachers will thus need to move away from linear thinking, now embracing a circular view of how learning is taking place in the class. A new role of the teacher as a steersman or a variety regulator is required, aiming to achieve sufficient variety to address the diverse inputs of the students. Having the variety or range of conversations and knowledge allows for a wider catchment of topics that can be positioned or framed in the hope that the students in the class will gladly accept and absorb this information into their own knowledge, thus not violating Ashby's law of requisite variety, which is that only variety can match, absorb or destroy variety [21].

The classrooms or conversation spaces should not be assumed to be always harmonious. On the contrary, the differences that arise in conversation is in fact the reason for the need to converse [22]. As the differences arise in conversations, so too will there will be conflicting ideas. It is through resolving these conflicts in the classroom whereby understanding can take place instead of rote learning, for learner and teacher are in conversation with one another. Without the conflict there would not be the opportunity for cooperation, which is one of the behaviours the teacher requires for there to be learning taking place. Notwithstanding that the teacher may also be learning from the information they receive from the students – each perturbing each other in a circular manner.

The students want to learn the content to achieve their goals, to which the teacher is the specialist in. However, the students are the context, thus the teacher is no longer the expert in contextualisation of the knowledge. The *map*

is not the territory, as Alfred korzypski [23] and later Bateson reminded us. A map of something is not that thing without the human experience of the thing which one seeks to understand. To make the map the territory, one needs to place oneself in the content and context. Every teacher knows that it is much easier to present information to people when the audience can relate to the information, rather than relying on an abstract view of it. Achieving successful contextual teaching and learning will address the ideals set out by the South African Department of Higher Education, who specifically require that learning environments are constructed taking into account the contexts of the students, allowing for many methods for learning programs [1, p.48]. In simple terms, Viktor Frankl [24] reminds us that with increased freedom, comes increased responsibilities. Thus, as the students achieve more independence in their learning, they too will experience more responsibilities. But Frankl also reminds humanity in his book *Man's Search for Meaning* that in the face of serious extenuating circumstances, amazing achievements can be made when there is personal meaning attached to the situation. Teachers simply need to find the student's reason for being in the class and work with it. The road becomes less rocky.

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