REFLECTIVE PRACTICE AS BASIS FOR SUSTAINABLE TRANSFORMATION A PEDAGOGICAL CHALLENGE

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Abstract

It is becoming clear that shifting towards a more sustainable global social-ecological system will require not just changes in technological and economic systems, but also deep-seated personal transformation that can drive alternative behaviours. This level of transformation requires a shift towards a relational worldview that sees the world as interconnected and interdependent complex system in which small actions can have large effects. This, in turn, introduces a range of values, beliefs and practices that differs from the reductionist worldview that is criticised for creating current unsustainable conditions and practices. Education remains a critical tool for changing attitudes and beliefs and the field of education for sustainable development is promoting experiential educational methodologies with their emphasis on reflective practices, as one of the more effective ways of affecting this transformation. The paper will explore this pedagogical approach further in the context of built environment education, drawing on the course VKN 320 presented at the University of Pretoria, to ask how to effect this transformation through pedagogical interventions in the teaching of sustainable construction. The course itself is a quasi-experiment and the paper investigates its success in affecting a shift in worldview.

1. Introduction

A concept introduced in the global political discourse with the Cocoyoc Declaration (UNEP/UNCTAD, 1974), the issue of sustainability continues to grow in importance. Twenty years after Cocoyoc, Orr (1994:3) wrote that there are three crises looming: a food crisis, a crisis caused by the ending of the era of cheap energy and lastly, a crisis based on exceeding ecological thresholds and the limits of natural systems. Move forward another couple of decades, and current scientific findings on climate change and other ecological thresholds (e.g. Steffen, *et al.*, 2015)indicates that early warnings have largely fallen on deaf ears, with a lot of lip service paid to sustainability, but very little action taken at meaningful scales.The result being that, as Winston Churchill (1936) put it: “we are entering a period of consequences”.

While the sustainability debate has cycled repeatedly through technological, political and economic solutions (Du Plessis, 2012), there is a growing realisation that these approaches will only succeed if there is a change of heart; if people’s values, beliefs and other constructs are aligned to sustainable practices. Sustainability needs to begin with self. Murray (2011:x) suggests that people are aware of what sustainability entails, but that information is not permeating and influencing their personal choices. On the professional side, they can tick the boxes regarding the comprehension of the concept, but on the personal side, their practices indicate a lack of personal development regarding the sustainability agenda. Furthermore, Murray suggests that personal values, attitudes and beliefs are central in determining our response to sustainability.

Education remains a critical tool for changing attitudes and beliefs, and inspiring action for change (Anderson 2012:193). It therefore features prominently in the sustainability agenda. In 2002, the United Nations General Assembly declared 2005 to 2014 as the United Nations Decade for Education for Sustainable Development (DESD), with the intention of asserting the role of education in realising a more sustainable world (Wals, 2014:8). Higher Education Institutions (HEIs) have also embraced education for sustainable development (ESD) through adding modules or courses with ESD content or through integrating ESD in existing ones (Wals, 2014:10). Nevertheless, despite all this education on sustainability, there is a growing concern about the lack of progressin reducing the negative ecological impact of humankind on planetary support systems.

Orr (1994:7-15) attributes this to the kind of education we have, suggesting that it is premised on epistemologies promoting fragmentation and mutual exclusivity. This thinking is attributed to Galileo and Descartes, the former esteeming the analytical mind over the creative and emotive part, and the latter separating mind and matter (Du Plessis and Brandon, 2014;Capra, 1997). This kind of thinking that sees the world as divisible into mutually exclusive components is reflected in our education systems through courses that are discipline orientated (Orr 1994:11), with little interdisciplinary interaction. It is also reflected in our unsustainable development models that allow the exploitation of the Earth’s resources without understanding the ecological relationships. We therefore need a different kind of education - atransformational approach to education that will develop a new relational worldviewto replace the mechanistic one that has created the

current unsustainable development model(Hes & Du Plessis 2015:24).The challenge is to develop such an educational approach. In 2013 the Department of Construction Economics at the University of Pretoriaintroduced a course in Sustainable Construction which implemented a hybrid teaching model, combining instructional teaching and experiential education, to address this challenge. The success of this model in instilling an ecological worldview is the focus of this study.

2. Literature review

The development of this model required exploration of three different aspects: the concept of an ecological worldview and the skills set it would require; the idea of the 'sustainable self' (Murray, 2011) and the required personal transformation; and an investigation into suitable pedagogical approaches.

2.1 The ecological worldview

Capra (1997:4) proposes that many environmental and social problems are facets of a greater concern, the crisis of perception. He states that we are instructed by an outdated worldview that cannot handle the reality of an overly populated and globally interconnected world, and need a new paradigm that can deal with this reality. A shift in worldview, from a mechanistic to a holistic and integrated one is required to change the detrimental course of the current development trajectory and this shift is already happening (Du Plessis, 2009:102,344).

Capra (1997:6)proposes that "the new paradigm may be called a holistic worldview, seeing the world as an integrated whole rather that a dissociated collection of parts". Goldsmith (1988) decided to use 'ecological' to describe this emergent, holistic and integrated perspective. He stated that 'ecology' is, among other things, a non-disciplinary study, holistic, subjective and emotional. The 'ecological worldview' then becomes a perspective that appreciates the interconnectedness of the world, and that whole is more than the sum of its parts (Smuts 1987). Capra (1997:6) concurs and suggests that 'ecological' be used instead of 'holistic', as holistic speaks of components and their interdependencies while ecological also includes environment, as all systems exist within a context. This allows our global image to shift from a fragmented world to one founded upon whole systems thinking (Du Plessis, 2009:4), and specifically relevant to living systems (Capra, 1997:35). In this view, the world can be seen as "a fundamentally interconnected, complex, living and adaptive social-ecological system that is constantly in flux" in which humans are seen as "an integral part of nature and partners in the processes of co-creation and co-evolution instead of being merely users or clients of various ecosystem services" (Du Plessis, 2012:15).

Senge (1999:69) describes systems thinking as a framework for seeing wholes, interrelationships, and patterns of change; and, as Capra (1997:30) explains, it is contextual – meaning that, to understand something, it has to be put into the context of a larger whole. Wilber (2001:113) suggests the term 'holographic paradigm' to refer to his understanding of an emerging worldview that sees the whole in the part. He refers to this as an integral paradigm that would "include not only the 'hard-ware' of physical sciences but also the 'software' of philosophy and psychology and the 'transcendental ware' of mystical-spiritual religion" (Wilber, 2001:1). From these positions it can be argued that the most important skills to develop, enable and support an ecological worldview are systems thinking and integral thinking – seeing relationships and flows, seeing wholes and the self as part of the whole; and the psychological re-integration of humans into nature.

2.2 Developing the sustainable self

We are beings whose existence is based on systems (Hes & Du Plessis, 2015:27), from respiration to digestion; our cognitive functioning is no different. Behaviour is inspired by attitude, and attitude is inspired by information (Maio & Haddock, 2010). This information is not held remotely by our cognitive functioning, but is intertwined with and informed by our values, religious inclinations, locality, history, emotions, etc. in an equally interconnected system. Experiential learning looks at education in this manner, in a holistic, systems-based approach, focusing on developing the individual - it seeks to develop the sustainable self.

To change society, change must begin with self as in understanding the complexities of self, and the systems understanding that can be brought into practice(Pappas & Pappas 2014:12-13). This position is not without opposition, as some commentators state it brings us to the place of autonomous self, thus working contrary to the interdependent and systemic approach needed for sustainability (Jucker, 2012). Sustainability in the self means the embodiment of ecological values, and reflecting these in the way we live, think and work. It is about acknowledging that external barriers to change exist, but working to change the internal ones, ones that each of us can work on (Murray 2011:2). Du Plessis (2013) identified 10 such values, acknowledging that these are not the only ones underlying the ecological worldview, but appreciating that they are fundamental.

During 2012 a series of in-depth interviews were conducted with over fifty people from around the world to understand the change that needs to occur in the way practitioners live, think and work (Hes & Du Plessis,2015:10). These interviews highlighted a number of lessons in three key areas: 1) how to change professional practice; 2) the different role the practitioner has to play in the project over its lifetime; 3) and the personal development that is necessary to become an effective regenerative development and design practitioner.

Five lessons were identified that points to the personal transformation that is required. The first is that practitioners must *be prepared to integrate levels and cross lines*. These levels are those of development, in which the practitioner moves from the baseline of green building to regenerative work, and from thinking in dualities (e.g. interior-exterior; humans-nature; us-them) to thinking in wholes. The second lesson learnt is

that practitioners must *live like impeccable warriors*. This means that they must be willing to express their emotions, to share feelings and thus allowing collaboration of a higher order. The third lesson is that practitioners need to *put roots down that will anchor and sustain them*. There is a need to take care of self, to nurture not only the body but also the soul and spirit. It also means connecting with nature and the communities where they live, to remain conscious of the interconnectedness that they must bring into their work. The fourth lesson learnt is *living with integrity*. This means that one must behave consistent with an internal framework of principles and integrate elements of self into a harmonious whole. The last lesson identified is *not being a lazy thinker*. Practitioners need to put the time in to thoroughly apply their minds to be able to deal with complexities. They need a reflective contemplative approach to the information they deal with, and extend this critical reflection to what others have done. This is to safeguard against fallacies, dangerous assumptions and inaccurate argumentation.

Hes and Du Plessis (2015:215–225) further discuss how one can be part of the change without being overcome by the daunting scale of action needed. They suggest that one must look at individual actions as *dropping a pebble in the pond*. This is to say that we just need to do what we can, that through leveraging the power of self-organisation, small actions can cause ripple effects in the lives of others and bring about great change. These kinds of actions include doing random acts of kindness; senseless acts of beauty (e.g. yarn bombing, guerrilla transformations of objects in public spaces, certain graffiti types and art installations in downtrodden spaces), guerrilla gardening and tactical urbanism.These lessons also form the basis for the experiential learning approach that was developed, as described in Section 3 below.

2.3 Pedagogical approaches

Having understood the worldview and skills set we desire to develop in people, we need to find an educational approach fit for purpose. Our current dominant approach consists largely of instructional learning, which is designed to teach the individual from outside inward. Students are subjected to a mechanistic learning environment, which limits their participation in the learning process. Educators alike are forced to adhere to elaborate teaching guides and teaching material, aimed at channelling them into a specific paradigm(Duobliene 2013:41). The success of students is measured in their ability to do rigorous note taking and regurgitate that information in assessments, with the learning environment non-conducive for participation or creativity (Owens 2013). Sterling (2003:205) calls instructional learning a transmissive educational methodology (practice), which he states is all about transferring knowledge. Furthermore, he states that change in education is imposed through direction and is non-participative, unlike the transformative (experiential) educational methodology.

Historically, the basic goal of education has been to teach students how to think (Wilke, 1993:32). The general critique of instructional learning is that it does not afford much opportunity for critical thinking. Critical thinking is an important element in sustainability education, in allowing a student to create knowledge for themselves with guidance from the educator. Ketlhoilwe (2010:144) suggests that sustainability education was designed to develop critical thinking as a means to induce behavioural and attitude change. Duobliene (2013:41-43) further states that instructional learning is a unilateral process, allowing no feedback. Feedback, in this regard is dialogue (understanding from group interactions) and critical thinking (understanding from individual reflection). This is reiterated by Sterling (2003:205) where he states that a transformative (experiential) educational methodology allows students to create and own meaning. Instructional learning functions in disciplines, in neat boxes, and this very approach creates the impression that the world is like that (Orr, 1994:23).

Experiential learning, also known as phenomenological learning, aims to teach an individual from the inside out. It is important to draw a distinction between experiential education and experiential learning. Experiential learning, more commonly known as ‘learning by doing’, is but a subset of experiential education (Roberts 2013:3). The Latin root for the word education is ‘educere’, which means ‘to draw out’. Ketlhoilwe (2010:146) states that whichever learning approach is used, it must offer experiential learning opportunities which will draw out the socio-ecological experiences of students that will complement the theoretical framework of the teaching and learning process. Both instructional and experiential learning are utilised in sustainability education, but the argument is for more of the latter and less of the former. It is an argument for subsuming rather than one of negating (Sterling, 2003:206). In developing an ecological worldview, a systemic approach is required and this is best satisfied by experiential learning.

Our understanding and application of experiential learning is largely attributed to the works of David A. Kolb (Kolb, 1984), with regards to his experiential learning theory (ELT) model and his learning styles inventory (LSI). Kolb proposed that learning happens in a four-step cycle (ELT), and that learners prefer to learn in one of four styles (LSI). Kolb refers to three models of experiential learning.First is the Lewinian Model of Action Research and Laboratory Training, based on work done by Kurt Lewin. This model is the more commonly used one, due to its comprehensiveness. The second is John Dewey’s Model of Experiential Learning. Lewin expanded on this model in creating his own, and included group dynamics and action research to Dewey’s framework. Dewey expounds more on the developmental nature of the learning process, and how experiences of our environment are ultimately transformed into purpose (Kolb, 1984:22). The third is Jean Piaget’s Model of Learning and Cognitive Development – Piaget is the founder of the Theory of Constructivism. Piaget’s focus is on the stages of cognitive growth that an individual goes through. These four stages span the years one to fourteen. He highlights that individuals develop from a phenomenal worldview, characterized by individuals fascinated by stimuli e.g. a child playing with toys, encountering fire for the first time etc. Ultimately, they possess an abstract constructionist worldview, where the individual is making sense of their world through reflection e.g. finding the moral of a story (Kolb, 1984:23–25).

These three models are similar in several aspects. The first aspect is that all reflect the cyclical nature of learning: we experience, reflect, draw conclusions and then test those conclusions. There is therefore no pinnacle in learning because our environment is always changing. This means that what was an accepted theory a while ago, may fail in application today. The second aspect is that the models indicate that learning is developmental in nature. Learning changes not only the mind, but alters our value systems, our perceptions, beliefs and emotional condition. The third aspect is that underpinning such learning is an interaction between the individual and the environment. All three indicate that learning cannot be done in isolation, as is the case with instructional learning. Information requires context to truly bring understanding. This is why there is a drive for teaching with locality in mind. What is taught by educational programmes should take into consideration the prevailing local conditions (Ketlhoilwe, 2010:143).

3. The Course Module

With the above lessons and pedagogical approaches in mind, a quasi-experiment was conducted to investigate the effectiveness of using an experiential and reflective educational model in developing an ecological worldview. The vehicle for this experiment was theSustainable Construction (VKN 320) module, which focuses on sustainability education or education for sustainable development (ESD).The module consists of three themes: a) Sustainability Literacy; b) The Sustainable Self; and c) Becoming a sustainability practitioner. While there was a component of instructional teaching in all three themes, the main focus was on reflective individual and group exercises. Group exercises included in-class systems thinking exercises and reflections. The individual exercises (tasks) are grouped into assignments structured as described in Table 1.

Table 1VKN 320 Individual assignments

ASSIGNMENT AND TASKS	DESCRIPTION
Assignment 1: My contribution to the problem	
Task 1: My ecological footprint	The tasks in this assignment were intended to make the students aware of their direct relationship with the natural resource base through calculating their ecological footprints; keeping track of their waste; and experiencing what it feels like to live on five litres of water a day.
Task 2: Waste not, want not	
Task 3: Understanding scarcity	
Assignment 2: Exploring alternate futures	
Analysing a dystopian/post-apocalyptic novel	In this assignment students were made aware of the behaviours of complex systems by identifying patterns of self-organization and chaos theory in the literature example. They were also asked to reflect on the likelihood of their futures playing out in a dystopian society, with reference to climate change, socio-economic fault lines and technological development, and their own readiness for living in such a world. The intention of this exercise was to introduce complex systems thinking and its real world applications and develop basic scenario thinking skills, identifying critical factors in social and technological development that shape future development pathways and the possible unintended consequences of these.
Assignment 3: Seeing the world differently	
Rice experiment	This assignment built on the work of Masaru Emoto and the intention was to challenge students' perceptions and open their minds to the possibility that we may be connected to each other and the world around us in ways we do not yet understand, that our consciousness can influence the world around us, as implied by the theories of quantum physicists such as David Bohm, Ervin Lazlo and Frijtof Capra, and to think about what this could possibly mean for how we should behave.
Assignment 3: Connecting to change the world	
Task 1: Mindful eating	These series of tasks relate directly to the development of the sustainable self; developing the students' skills in mindfulness and the ability to reflect on their own thought processes, and develop emotional and physical states that will help them to change their own behaviour in ways that will increase both personal and planetary wellbeing.
Task 2: Going barefoot	
Task 3: Being grateful	
Task 4: Random acts of kindness	
Task 5: My ten commitments	

[1] Dr Masaru Emoto was a Japanese scientist who investigated the effect of a number of factors, including emotions, prayer and exposure to images and music, on water, and by extension, living cells

4. Research Methodology

This study compared the sustainability consciousness of students before and after the intervention (VKN 320 classes). The population comprised of the 2013 class for the VKN 320 module, comprising of 139 students. A questionnaire was disseminated during the beginning of the semester (July) and again at the end of the semester (October). It comprised of 22 questions using a 5-point Likert scale. The questionnaire was based on the New NEP (New Ecological Paradigm) scale (Dunlap, *et al.,* 2000), with some adapted questions and

some additional questions to test systems thinking. The questions adapted from the New NEP scale were questions 9, 10, 12 and 22. These in the New NEP scale are questions 10, 4, 9 and 7 respectively. New NEP question 10 focuses on Ecocrises, while 4, 9 and 7 all focus on Anti-exceptionalism. The other questions focus on values associated with the ecological worldview. The questionnaire is available in Annexure A.

In collecting the data, the completion of the questionnaires was done during class time. Students participating signed consent forms and each chose their own pseudonym, which was used in both questionnaires. This was to enable a comparative analysis to be conducted without revealing the identities of the students. Students were requested to record their pseudonym, to be able to use it again in the second round of questionnaires. Of the 139 students in the class, 139 completed the July questionnaire and 85 completed the October one. Of all the respondents, 42 cases could be matched, as they had the same pseudonym in both July and October. These form 30% of the population, are reflective of the population and were used to do the comparative analysis. The unmatched cases were used for a descriptive statistics analysis.

Data analysis was performed on IBM SPSS 22. The questionnaire had disproportional directionality. Of the 22 questions, only 3 were in the 'anti-ecological worldview direction'. These are questions 2, 12 and 16. For analytical purposes, the three questions were changed to a 'pro-ecological worldview' direction in SPSS. The reliability test of the questionnaire was conducted. Forty two of the responses permitted a comparative study, where a two related samples t-test was conducted to evaluate more accurately the effect of the intervention. The data failed to meet the assumptions of the parametric dependant t-test. So the non-parametric Wilcoxon Signed Ranks Test was used to determine if there was a significant difference between the first and second questionnaires, thus determining the effectiveness of the intervention.

The Chronbach alpha for both the July and October populations was adequate, being 0.867. For questionnaires, an acceptable value is ≥0.7. Therefore, this alpha value is relatively high. Occasions reliability and factor analysis were not conducted.

5. Findings and Discussion

5.1 Descriptive statistics

Table 2Descriptive statistics

JULY DESCRIPTIVE STATISTICS						OCT DESCRIPTIVE STATISTICS					
	N						N				
	Valid	Missing	Median	Mode	Std. Deviation		Valid	Missing	Median	Mode	Std. Deviation
Q1	138	1	1.00	1	1.188	Q1	85	0	1.00	1	1.393
Q2	138	1	2.00	1	1.275	Q2	84	1	2.00	2	1.310
Q3	136	3	3.00	3	1.003	Q3	84	1	3.00	2	1.153
Q4	137	2	3.00	3	1.007	Q4	85	0	3.00	3	1.126
Q5	138	1	3.00	4	1.116	Q5	85	0	4.00	4	1.140
Q6	138	1	2.00	2	1.224	Q6	83	2	3.00	2	1.094
Q7	137	2	3.00	4	1.204	Q7	85	0	3.00	4	1.269
Q8	137	2	2.00	2	1.233	Q8	85	0	3.00	2	1.160
Q9	137	2	3.00	4	1.232	Q9	83	2	4.00	5	1.272
Q10	137	2	3.00	4	1.326	Q10	85	0	3.00	3	1.268
Q11	136	3	2.00	2	1.211	Q11	85	0	3.00	2	1.238
Q12	138	1	4.00	5	1.227	Q12	85	0	4.00	4	1.161
Q13	135	4	2.00	2	1.164	Q13	84	1	2.00	1	1.262
Q14	138	1	4.00	5	1.295	Q14	85	0	4.00	4	1.270
Q15	137	2	2.00	2	1.170	Q15	84	1	2.00	2	1.144
Q16	138	1	4.00	4	1.352	Q16	85	0	4.00	4	1.284
Q17	138	1	2.00	2	1.243	Q17	85	0	2.00	2	1.297
Q18	138	1	3.00	3	1.171	Q18	85	0	2.00	2	1.181
Q19	137	2	2.00	2	1.245	Q19	84	1	2.00	2	1.249
Q20	137	2	2.00	1	1.233	Q20	84	1	2.00	1	1.342
Q21	138	1	2.00	1	1.151	Q21	85	0	2.00	1	1.280
Q22	138	1	1.00	1	1.156	Q22	85	0	1.00	1	1.499

The descriptive statistics for July and October are shown below in Table 2. The frequency tables for each are available in Annexure B and C respectively.

From the descriptive statistics, it can be seen that there is little variance between the modes and medians of the July and October results. Regarding the modes, only questions 2, 3, 9, 10, 12, 13, 14 and 18 (eight of twenty-two or 36%) are different and they are different by one point up or down. Regarding the medians, only questions 5, 6, 8, 9, 11 and 18 (six of twenty-two or 27%) are different, by one point up or down as well. The descriptive statistics at face value indicate that the intervention (hybrid teaching model) was not successful. However, the data also indicate that the students started off with a high level of environmental awareness

(the main test of the NEP scale). This small difference between the cases can also be attributed to the lack of validation of this questionnaire as a measurement tool, as no pilot test was conducted.

In Table 3 each question is discussed individually in a qualitative manner using the data and modes in Table 2.

Table 3Qualitative Analysis

	QUESTION	DESCRIPTION	CHANGE
Q1	We can understand something by breaking it down into its component parts.	Most students strongly agreed with the statement initially, indicating a reductionist worldview. There was no change in the mode, indicating that there was no improvement.	none
Q2	The whole of something is no more than the sum of its parts.	The directionality of this question was changed. Initially the mode indicated that students strongly agreed with the statement. The mode changed to them agreeing somewhat. This indicated a slight improvement in their stance.	better
Q3	Most processes are linear and characterised by cause and effect.	Initially most students were not sure, but later changed, indicated by the mode, to somewhat agreeing with the statement. This shows that they did not fully understand the concept of feedbacks.	worse
Q4	Most issues and events are fundamentally discrete (separate) or may be regarded as such and may be dealt with adequately in a segregated way.	Again, this question looked at the understanding of systems thinking. Students initially were not sure, and remained not sure; the mode did not change.	none
Q5	It is ethically acceptable to draw your circle of attention or concern quite tightly, as in 'that is not my concern'.	This question looked at values around ecological thinking, which include social justice. Most students disagreed somewhat with the statement initially, and even after the course, still disagreed somewhat.	none
Q6	We can define something or value something by distinguishing it from what it is not, or from its opposite.	This question speaks to the interrelatedness of things. Initially students agreed somewhat with the statement. The mode did not change, meaning they still agreed somewhat.	none
Q7	We can understand things best through a rational response. Any other response (e.g. intuition) is irrational.	Students somewhat disagreed with the statement. This supported the ecological worldview perspective which posits the validity of multiple sources of knowledge over and above the scientific method. The mode did not change.	none
Q8	If we know what the state of something is now, we can usually predict future outcomes.	This question tests the understanding of complex system behaviours. Students initially somewhat agreed with the statement, and the mode did not change.	none
Q9	I think the reports of climate change are exaggerated.	Initially students somewhat disagreed with the statement. Their understanding improved as they ended up strongly disagreeing with the statement; this was an improvement	better
Q10	I believe that technology will find a solution to any environmental problems we may face	The question looks at the belief that human ingenuity would be able to manage nature. Initially students somewhat disagreed with the statement. After the course, students were not sure, indicating that their stance worsened.	worse
Q11	My personal contribution to any environmental problem is very small	The ecological worldview's values include taking responsibility for one's personal impact. Students somewhat agreed with the statement, indicating an understanding of the value. The mode did not change, so they still somewhat agreed after the course.	none
Q12	My personal welfare does not depend on the welfare of the natural world	The directionality of this question was changed. This question looks at understanding that we are dependent on natural systems that have limits, and that by damaging them, we put our own livelihood in jeopardy. Initially students strongly disagreed, this changed to somewhat disagreed, indicatingan improvement.	better
Q13	I think of the natural world as a community to which I belong	This question looks at one's understanding that humans are not superior, but another part of the web of life. Students initially somewhat agreed with the statement. Later students strongly agreed, indicating an improvement.	better
Q14	I feel disconnected from nature.	Sustainability education aims to teach people that we are an integral part of nature. Students initially strongly disagreed with the statement. They later somewhat disagreed, meaning that their stance worsened.	worse
Q15	I have a deep understanding of how my actions affect the natural world.	The question looks whether we understand the impact we have on nature e.g. carbon footprint, waste production. Initially students somewhat agreed with the statement. The mode did not change; students still somewhat agreed with the statement.	none
Q16	Whilst plants and animals are essential to human existence, I have no personal bond with most of them.	This question looks at the interconnectedness of life. Students initially somewhat disagreed with the statement, and continue to somewhat disagree, indicating some level of connection with nature.	none
Q17	I feel that all the inhabitants of Earth, human and non-human, share a common life force	This question looks at humankind being part of the web of life. Initially students somewhat agreed with the statement. The mode did not change, and they still somewhat agreed with the statement.	none
Q18	Like a tree can be part of a forest, I feel embedded within the broader natural	This question refers to holism, that we are embedded in the environment around us. Students were initially not sure. After the	better

	world	course, students somewhat agreed, indicating an improvement.	
Q19	The world is not merely around us but also within us.	This question also looks to the interconnectedness of life. Students initially strongly agreed with the statement. The mode did not change.	none
Q20	I think I can make a difference to the world.	This question looks to understanding that change does not necessarily have to be huge, but that many people doing little things differently can bring about big change. Students initially strongly agreed with the statement and the mode did not change.	none
Q21	I am aware of how my actions affect other people, including those outside my circle	This question concerns understanding that actions have ripple effects, beyond what one thinks, and one has to be conscious of those effects. Students initially strongly agreed with the statement, and maintained this stance; the mode did not change.	none
Q22	We are all responsible for creating the kind of world that will be good and healthy to live in for all beings, human and non-human	This question looks to understanding that humankind has an obligation to other species that their existence is not jeopardised by their conduct. Initially students strongly agreed with the statement and maintained their stance; the mode did not change	none

From the above it can be seen that while the students did enter class with some environmental sentiments such as a connection to nature, their awareness of their relationship with their environment improved. However, their understanding of systems thinking actually worsened, their belief in technological solutions increased and their sense of disconnection appear to have worsened. There may be a number of reasons for this, which this paper does not have room to explore.

5.2 Wilcoxon Signed Ranks Test

The Wilcoxon Signed Ranks Test was used to compare cases between the July and October questions to determine if a statistically significant difference existed, thus proving or disproving the effectiveness of the intervention. The comparative cases were used: 'Q' represents a July result, while 'OQ' represents an October one. The summarised Test Statistics are presented in Table 4 below, while the Wilcoxon Signed Ranks Test results can be found in Annexure D.

Table 4Summarised Wilcoxon Signed Test Statistics

TEST STATISTICS[a]		
	Z	Asymp. Sig. (2-tailed)
OQ1 - Q1	-1.187[b]	.235
OQ2 - Q2	-3.298[c]	.001
OQ3 - Q3	-2.401[b]	.016
OQ4 - Q4	-.112[c]	.911
OQ5 - Q5	-1.721[b]	.085
OQ6 - Q6	-.941[b]	.347
OQ7 - Q7	-.231[b]	.817
OQ8 - Q8	-.042[c]	.966
OQ9 - Q9	-.633[b]	.527
OQ10 - Q10	-.442[c]	.658
OQ11 - Q11	-1.691[b]	.091
OQ12 - Q12	-3.969[b]	.000
OQ13 - Q13	-.398[b]	.691
OQ14 - Q14	-.353[b]	.724
OQ15 - Q15	-.607[c]	.544
OQ16 - Q16	-1.363[b]	.173
OQ17 - Q17	-.101[b]	.920
OQ18 - Q18	-.366[c]	.714
OQ19 - Q19	-1.069[c]	.285
OQ20 - Q20	-.141[c]	.888
OQ21 - Q21	-.392[c]	.695
OQ22 - Q22	-.173[b]	.863

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.
c. Based on positive ranks.

Table 4 indicates the test statistic, the Z values, and their corresponding p values (last column). The p-value indicates which changes are statistically significant: those with a p-value ≤0.05. The results indicate that only two questions indicate significant differences between the cases, namely questions 2 and 12. Both these provided a p-value of p≤0.05. This is in line with the descriptive statistics results, and confirms the conclusion that while there was improvement in some significant areas, the intervention was mainly not successful.

However, the validity of the tool is still a major factor, possibly distorting the results. In further analysis, the high number of questions in which there was no change indicated a high baseline agreement with ecological paradigm values, which further skews the data.

6. Conclusions and Further Research

The study aimed to evaluate the success of a hybrid teaching approach aimed at shifting students towards an ecological worldview. Statistically speaking, the data indicate that the model was not successful. However, a high baseline agreement with ecological paradigm values was indicated, which may skew perceptions of success, and important aspects such as a greater awareness of the relationship with nature did improve. However, the students' perception of the world remains largely reductionist, and one can therefore argue that the intervention was mostly unsuccessful.

There were also some problems with the data. Participants forgetting pseudonyms affected the sample sizes, which affects the results and conclusions to be drawn. Secondly, the measurement tool used must be validated through a pilot test before administering to participants, as it affects the conclusion greatly. The experiment was repeated in 2014 and 2015 with another pseudonym formula and slightly revised course content and presentation, but retaining the same questions. This data still needs to be analysed. The question remains whether it is possible to encourage a shift towards a more holistic and ecological worldview through education alone. Qualitative feedback from the assignments indicates that for some individuals there was a significant shift in thinking. Future research may want to do away with the NEP scale and make use of psychological testing of cognitive development such as that developed by Clare Graves (Beck & Cowan, 1996) or Suzanne Cook-Greuter (2013), which can test movement towards what Wilber refers to as higher developmental altitudes with a more holistic, systemic and worldcentric worldview (Wilber, 2000:5).

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8. Annexures

The annexures are available from https://www.dropbox.com/s/5vr68mo9xx4tn1q/SASBE2015-REFLECTIVE_PRACTICE_Supplementary_material.docx?dl=0

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