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THE PERSPECTIVES OF ENVIRONMENTAL SCIENCES ALUMNI ON WHAT THEY LEARNT - FROM THEORY TO PRACTICE

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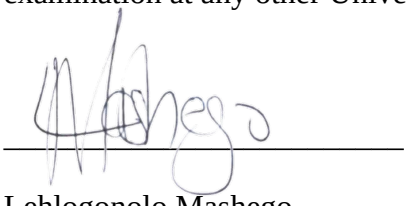
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A Research Report submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science.

DECLARATION

I hereby declare that this research is my own unaided work, and that recognition has been given to all references used. This is being submitted for the Degree of Masters in Environmental Science in the Faculty of Science at the University of the Witwatersrand.

Additionally, this research has not been submitted for any other degree and/or examination at any other University.



Lehlogonolo Mashego

12 October 2021

DEDICATION

To my late father Kabishi Ephraim Mashego, this one is for you Daddy.

Thank you for making my wildest dreams possible and enhancing my life experience with fruits to sustain and set me up for the real world, comfortably. As a promise to you, I will continue to fulfil the wishes and aspirations you had for me.

As a commitment to all my forefathers and yourself, I will not let your effort and blood fall in vain. Ke ya leboga ba Tau.

"Nna reboa shakoaneng, shakoaneng le le golo, labo kgomo le motho, kgomo le motho go phelang go phala motho gobane ga jewe, kgomo re lla pitja. Re baga mmatjako a Mphokane. Mphokane ke mabele a khuru, tlogoloane tja go baka goja dinkwe dibaka moloko.

Re segwete se mela ntsweng, re roba thoko tja badishi, sekhurukhuru ditsebeng, serubile thoko tja bashimane le basetsana.

Re mapulana le makwetla, re malemela peba. Re malemela peba, re malema mabele resa tlo aja.

Ke tjaba baditi."

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I would like to thank my mother Peggy Mashego and brother Tagishi Mashego for being the greatest sources of motivation, I will forever be thankful for your continued love and support. To my loving family and friends, the constant reminders and affirmations went a long way and thank you for being active cheerleaders in my life. To Itumeleng Maredi thank you for taking more on your plate to make the experience more pleasant for me. Last but not least, I would like to give thanks to God for carrying me through this challenging journey, it certainly hasn't been easy, but we conquered.

ABSTRACT

In spite of the global awareness of environmental challenges and direct knowledge of environmental sensitivities, a global shift towards pro-environmental practices is rather slow. This is important considering the urgency of curbing this phenomenon and all the structural complexities. Through the analysis of traditional tools, contemporary tools and opportunities in the environmental programmes, the need for sound solutions is more critical. While environmental education contributes towards environmental knowledge and potential environmental consciousness, understanding of other drivers is effective in assessing the level of pro-environmental behaviour. Environmental attitudes, behaviour and consciousness all relate to internal drivers which could potentially be triggered from environmental knowledge and awareness; or through the conceptualisation of the current global impacts. The drive towards sustainable development has further stressed the need to integrate the environment, economics and social dynamics, and the institutions at question have thoroughly managed that – however, implementation gets lost along with the various limitations that exist in the system.

The aim of this study was to explore the perspectives of environmental sciences alumni who graduated from two environmental sciences masters' programmes at two universities in South Africa on how they felt these programmes prepared them for their current work and where the programmes may need to be improved to better prepare graduates for employment in the environmental profession. The sampled alumni consisted of 40 participants with 20 from each institution. Independent interviews were conducted with all participants using a questionnaire with both open-ended and close-ended questions. The findings of this study motivate that environmental programmes fulfil the mandate of training, triggering environmental knowledge, awareness, pro-environmental behaviours and most importantly, consciousness. The identified limitations are based on structural elements which typically involve industry, community engagement and socio-political stability. Bridging the gap between theory and practice is evidently still growing, with further interventions in place and planned for better readiness for students. It is hoped that this study will provide a practical model

in which further assessments may be developed to further explore the topic and drive sustainable development amongst professionals.

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CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

The environment is a highly complex system that is continuously being exploited by anthropogenic agents - human activities have given rise to direct, indirect and cumulative environmental impacts (Aktas, 2015; Wang, 2014). The result of this environmental exploitation includes waste generation, pollution, climate change, resource depletion and unsustainable development patterns (Berthoŭ, 2013; Longhi, 2013). The complexity of this relationship between the environment and utilising its resources lies in managing the negative impacts caused by anthropogenic activities to achieve sustainable development and better manage the use of resources (Aktas, 2015). Despite the global awareness of these environmental challenges and a lack of sustainable practices and available resources, global change towards pro-environmental practices is slow; and the means of curbing this phenomenon are complex. Environmental knowledge is mandatory in mitigating the current environmental challenges to promote environmental awareness, pro-environmental practices, favourable attitudes and sustainability (Aktas, 2015; Shafiq *et al*., 2016).

In the drive for sustainable development and environmental management, businesses are working towards these pro-environmental practices, minimising environmental harm and reducing their ecological footprint. Sustainable development strategies have placed pressure on businesses to move towards sustainable practices and in essence employees are required to promote pro-environmental behaviours in their practice (Wang, 2014; Shafiq *et al*., 2016). This concept is referred to as eco-entrepreneurship, which is classified as an innovative approach in business operations that seeks to develop products and services with minimal impact on the natural environment and its resources (Hamburg and Bucksch, 2017; Vallet *et al*., 2017). For this concept to be fully applied, the environmental awareness, education and normative values of the entrepreneurs need to be triggered to evoke pro-environmental behaviours (Aktas, 2015; Shafiq *et al*., 2016). This is a contemporary practice and as such requires the intervention of government, community members and key stakeholders to ensure the successful uptake by business. Primarily, the background of this concept and its importance need to be understood and this begins with the training received for pro-environmental practice (Aktas, 2015; Shafiq *et al*., 2016).

1.1 Environmental Education – Theory and Practice

Environmental education is defined as a tool aimed at influencing and redirecting human behaviour towards pro-environmental actions, with the purpose of protecting the environment and its resources (Wessels and Mkhari, 2007). This type of education encourages building the expertise of the recipient of the training towards environmental management and sustainable development, whilst gaining greater knowledge on green innovation (Dangelico *et al.*, 2017). In the context of this study, environmental education refers only to the formal training received by students from universities through the respective environmental programmes; particularly referring to Science, Humanities, Engineering Education and Business faculties respectively. Internationally, the term 'environmental education' first originated in 1948 and was defined as a lifelong process of learning, action and reflection through the primary consideration of environmental aspects (Bhandari and Abe, 2002) in its entirety (Ardoin, 2009). Through this, the integration of green practices in curriculum and training is promoted (Bhandari and Abe, 2002); and has become necessary in combating the current environmental challenges - more so, driving environmental management and sustainable development (Wang, 2014). Environmental education is a tool used to increase environmental awareness and knowledge with the aim of having the trained students transfer and practice the skills and expertise acquired (Rakotomamonjy *et al.*, 2015). The purpose of environmental education is to redirect the minds of humans in a pro-environmental manner, to raise consciousness, drive sustainable development and introduce eco-entrepreneurs into the market (Bhandari and Abe, 2002; Wessels and Mkhari, 2007; Ardoin, 2009; Wang, 2014). Environmental education and training further contribute towards increasing pro-environmental normative values, enabling people to make proactive decisions towards driving sustainable development (Ardoin, 2009; Wang, 2014) through the environmental knowledge gained.

Environmental practices are defined as actions that seek to reduce the negative environmental impacts caused by past and current activities (FPS, 2017). These are also referred to as environmental actions fulfilled by respective role players in the environmental profession and/or associated fields, granting the opportunity to drive environmental change and management through planning, monitoring and addressing

the existing environmental pressures within one's professional capacity. While there are various guiding policies, research and competent experts; environmental action is not without challenges and structural barriers, however, more imperative to address in present day (Kollmuss and Agyeman, 2002; Steg and Vlek, 2009; Nel and Wessels, 2010; Liefländer and Bogner, 2015). Learning institutions play a critical role in paving the way for environmental practice through the environmental content offered as part of their curricula, exposure to industry and further triggering awareness and consciousness to drive sustainable environmental protection (Seema *et al.*, 2014; Aktas, 2015; Shafiq *et al.*, 2016). The role of environmental education is crucial in equipping experts with the skills needed to enhance environmental protection as well as holding a moral environmental responsibility in professional practice (Seema *et al*., 2014). In reality, environmental practice continues to be limited with priorities being placed on addressing socio-economic challenges and not environmental related matters, however for there to be sustainable development, environmental considerations also need to be prioritised (Wang, 2014; Rakotomamonjy *et al*., 2015; Shafiq *et al*., 2016; Dangelico *et al*., 2017; Hartmanna and Vachon, 2018). The environmental sensitivities no longer allow us to isolate addressing socio-economic issues from environmental pressures and as such need to integrate variables of influence to achieve sustainable development. The quote below captures the essence of discussion regarding environmental practice:

> *"Good environmental practices should not be seen as a catalogue of things that can and cannot be done, reducing environmental care to the things that are in that catalogue. It is mainly an attitude, manifested in multiple actions, depending on the special circumstances to each one, for example how and where we work or live." (Chuvieco and Burgui, 2016 as sourced from FPS, 2017:14).*

Good environmental practice is achieved in different ways and in this research, we refer directly to the influence of it being taught and possibility of it be learnt through different experiences in the education, training and work environments. Exposure to environmental realties and knowledge of the opportunities, promotes one's attitude and will to act responsibly. Allowing one to demonstrate positive environmental practices and further drive sustainable development in their respective roles. The drivers are both internal including all human psychology and motivation, and external which include immediate environment, politics, economics and social needs. The linkage of theory

and environmental practice is dependent on different factors which is discussed in further detail in Sections 1.2 to 1.4. It is to be noted that the ability to efficiently apply theory into practice is rare (Kollmuss and Agyeman, 2002; Steg and Vlek, 2009). As such, it is now more important than ever to further determine the gaps and plan for mitigation.

1.2 Traditional Tools for Environmental Education

Traditional education approaches are based on mainstream environmental content (Koehn and Uitto, 2013). These exclude additional tools that enhance environmental learning experiences (Ruchter *et al*., 2010). Several authors define traditional education approaches as a method of teaching when educators direct learning through indoctrinating passive students and reciting techniques (Ginsburg, 1998; Steiner and Posch, 2006; UK Essays, 2018). This is the typical textbook learning with no flexibility or allowance of students to engage further or even challenge what is being taught. This creates no room for independence in thinking and understanding of critical aspects. The traditional tools follow rigid programmes which are not always up to date and rely on set history data which may not be fully relevant in present day. On the contrary, we cannot disregard the value in historic data as it grants us a reference for issues we might have not directly been able to engage with. As a consequence, students risk not developing critical thinking, problem solving and decision-making skills. For the purpose of this study, the traditional tool explored was the multidisciplinary approach. This approach is understood within literature as the most attainable amongst institutions, which has potentially contributed to it being widely practiced, yet is the least integrated approach (Stock and Burton, 2011). While researchers' primary aim is to share knowledge for comparative reasons, the multidisciplinary approach makes limited attempts to cross boundaries between disciplines nor generate integrative knowledge (Tress *et al*., 2005). Steiner and Posch (2006) stress the importance of integrating different disciplines while considering structural measures in place as well as the political climate. This is a shortcoming in the multidisciplinary approach as it does not fulfil the mandate of addressing complex issues with limited engagement with other disciplines.

In theory, many approaches have been introduced over the past few decades to account for the changing world and environment. Traditional approaches seemingly lack a comprehensive framework which makes provision for the geographical location, political history and environmental context (Koehn and Uitto, 2013). The opportunity was then to introduce an approach which makes provision for dependent factors outside the mainstream approach. In contrast, the basic design of the contemporary approaches was to close the gap which exists in these multidisciplinary environments. Koehn and Uitto (2013) highlight that many initiatives contain courses which lack detail, structure and local context, which in turn introduces a future challenge where students lack the ability to fully apply their training in practice. The biggest issue stressed by Koehn and Uitto (2013) is the contextualisation aspect, the inability of a student to apply their training to their local setting; hence having difficulty in entering the workplace. Educational content tends to be Eurocentric and, in the South African context, is not fully applicable given the different environments and socio-economic conditions, therefore the actions which need to be applied are not the same and cannot be treated as such. As a result, the strategies applied are not sustainable and potentially have a negative impact on the environment and socio-economic dynamics. An example of a global solution being applied on a local scale includes the attempt to protect endangered species as opposed to prioritising the basic needs of the disadvantaged population (Steyn, 2002). This further results in great dissatisfaction and socio-political unrest due to the inability to understand the local needs in addressing issues.

The goal of the SDGs is to incorporate all aspects that influence sustainable development, however, the context of the area in which it is applied is critical in theory and practice. In addressing the existing gaps between theory and practice, more investment has been focused on changing the training style and maximising environmental contributions (Koehn and Uitto, 2013). Ruchter *et al*. (2010) discuss how the use of different teaching techniques, adding new technological tools and relevant supporting software programs does not necessarily affect environmental literacy, but can potentially increase environmental knowledge and motivation to engage with environmental activities. The opportunities regarding environmental education lie in driving more contemporary approaches, integration and aligning

psychological aspects (these will be further discussed in this study for contextual purposes, see Chapter 1: Section 1.3.

A study conducted by Singh (2013) demonstrates the extent to which prior project experience integrated in the formal curriculum enhances students' perspective and ability to work in other environments. This study was conducted to address environmental issues with the local/adjacent community, thereby creating an opportunity for practical experience and application of knowledge before entering the workplace. The added value is subsequently not only directed by theoretical references, but driven by context derived from the engagement with the community members and efforts to address the local environmental issues (Singh, 2013). The contextualisation value demonstrated by Singh's (2013) study supports Koehn and Uitto's (2013) argument of the necessity to ensure that context is achieved in theory and furthered in practice. Many institutions fall short on the ability to provide such experiences as outlined by Singh (2013), and as a result the efforts towards mitigating environmental issues are not sustainable due to the lack of consensus and engagement with the community. It is evident that the nature of dealing with the complexities of the environment means that one is constantly assessing action plans and efforts to maximise environmental contributions. The earlier this is embedded in environmental education, the sooner students' capacity will develop to be innovative and contribute towards greener solutions in practice (Singh, 2013). The transition from traditional to contemporary tools is supported by recommendations which include:

- Increasing the staff involvement from a training level in workplace readiness (Bhandari and Abe, 2002; Singh; 2013).
- Developing sound partnerships which will further promote the efficiency of the training and its output (Bhandari and Abe, 2002; Wang, 2014).
- Consistency in reviewing of curriculum content and programmes (Rickinson and Lundholm, 2008).
- The facilitation of governance, mobilising external assistance and industry visibility (Bhandari and Abe, 2002).

1.3 Contemporary Education Approaches

Climate change, natural disasters and the growing population are all realities of today. Dealing with these complexities requires new ways to source knowledge and research to aid in strategy development as well as decision making (Mitchell et al., 2015; Sakao and Brambila-Macias, 2018). These complexities require the correct intervention measures and the relevant range of specialised experts. Steiner and Posch (2006) and Caldwell (2015) - amongst others - demonstrate the need to apply contemporary approaches to complex environmental challenges. The contemporary approaches refer to modern techniques applied in formal education which exercise engaging with different disciplines, allowing far greater local context and exploring technology at more extensive lengths.

The contemporary approach has been education for sustainable development (ESD), taking into account technological advancements and structural dynamics (Bhandari and Abe, 2002; Vaindirlis; 2016). The identified features of contemporary approaches include the futuristic focus, sensitivity to societal realities and context, and systematic as well as innovative focus (Bhandari and Abe, 2002; Steiner and Posch, 2006; Singh, 2013; Dangelico *et al*., 2017). Unlike the traditional approach of environmental programmes, these take into account the changing environment to ensure that knowledge and awareness instilled in students will pave the way to more sustainable practices. It also needs to be stressed that contemporary approaches introduce new perspectives to strategies and implementation plans that have been proposed and executed but have not been successful (Bhandari and Abe, 2002). The analysis thereof has shifted to take into consideration the student's perspective to ensure that experience and training are maximised.

Presently, there is a great level of attention being given to environmental education; however, it has been found that very little attention has been paid to the perspective of students (Rickinson and Lundholm, 2008; Rakotomamonjy *et al.*, 2015). Ardoin *et al.* (2020) illustrate that environmental education is a transfer of data which uses different tools that are inclined to enhance environmental attitudes, values and knowledge, and it builds skills which promote professional readiness and create collaborative actions amongst professionals. It also facilitates theory through research and assessments and workplace implementation and action.

This is concerning as students are a key stakeholder in the reformulation of the approach towards environmental education and training (Bhandari and Abe, 2002; Rickinson and Lundholm, 2008; Seema et al., 2014). Rickinson and Lundholm (2008) explored this phenomenon and found that the three underlying issues restricting the maximum engagement in training expressed by students include different emotional responses to the content, as well as different opinions and views of what should be taught. In reality it is impractical to design a curriculum based on the input of all students; however, the inputs need to be taken into consideration as students tend to reject the core of the teachings and further do not contribute towards pro-environmental practices should their ideas not be reflected in the teaching (Rickinson and Lundholm, 2008). The issues expressed are a result of the different views and demands within the field, since such human motivation and attachment are aspects which directly impact individual practices. The urgency behind incorporating the views of the students is to bridge the gap in ideas between the program developers and the students receiving the exposure (Rickinson and Lundholm, 2008; Koehn and Uitto, 2013; Singh, 2013). This further stresses the importance of a collaborative approach which maximises the output for all parties involved and also further stresses the ESD approach.

Environmental education provides a foundation for enhancing environmental knowledge and environmental awareness, therefore the practice of pro-environmental behaviours is primarily based on the knowledge acquired (Dono *et al.*, 2010; Aktas, 2015; Shafiq et al., 2016). In identifying the role of environmental education, it is critical to acknowledge the role of personal choice and human motivation (Chen et al., 2013). With South Africa being a developing country, the underlying focus is aimed at promoting the well-being of humans, whereby the level of sacrificial contributions towards the environment is minimised (Chen et al., 2013). In contrast, the needs of the human population and drivers of psychology cannot be addressed without adequately taking the environmental resources into consideration (Strydom and King, 2009). Kollmuss and Agyeman (2002) and Dono *et al.* (2010) stress how normative influences and human motivation need to be aligned with the environmental education gained through the different mediums of training and means of maximising human environmental knowledge and awareness: therefore the linkage between the norms, motivation education and will is profound in nature (see Chapter1: Section 1.4). To

further stress this, the two contemporary approaches explored in this study are the interdisciplinary and transdisciplinary approaches deriving from the environmental education programmes.

The core goal of the interdisciplinary approach is to integrate concepts, methods and principles from various disciplines (Lawrence, 2010). This approach grants the opportunity for coordination- and integration-centred collaboration amongst professionals and researchers from different disciplines (Guimarães, *et al*., 2019). In practice, more institutions now apply this within the environmental programmes, potentially due to the opportunity of integrating different fields of study, as well as including reference to real-life occurrences. Unlike the multidisciplinary approach, this approach is seen to be a step up - considering its core principle of integrating different relevant disciplines in addressing issues that require critical application and specialised expertise. This integrates fields such as economics, social sciences and natural sciences with the primary aim of bringing equal opportunity and longevity for the environment, human population and economic activity holistically (Stock and Burton, 2011; Lang *et al*., 2012; Scholz, 2017; Holmer and Larsson, 2018). On the contrary, this approach lacks the participatory aspect as it includes social research and drivers; but excludes direct public engagement, which is traditionally experienced in the work environment (Stock and Burton, 2011).

Nel and Wessels (2010) stress the urgency of introducing alternative tools to address environmental management and moving away from the mainstream approach, but applying contemporary tools which will redirect behaviours towards sustainable development. In establishing a sound tool, it is critical to acknowledge that a matter such as environmental management with such great magnitude requires the application of multidimensional approaches which consist of multiple tools as well as an interdisciplinary experience to address the overall environmental conditions (Nel and Wessels, 2010; Setó-Pamies and Papaoikonomou, 2016; Warburton, 2003). Holmberg and Larsson (2018) in their research indicate how leadership for sustainability transitions is the capability to create transformative momentum in a sustainable (desirable) direction, calling for meaningful conversations on sustainable futures and future green leaders. The aim of the study was to develop a conceptual framework which will inspire and support this transition. Reference is made to how contemporary

approaches integrate the academic environment and society, which is beneficial as it allows for robust knowledge in co-development along with key public stakeholders; which include civil society, government and developers (Holmberg and Larsson, 2018). In addition, the approach opens up the opportunity for mutual learning between scholars and researchers from different fields, as well as between sciences and societal practice (Lang *et al*., 2012; Scholz, 2017). The use of contemporary tools redirects the focus; as it highlights the importance of the environment and resources as the points of planning and implementation - as being informed by multiple agents and research platforms. However, this has been difficult to achieve as disciplines often conflict with each other (Wals *et al*., 2014). This difficulty arises from the challenge in integrating the different disciplines, building an integrated team of experts and an equally fulfilling outcome for all. The complexity of the natural environment has forced other fields to contribute to sustainable development and environmental management, putting these in the forefront of driving sustainable development (Adroin, 2009; Wals *et al*., 2014). As a result, a transdisciplinary approach has been introduced as a means of bridging the gap between environmental professional and other associated disciplines (Nel and Wessels, 2010).

Steyn (2002) illustrates how the interest in the interdisciplinary approach opened up an opportunity for collaboration with other disciplines. The examples he provides are a mining related incidence at Hlobane Colliery which killed 68 mineworkers in an explosion; as well as the impact from the tailings dumps which were not adequately rehabilitated and protected against further impact in Mafefe District. Steyn (2002) demonstrated that the incidences required the engagement with fields outside the environmental field such as Occupational Health and Safety professionals, municipalities, communities and respective technical specialists. The intricacies that came from the incidences required the collaborative input to develop sound solutions from the different disciplines and key stakeholders. More so, the remedial actions for the incidences highlighted the importance of integration in order to have a holistic understanding of the environmental, economic and social sensitivities. He further commends the role and response of government in driving legislation, planning, monitoring and governance (Steyn, 2002).

Transdisciplinarity is a growing concept globally which seeks to promote a contemporary approach to addressing the current complexities (Torkar and McGregor,

2012). This approach is based on different disciplines which cross boundaries/faculties but promote a holistic view and understanding of far more complex aspects, unlike the traditional models. The concept includes dialogue amongst different fields of speciality, where the challenges of the world are lived out (Torkar and McGregor, 2012) and the insights from the different fields provide a broader understanding of the identified problem (Caldwell, 2015; Holmberg and Larsson, 2018). Additionally, Caldwell (2015) stresses that transdisciplinarity draws knowledge from different sources to reach an outlined problem/challenge whilst making use of the available tools and resources. The main difference between the interdisciplinary approach and this approach is based on the value that is presented by engaging with non-academic participants (Stock and Burton, 2011). Equally so, the transdisciplinary approach is the most desirable as it combines interdisciplinarity with participatory approaches, which is critical for sustainable development. (Stock and Burton, 2011). On the contrary, the ambiguity of the approach makes it challenging to achieve within environmental programmes given the interchangeable disciplines that are determined by an identified issue (Guimarães, *et al*., 2019). While this is the most desired approach, its application in environmental programmes is rather difficult, given the limitations institutions have within the programmes and external structural bodies (Stock and Burton, 2011; Fiala *et al*., 2018).

The complexity of environmental management and sustainable development has created the need to incorporate different sources of knowledge and modern tools in order to address the key environmental issues that exist (Warburton, 2003; Goring *et al*., 2014; Nel and Wessels, 2010; Setó-Pamies and Papaoikonomou, 2016). A multidisciplinary approach is understood as both centralised; and a limiting factor, in addressing environmental issues that require a broader understanding of environmental agents contributing towards environmental degradation, which is ultimately achievable with transdisciplinary education and training (Kapoor, 2001; Goring *et al*., 2014). The work done by Vaindirlis (2016) demonstrates how; in application, this approach is a great intervention measure, as seen in its application to expose students to real life scenarios through the Frankenwald Estate eco-urban renewal project in Gauteng, South Africa. In this project, different disciplines as well as the provision of technology and engagement with community were used in collaboration to cultivate environmental management and create awareness. This transdisciplinary approach offered both

theoretical and practical engagement in subjects which students are likely to encounter when entering the work environment. Theory on its own can only trigger a certain level of consciousness whereas direct engagements and experiences propel us to act towards sustainable actions. In addition to the fact that the natural environment is highly complex, humans are agents of environmental damage and resource depletion due to the rapid rate of development. The current drive is to practice sustainable development; however, this requires collaboration and engagement between all key stakeholders that will be driving the plans towards achieving sustainable development (Warburton, 2003; Goring *et al*., 2014; Wals *et al*., 2014; Holmer and Larsson, 2018).

Dealing with environmental challenges requires new ways to source knowledge and research to aid in strategy development and decision making (Mitchell *et al*., 2015; Sakao and Brambila-Macias, 2018). A contemporary approach helps with identifying and understanding the diverse range of perspectives and frameworks to reach this goal (Bernstein, 2015; Mitchell *et al*., 2015). The benefit of this, according to Mitchell *et al*. (2015), lies in the exploration of perspectives to ensure that the chosen strategy is the most suitable; and Bernstein (2015) adds that the nature of inquiry is tackled by introducing creative solutions with the engagement of key stakeholders. As discussed by Warburton (2003), the connection of different fields and stakeholders which hold different expertise contributes to a more holistic solution given the issues at hand. The broad range of perspectives provides a more complete understanding of the inquiry which is a fundamental attribute when tackling complex wicked problems such as environmental degradation, global change/climate change and achieving sustainability (Marques *et al*., 2015). Consequently, wicked problems require the application to move away from mainstream analysis application, as the intricacies require the expertise offered from contemporary approaches. The approach accounts for the complexities in the world whilst stressing the input from stakeholders for points of reference (Bernstein, 2015). An important factor of the approach is that it has introduced practical solutions to real life issues given the context and resources in each specific inquiry (Bernstein, 2015). The complexity of sustainability and environmental issues is that the source of reference needs to be multi-dimensional, accounting for broad applications and assessing different strategies to apply the most suitable solution (Bernstein, 2015; Marques *et al.,* 2015).

Dale and Newman (2005) discuss how their study demonstrated a better response towards addressing environmental management by having a background in contemporary approaches and knowledge. Their study supports the need of modern techniques in addressing sustainable development and current environmental issues. Further studies which have been conducted in support of this include Goring *et al*., (2014); Aktas (2015); Howlett *et al*., (2015); Marques *et al*., (2015) as well as Holmer and Larsson (2018). The framework presented by Holmer and Larsson (2018) focuses on the participants' perspectives of understanding the dimensions of contemporary approaches. The natural environment requires the understanding of all environmental elements including resources, abiotic and biotic factors, and the interrelations between the elements; furthermore, it is crucial that one determines the interdependency between the social, economic and environmental components of the system (Warburton, 2003; Dale and Newman, 2005; Stock and Burton, 2011; Lang *et al*., 2012; Scholz, 2017; Holmer and Larsson, 2018). The effectiveness of contemporary approaches therefore requires one to understand all these dynamics in order to fully execute environmental management, achieve sustainable development and address key identified environmental issues (Howlett *et al*., 2015).

The transdisciplinary approach in application and interdisciplinary approach in research and theory allow parties that are not traditionally included in development planning such as communities to engage and bring in their input (Kapoor, 2001) which is more intensive than traditional public participation conducted as insights are to be drawn from the subjects. This results in ultimately connecting different disciplines, enlightening awareness, understanding and promoting pro-environmental behaviours (Warburton, 2003; Holmer and Larsson, 2018). This refers to both approaches with equal influence to drive pro-environmental behaviours. The application of the transdisciplinary approach further triggers this, considering the extent of the participatory activity (Stock and Burton, 2011).

The advantages of the presented contemporary approaches include:

- Allowing one to solve problems from a holistic angle with a decentralised focus (Marques *et al*., 2015), referring to both approaches.

- Promoting more versatile and non-fixed planning and implementation strategies (Ameyaw *et al.,* 2017), referring to both approaches.
- Maximising collaboration with stakeholders not directly in the environmental field and allowing for multiple perspectives which is beneficial for brainstorms and strategy development (Goring *et al*., 2014). This refers to the transdisciplinary approach considering the level of participatory activity required to make efficiently manage the approach.
- Developing sound solutions to critical environmental issues and conditions (Kapoor, 2001; Dale and Newman, 2005; Goring et al., 2014; Aktas, 2015; Marques *et al.,* 2015; Holmer and Larsson, 2018), referring to both approaches.

The three fundamental aspects of the contemporary approaches include situation, learning and knowledge (Mitchell *et al.,* 2015; see Figure 1). The "situation" makes up the context or framework of the identified issue or aspect (Mitchell *et al*., 2015), taking into account human aspects such as values, norms and habits (Ostrom, 2005), and is further discussed in Section 1.4.

As discussed by Bernstein (2015), the situation inquiry includes human interaction and engagement, as sound solutions are derived from the engagement with stakeholders, providing different perspectives for maximum benefit in addressing the issue at hand. The situation is further based on the root of the issue or aspect of inquiry (Mitchell *et al*., 2015), therefore a clear investigation of the situation is important in order to develop a problem statement. The "knowledge" makes up the background and acquired learning through training, education, awareness and exposure sourced from different experiences (Mitchell *et al*., 2015). This aspect is essentially important when dealing with complex scenarios, where all the driving forces which exist in the environment need to be accounted for (Marques *et al*., 2015). The "learning" makes up the formal and informal training which contribute to addressing the situation (Mitchell *et al*., 2015), and this aids in understanding the situation, as well as providing a conceptual framework of the situation at hand. The learning aspect is sourced from the acquired training, awareness and intended exposure. The overall project boundary consists of the application of the three aspects to address the underlying issues or challenges (Mitchell *et al*., 2015). Figure 1 demonstrates the interdependence between the three aspects.

Therefore, environmental management and sustainability require the integration of the three aspects to fully apply the transdisciplinary approach.



Figure 1: Conceptual map of the transdisciplinary approach (Mitchell *et al*., 2015)

Analysing transdisciplinary approaches is important, but equally so, the curriculum being presented to students and prospective professionals needs to be investigated (Singh, 2013; MacDonald and Shriberg 2016). Apart from possible gaps in the curriculum design and approaches, many learning institutions battle to align the fundamental aspects of the contemporary approach in their teachings and trainings (MacDonald and Shriberg, 2016). Following the study by Singh (2013) which assessed the value of integrating practical experience in formal training, the outcome presented that students who were exposed to the working environment showed the following: an enhanced understanding, as well as an enhanced level of critical thinking and ability to develop innovative strategies; which would contribute towards their personal development within the field. In the long-term, this could pave the way towards being future green leaders. It is critical to note that the type of exposure for students at universities is different to that of a student from a Technicon (Rambe and Mbeo, 2017). This is based on practical work being a pre-requisite in meeting the requirements of the degrees at technicons. On the other hand, work exposure for university students is

generally done on a part-time basis and managed on personal free-will. MacDonald and Shriberg (2016) further demonstrate that, by applying a mixed practice of teachings to industry, students have a deeper understanding of sustainable development and apply their mind at university level to get acquainted with the concept of sustainable development along with environmental management. The benefit of this is that students are challenged to think critically within the boundaries of their context (Dangelico *et al*., 2017; MacDonald and Shriberg, 2016; and Singh, 2013). However, at university level some key shortcomings of the courses being offered may include the unconsolidated focus and environmental content range offered (Ramos *et al*., 2015; MacDonald and Shriberg, 2016).

Additional limitations identified include:

- The range of resources required (financial and human) - this often influences project progress with the range of expertise required to fulfil the set mandate (Axelsson *et al*., 2020).
- Time is a critical challenge, since the nature of environmental sensitivities requires immediate action further based on severity. The extent to which projects run is not fully sufficient considering the magnitude of the issues, the research needed, further training for preparation and planning as well as time to address the issues (Nel and Wessels, 2010).
- Practicality of proposed solutions for the application to local challenges being encountered (Nel and Wessels, 2010; MacDonald and Shriberg, 2016).
- Relevant presence of stakeholders: this is critical, but its achievement rather challenging (Axelsson *et al*., 2020). The project team is the lifeline that drives the success of the project, and not having the relevant parties present will hinder this.
- No focused communication platform nor commonly shared research framework from the range of disciplines (Brandt *et al*., 2013).
- Challenging to facilitate at a larger scale, with the need for comprehensive training prior to project commencement (Tress *et al*., 2006). This study indicated how it is far more complex involving different professionals and

accounting for different disciplines, considering the different elements taken into consideration. This impacts timing, targets and action plan; however, with clear objectives, this is far more beneficial on a long-time basis considering the level of engagement on the subject matter.

In the quest of addressing such challenges/limitations within the field, educators or lecturers play a fundamental role in paving the way for students. Lozano *et al*. (2013) stress how, primarily, educators need to be fully equipped to be placed in a position where they can conduct environmental education, and they need to understand the components which make up the environment and the linkages between them. They should also have experience in the working environment. By doing so, the manner of training is enhanced and it promotes the experience of the students receiving the training. Wright and Horst (2013) demonstrate how Canadian students (all under the Association of Universities and Colleges of Canada) argued that the educators lacked the ability to integrate sustainability into the curriculum. This challenges the overall approach of contemporary education and as such, it is equally important to expose educators to continuous training and education to ensure that the structural changes, training styles and key aspects are understood in order to maximise the training experience for students. As a result, the curriculum can be more flexible, dynamic and well-structured to fit the needs of the environmental sector, industry, students and the learning institution (Zemler, 2016).

1.4 Environmental Attitudes, Behaviour and Consciousness

Hartmanna and Vachon (2018) state that environmental sciences are based on the make-up of the environment as examined in conjunction with the psychological dynamics of humans; and external factors such as finance, politics and research in order to reach sustainability adequately. According to Strydom and King (2009), the complexity of this field leaves no room for the subject to be analysed in isolation. Environmental education presents knowledge, experienced professionals, personal choice perseverance, network connections, quality of formal training, money and gender education (Nel and Wessels, 2010). While the exposure to contemporary approaches adds value to students, it does not result in students being pro-environmental in their

behaviour. Environmental programmes enhance the readiness of professionals when entering the workplace; however, institutions cannot track further actions and implementation (Collier, 2018). More so, implementation is potentially deeper than the ability to conceptualise the gained knowledge, and consideration of psychological drivers and structural dynamics further have an influence. In understanding the human psychology (internal factors) behind pro-environmental behaviours, the value gained from the contemporary approaches can be better understood. Internal factors include acquired personal skill sets which are necessary to successfully undertake work tasks (Kollmuss and Agyeman, 2002; Lafuente and Sánchez, 2010; Nel and Wessels, 2010). Furthermore, it refers to personal passion, appreciation of the environment, awareness, and personal choice to love and care for the natural environment. Moral values were also reported as prerequisites to taking care of the natural space environment (Lafuente and Sánchez, 2010; Nel and Wessels, 2010).

Attitude is defined as the manner in which one thinks, feels and acts (Oxford Advanced Learner's Dictionary, 2010). This further refers to one's views, and in the context of environmental attitude it refers to the environmental view of an individual (Steg and Vlek, 2009). Furthermore, attitudes are defined as the social attributes controlling behaviours and one's ability to interact with the receiving environment (McBroom and Reed, 1992). One's attitude propels one's behaviour, therefore one's view and social attributes will determine the actions followed to achieve environmental protection. Several authors demonstrate that critical understanding and environmental awareness trigger positive environmental attitudes amongst the human population (Kollmuss and Agyeman, 2002); Berthoŭ, 2013; Longhi, 2013). Equally, the social attachment to; and appreciation for, the natural environment play a pivotal role in understanding and building environmental attitudes.

Behaviours and implementation strategies that favour environmental management and sustainable development are also known as pro-environmental behaviours. Kollmuss and Agyeman (2002) define pro-environmental behaviours as the intentional behaviour of reducing the negative impact that an action can have on the environment. They draw closely on intention and motivation behind the implementation, illustrating how these drive pro-environmental behaviours and trends. Steg and Vlek (2009) add that it refers to behaviour that harms the environment as little as possible, or even benefits the

environment. The role of education and training in raising environmental consciousness is thus crucial, for it encompasses the values and beliefs necessary for developing a sense of social and moral responsibility in students towards environmental protection (Seema *et al*., 2014). The efficiency of pro-environmental behaviour means tackling all aspects and developing strategies with the consideration of the whole process (Kollmuss and Agyeman, 2002; Steg and Vlek, 2009; Nel and Wessels, 2010).

Environmental consciousness is classified as the motivation, psychological and normative factors, values, norms and habits related to an individual's inclination to practice pro-environmental behaviours (Lafuente and Sánchez, 2010). It is critical to understand that environmental consciousness is not an isolated driver of pro-environmental practice but instead relies on other tools for its efficiency (Lafuente and Sánchez, 2010; Nel and Wessels, 2010). Before other tools can be applied, the psychological nature of humans needs to be understood, including the environmental attitudes which determine the relationship and view one will have towards the environment and its resources. Kollmuss and Agyeman (2002) demonstrate in their study how education/background, the psychological factors and internal drivers determine one's inherent pro-environmental practice - as demonstrated in Figure 2. Internal factors are traits adopted at different times in one's life and the sources may vary greatly - for one to fully apply their environmental education, one needs to align one's mind to consciously contribute towards environmental management and sustainable development (Liefländer and Bogner, 2015). Consciousness controls the normative drivers, the values, attitudes and perceptions towards the environment; this necessitates targeting the human mind as early as possible to direct the thinking towards sustainable practices (Lafuente and Sánchez, 2010; Nel and Wessels, 2010; Liefländer and Bogner, 2015).

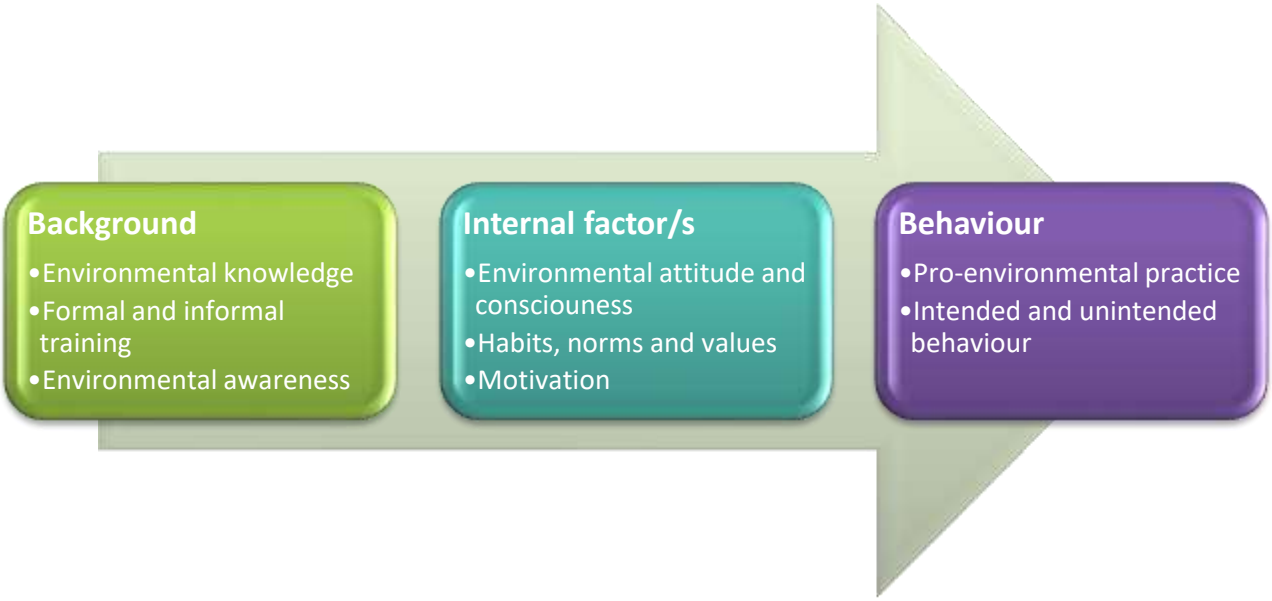


Figure 2: Early models of pro-environmental practice (Kollmuss and Agyeman, 2002; Nel and Wessels, 2010; Liefländer and Bogner, 2015)

Environmental consciousness is closely tied to environmental attitude, as both refer to the gained relationship between an individual and the environment. Restall and Conrad (2015) refer to a connectedness with nature and understanding that connectedness means critically understanding the attitudes which drive the relationship. Attitude may be seen as a subset of consciousness; however, it is important to understand the attitudes that drive pro-environmental practices and the limitations thereof. Attitudes are understood to be great predictors of environmental behaviour (Kaiser *et al*., 1999; Hartmanna and Vachon,2018); consequently, if one has a positive attitude and exhibits a positive view, this results in favourable environmental practices. Attitudes control the human mind and therefore, if efforts are put in place to redirect the attitudes of humans, as a result their views will inevitably change, which will drive pro-environmental behaviour (Kaiser *et al*., 1999; Kollmuss and Agyeman, 2002; Nel and Wessels, 2010; Restall and Conrad, 2015). Environmental quality in environmental management and sustainable development thus depend on human behavioural patterns and the root controls; psychological and normative factors need to be aligned to maximise environmental quality (Steg and Vlek, 2009). Figure 2 is a clear illustration of the core

determinants controlling pro-environmental practices, and the study thereof requires the holistic understanding of the process.

1.5 Rationale and Motivation for the Study

Research has been the leading tool in providing insight to guide decision making and strategic recommendations accounting for current environmental pressures and occurrences. Understanding the limitations of environmental practitioners is essential in developing strategies and adopting plans that will benefit the environment. Research serves the purpose of understanding the opportunities and threats which practitioners are faced with in the drive towards sustainable development. This research in particular is centred on two institutions in South Africa which are both recognised as prestigious universities with a longstanding history in the field of environmental sciences (Collier, 2018). The research hoped to assess the effectiveness of these universities in providing a link between the educational component and professional application of the gained knowledge in the field of environmental sciences.

1.6 Aim and Objectives

The aim of this research was to explore the perspectives of environmental sciences alumni from two universities in South Africa on how their chosen degree prepared them for their current positions in the field of environmental sciences/management. To achieve this, three objectives were derived, namely:

i. To identify the teaching approaches applied in the two postgraduate programmes;
ii. To assess the level of pro-environmental behaviour amongst alumni; and
iii. To explore the advantages and gaps for practical application of knowledge which exist at a curriculum level through the perspective of the alumni.

CHAPTER 2: METHODOLOGY

This chapter discusses the research methodology used to acquire and process the primary data collected. It includes the overview of strengths and weaknesses tied to the methodology used. Lastly, it includes the various sampling techniques, participant selection and channels followed for data analysis.

2.1 Case Studies

This study included a case study approach which was based on two universities offering environmental programmes. Church *et al*. (2019) demonstrates their view on how case studies are a positive contending tool for debates surrounding subjectivity and bias. The case study method is seen to be one that explores real-life activities over time through detailed analysis, managed by involving different sources of information (Creswell, 2013). Therefore, the inclusion of multiple sources of information is an important component of perceived reliability of research conclusions (Church *et al*., 2019). On the contrary, the thoroughness can be difficult to prove and result in findings being challenging to validate (Creswell, 2013). Case studies are critical in setting the tone of understanding a subject and act as a base reference for any assessment.

The environmental sciences masters programmes of two South African universities located in Gauteng Province, South Africa were used as case studies for this study; namely the University of Witwatersrand (Wits) and University of Pretoria (UP). Both have been ranked in the top 10 of the South African universities and further in the BRICS university ranking for both 2017 and 2018 based on the QS BRICS university rankings 2019 (Collier, 2018). The rankings placed Wits second and UP third (Collier, 2018).

In reference to the environmental coursework masters programmes offered in the two institutions, both universities offer courses from undergraduate to postgraduate level (Table 1). They are both national leaders in tertiary education and research and are further recognised for their excellence in offering quality education and workplace readiness (Collier, 2018).

Wits has an environmental/earth sciences department called Animal, Plant and Environmental Sciences (APES) which was founded in 1917. The department continues to be inclusive of the mining industry, geography, social sciences and the

biology (University of Witwatersrand, 2017). The department offers a variety of degrees that encompass the principles of a transdisciplinary approach but are in fact interdisciplinary in practice - some of these are tabulated in Table 1 (University of the Witwatersrand, 2017b). The department has over the past 100 years taught thousands of students who have become pioneers and leaders in climate change, environmental research, conservation and education (University of Witwatersrand, 2017a). The theme is described as "The Biology of a Changing World: Conserving African Biodiversity", and the department further prides itself in producing quality teaching and research thereof (University of Witwatersrand, 2021).

UP is also one of the most prestige institutions in South Africa (Collier, 2018) – their Geography, Geoinformatics and Meteorology department offers different degrees, of which some are tabulated in Table 1. The department is closely aligned with the Centre of Environmental Studies. The department's focus is centred on quality research and education which revolves around a common theme: "Sciences concerning our changing living environment" (University of Pretoria, 2018b), which is further translated in the mission, vision and ultimately academic curricula. As studied in the context of different disciplines comprising environmental sciences, geodesy, physical geography, human and urban geography, geoinformatics, meteorology and remote sensing, this department continues to integrate different disciplines (University of Pretoria, 2018b).

The programme analysis at the respective institutions was conducted based on existing pamphlets, posters, website information and different data gathered from different social media platforms sourced directly from the institutions. When going through the information, the areas of interest included the programmes' objectives, intended learning outcomes, general teaching approach and structure of the programmes in terms of course selection and research. The programme curriculum was important in analysing the content of the environmental programmes for context purposes. Given the author of this study's personal experience of attending both institutions, the gathered orientation documents she had collected - including both old and current marketing and background documents - acted as a source of reference for the institutions. For missing information she engaged directly with the programme coordinators which proved to be of important value, considering the extensive background and great insight shared. The nature of this research had not initially considered perspectives outside

those of the alumni. Including other parties and/or role players would have added more richness in the presented results. However, this presents an opportunity for future research and where different levels of role players can further be included (local, regional and national).

Table 1: Examples of programmes being offered.

WITS	**UP**
BSc (Hons) Animal, Plant and Environmental Sciences in the field of Zoology, Botany or Environmental Sciences and Ecology	BSc Geography and Environmental Science; MA and MSc Geography; MSc Environmental Science (research and coursework); PhD Environmental Science; PhD Geography
MSc Environmental Sciences	BA Geographical Sciences
MSc by Dissertation	BSc Geoinformatics
MSc Resource Conservation Biology	BSocSci Hons Geographical Sciences
MSc Resource Conservation Biology	BScHons; MSc; PhD Geoinformatics
MSc by coursework and Research Report in the field of Resource Conservation Biology; Interdisciplinary Global Change Studies; Geographical Information; Systems and Remote Sensing; Archaeological Heritage Management; Hydrogeology; Economic Geology; Science Education	BScHons; MSc; PhD Meteorology
Doctor of Philosophy	MA Environment and Society (coursework); PhD Environment and Society
-	MSc / PhD Air Quality Management

Based on the accessed information regarding the offered environmental programmes, key themes and patterns were established. The richness of course options and postgraduate opportunities was vast, with operational experience and diverse research opportunities. The range of courses was assessed to determine the variance which students have in selecting their programmes, and more so, room to select subjects. Departmental themes and offered content were analysed to present any linkages between what was translated from the theme into the respective environmental programmes. The reference to the different disciplines helped in primarily identifying whether the institution does offer a contemporary learning approach.

2.2 Interviews with Alumni

Data were collected through a series of interviews with alumni from both institutions. Interviewing is the primary step in collecting data in mostly what is known as qualitative research (Stuckey, 2013). One identifier of qualitative research is the social perspective or experience being investigated from the participant's viewpoint (Tharenou and Cooper, 2007). McPherson and Griffin (2014) discuss how different objectives trigger different types of interviews. The selected method for this study was that of a semi-structured interview which allowed for descriptive findings due to the nature of the method (Stuckey, 2013; McPherson and Griffin, 2014; Kowalczyk, 2015). The purpose of this method was to provide detailed content into addressing the aim and its objectives, therefore the approach allowed for quantitative findings and evaluation of the data gathered (Kowalczyk, 2015). The reasoning behind having more open-ended questions was to ensure that the answers provided by the participants were not directed and restrictive, which is a risk presented by interviews (McPherson and Griffin, 2014; Kowalczyk, 2015). Finally, an opportunity was given to the participants to provide comments, concerns or issues pertaining to the study which were not covered in the interview conducted. The interviews all had different elements to them: some were more engaging whilst others were direct and were satisfied with the experience. The primary intention in collecting data was to engage with participants of different professional experience for maximum objectivity and range and further believe that was achieved.

Ethical clearance was applied for and granted under the University Human Research Ethics Committee (non-medical) before engaging any of the participants. The referencing protocol number is 1908 in support of the accepted ethical clearance as issued on 18 November 2019.

All interviews were conducted in a virtual way, having taken place via direct telephonic calls, Zoom and Microsoft Teams. The method of conducting the meetings and time was based on the choice made by the participants and their availability. Each participant was interviewed individually for 30 to 45 minutes, with some sessions running for an hour and a half. The empirical work for this study was scheduled to be carried out over April and May 2020 during the first quarter of Covid-19. Although the benefits of direct engagement were lost, this approach seemed to encourage participants to accept the invitation. All sessions were recorded for reference purposes and transcribed. Before the interviews were conducted , the key aspects to be noted from the study, developed participation information sheet and consent form were sent to the participants. Once in agreement, all key terms were described for familiarity and the objectives of the study were further explained. Depending on preference, some participants called in to get more background information and to complete the questionnaire independently, while some allowed the researcher to make notes during the sessions. All participants were forthcoming and had no serious issues encountered.

All participants were sourced through a random selection provided by representatives from both institutions. Approximately 60% of the students were suggested by the programme coordinators, and the additional 40% sourced through LinkedIn connections. The intention of the random selection of participants was to get a range of perspectives and persons from different fields of specialisation in environmental sciences/management. In total, 40 participants (20 from each institution) were interviewed. To fulfil the desired sample range, the following criteria were used as a benchmark to identify suitable participants:

- The deemed procedure of applying for human (non-medical) ethical clearance from the Witwatersrand Committee was adhered to (Protocol No. 1908).
- Masters' selection process of alumni based on the school database and referrals.

- The participants were from different clusters of industry to maximise the perspective, Academics, Environmental Consultants, Mining and non-government organisations.
- The sample group consisted of participants that have and/or will graduate within the last five years.

The interview questions were focused on the key outcomes from:

A. Theoretical background gained from environmental programmes.
B. Applicability of environmental programme to current environmental issues.
C. Link between theory and practice in understanding the effectiveness in minimising the gaps.
D. Contemporary approaches and value for alumni.
E. Workplace readiness and practical experience.

2.3 Data Preparation and Analysis

Before data analysis, variables were checked for data collection and entry errors. Figures that were incorrectly captured were rectified following a verification process against the original data. The data was analysed using the tabulated variables presented from the study. Data was captured in Microsoft Excel for further analysis and linkages between variables. The primary step in processing the data was for the researcher to familiarise herself with the data and establish the main themes, by going through the recordings and interview response notes. From the data collected and consolidated, key themes were established, and relationships between variables were identified. A detailed discussion took place with her (the researcher's) supervisor to workshop the results and discussion which guided Chapters 3 and 4 of the study. In summary, Saunders and Lewis (2012) demonstrate that qualitative data requires the comprehension of data collected, modelling the data, searching for themes and understanding the core relationships between the different variables, which was fulfilled in this research.

CHAPTER 3: RESULTS AND DATA ANALYSIS

It was critical to ensure that the sample group had representation from both genders. More women participated in this study than men, with approximately 64% of the total participants being women and the remaining 36% men. The ages of the participants ranged from 26 to 44 years with all participants having graduated or completed their programmes within the last five years.

Table 2 below shows the distribution of participants by their respective specialised field of expertise. The majority of the participants were environmental specialists/consultants, and a few were teachers or lecturers (see tabulated record in **Table 2)**

Table 2: Participants' current area of speciality

AREA OF SPECIALTY	COUNT	FREQUENCY (%)
Planning and Licensing	**11**	**30,67**
Environmental Assessment Practitioner/ Senior Environmental Assessment Practitioner	4	13,33
Environmental Consultant / Environmental Officer	3	10
Environmental Scientist / Consultant	1	3,33
Environmental Contamination Consultant	1	3,33
Environmental Management Regulator / Regulator	2	6,66
Management and Compliance	**6**	**20**
Environmental Construction Officer	1	3,33
Environmental Control Officer / Senior Environmental Control Officer	2	6,66
Environmental management intern	1	3,33
Environmental Manager	1	3,33
Environmental Monitor	1	3,33
Specialist	**7**	**23,33**
Environmental Liaison Officer / Stakeholder Engagement Officer	2	6,66
Air Quality Specialist (Environmental Consultant)	1	3,33
Cellular Biologist	1	3,33
Engineer	1	3,33
Water Consultant / Integrated Catchment Manager	2	6,66
General / Other	**6**	**20**

AREA OF SPECIALTY	COUNT	FREQUENCY (%)
Environmental Campaigner (Educator) / Teacher / University Lecturer and Researcher	3	10
Project Manager	1	3,33
Generalist	1	3,33
Unemployed	1	3,33
Total	**30**	**100,00**

3.1 Programme Assessment

The results presented in this study indicate that the environmental programmes offered at both institutions, Wits and UP, apply interdisciplinary teaching approaches but draw from the transdisciplinary approach in including participatory activities and non-academic considerations. The objective of the institutions is to equip students by providing quality education to apply further in their careers. The range of courses offered was similar amongst Wits and UP, which respectively included environmental law, environmental impact assessment, geographic information system (GIS) geomorphology, development framework (which focuses on finding solutions to current socio-economic crisis, considering political influences as well as legislative regulation which forms the basis for economic development frameworks), remote sensing, integrated environmental management, ecological risk assessment management, ecological social impact assessment, impact mitigation management, integrated environmental management system auditing, ecotoxicology, research methodology, environmental research report, geomorphology, environmental management, sustaining population (ethnoecology), mining environment, energy environment, safety, health, and environmental quality systems. What was common between the two institutions was the offered course options and flexibility thereof, postgraduate opportunities were vast; and operational experience of respective departments has been sustainable and credible.

3.2 Alumni Views and Perceptions

The results presented in this study demonstrate a close correlation with the research gathered from other academic sources, as well as primary data collected as part of the

study. The criteria used to establish a sample group was fulfilled with 40 participants, training relevance and alumni experiences.

The participants were all studying at different points in their lives, and it was evident that the information provided about each programme was in line with the experience of the alumni, with an overall 70% agreement rate from Wits and 80% at UP. The impression level was high with great remarks having been expressed regarding both institutions:

"The school and content exceeded all my expectations." – Wits Student

The abovementioned quote is a direct reflection of the reference documents perused in refining the methodology, highlighting the richness of the content offered and range of valuable exposure for the students.

A recurring theme in the data was the need for practical activities in institutions, however, as previously indicated, the mandate to fulfil this is not for universities but rather Technicons (Rambe and Mbeo, 2017). Another key outcome which presented itself was the extent of information available on the institution's website. A combined 10% of participants from both institutions explicitly stated that access to information is critical and that the information available now on the school website is impeccable. More so, with the temporary move to more activities being virtual/remote due to COVID restrictions, more features are being implemented to enhance environmental education.

3.3 Perceived Strengths of the Programmes

Participants were asked what they viewed as strengths of their received formal training. Their responses specifically highlighted the range of environmental courses offered, a blend of practical and research component of their studies and the underlying theoretical course content (Figure 3).

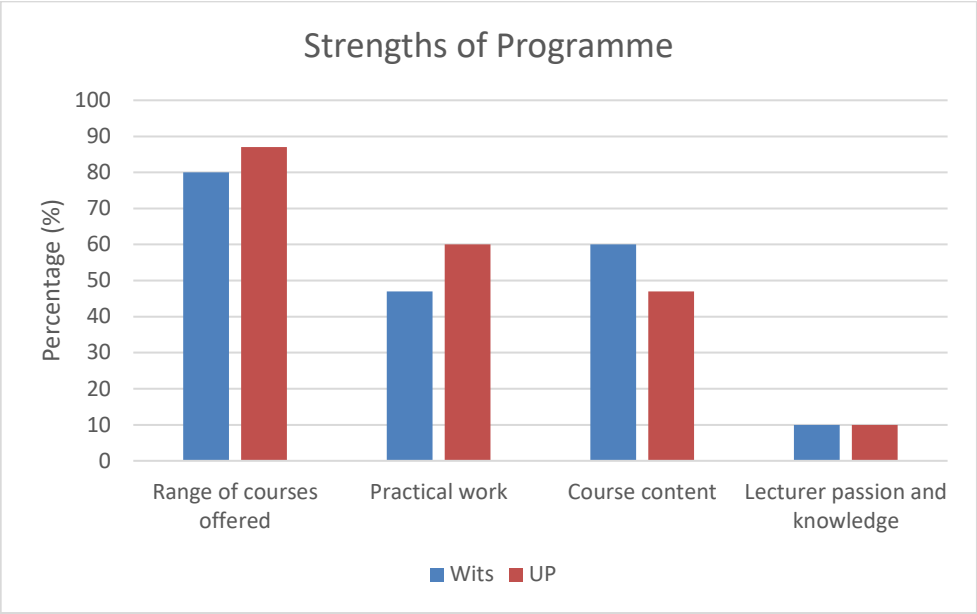


Figure 3: The four most frequently perceived strengths of the environmental programmes

3.3.1 Range of environmental courses offered

One major strength of the training revealed by the participants from both universities related to the range of courses that were offered; which made it easier for students to make their preferred choice, especially those students who wanted to narrow their studies to cover more on their areas of specialisation. The participants said that the array of courses offered helped them improve their understanding. For instance, one of the participants said:

> *"Courses on wetland watercourse including estuaries helped me in understanding the important role of the wetland ecosystem."*

In relation to the Geographical Information System (GIS) course, another participant said:

> *"The course has shown me how information on the environment was displayed".*

According to 80% of participants from Wits and 87% from UP, the range of courses offered by the training they had received presented a strength in that the courses were applicable to their work context and hence the knowledge gained was used daily in the environmental field. For instance, some of the courses provided opportunities for

developing improved report writing (scientific reporting), as well as statistical analysis and critical thinking skills of students, allowing them to apply their minds in different situations and gain knowledge on aspects such as environmental law applicable daily in the environmental industry.

3.3.2 Practical Components of Education

The second strength identified by the participants related to the practical and research components of the training. For instance, participants commented that lecturers would prescribe assignments for students to complete as a way of showing the extent to which they understood fundamental course concepts. The participants showed that the practical component provided enough practice and hence improved understanding of concepts. Importantly, participants noted that the practical exposure could be preceded by the theory component. This view was supported by one participant who said:

> *"One needed to familiarise with content prior to undertaking practicals and exposure to real-life issues".*

Participants highlighted that practical and research components of the training included offering studies by research, for instance, studying for a degree entirely by research (dissertation). However, this should be accompanied by quality research supervision by the lecturers. The participants revealed that practical exposure within environmental programmes could potentially maximise student readiness prior to entering the work environment. Also, by undertaking their training by research, the learners' independence of learning would be promoted. Courses such as remote sensing were reported to constitute the practical component of the training which would further be relevant to students in a coursework centered environmental programme.

3.3.3 Theoretical Course Content

60% of participants from Wits and 47% from UP expressed that the theoretical course content of the courses offered by the two institutions were seen as a key strength. Specifically, the courses offered provided students with a theoretical and practical aspect of the environmental management framework in South Africa. More so, course contents covered a broad range of areas which allowed students to be acquainted with

key aspects of environmental management and further promoting workplace readiness. In addition, the contents allowed for a broad and increased level of learning.

3.3.4 Lecturers

An unexpected strength expressed was the expertise of lecturers. This was highlighted as one of the strengths in the interviews, with a combined 20% of the participants in agreement. For instance, participants revealed that course lecturers were active, flexible and passionate about the courses they taught. The participants said that passion allowed lecturers to willingly assist students, hence helping them succeed in their training which was based heavily on theory. The students also revealed that flexible lecturers allowed them to structure their courses in a way the students wished to. Apart from flexibility and passion, the participants highlighted that they were given sufficient time to work on allocated coursework presented. Finally, participants revealed that lecturers were more engaging, that is, they properly implemented their professional and background expertise, for example, on energy courses which led to expert learning, resulting in excellent theoretical knowledge being gained.

3.4 Perceived Weaknesses of the Programmes

Participants were also asked to give their views on what they perceived to be weaknesses of the training program. The main weaknesses of the program highlighted included lack of practical experience and time and work constraints (Figure 4).

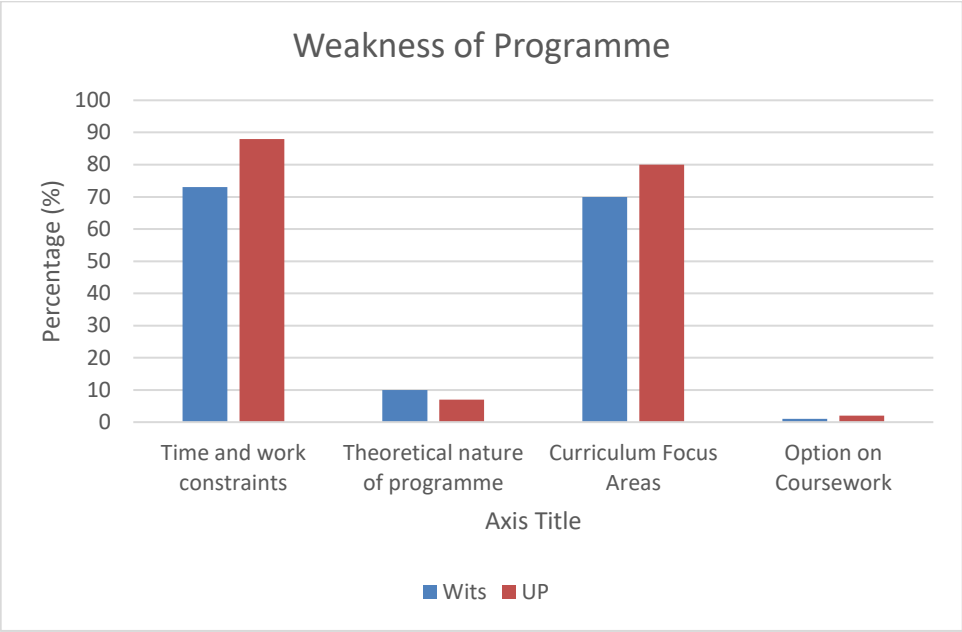


Figure 4: The four most frequently perceived weaknesses of the environmental programmes amongst Wits and UP

3.4.1 Time and work constraints

73% of participants from Wits and 87% from UP revealed that inadequate time was allocated to several courses which was a major weakness of the training.

Inadequate time allocation meant that course content ended up being presented in a rushed and incomprehensible manner, as noted by one of the participants:

> *"Time allocated to coursework is short and limited meaning content presented is rushed and key concept can fully be explored."*

The other weakness pointed out by three participants related to how the training program restricted professional full-time workers. This overall pressure in coursework is exacerbated by the fact that employers will not allow for time off work which may mean that parties end up either compromising or having to manage two components; that is, the study and work components. Also, 7% of the participants revealed that the training courses extend for longer periods which in many cases required one to take time off which is unfortunately not available. The participants said that this weakness presented an opportunity to consider offering the training during evening sessions.

An unexpected weakness raised was related to the role of technology and the ability to keep up to date with industry trends. This includes, but is not limited to, contributions towards teaching, learning, data collection, capturing, analysis of changes, access and time management. Moreover, participants reported that socio-political dynamics in most cases delayed project implementation, amendments on legislation and other institutional arrangements. Furthermore, a combined 27 % of participants reported that decisions taken were in many cases influenced by other aspects like social or political pressure other than being informed by scientific analysis.

3.4.2 Theoretical nature of environmental programmes

A further weakness pointed out by 17% of the participants hinged on the overly theoretical nature of courses offered. The participants bemoaned as too theoretical considering the limited practical exposure within the programme and extensive literature covered. One of the participants reported that more efforts needed to be placed on the practical applications given different environments and challenges faced by practitioners in real-world situations. This view was supported by one of the participants who reported that:

> *"Not everything one is exposed to in the workplace can be linked to what was learned at school".*

Related to theoretical aspects of the programmes are issues of poor standardisation of assessments, perceived subjective evaluation and narrow scope of the subject matter; as per a total of 53% participants from Wits and 40% from UP. This issue further links to the lack of practical exposure within the environmental programmes. It is to be noted that the reference to practicality with Wits and UP does not apply, as the mandate of a university is not inclusive of practical exposure whereas Technicons fulfil this mandate by having programmes inclusive of practical experience as a pre-requisite of completing of a degree/programme (Rambe and Mbeo, 2017).

53% of the participants from Wits and 40% from UP noted that the lack of practical application of some of the courses offered was a weakness of the environmental programmes. For instance, compulsory internships which complement the students' course would be helpful to gain work experience. This view was also supported by the

argument that more practical work and site visits were required in order to better equip students for the type of work they might be employed to do. It is also important to note that lack of practicality of some courses did not apply to all courses, as courses such as statistics, geomorphology and climate change which did not include much in terms of practical work, were still applicable in practice and helped them in the working environment; as noted by 60% from Wits and 47% from UP.

10% of participants from Wits and 7% from UP further revealed that real-life and practical examples remained untaught at universities, which presented a wide gap between theoretical learning at institutions and practical learning at industry level. This lack of practical exposure was perceived to be closely linked to low level engagement of universities with experts from industry. Other participants equated lack of practical experience and workplace readiness to lack of practical measures by institutions to incorporate practical concepts into the theory presented, for example, scientific writing opportunities and work exposure. Some participants noted that the training had a weakness related to poor dissemination of information on the programmes as potential candidates were still unsure of career opportunities related to the degree.

3.4.3 Curriculum Focus Areas (CFAs)

One of the goals of this study was to learn about the areas that training courses focused on, therefore participants were asked about some of the areas focused on in the curriculum. The top eight areas of focus included environmental law, environmental impact assessment, environmental management, environmental planning, geography, management, mining and ecosystem. Table 3 provides details of the focus area, its frequency of occurrence expressed as a percentage of the total different courses offered.

Table 3: Respective focus areas presented in programmes

Focus Area	Percentage (%)	
Earth	Wits	UP
Ecology / Biology / Biodiversity	6,82	-
Zoology / Entomology	-	3,41
Geography	-	3,41
Geology / Geomorphology	4,55	-
Soil science	-	1,14
Water management	1,14	-
Environmental Management / Science		
Environmental impact assessment (EIA)	5.11	5.11
Environmental Management / Environmental Science	3.41	5.68
Environmental planning	-	4,55
Climate Change / Environmental Change / Global Change Studies	-	4,55
Social		
Socio-economic / Social and Economic Sustainability	-	2,27
Law		
Environmental law	6.82	5.68
National policy	-	1,14
Environmental principles	2,27	-
International relations	-	1,14
Social policy	-	1,14
Management		
Conservation / Nature Conservation	3,41	-

Energy management	2,27	-
Management / Integrated Environmental Management	4,55	-
Waste management	2,27	-
Monitoring and Evaluation	-	3,41
Environmental Risk Management	-	3,41
Sustainable development / Industrialisation / Urban Development	-	3,41
Engineering		
Environmental Engineering Design / Engineering	2,27	-
Specialised		
Geographical information system (GIS)	-	2,27
Mining	3,41	-
General		
Environmental Research	1,14	-

One of the weaknesses of learning from different disciplines was the risk of over-generalised course content, which meant that students needed to pursue further courses once employed in order for them to fill knowledge gaps and perform effectively; a total of 93% of participants from Wits and a further 93% from UP agreed. While this was noted as a weakness, the field of environment science is complex and consists of many different elements. The nature of the programmes being offered aims to cover as many aspects within the field while granting students a holistic view of the different environmental components. One of the two participants that indicated that there was no need expressed that she had exhausted the need to study further. To emphasise this point, one of the participants (3%) said the following:

> *"One thing that I noticed is that most modules had a generalisation approach. Once you get into corporate world and you take up a role as an Environmental Officer there are several short courses one needs to do in order to practice*

effectively, for example, ISO certification specific to different sectors such as mining etc. This also extends to the need to be affiliated to several professional bodies such as SACNASP, NACA."

20% of participants from Wits and 13% from UP viewed several of their chosen courses as limiting and restricting as they lacked important aspects of the field such as relevant environmental legislation. In this context, one of the participants reported that environmental legislation was not a prerequisite within the environmental programme, yet its application or use was needed on a daily basis in the workplace. Moreover, other participants revealed that in cases where environmental legislation was included in the training program, its depth failed to address other legislative challenges, especially when pursuing the route of becoming an Environmental Management Regulator. The view was further elaborated by one of the participants who said:

"I think the gap is on the legal aspects of being an Environmental Management Regulator. There are other aspects of law that are very important such as knowledge of Administrative Law which is very critical in monitoring and enforcing environmental law such as NEMA".

Moreover, 40% participants from Wits and 60% from UP reported that they felt universities were not doing enough to emphasise the fact that the field heavily depended on legislation. For example, one participant from UP believed the curriculum focused hugely on EIA with less consideration for other work aspects, for example environmental monitoring, stakeholder engagement and licensing. The study also revealed that 10% of Wits participants and 13% from UP believed it was important to get the experience of being in a work environment during formal education. Furthermore, some participants believed that their university education did not meet the requirements of the working environment. Participants revealed that this was caused by noticeable gaps between how they were expected to perform compared to their actual performance. In other words, the participants reported that they were expected to perform the same way as persons with a number of years of practicing experience while overlooking the fact that they are inexperienced graduates.

Another weakness that was highlighted related to the fact that the legislative framework learned applies only to South Africa, limiting any prospects of working overseas unless one is willing to invest more to learn environmental legislative laws of their intended country of employment. For instance, one of the participants from Wits reported that:

> *"Perhaps the gaps are as a result of the country which I chose to practice in, New Zealand, as legislation and environmental contaminants that are primarily tested for vary from those of South Africa. Hence, the gaps for me are primarily in environmental legislation."*

3.4.4 Participants' options to choose courses for the coursework component of the degree

10% of participants indicated not having a choice in the courses, with most reasons cited being external, for example the fact that their project was funded by an outside source, so choices were limited based on the funder's requirements. Additionally, the period in which one does complete their environmental programme is another factor as it either limits course choices, should one complete within minimum time, or is advantageous - should it take one longer to complete the degree - as not all courses are on offer every year.

3.5 Suggestions to Maximise the Value of Environmental Programmes

In this section, findings are presented on participants' views on what universities could do in order to maximise the value of the two programmes. Responses were categorised into student-centeredness approach (SCA), practice-based learning (PBL), research promotion (RP) and course design process (CDP)

3.5.1 Student Centeredness Approach (SCA)

A combined 53% of the participant responses suggested that, in order for institutions to maximise the value of education, a student-oriented approach should be applied in the academic environment. Students should be kept informed of career opportunities in specific fields after successfully completing courses related to these fields. Although the mandate of a Technicon is heavily reliant on the practical inclusion in programmes, universities have a core mandate to provide formal education. Moreover, a combined

30% of participants revealed that the value of the programmes would be maximised if institutions were to start providing internships to post-graduate students as part of curriculum practical/industry exposure in the same way as Technicons do. Furthermore, the value of the training could also be maximised if lectures were pre-recorded and made available online, especially when it comes to explaining complex concepts of the training courses. Participants also suggested that institutions could maximise the value of the programmes by holding full induction sessions that are meant to equip students, for example, launching new students' research supervision opportunity programs. Finally, the student-centred approach entails the need for institutions to continuously engage with and guide registered students with the goal of helping them complete their qualification and ensuring it remains relevant for application.

3.5.2 Practice-based learning (PBL)

Another suggested way in which institutions could maximise the value of their programmes is closely related to promotion of practice-based learning (PBL), as derived from a combined 23% of the participants' responses. Participants suggested that institutions should consider providing practical learning opportunities to enhance workplace readiness. This can be maximised if institutions made efforts to bridge the gaps between practice and theory by further integrating with industry. It can be achieved by inviting guest speakers or lecturers to help bridge the gap between coursework and practical work. This in turn will expose students to different perspective and the realities faced in industry. In addition, participants suggested that institutions need to have functional practical technology so as to strengthen capacity building. This also extends to having practical live illustrations of what students are likely to experience in the work environment. More so, participants encouraged institutions to put measures in place to increase students' practical exposure to scientific writing. Some opportunities to rework disparities between theory and practice suggested include:

a. Experiential Training – participants highlighted that the environmental programmes should include intermediate training in the form of internships and graduate programmes. The experience gained from this intermediate training

would help launch the students into their future job prospects. This could be made clearer by highlighting what was said by one of the participants:

"In my experience internship helped me tremendously as my capabilities and exposure was clear to my employer and subsequently understood that I was coming with theoretical background and that the previously undertaken internship role had equipped me for the workplace.

The results were valuable in understanding the expectation of the alumni even with the clear mandate of institutions having been stressed.

One participant also noted that essential skills such as project management, advanced computer literacy and presentation needed to be identified, especially those that promote easy transition from theory into practice. For instance, one of the participants argued that institutions were more fixed compared to the workplace in the sense that fundamental concepts remain unchanged, but solutions were more progressive due to technological innovations. Consequently, formal training ought to prioritise essential skills in order to ensure that students have an easy transition to the practical work environment.

b. Early exposure to environmental legislation and its application – one participant believed that the disparity could be minimised by having a stronger legislative component and also by allowing students to gain more practical exposure during their studies to how laws/policies are applied. Moreover, participants highlighted that environmental legislation needed to be further enforced as its enforcement could help set the foundation for the environmental management practice. Participants' views were that many students lacked the capability to engage with local legislation despite the fact that the field is heavily dependent on and directly managed under certain laws.

c. Assessing and understanding certain levels of competence – participants had the view that training institutions needed to offer courses that had a practical element as opposed to courses that are entirely theoretical. In other words, courses should give students an opportunity to work with real-life data that they are more likely to come across one day, for example, environmental data collected by the provincial government. Moreover, the course should be taught

in terms of how the data are used to address real-world scenarios, for example using mapping and understanding the data.

Another aspect closely related to the course is concerned with how the course is designed. Who are the course designers? In this regard, participants advised that the process leading to the development of course content should be inclusive, that is, it should include all stakeholders including the industry. In other words, participants suggested that the development of curricula should always involve all key individuals from industries so that their expectations are embedded into the curricula and teaching process. Further, it should also involve the process of merging relevant practices into theoretical coursework, the result of which would better equip scientists and aspiring environmental professionals. Thus, involving the working environment in decisions related to curriculum design can be very important if disparities between theory and practice are to be minimised.

d. Align course content to prepare students for the industry – by having content heavily anchored on industry developments, participants believed that the students would be more aware of what is happening in the industry and be more prepared for the workplace environment. For instance, one participant expressed that practical preparation was limited and so was alignment between theory and practice. Consequently, the course content and practical experiences from the workplace ought to align. The alignment would lead to striking a balance between expectations and requirements from graduates, a situation which participants believed could contribute to limited disparity between theory and practice.

e. Environmental application portals for workplace readiness – bringing to the attention of students existing applications and acting as the interfaces between students and prospective employers, for example through live job portals. Participants believed that environmental application-related courses would benefit students. This also includes other applications such as software programs that are mainly used in the area of specialty. For instance, participants agreed that, as professionals, they encountered many challenges during the

application processes simply because they did not have prior knowledge of application portals such as SAHRIS portal, IWULs portal, and the DEFF Screening tool, which are critical tools. Thus, efforts to have students master how to use some of these tools may help prepare them for the workplace. In other words, there must be workplace readiness programmes that are also embedded in the formal programme to cater for students' preparedness and future practical references needs.

3.5.3 Research Promotion (RP)

According to a combined 22% of participants, another way in which institutions could maximise the value of the training is through research promotion. Following the need to master the practical component of the field, participants reported that institutions needed to keep promoting research as a way of encouraging students to build interest in the field of environmental science. Also, the participants highlighted that this could be achieved if institutions strived to ensure that their partnerships with the corporate world keep on growing. This, in turn, will increase the growth in the number of companies granting students the opportunity to carry out research studies. Moreover, institutions should also spearhead workshops aimed at facilitating the linking of institutional research programmes and workplace activities.

3.5.4 Course Design Process (CDP)

The design of courses for the degree was also reported by a combined 2% participants as one of the ways by which institutions can maximise the value of their programmes. The process of course content design should aim to ensure that course content speaks to the demands of industry and aligns with environmental management requirements in the context of South Africa. This would entail bringing people from different professional environments and disciplines into the process of developing or refining a programme which ought to have more value from the input of associated parties. Moreover, participants reported that course design should seek to produce content that allows students to critically analyse the South African government environment management. For instance, one of the participants said:

"Given future challenges in this area of specialty, a course geared towards preparing future scientists for it, such as presenting sound solution application implementation is critical."

Furthermore, participants believed that institutions could work to ensure that time was properly allocated to coursework modules while also considering promoting virtual engagements which would lead to better time management for coursework and research.

3.6 Common aspects between the curriculum and practice

To ascertain common aspects between the environmental programmes and the actual practice in a real industry set-up, participants were asked about their views regarding what may be common aspects between theory and practice. Three key aspects emerged from their responses, namely environmental legislation, theoretical-based practice (TBP) and practice-based curriculum (PBC). The following were perceived as common drivers for futuristic work and industry readiness:

- Environmental Legislation – a combined 50% of the participants stated that the curriculum and the practice were common in legislation principles, environmental legislation, timeframes and purpose. That is, the same environmental laws or legislation, policies, environmental concepts that were taught were constantly referred to in actual practice.
- Theoretical-based Practice – a combined 22% of the participants highlighted that the theories learned in classes served as a basis for engaging with practical work, which in their opinion was much more complex as it involved different cultures and approaches for dealing with environmental issues. In this regard, it was noted that the curriculum and practice were linked through case studies, usually taken from practical examples in industry to serve as learning experiences for students. This view was also supported by another participant who stated that:

  "Curriculum provided a background and foundation that was fair enough to prepare one for employment".

- Practice-based Curriculum – A combined 23% of the participants believed implementation at a workplace succeeded curriculum implementation at higher education institution level. Also, participants highlighted that curriculum and practice intersected at the subject of research.

3.7 Factors Contributing towards one's ability to practice

In this section, findings regarding views and beliefs of what participants thought were the internal and external factors that contributed to their own ability to practice are presented:

- Internal factors - personal upbringing – Participants believed that besides the theory and practice, personal upbringing of individuals constituted one major internal factor that contributed towards their ability to drive environmental protection.
- External factors – Education was the most common response with a combined 73% of participants in agreement, followed by the role of the work environment at a combined 14% and practical experience at 13% respectively. In addition, the participants believed that education was important for ingraining principles into people's minds with the result that they understand why a certain field of interest was important.

An unexpected outcome from the interviews was the role of professional registrations in providing credibility as a professional. In discussion, 33% of participants from Wits and 20% from UP further stressed the value of this external factor. To elaborate this point, one of the participants said the following:

> *"One thing that I noticed is that most modules had a generalisation approach. Once you get into corporate world and you take up a role as an Environmental Officer there are several short courses one needs to do in order to practice effectively, for example, ISO certification specific to different sectors such as mining etc. This also extends to the need to be affiliated to several professional bodies such as SACNASP, NACA".*

3.8 Measures to be followed by students to bridge the gap

The purpose of this section is to present some of the views proposed by the participants as measures to be followed by students in order to bridge the gap between what they learn at university and what is practiced in workplace environments. This section further links to the proposed mitigation measures and opportunities of the current gaps in the previous sections. Three measures were identified from the survey responses, namely professional networking, early exposure to the workplace as well as continuous learning and self-study initiatives:

- Professional networking – This followed the participants' views that universities needed to expose students to companies and relevant professionals in the industry to get their "foot in the door" of the companies. However, the findings revealed that some students believe that it is their own responsibility to get themselves known by companies. For instance, one of the participants reported that:

  "Once students are enrolled in their environmental programme, they should make sure that they identify and connect with people who are already practicing in their field using social network platforms like LinkedIn to set a good footing for future professional careers".

This view agreed with the view of another participant who further acknowledged institutions for doing enough, and as such students needed to be responsible enough to do more for independently.

- Early exposure into the workplace – Early exposure to the workplace includes tracking of trends in industry as early as possible as well as being practically involved through internships and volunteering. Also, early exposure entails getting to know the departmental requirements and networking as early as possible. This further enhances the transition into the corporate world, making it swifter and leading to personal professional development.
- Continuous Learning and Self-Study Initiatives – Participants reported that students should pursue further relevant studies in their own time while also

contacting subject matter experts for assistance wherever necessary. For example, if students intend to practise their professions overseas, self-studying the relevant legislative framework for the jurisdiction of concern is of vital importance. Hence, continuous learning should form the best practice for students if the intention is to further minimise the existing gaps between theory and practice.

3.9 Strengths of Interdisciplinary and Transdisciplinary Approaches for Enhanced Theoretical Background

In this section, the findings on the participants' views on the strengths obtained from contemporary learning courses to enhance theoretical background are presented. The responses specifically highlight the strengths relating to expanded knowledge, skills and opportunities (Figure 5).

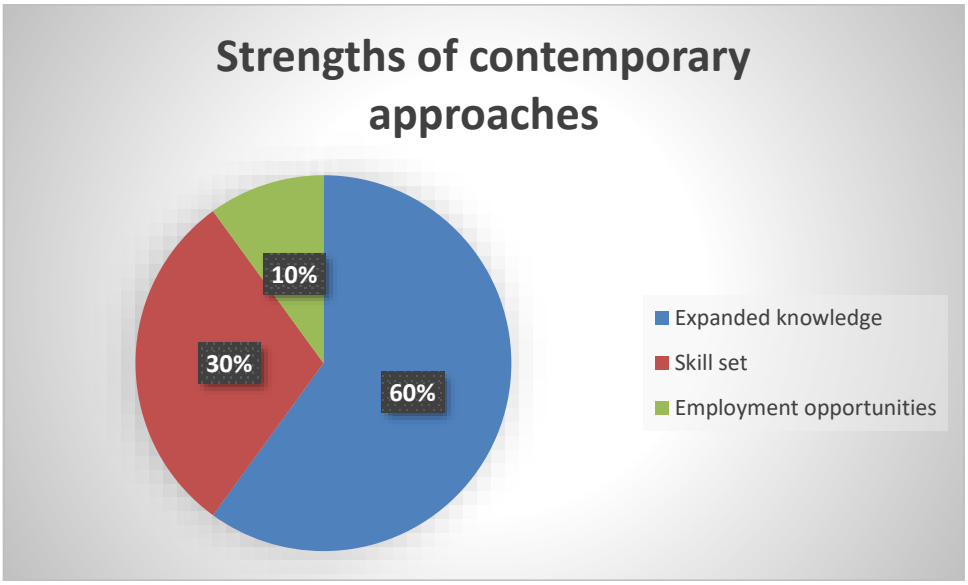


Figure 5: Alumni view on strengths of contemporary teaching approach

3.9.1 Expanded Knowledge

A combined 60% of participants believed that learning from different disciplines allowed them to broaden their knowledge, for example, knowledge of different environmental fields. According to the participants, this presents strengths since different disciplines can easily adapt to varied practical scenarios. Furthermore, the participants revealed that both inter - and transdisciplinary learning exposed them to

many opportunities which are available in practise and have helped them decide on their intended field of specialisation. The nature of the approach exposes one to a broad range of teachings which is beneficial in the field of environmental management and sustainable development. This therefore implies that interdisciplinary learning allows for a broader background which in turn allows for the proper engagement.

Participants noted that the environment was complex and as such presented many different components where only more and broader skills and knowledge could help to understand this complexity. For instance, one of the participants believed inter – and transdisciplinarity broaden knowledge and enhance preparedness for the workplace.

The findings showed that the participants were well aware that more knowledge came from bringing together the many different knowledge disciplines. Inter- and transdisciplinary learning drive problem solving by facilitating the integration of perspectives from society/during the research process which improves the process of knowledge production, triggering critical thinking and conceptualisation in practice. In addition, through learning from different disciplines, one learns how different factors are interlinked (for example, the link between environmental, economic and social issues). Also, some participants believed transdisciplinarity helps students to understand concepts at much deeper levels since the same concepts can be tackled in more than one way, making them much easier to understand due to enhanced perspectives owed to broadened, different ways of looking at concepts of interest. In other words, transdisciplinary learning represents a high-end approach which allows an individual to have a broader perspective and learning experience.

3.9.2 Expanded skill sets

The findings from this study showed that one of the strengths of learning from different disciplines is expanded skill set acquisition by the students, with 30% of the participants in agreement. The results showed that interdisciplinary learning potentially encourages critical thinking since most of the courses are linked in many ways. For instance, participants revealed that their engagement with the different content enabled them to be critical thinkers and promoted holistic views on different subject matters. In addition, participants believed that it prompted them to become more holistic and critical

thinkers. Furthermore, participants highlighted that it promoted analytical thinking while letting them be more like generalists who possess broader knowledge that cuts across many different topics. One participant indicated their involvement in working on a development project that required the participant to engage in town planning whereas some participants were exposed to Urban Geography, social needs where some participants have taken disciplines within the Social Sciences, economics and engineering. Considering that the background has already been set, it makes the involvement in such projects much easier. Moreover, the findings have shown that interdisciplinarity promotes strong comprehension skills important for comprehending subjects from many varied sources. Participants also revealed that learning from multiple fields enhances their theoretical background by developing the much-needed collaborative and teamwork skills which are the modern-day centrepiece for undertaking collaborative research. In other words, collaborative and teamwork skills give students an extended ability to work well with people from different technical fields. This is generally achieved on longer term projects such as research/thesis which allow students to engage in different disciplines and with professionals practicing in different fields.

Therefore, as students become holistic, critical and analytical thinkers, collaborative, creative and versatile, participants believe that they will be better equipped for a work environment and more employable to various companies and institutions. This view was summarised by one of the participants who said the following:

> *"In my case as I did Chemistry and Environmental sciences it was very easy to take up a technically complex role (Air Quality Specialist) and perform well. On numerous projects I relied on my chemistry background to undertake tasks on Air Quality Impact Assessments or Greenhouse Gas Reporting"*

Hence, being exposed to many disciplines expands one's thinking while setting one up to integrate and work well in the workplace environment. Finally, management skills are also acquired as students become able to integrate all aspects in environmental management as well as managing various aspects of environmental management, for example, water, air and waste.

3.9.3 Expanded Employment Opportunities

10% of the participants expressed the view that contemporary learning relates to the resulting ability to work well with people from different technical fields which improves one's chances of getting placement in varied organisations. Thus, one could end up having expanded employment opportunities. For example, as one interacts with students from different fields, collaborative and networking skills are honed, leading to better job prospects post-training era. One participant revealed that it was advantageous for students to get exposure to many different disciplines as it contributed to better execution of assigned tasks and duties in a manner that will enable them to be known by a variety of stakeholders.

Another strength of contemporary learning is the relatedness of courses since every course is often designed to be a building block to appreciate the subsequent courses. This not only helps in expanding the network of involved students but also in improving chances of successfully finding job placements in the future. To conclude, participants believed that interdisciplinary learning gives students a head start and a boost, especially those eyeing to go into industry taking into account the fact that different disciplines interact and complement each other.

3.10 Weaknesses of Inter- and Transdisciplinary Approaches for Enhanced Theoretical Background

Participants stated that exposing students to different disciplines or courses does not present any weaknesses as it is usually done with the intention of enhancing theoretical background. Consequently, the weaknesses pointed out closely relate to course focus, time and skills.

3.10.1 Course focus

Participants noted that, as the course focus becomes broadened, students would become prone to information overload - coupled with the likelihood that the course would become vague while moving very far away from being able to address real-world and daily environmental issues or industry issues. For instance, one participant believed the courses focused on research rather than solving real world issues. However, this view could be open to argument since research is in most cases designed to solve real-world

problems. On the other hand, the view might be relevant for some research studies that do not address real-world problems that students can relate to. In addition, participants believed that exposing students to different disciplines presented a weakness as it carried the potential to lead them into confusion due to different explanations of the same concept.

3.10.2 Lack of specialised skills

Another weakness of exposing students to different disciplines related to a lack of specialised skills that the students thought would be gained by the end of the training. In other words, students believed that the exposure to different disciplines limited specialisation in a specified field of interest. Because of this constrained acquisition of specialised skills, participants believed that it was one of the reasons why they would be required to engage with further skills development programmes after their training so that they could get the required specialised skills for their area of specialty. The fact that students are exposed to different fields and subjects means that the approach does not encourage specialisation. This view can be further elaborated by noting what one of the participants said:

> *"Being exposed to different disciplines leads to attainment of a less specialised qualification. Some students end up acquiring half of the knowledge for each discipline and they could end up in a limbo situation."*

The consequence of the preceding view is that, at the end of the environmental programme, students do not know where to go since they will not be fully trained to master one specific area of interest. Thus, inter-and transdisciplinary learning may be described as weak in that it turns students into "Jacks of all trades but masters of none". In other words, students become knowledgeable about many things but without becoming a master or an expert in any of those things.

3.10.3 Competition for time resources

Time allocation to courses was also revealed as one the weaknesses of being exposed to different disciplines. For instance, participants expressed that exposure to different disciplines could lead to students losing a lot of time by trying to compare what is said

in those different courses. In addition, inadequate time would end up being allocated to the process of refining specific skills with the vast range of content presented. Therefore, exposure of students to different disciplines presents a weakness in attempts to enhance theoretical background since balancing everything will always be a problem.

3.11 Need for further study

The participants were also asked if there was a need for further study. Figure 6 below illustrates the ratios, demonstrating that nearly 9 in every 10 believed there was a need for continuous learning while only 1 in every 10 believed there was no need for studying further.

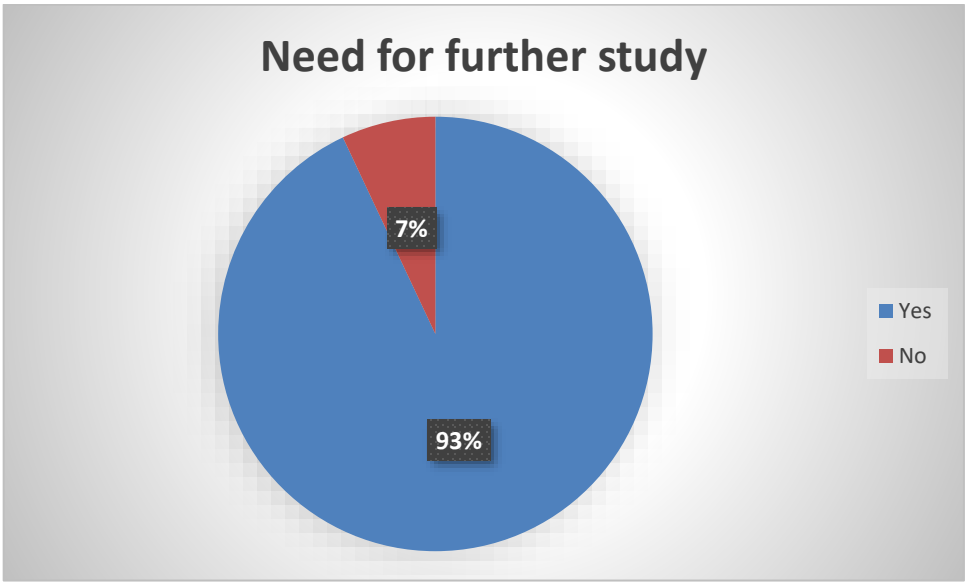


Figure 6: Illustration of responses on the need to study further.

The following are aspects raised by participants regarding the value of studying:

- Develop experiences in field – A key tool to understanding main environmental issues/gaps which can be closed through undertaking of more research studies. Moreover, participants highlighted that they needed to study further because of the need for environmental education documentation, for better professional credentials and professional practice.
- Awareness – The study revealed that participants studied further because they were always seeking to refine their critical thinking skills as well as fulfilling

the need to stay up to date with a vast amount of information already existing within knowledge domains of environmental management.

- Improve capacity challenges – Participants also highlighted that the need for people to study further related to the need for addressing institutional capacity challenges. There is a constant need to further develop one's knowledge and this is deemed important in continual development with the changing world. This point is further illustrated by what one of the participants said:

  "Everything always needs research to improve capacity around interaction between reality and social systems and provide a greater understanding of analysis drivers behind sustainability challenges".

- The need for continuous learning – Participants stated that their need to keep on studying arose from the view that life-long learning was an important tool for keeping people up to date in a dynamic world that is forever changing.

- Professional research – The need for people to become professional researchers in their areas of specialty. A combined 83% participants revealed that they studied further because there was a growing need for them to become professionally accountable in their specialised disciplines of practice.

3.12 Contributions of the transdisciplinary approach in the workplace

In this section, the findings are presented on some of the contributions of the approach in the workplace environment. Some of the themes identified were critical thinking, knowledge and ideas, advancing people's understanding and increased professional learning, engagement and discipline.

3.12.1 Critical thinking

One of the contributions of a transdisciplinary learning approach is that it presents a great preparation tool for the workplace, especially in terms of enhancing skills, for example analytical and critical thinking skills. In addition, a combined 63% of participants agreed that a contemporary approach to learning allowed them to cut across their ways of thinking, including their epistemological frames of thinking. This in turn

allowed for a reflexive response to the manner the participants approached challenges, resulting in more efficient and effective responses to challenges faced in the workplace.

3.12.2 Knowledge and Ideas

A combined 40% of participants revealed that the transdisciplinary learning approach contributed to the generation of new, good and broad ideas and knowledge; further adding to the gained knowledge and understanding which enabled them to comprehend a broad span of factors normally encountered in the field of environmental management and protection.

3.12.3 Advancing people's understanding

Another contribution of transdisciplinary learning is that it increases people's understanding of different work disciplines, as expressed by 33% of participants. In addition, it contributes to people being better equipped for the workplace and possessing the ability to work efficiently with other people from different technical fields.

3.13 Bridging the gap between theory and industrial practice

This section presents a summary of participants' views regarding what they thought industries and institutions can do in order to bridge the gap between theory and practice.

- Get professionals from the industrial workplace and bring them to various universities to expose students to their long-live gained experience. 40% of the participants stated that, by bringing in professionals with industry experience, students would learn the best requirements of the workplace environment as prescribed by the professional directly. This may also allow for effective communication between the training institution and the industry, thereby promoting the sharing of knowledge sharing as well as engagements to build.
- Engage the industry for student internships to provide them with work experience and exposure to the workplace, which relies on more offerings for practical learning.

- To limit the gaps between theory and practice, the institution and industry could consider amending the curriculum so as to make it more aligned with what will be happening in South Africa - including how other countries implement environmental management and the environmental legislation that can effectively be applied locally.

3.14 Key Performances or Activities

In this section, findings are reported on key activities that participants thought should be conducted in the workplace which greatly promoted individual abilities to being pro-environmental as opposed to the presented formal training. Three themes were identified, namely personal behavioural change (10%), research and technological innovation (40%) and accountability promotion activities (50%).

3.14.1 Personal Behavioural Change Activities

Participants revealed that activities such as direct involvement in projects, site-studying and personally witnessing some of the environmental issues first-hand encouraged them to become more pro-environmental. This is closely tied to moral responsibility and psychological factors that trigger the behaviour. Although not fully explored in this study, this is a critical aspect and introduces opportunities for future study. To further illustrate the power of activities that aimed at shifting personal behaviour change, one of the participants said:

> *"Personally, the number of engagements I had with the likes of Centre of Environmental Rights, GreenPeace, the community at large during public participation processes really opened my eyes on the impacts of mining in the environment and human vulnerabilities."*

Thus, participants reported that exposure to real-life problems and seeing the evident realities transpiring within the different industries drove people into becoming pro-environmental, but this is not always the case with different restricting factors that hinder with responsible action. Another participant concurred, saying environmental planning and its practice carried potential to contribute positively to the mitigation environmental issues bedevilling society.

3.14.2 Research and Technological Innovative Activities

To promote people to become pro-environmental, the workplace should also engage in research so that the power of science can be fully brought into action. It is also important to highlight that paying the required attention to science requires personal behavioural change.

3.14.3 Accountability Promotion Activities

Another set of activities which workplaces do to promote pro-environmental behaviours relates to how certain organisations hold themselves accountable to their activities in the environment. One participant said that monitoring and tracking had allowed him to become pro-environmental, as the tracking of activities alerts you to analyse one's impact.

CHAPTER 4: DISCUSSION

The aim of this study was to explore the perspectives of environmental sciences postgraduate students (PGS) and alumni, from theory to practice, of two environmental science masters programmes at two universities in South Africa. This chapter details the main findings and conclusions presented in previous chapters. The focus of this chapter is to explain the theoretical background and professional work experiences of postgraduate students and alumni through the analysis of different variables. Secondly, the discussion of the offered environmental education and influence, which will further link to the discussion of the opportunities and gaps that exist at a programme level. Thirdly, the migration from traditional teaching approaches to contemporary practices for smoother transition into the workplace: this will guide in determining the perceived role and value of the transdisciplinary approach towards professional application. And lastly, the link between environmental education and professional application in contributing towards the level of action and pro-environmental limitations in the system that hinder the implementation.

4.1 The effectiveness of the presented programmes

The effectiveness of environmental education relies on the offered content covered, knowledge passed on, consciousness triggered and contextual relevance (Nel and Wessels, 2010; Shafiq *et al*., 2016). The programmes' ability to align current environmental sensitivities and limitations further enables professionals to fulfil their mandate in practice. A participant expressed the below statement:

> *"The offered programme mostly teaches scenarios common in real world, different environments, with a local context. This further makes it easier to relate theory and professional application back locally based environmental issues."*

In agreement of the aforementioned statement, this is critical in addressing the local challenges whilst prioritising SDGs. The effectiveness relies beyond the offered programme but lies in one's ability to conceptualise the theory and apply it in professional practice. The sensitivities experienced in each geographical area are subject to different impacts and drivers, as such the ability to link theory and present sound solutions is fundamental in moving towards sustainable development (Nel and Wessels, 2010; Liefländer and Bogner, 2015).

Contrary to an international/mainstream programme, localised programme is usually limiting as it is restricted by regional, continental and global trends unless already applied and/or researched within South Africa. As an environmentally diverse nation, it is imperative to continuously explore subjects of focus to ensure that the programmes align with international standards, and account for global trends whilst allowing for a localised focus.

A participant from Wits reported that:

> *"Perhaps the gaps are as a result of the country which I chose to practice in, New Zealand, as legislation and environmental contaminants that are primarily tested for vary from those of South Africa. Hence, the gaps for me are primarily in environmental legislation."*

This goes back further to the benefit of localised strategies in exposing the national activities to participants. However, this is seemingly challenging to meet when working on projects that require crossing of nationals borders. It needs to be stressed that while institutions offer environmental education, reference to non-national laws cannot be relied on to account for what is happening globally.

With the different elements that go into the programmes, it is important to draw findings indicating the perceived strengths as part of this study. The main findings include three different variables, with the range of courses having been the most recurring as followed by the level of academic support and online/on campus facilities. Over 84% of surveyed participants commended the range offered and further stressed this as a strength. From the researcher's engagement with the participants, this was a major strength, followed by compliments and positive feedback on the role it has subsequently played. The aspects of this observation are further discussed below.

Two participants respectively had the following to say:

> *"You could choose, and the pool of choices was big."*
>
> and
>
> *"Had the opportunity to pick courses from different departments which broadened the options."*

This is an indication of the range and options offered. From personal experience and other surveyed engagements, our programme allowed us to tap into different disciplines and to further align developmental and professional goals.

However, a combined 10% of PGS and alumni disagreed with having had a choice. One participant stated the following:

> *"There were limited choices, other years might have more courses. It probably depends on the availability of the lecturers that present the courses."*

The expressed statement is one that the researcher can further attest to, since she found that courses offered over an annual basis are limited/limiting for PGS doing the degree over one or two years. Her experience was somehow beneficial to her, considering her ability to be exposed and do more modules over the extended period in which she was working on her masters (this study).

Although there are structures and requirements behind each programme, the intricacies that come with the programme offerings need to be versatile in granting all students the opportunity to fully explore their options and alignment with personal development prosect (Warburton, 2003; Dale and Newman, 2005; Howlett *et al*., 2016).

> *"I had no choice as I was funded and had guidelines to meet."*

The aforementioned statement was a clear example of a lack of alignment. In many cases, funders direct the programme and research to be conducted. This is generally based on set institutional objectives or research demands. Although this is generally externally caused, this continues to be a challenge for PGS and alumni.

On the contrary, participants indicated a range of weaknesses in the presented programme, and these are influenced both by the institutions and personal capacity. One critical finding which the researcher had assumed would have been a more significant finding, is based on lack of practical experience. Research done by authors Dale and Newman (2005) and Howlett *et al*. (2016) indicate to a great extent, the need for the inclusion of practical offerings into environmental education. This is evidently favourable for the experience of PGS and alumni as this further promotes the competence of when entering the workplace. One participant expressed the following statement in support of the extensive benefit that is presented in workplace readiness:

"In general, the courses presented particularly modules on environmental sciences, helps to sufficiently consolidate the link between practical and theoretical components of the programme and readiness for the work environment."

Major findings in the weaknesses were based on time (42% of participants) and work (32% of participants) constraints; and a combined total of 74% endured challenges with time and work balance. This resonated with the researcher, given her own challenges in balancing work and meeting her academic goals. Regarding time, one participant stated:

"*On theoretical side things, time allocated to coursework is short and limited, meaning content presented is rushed."*

Although there is a range of courses being offered, insufficient time is allocated to each subject, influencing the quality and theoretical value of the programme. Additionally, work balance is critical when studying part-time, since it was evident that this was a challenge for the participants with 32% expressing the difficulties that came with work pressure and furthermore performing in the programme. Nel and Wessels (2010) stress the need to apply measures that are feasible for institution, promote seamless learning and further assist in curbing the difficulties experienced with part-time learning.

The proposed suggestions to maximise the value of the environmental education as identified in this study include:

- Student-centeredness approach (SCA) – 53%: This primarily ensures that the experience of the PGS and alumni runs efficiently, and all required measures are in place to promote the experience endured through their programme.
- Practice-based learning (PBL) – 23%: This links to restricted opportunity for the programmes to incorporate practical learning. enable students to understand and apply theoretical knowledge in a practical manner.

Despite the type of environmental education gained through the respective programmes, it is important to understand that the complexity of fulfilling one's consciousness towards being pro-environmental further lies on the ability to tap into environmental knowledge to trigger awareness and the will to act. Objective 2 of this research was meant to allow for deeper understanding, however for this to be achieved; a full assessment on the awareness triggers, behavioural drivers and level of environmental consciousness would have had to be conducted. This introduces another opportunity for

future research which could not fully be addressed within the current study. Kollmuss and Agyeman, 2002; Aktas, 2015 and Shafiq *et al*., 2016 indicate that environmental knowledge is mandatory in mitigating the current environmental challenges to promote environmental awareness, pro-environmental practices, favourable attitudes and sustainability. It was further determined through the study that there are different drivers that contribute towards acting pro-environmentally - even with a background in environmental education.

The responses were divided into the following themes: personal behavioural change, research and technological innovation, and accountability promotion activities. Although not extensively examined, the outcomes were critical in the current study. The personal behavioural change which is further tied to psychology was highlighted to a great extent. The ability to relate personally to the sensitivities of our environment was a recurring finding amongst most participants. Likewise, the more the researcher witnessed the environmental sensitivities and direct impact it has on the human population, she knew she had to do something. Restall and Conrad (2015) refer to connectedness with nature, where they demonstrate how this enhanced the will to be able; be aware and act pro-environmentally. One participant stated the following:

> *"Personally, the number of engagements I had with the likes of CER, GreenPeace, the community at large during public participation processes really opened my eyes on the impacts of mining in the environment. And also making it clear why there is a need for more stringent regulation to hold the mining sector accountable."*

This further links to the role of human psychology and emotional attachment towards the natural environment (Kollmuss and Agyeman, 2002; Steg and Vlek, 2009). Contrary to the global awareness and widespread of professionals, there are still structural factors that need to be addressed, as well as urgent behavioural change (Aktas, 2015). The researcher is of the view that education on its own is not the final answer, and that triggering environmental consciousness and awareness should continue to be the priority to ensure that change is driven for a more sustainable nation. It is to be noted that psychological factors and internal drivers determine one's inherent pro-environmental practice (Kollmuss and Agyeman, 2002; Steg and Vlek, 2009). Linking back to Chapter 1: Section 1.4, this further adds to the research presented. So, in determining the effectiveness of the presented programmes, one needs to understand that in order to fully

apply their environmental education, one needs to align their mind to consciously contribute towards sustainable development and allow themselves to tap into the sensitives that are presented thereof (Liefländer and Bogner, 2015).

4.2 The rationale of the inter- and transdisciplinary approach and feasibility in full application

Cotemporary approaches are growing in popularity (Lawrence, 2010; Torkar and McGregor, 2012; Caldwell, 2015; Holmberg and Larsson, 2018; Guimarães, *et al*., 2019) which can be assumed to be directly determined by the current environmental pressures and drive towards sustainable development, as well as the need for integrating disciplines to address such issues. The findings of this study have indicated the added value that was presented through the contemporary approaches; inter- and transdisciplinarity.

This study has presented findings on the participants' views on the strengths obtained from learning from different disciplines or courses to enhance theoretical background. The strengths relate to the expanded knowledge (according to the participants, this presents strengths since different disciplines can easily adapt to varied practical scenarios) and skills (findings show that contemporary learning potentially encourages critical thinking). The discussion of Mitchell *et al*., 2015 detailed in Chapter 1: Section 1.3 also referred to in Figure 1 has been further cleared to demonstrate the linkage between literature and the presented findings. This approach further enabled postgraduate students and alumni to become more holistic in understanding environmental concepts; and promotes critical thinking in tackling environmental planning and implementation. Furthermore, participants highlighted that the approach allowed them to enhance their analytical thinking while letting them be more like generalists who possess broader knowledge which cuts across many different fields' topics. Moreover, the findings have shown that contemporary approaches promote comprehension skills important for comprehending subjects from many varied sources (Dale and Newman, 2005; Howlett *et al*., 2016). In the experience of the researcher, this approach has been of great benefit in equipping her for the current industry she is serving. The constant project changes, teams and environmental sensitives require for one to think more critically, further engaging with different role players and being able to carry the overall mandate with a common objective. It needs to be further expressed

that, unlike the transdisciplinary approach, the study has demonstrated the consistent application of interdisciplinary teaching. This is potentially due to the complexity in achieving inter- and transdisciplinarity, but the core principles are similar. Considering the extent to which contemporary approaches were explored in this study, this finding has validated the limited primary data and potentially is a result of the limited implementation of this approach in institutions.

The complexity of environmental management does not allow for key disciplines to work in isolation (Warburton, 2003; Nel and Wessels, 2010; Goring *et al*., 2014; Setó-Pamies and Papaoikonomou, 2016;); as such, contemporary approaches have positively contributed towards the expertise and presented measures. In addition, these approaches allow for collaboration with different technical teams; as one participant expressed:

> *"In my case as I did Chemistry and Environmental Sciences it was very easy to take up a technically complex role (Air Quality Specialist) and perform well. On numerous projects I relied on my chemistry background to undertake tasks on Air Quality Impact Assessments or Greenhouse Gas Reporting."*

There is an urgency behind incorporating the different views both at a programme and work level; this is critical in bridging the gaps that already exist, as well as granting an opportunity for new ideas and solutions to address the identified environmental sensitivities (Koehn and Uitto, 2013; Singh, 2013; Rickinson and Lundholm, 2008).

The value of the approach cannot be omitted. At this stage, it is more critical to address the structural difficulties in resolving environmental sensitivities that are presently being lived with; furthermore, this can ultimately be fulfilled through the application of the different dependent disciplines and external collaborations to achieve a wider range of perspective and technical support.

Contrary to the popularity in contemporary approaches, the feasibility in application has raised alarms considering the difficulty in fully operating on the basis of these approaches. The most common responses expressed were based on the inability to refine a skill set and specialise in a subject/discipline. The structure of the programmes become fragmented with no room to group for specialisation. The difficulty would restrict the options available against the student programme expectations. This contributes to the general understanding of a subject and does not allow for the respective subjects to be fully comprehended as the main objective is to provide an overview of a discipline.

To bridge the gap in the approach, it is imperative to ensure that continuous means of development are fulfilled. This study has indicated that 93% of participants approved of the need to study and develop further. In support of the aforementioned, the changing environment does not allow for one to not be open to learn, and to participate in training and research and as such, ensure that all platforms in which one can grow are exhausted for one's own benefit and professional goals. This point is further illustrated by what one of the participants said:

> *"Everything needs research to improve capacity around interaction between reality and social systems and provide a greater understanding of analysis drivers behind sustainability challenges".*

So, in determining the rationale of the transdisciplinary approach and feasibility in full application, one needs to understand the tools provided and need for independent implementation to ensure that all components work together, paving a way to sustainable development through the use of contemporary tools and understanding of human psychology (Dale and Newman, 2005; Howlett *et al*., 2016).

4.3 The contribution towards readiness of the institutions for students to enter professional practice

As previously shown, readiness is based on different factors and experiences. Environmental education is fundamental in setting the groundwork which is further influenced by psychological and political drivers (Bhandari and Abe, 2002; Wessels and Mkhari, 2007; Ardoin, 2009; Wang, 2014; Rakotomamonjy *et al*., 2015; Dale and Newman, 2005; Dangelico *et al*., 2017). This directly influences the ability to implement sound measures aimed to address the environmental sensitivities. This study illustrated the need for additional external factors outside the formal environmental education offered. One participant stated the following:

> *"Formal education would never have been enough on its own. The institution itself sets the first step but the work environment requires the application of other factors."*

In agreement of the aforementioned statement, the researcher's ability to fulfil her role has been greatly dependent on the continuous focused learning and training, and the ability to critical tackle environmental planning and associated activities. As in any space

when learning, the information sets the basis for further interrogation. This study has presented the views of the participants regarding bridging the gap that exists between theory and practice. Three main findings presented, namely practical experiences; intermediate training such as internships, and graduate programmes to help minimise the impact of the transition. The views of two participants with regards to this were:

> *"Institutions and industry need to come together top further cater for entry level opportunities to curb not only the unemployment statistics but to allow for more opportunities for young professionals to enter the job market."*
>
> And
>
> *"In my experience internship helped me tremendously as my capabilities and exposure was clear to my employer and subsequently understood that I was coming with theoretical background and that the previously undertaken internship role had equipped me for the workplace."*

It is to be further stressed that the reference to practicality and experiential training with regards to the two institutions does not fully apply, as the mandate of a university is not inclusive of practical exposure - unlike Technical Institutions (Rambe and Mbeo, 2017).

The study indicated that the total recurrence of the need for practical experience was estimated at 40%, with participants greatly stressing the value and need to incorporate into the formal programmes. Currently, more efforts have been placed by universities to curb this; however, at its core, the extent will never reach that of Technical Institutions.

Additionally, the role of networking is a skill set required in the work environment to run and maintain the operations of an organisation and business. This cannot directly be taught outside the opportunity to allow students to engage amongst one another and with respective industry role players. This relies further on one's social skills and ability to direct interactions towards a desired outcome. Based on the researcher's own experience, she is of the opinion that with industry experience comes great confidence to network and further attract prospective business. Given the aforementioned statement, environmental education solely sets the basis of knowledge, the practical experience builds on the application of the knowledge gained and the relations built further direct the engagements and collective circles established (Nel and Wessels, 2010; Dangelico *et al.,* 2017). One cannot isolate the importance of intermediate training and the ability to successfully network (Nel and Wessels, 2010).

This study further indicated that 30% of the participants identified the importance of industry in implementation of green solutions and environmental management. Thus, 30% of participants expressed the leading role of industry to either grant an opportunity to apply change or further pass down their skills for an integrated organisational team. For the researcher, a significant challenge endured was based on her drive to do things differently in a system that had been running prior to her arrival. This is an issue when working with a team that requires deep perspective to merely hear any ideas. Therefore, the question of implementation is a contested one given the rigid factors that stand in the way of implementation and sustainable change (Bhandari and Abe, 2002). The work done by Nel and Wessels (2010) suggests that implementation continues to threaten the progress of intended activities to address the existing environmental sensitivities. The researcher is of the view that the ability to successfully develop new strategies and align the primary business objectives that allow implementation is critical in a sustainable work environment and critical for sustainable development. The aforementioned statement is supported by several authors (Bhandari and Abe, 2002; Dale and Newman, 2005; Wessels and Mkhari, 2007; Ardoin, 2009; Wang, 2014; Rakotomamonjy *et al*., 2015; Dangelico *et al*., 2017), stressing the importance of building the expertise of the recipient of the training whilst enlightening individual green innovative capability.

A key global trend is centred on sustainable development and associated strategies. These have placed pressure on businesses to move towards sustainable practices and in essence employees are required to promote pro-environmental behaviours in their practice and green innovation (Wang, 2014; Rakotomamonjy *et al*., 2015; Shafiq *et al*., 2016; Dangelico *et al*., 2017; Hartmanna and Vachon, 2018). Driving transformation in business to directly drive environmental change and management. For this concept to be fully applied, the environmental awareness, education and normative values of the entrepreneurs need to be triggered to evoke pro-environmental behaviours (Aktas, 2015; Shafiq *et al*., 2016).

CONCLUSION

This study was conducted on a group of 40 postgraduate students and alumni from two tertiary institutions in South Africa. The aim of the study was to determine the perspectives of environmental sciences postgraduate students and alumni, from theory to practice on two environmental sciences masters' programmes at two universities in South Africa. The research was carried out by means of questionnaires through virtual interviews which took place over April and May 2020. The study explored the discussion of the offered environmental education and influence, which was further linked to the discussion of the opportunities and gaps that exist at a programme level. The migration from traditional teaching approaches to contemporary practices for smoother transition into the workplace aided in determining the perceived role and value of the transdisciplinary approach towards professional application. And lastly the discussion of the link between environmental education and professional application in contributing towards the level of practice and pro-environmental limitations in the system that hinder the implementation.

The study has shown the concurrent effort placed by institutions to meet the changes in industry and the environmental crisis. The application of contemporary approaches has been a positive contributing factor in promoting workplace and professional application readiness. On the contrary, the isolation of internal and external factors cannot be left out considering the extent of influence thereof. The results of the study further suggest that the need of integrating emotionally stimulating activities is critical for social attachment triggers action and once there is awareness, environmental consciousness is triggered. Bridging the gap between theory and practice is evidently still growing with further interventions in place and planned for better readiness for students. Compared to other studies in line with the contemporary approaches and efficiency in workplace readiness, the focus was mostly on the curriculum and set programmes. This study however, greatly touched on the internal, external and structural factors that hinder or promote the successive implementation of the approach within the academic environment and workplace thereof. In conclusion, this study has provided a practical model in which further assessments may be developed to further explore the topic.

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APPENDICES

Appendix 1: Minutes from the Proposal Seminar

Postgraduate Committee Meeting for Lehlogonolo Mashego (715983)

Masters (CW/RR) project proposal:

Sustainability, from theory to practice

Committee:

Prof Francesca Parrini (chair)
Dr Ute Schwaibold (principle supervisor)
Prof Coleen Vogel

Biology Building B115; 1 Feb 2019 11h15

Comments and suggestions related to the proposal:

- Reword the aim to focus on the students' perspectives on the education and gaps and challenges;
- Clarify what you mean with "transdisciplinarity". It refers to going outside of the university; consider including this only as a part of the interview and assessment in terms of whether the curricula include any transdisciplinary aspects and if yes, how useful these were;
- Clarify the psychological aspects you want to assess and how or rather replace this with "motivation behind decisions";
- Cluster your sample by sector;
- Highlight which degree they got (honours and masters);
- Limit to biophysical sciences;
- Consider time since graduation (graduated in the last 5 years);
- Increase sample size to 20 per university;
- Find papers from Chalmers University (John Holmberg) to guide theory around transdisciplinarity;
- Lit review: zoom in on transdisciplinarity and education; cut out psychology;
- Clarify methods

Final comments:

- It was agreed that the updated final proposal should be submitted by 15 Feb 2019 at the latest. The meeting ended at 11h50.

Appendix 2: Questionnaire

Title of project: The relationship between presented curricula and pro-environmental practice amongst postgraduate students and/or alumni
Name of researcher: Lehlogonolo Mashego
Date: March 2020

These questions will be used to guide the interview, however the aim will be to allow the participants to speak freely and not be limited by these questions.

Questionnaire

1. **Demographic**
   - 1.1 What is your preferred gender designation?
     e.g. female or male
   - 1.2 How old are you?
   - 1.3 What is your highest tertiary qualification?
     e.g. BSocSci Geographical and Environmental Science, MSc Environmental Science
   - 1.4 What is your specialised field of expertise?
     e.g. Environmental Assessment Practitioner, Stakeholder Engagement Officer, Specialist
   - 1.5 Where did you obtain your tertiary education?
     e.g. University of Pretoria or University of Witwatersrand

2. **Theoretical background/applicability**
   - 2.1 What were the strengths of the presented formal training received?
     e.g. specify courses, number of courses of manner in which course were conducted
   - 2.2 What were the weaknesses of the presented formal training received?
   - 2.3 What are the areas the curriculum focused on?
   - 2.4 Was there a choice of courses for the presented coursework component of the degree?

2.5 What in your opinion may be done by institutions to maximise the value of the presented formal training?

3. Link between theory and practice

3.1 From your observation and experience, what are the common aspects between the curriculum and practice?

3.2 What are the internal and external factors contributing towards one's ability to practice?

3.3 What (if any) are the gaps between what you learned at varsity and what you needed to know in practice?

3.4 What measures may be followed by students to bridge the gap?

4. Transdisciplinarity

4.1 What are the strengths and weaknesses of being exposed to different disciplines (courses) to enhance your theoretical background?

4.2 Is there a need for further study, research or experience as a result of the approach?

4.3 What are the limitations of the approach?

4.4 Contributions of the approach in the workplace?

5. Experience

5.1 What between the formal training and workplace application needs reworking to limit the disparities between theory and practice?

5.2 What can be done by institutions and industry to bridge the gap between theory and industrial practice?

5.3 What key performances or activities are conducted in the workplace which have greatly promoted your ability to being pro-environmental as opposed to the presented formal training?

Appendix 3: Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF ANIMAL, PLANT AND ENVIRONMENTAL SCIENCES ETHICS COMMITTEE CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE **PROTOCOL NUMBER: 1908**

PROJECT TITLE The relationship between presented curricula and pro-environmental practice amongst postgraduate students and/or alumni.

INVESTIGATOR Lehlogonolo Mashego

SCHOOL/DEPARTMENT OF INVESTIGATOR Animal, Plant and Environmental Sciences

DATE CONSIDERED 18 October 2019

DECISION OF THE COMMITTEE Approved unconditionally

EXPIRY DATE Date of submission of the project report

ISSUE DATE OF CERTIFICATE

CHAIRPERSON _____
(Dr Shalini Dukhan)

cc: Supervisor/s : Dr Ute Schwaibold

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School ethics committee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

_____ 18 / 11 / 2019

Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES