

# Education for Sustainable Development (ESD) Infusion Into Curricula: Influences on Students' Understandings of Sustainable Development and ESD



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## Abstract

Formal education for sustainable development (ESD) is in large part dependent on capacity–building and training of teachers as they are the individuals who must both deliver ESD at the classroom level as well as utilize their own knowledge, values, and skills in support of sustainability. In this paper, teacher educators within a higher education institution in Jamaica who infused ESD in their course delivery analyze data collected from approximately 140 of their students pre– and post–intervention to ascertain whether individuals' awareness and knowledge of sustainable development (SD) and ESD had changed because of the infusion process. Preliminary findings indicate that students' understanding of SD broadened after the courses, with most students believing that SD involves social, economic, and environmental improvements that do not come at the expense of our natural resources. Additionally, students' thoughts about ESD shifted, with students highlighting aspects of the interdisciplinary nature of ESD, and ESD as involving equitable, inclusive education. The findings are significant in highlighting how intentional infusion of ESD into courses can enhance students' knowledge and awareness of SD and ESD.

*Keywords:* education for sustainable development, sustainable development, teachers, infusion, Jamaica

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## Introduction

Education for sustainable development (ESD) is critical to achieve sustainable development (SD)—societal well-being based on a balance between economic development, environmental sustainability, social inclusion, and good governance (Sachs, 2012). As UNESCO (2020) highlights, “ESD empowers learners with knowledge, skills, values and attitudes to take informed decisions and make responsible actions for environmental integrity, economic viability and a just society empowering people of all genders, for present and future generations, while respecting cultural diversity” (p. 8). This is important for the Caribbean given the various sustainability issues that challenge the region, such as climate change and violence (Down, 2015b).

ESD is most effectively pursued by formal, non-formal, and informal means geared at all education levels and sectors within society. At the tertiary level, ESD is particularly important given higher education institutions’ potential to engage in public awareness and education, to serve as models of sustainability for the wider society, and to implement project- and community-based ESD and sustainability work that is relevant for the communities and the wider society that these institutions serve. Indeed, Ryan and Tilbury (2013) propose that higher education is critical for engaging individuals with sustainability because “this is the arena for significant encounters with critical thinking, provocative questions and alternative ideas about our current patterns of development and our potential to devise new ways of living” (p. 273). Additionally, the role of universities in shaping the managers, decision-makers, and teachers within society necessitates their acknowledgment of the critical role they play in shaping sustainability at national and local levels (de la Harpe & Thomas, 2009).

With this in mind, this paper highlights one component of a larger collaborative action research project carried out by an ESD Working Group (WG) comprising teacher educators from various disciplines. Within the larger project, their task was to enact and evaluate the infusion of ESD into their undergraduate and postgraduate course delivery through a collaborative approach (Roofe et al., 2021). This undertaking was seen as critical given the integral role that teacher educators and teachers play in the promotion of ESD (McKeown, 2014; UNESCO, 2014). Whilst the collaborative process at the forefront of the undertaking was an important aspect of exploration for these teacher educators and is elsewhere documented (Roofe et al., 2021), this paper focuses on the ways in which the infusion of ESD content enhanced and engendered ESD awareness (recognition of and sensitivity to sustainability issues) and knowledge (basic understanding of sustainability issues) amongst pre- and in-service teachers in selected courses. The authors draw on Hungerford et al.’s (1989) definition of infusion as the “integration of the content and skills into existing courses in a manner as to focus on that content (and/or skills) without jeopardizing the integrity of the courses themselves” (p. 57). The following research questions (sub-questions of the larger research undertaking) provided

direction for the intervention with the students:

1. In what ways has the process of ESD infusion enhanced students' knowledge of SD?
2. In what ways has the process of ESD infusion enhanced students' awareness of ESD?

Thus, the authors wanted to see if, after infusion, students' awareness and knowledge were enhanced; that is, whether they had awareness and knowledge that did not exist previously and/or whether they experienced broadened and more holistic awareness and knowledge. This research undertaking is significant given that the education sector at all levels is challenged to engender a sustainability consciousness amongst its student population, to develop citizens "mindful of the common good, attending to equitable social and economic relations and to the care and protection of the environment" (Down, 2015a, p. 105). Notwithstanding this, whilst there is a growing body of literature on ESD within the Caribbean (e.g., Collins-Figueroa, 2012; Down, 2015a), engagement with students' sustainability knowledge, particularly at the tertiary level, is lacking. This research thus contributes to this body of literature. Moreover, by focusing on the changes in students' knowledge and awareness through the infusion, it can offer insights for those interested in initiating similar models of infusion at their institutions.

## Literature Review

### *Teachers' Knowledge, Values, and Skills in Support of Sustainable Development*

The concepts of SD and ESD have been an integral part of global discourse. In 2015, the United Nations General Assembly set 17 Sustainable Development Goals (SDGs) aimed at empowering people to respond and adapt to present and future opportunities; that is, to live sustainable lives (OECD, 2017). The role of education as a major tool for linking the environment with responsible development is reflected in all 17 SDGs, particularly SDG 4.7, which aims to "ensure that all learners acquire the knowledge and skills needed to promote sustainable development" (Leicht et al., 2018, p. 25). The focus of ESD then is linking education with SD, while ensuring a focus on the interrelated environmental, social, and economic dimensions of SD (OECD, 2008).

The integral role of education in the accomplishment of the 17 SDGs has implications for teacher education. Teachers spend time with students who will be future citizens, leaders, and decision-makers. It is therefore crucial to address teacher educators' and teachers' SD and ESD awareness, knowledge, understanding, values, and competencies, as these will play a major role in developing students' future problem-solving and decision-making capacity. Teacher education focused on ESD seeks to empower teachers who will in turn empower learners about SD issues aimed at improving the quality of the environment and quality of life (Anyolo et al., 2018; Shumba, 2018). However, McKeown (2014) cautions that "Reorienting teacher education typically takes years of work in teacher education institutions to create deep and enduring

changes” (p. 129). One reason for this is variation in teachers’ SD and ESD knowledge and competencies. Thus, successful teacher education in SD and ESD will depend on both competent and committed teachers who are motivated to act as change agents (Frisk & Larson, 2011).

Barth and Rieckmann (2012) conducted a case study of 18 faculty members at a university in Ecuador who were provided support for implementing ESD. The individuals participated in a 1-year program that targeted three outcomes: (a) developing individual competencies in teaching about SD; (b) successful integration of SD issues into teaching; and (c) long-term organizational impact. The findings indicated “strong development of key competencies for sustainability and education for sustainable development” (Barth & Rieckmann, 2012, p. 31). The faculty members reported successfully integrating ESD in their teaching, for instance by collaborating with colleagues in other disciplines, and providing meaningful learning opportunities for their students by combining theoretical learning with practical applications. Similar findings were reported by Biasutti et al. (2018) from a study conducted with eight faculty members of various disciplines from two universities in Jordan who participated in a project aimed at building capability to incorporate ESD in curricula and pedagogy. Participants in the latter study reported changes in attitudes, teaching and assessment methods, and course design skills.

At the secondary level, Gustafsson et al. (2015) used Clément’s KVP model (knowledge, values, [social] practices), the three dimensions from the Brundtland SD definition (environmental, social, economic), as well as culture as a theoretical frame to identify SD and ESD features from interview data collected from 11 teachers. When the model was applied, findings revealed that teachers displayed knowledge of the SD dimensions but did not mention culture specifically. There was variation of teachers’ knowledge of the interrelatedness of SD—some had knowledge of three dimensions while others only recognized one. This finding is similar to those of studies conducted in Germany with 184 pre-service teachers (Burmeister & Eilks, 2013), in the U.K. with 61 geography and science student teachers (Summers et al., 2004), and in Latvia involving 32 novice teachers teaching from Grade 3 to Grade 12 (Zhukova et al., 2020). All the studies reported that the teachers tended to recognize and focus on individual aspects of SD and ESD, such as the ecological and economical rather than the interdependent dimensions. Okręglicka (2018) reported on 300 Polish university students’ who experienced ESD infusion into their courses. The students scored 5.643 points on a 7-point scale measuring their commitment to sustainability, which signalled strong intentions for applying SD principles in the future. These results were linked to teachers’ increased familiarity with SD issues based on their university courses. Additionally, according to Qablan (2018), “many teachers in many classrooms still remain unaware of the transformative nature of ESD and its effectiveness in promoting competent and socially active learning among students” (p. 155).

With respect to the values and practice elements of the KVP model (Gustafsson et al., 2015), the teachers generally agreed that SD teaching is important in all subjects; however, there were varied responses on the source of the “commission” to teach SD proposing the curriculum, subject syllabi, and the Ministry of Education. For the “practice” criterion, teachers stated practices that included teaching alone and collaborating with colleagues. Lecturing and group work were named as common teaching strategies utilizing resources that included: textbooks, information and communication technologies, and artefacts (movies, newspapers). Based on the deficiencies in teacher competency, various researchers recommended further training and more support for teachers in developing a holistic understanding of SD, as learning about these concepts is not priority in some countries (e.g., Borg et al., 2014; Burmeister & Eilks, 2013; Zhukova et al., 2020).

### **Teacher Capacity–Building to Infuse ESD Into Curricula**

For ESD integration to be successful, teacher preparation should address key content, issues, and values such as “respect for all lifeforms ... preservation of the planet’s natural resources ... and responsible consumption strategies that support prosperity” (Qablan, 2018, p. 138). These issues represent the interrelatedness of the environmental, social, and economic dimensions of SD, which teachers are reported to have difficulty understanding (OECD, 2008). ESD integration also calls for student–centred pedagogies and assessment strategies, which encourage critical thinking, problem–solving, decision–making, and participatory learning, which are more suitable to address complex issues (Qablan, 2018; UNESCO, 2017, 2018).

Burmeister and Eilks (2013) reported that pre–service teachers often display positive attitudes towards implementing ESD in their chemistry classes but usually lack general SD knowledge, specific chemistry content knowledge, and pedagogical content knowledge to use suitable instructional strategies for ESD in chemistry. According to Zhukova et al. (2020), in order to produce well–informed, critically thinking teachers, “teacher education programs should address the fundamentals of ESD more explicitly and meaningfully” (p. 43). However, there is a concern that “With teacher educators often having autonomy in what they teach and how they train teachers, the focus on ESD ... can be limited and ad hoc in nature” (UNESCO, 2017, p. 55) or even excluded.

One of the suggestions for addressing ESD more meaningfully is by introducing its elements into curricula, programs, and subjects at all levels of the education system through infusion or integration (Laurie et al., 2016; Otto & Wohlpert, 2009). According to Down (2008), infusion means “to weave into the existing curriculum, the knowledge, perspectives, values, skills/actions needed to transform society and to sustain the planet” (p. 38). This definition of infusion is in line with that of Hungerford et al. (1989) previously outlined, where integrating content and skills is emphasized. UNESCO (2018) indicates that ESD integration is “an all–

embracing and systemic concept and objective” (p. 17) involving curricular *and* whole institutional change. The terms mainstreaming—“the inclusion of relevant content and the use of appropriate teaching and learning methods, within the curriculum” (UNESCO, 2018, p. 20)—and embedding (Schrage & Lenglet, 2016) have also been used to describe ESD implementation. The idea conveyed is that ESD implementation requires focused, deliberate, and collective effort. UNESCO (2018) suggests several ways of ESD infusion or integration, including:

adopting a thematic, issue or problem-based approach like climate change, air pollution, deforestation (etc.), based on the local realities; incorporating the use of teaching and learning methodologies consistent with ESD principles of learner-centred and participatory approaches, such as field trips; conducting ESD-based co-curricular or extra-curricular activities, such as the use of student clubs and associations and activities; engaging with the local community, often through project-based learning opportunities. (p. 18)

Infusing ESD into existing courses and introducing stand-alone ESD courses or programs in teacher preparation has been done in countries such as Jamaica, Estonia, and Pakistan (e.g., Down, 2008; Elvisto & Henno, 2008; Kalsoom & Khanam, 2017; Makrakis & Kostoulas-Makrakis, 2012).

Despite numerous ESD activities in recent times, there is limited practice and a lack of success in higher education particularly in a holistic way, targeting curriculum, diverse disciplines, the three SD dimensions, teachers’ attitudes, SD content, and ESD pedagogical content knowledge geared towards institutional change (Jetly & Singh, 2019). Among the challenges identified are: developing unity on diverse agendas, collaboration on teaching, lack of training in how to teach ESD, limited ESD content in some syllabi, and shortage of ESD teacher educator experts (Anyolo et al., 2018; Qablan, 2018).

Ryan (2012) highlighted the need for performance indicators to show ESD progress. UNESCO (2018) has provided a useful framework for identifying holistic targets (e.g., content, pedagogy, context, leadership) in teacher education (see Table 1).

**Table 1***A Framework for Evaluating ESD Integration in Teacher Education*

Characteristics	Evidence
Content effectiveness	Identifying content areas in the curriculum aimed at developing learners' content and practice
Teaching and learning approaches	Teaching and learning strategies should be specific to the learners' local context, level, experiences
Relevance	Curriculum content and practice match local context and current policy framework
Mainstreaming	ESD content and practice evident within curriculum and throughout entire institution
Curriculum adaptability	Curriculum adaptable to change in the context
Commitment to transformation	Supported by leadership and fostered at all levels of the institution

Positive results have been reported on awareness and capacity building from ESD infusion in teachers' preparation and professional development. For example, in Jamaica, Collins-Figueroa (2012) explored how biodiversity was addressed in teacher education curricula by studying four teacher-training colleges, while Down (2007) infused ESD issues into an existing literature program in a pre-service teacher-training institution. In both studies there was curricular adaptability as appropriate content and pedagogy were selected that were in line with the community context. Ferreira et al. (2015) studied leadership capacity to effect system-wide change in primary teacher educators' ESD knowledge, skills, and teaching pedagogies in an Australian context, while Mills and Tomas (2013) explored how teacher educators in a Bachelor of Education program, also in Australia, integrated education for sustainability in their teaching.

The teacher educators in the latter studies effectively selected content and pedagogical and assessment strategies for subjects at the primary level. The studies however also identified perceived challenges by teacher educators related to lack of policy support for professional development opportunities on ESD relevance for their respective subject or curriculum area, how to best integrate ESD in their teaching, and developing resources that support ESD integration across the curriculum.

Only a few studies have explicitly, consistently, and coherently focused on teacher educators

educating future and in-service teachers to engage in sustainability action (Gough, 2016), particularly in the Caribbean region (e.g., Cambers et al., 2010; Down, 2010). The question of how pre- and in-service teachers perceive the value of ESD infusion for their awareness and competencies can be explored further. We sought to address these issues in this study by shedding light on the perspectives of pre- and in-service teachers in selected courses through the process of infusion.

### **The Jamaican Context**

To help situate the study, it is useful to share some basic details with respect to the country context. Jamaica, the third largest island in the Caribbean and the region's largest English-speaking island, has an approximate population of 2.9 million and is classed as having "high human development" according to the United Nations Development Programme (UNDP, 2022). The country's economy is highly dependent upon industries such as tourism, agriculture, and mining, thus rendering careful management of their natural resources critical. Jamaica grapples with various sustainability issues including vulnerability to climate change and other natural disasters, violence, low economic growth, and high public debt (Down, 2015b; Taylor, 2015; World Bank, 2020). Its education system is highly structured, with formal education offered at the early childhood, primary, secondary, and tertiary levels. Teacher education is offered for pre- and in-service teachers through teachers' colleges and universities.

Importantly, Jamaica has a long-standing history of environmental education and ESD, participating in international conferences, engaging in curriculum and program development, teacher education, and resource development (Collins-Figueroa et al., 2008). With respect to teacher education specifically, efforts to ensure capacity-building for pre- and in-service teachers have included infusion approaches, whole-school approaches, community-oriented approaches, and course and program development as some examples (e.g. Collins-Figueroa, 2012; Down, 2008, 2010; Ferguson & Bramwell-Lalor, 2018).

### **Methodology**

The main objective of this collaborative action research project research was to enact and evaluate the impact of ESD infusion on 140 undergraduate- and graduate-level students, who were either pre- or in-service teachers. To accomplish this, six members (teacher educators) of the ESD WG designed and conducted an intervention to engender and enhance both undergraduate and graduate students' awareness and knowledge of SD. These teacher educators worked in different disciplines such as science education, environmental education, ESD, curriculum and instruction, teacher education, and research methodologies. Some of these individuals were new to the concept of ESD and new members of the WG, whilst others were familiar with the concept and had been members of the ESD for several years.



Each member selected one of their own courses and made modifications with new materials, activities, assignments, and/or assessments that facilitated infusion of ESD skills, issues, perspectives, and values. What was done is outlined in Table 2 (Roofe et al., 2021).

**Table 2**

*How ESD Infusion Occurred in Each Course*

Course	Infusion Activities
Changing Cultures, Changing Schools	<ul style="list-style-type: none"> <li>– Sensitization to research activity and pre-test (Week 1)</li> <li>– Viewing of Pricey Bargains video; PowerPoint presentation and discussion on SD; listening to song Mother Earth's Cry; paired activity identifying and discussing sustainability issues (Week 11)</li> <li>– Mini lecture with PowerPoint and discussion on the concept of ESD; video presentation and discussion of a "sustainability school" (Week 12)</li> </ul>
Environmental Education	<ul style="list-style-type: none"> <li>– Sensitization to research activity and pre-test (Week 1)</li> <li>– Video presentation on ESD and discussion (Week 3)</li> <li>– Weekly in-class discussions focusing on changing consumption patterns, climate change, solid and hazardous wastes</li> <li>– Guest presenters from the Climate Change Division of the Ministry of Economic Growth and Job Creation in Jamaica, and the UNDP (Weeks 6 &amp; 7)</li> <li>– Completion of action project as course assessment to include ESD focus</li> </ul>
Fundamentals of Data Analysis	<ul style="list-style-type: none"> <li>– Sensitization to research activity (Week 1)</li> <li>– Mini guest lecture focusing on ESD-related concepts by ESD WG member (Week 5)</li> <li>– Reading of at least three journal articles on ESD and summary of the literature on ESD (Weeks 2–13)</li> <li>– Design of mini project collecting teachers' views on ESD included as part of course assessment (Weeks 3–13)</li> <li>– Two-page reflection on ESD infusion</li> </ul>
History of Science and Science Teaching	<ul style="list-style-type: none"> <li>– Sensitization to research activity and pre-test (Week 1)</li> <li>– PowerPoint presentation and discussion on what is sustainability; educational challenges for sustainability; implications of ESD for scientific literacy (Week 3)</li> <li>– Ongoing discussion of ESD related concepts as they emerged throughout the course</li> </ul>

**Table 2 (cont'd)***How ESD Infusion Occurred in Each Course*

Course	Infusion Activities
Principles of Curriculum Development and Implementation	<ul style="list-style-type: none"> <li>– Sensitization to research activity and pre-test (Week 2)</li> <li>– Video presentation on ESD followed by class discussion (Week 5)</li> <li>– PowerPoint presentation and discussion on ESD; peer teaching based on analysis of article by UNESCO (2015)</li> <li>– Repositioning and reconceptualizing the curriculum for the effective realization of SDG 4, for holistic development and sustainable ways of living; and one chapter from the text <i>SDG4 – Quality Education: Inclusivity, Equity and Lifelong Learning for All</i> (pp. 49–69) (Week 8)</li> <li>– Designing of units to include ESD principles as part of course assessment (Weeks 7–12)</li> </ul>
Teacher Leadership	<ul style="list-style-type: none"> <li>– Sensitization to research activity and pre-test (Week 1)</li> <li>– Video presentation on ESD and discussion, two YouTube videos about the Millennium Development Goals, Education for All, and the SDGs that explained the significance of concern and action for sustainability through education; PowerPoint presentation and discussion on ESD as an option for advocacy (Week 6)</li> </ul>

***Data Collection Procedures***

At the start of the semester, each research team member sensitized their students to the aims, purpose, and planned procedure for the project. Students were invited to participate and required to indicate their willingness to do so by signing an informed consent form. To determine the impact of the intervention, we designed an instrument (see Appendix) that would allow students to describe their understanding of four key concepts including the two that are the focus of this paper (SD and ESD). The instrument comprised two sections: one for demographic data and the other presented each key concept in a circle with lines attached. Students were asked to explain their understandings of four key concepts: SD; ESD; teachers promoting ESD; and ESD actions required of the teacher. Students were asked to complete this first at the start and again at the end of the semester.

***Data Analysis***

The completed instruments were collected by a research assistant who kept them secured. Analysis started after the post-course instruments had been completed. Participant responses were transferred from the handwritten forms into a Microsoft Word document and prepared for

initial coding by the research assistant. The list of codes and emerging categories were collated into a table. They were subjected to a second round of coding and thematic analysis by three of the researchers who worked collaboratively over six working sessions to produce initial assertions. These were then shared with the other three researchers who acted as peer reviewers by considering the degree to which the assertions captured the meaning emerging from the data.

## Findings

The findings are presented to reflect the themes according to each concept pre- and post-infusion. The two concepts of focus are SD and ESD.

### *Sustainable Development*

#### *Pre-Infusion*

Prior to infusion, seven students indicated that the concept of SD represented new knowledge, indicating they did not possess any information about it. Students who had some knowledge about the concept defined it in relation to four themes: natural environment, environmental protection, social equity, and national development.

#### Natural Environment

For those students who conceived of SD as focusing on the natural environment, their focus was on the replenishment and protection of the natural resources through means such as reforestation and the use of eco-friendly technology. Among the comments were the following:

“SD is about recreating and upkeep of resources that have been used up or depleted.”

“[SD] is the process of creating technological devices and skills that are eco-friendly to the environment” [in other words, the process for producing technological products that are not harmful to the natural environment].

“Replant trees (reforestation) to maintain habitation, prevent air pollution, and provide food for all.”

Although these students were primarily focusing on one facet (the natural environment), this is important given that the natural environment contains the resources and life cycles critical to the maintenance of human and non-human species.

#### Environmental Protection

Environmental protection from the students' perspectives entailed facilitating the use of resources for development while utilizing measures to protect the environment. Students' comments were as follows:

“[SD] is the way people use resources to carry out activities without the resources running out.”

“Developments that are being done do not deplete the present resources, but instead seek to preserve and maintain that which is present.”

“This is using available resources in a manner that will ensure that the future generation will benefit conservation.”

Related to the focus on the natural environment, students highlighted the importance of protecting the environment to ensure continuity of natural resources. In the last extract, future generations are considered, important given that sustainability carries implicit considerations for both present and future generations.

### Social Equity

The students also related SD to social equity with emphasis on issues pertaining to inclusive education as well as social and economic fairness through policy development. The following narratives by the participants indicate that SD is about:

“Ensuring inclusive equitable quality, education.”

“Developing policies that incorporate everyone in the society for them to be productive towards contributing to the economy.”

For those students, the focus was on social inclusion; that is, ensuring that all individuals are included in productive endeavours (in this instance, through policy formation and implementation), that enable them to be contributing members to the economy and, by extension, the nation. The focus on quality education supports this as quality education is a necessary precursor to individuals' abilities to be productive members of society.

### National Development Policies

For students who spoke about national development, they spoke to the institutional responsibility of governments to develop processes for the country to become self-sufficient and ensure investments in human resources. Some students expressed that national development would also benefit from the global community. They indicated that government structures should also benefit individuals so that they can have improved quality of life:

“[SD] is the overall thrust to boost the economic development of a country through education, training, production/manufacturing, health (physical, social, emotional/mental, spiritual).”

“[SD] refers to the process by which a country is self-sufficient.”

“[SD] is the ability of a country to invest in its people by providing adequate skills training and knowledge in its education systems.”

“[SD] is a part of the educational process which seeks to enable individuals with the skills,

an attitude which organizes resources so that they are able to be utilized in an economically and environmentally friendly way so that improvements will be made to the society and the world at large.”

Based on students’ perspectives during the pre-infusion phase of the intervention, students were discrete in their thinking about the conceptualization of SD. In other words, students did not see the connection between or among the different areas of SD.

#### *Post-Infusion*

Teacher educators sought to ascertain students’ conceptualization of SD at the end of the semester after the infusion process. This is referred to as the post-infusion phase. At the post-infusion phase, only one student indicated that they still did not know what SD was. Apart from this, students’ comments about SD reflected a more complex, integrated conceptualization of the concepts related to SD. Additionally there were more comments from students that reflected a future-oriented conception of SD.

#### Integrated Conception of SD

Students’ post-infusion narratives reflected a broader and more integrated understanding of the elements of SD than mentioned in the pre-infusion. The post-infusion narratives saw students speaking to SD’s social, economic, and environmental dimensions. Additionally, wider aspects of life such as individual and social changes were included, brought about by new mindsets and poverty reduction. The following comments reflect these views:

“The focus of [SD] is far broader than just the environment. It’s also about ensuring a strong, healthy, and just society.”

“The strategies also entail the provision of marketable human capital to ensure that the citizens are not dependent on the government for social provisions, thus reducing poverty.”

“The mindset of a people’s behaviour has to change.”

“Inclusion, and creating equal opportunity.”

These post-infusion conceptions illustrate a broadening of knowledge of SD given this more holistic and all-encompassing focus beyond single dimensions of sustainability. This is important since all of the dimensions are interdependent, with negative impacts on one affecting the viability of the others.

#### Future-Oriented Conceptions of SD

Post-infusion, more students became more future-oriented in their comments about SD, voicing considerations for generations beyond the present, actioned through resource

conservation and wider policy development. The following narratives are reflective of their expressions:

“This is development that meets the needs of the environment, society, and economy without neglecting the ability of the future generations to meet their needs.”

“It is about ensuring that decisions made have a positive impact on the future generation.”

“... conservation of available resources without compromising the ability of future generations to meet their needs.”

Pre-infusion themes (natural environment, environmental protection, social equity, national development) suggest disjointed awareness of SD as students' views reflected one-dimensional perspectives of SD. In comparison, post-infusion comments by students reflected comprehensive, integrated, and future-oriented conceptions. Therefore, the results suggest that students' understanding of SD was enhanced and their views evolved based on the infusion of SD in the courses.

### ***Education for Sustainable Development***

#### ***Pre-Infusion***

Before the ESD infusion, seven students indicated that they did not know or were unsure what the concept of ESD was about. After the infusion, no student indicated this. As with the concept of SD, however, the majority of students did have a foundational knowledge of the concept of ESD. Additionally, given that no student post-infusion indicated a lack of knowledge or uncertainty about ESD, this suggests that the infusion did influence students' understandings.

Students who had a sense of what ESD was about identified facets that focused primarily on individual development, civic responsibility, promoting awareness of natural resources, and being responsive to development priorities at all levels. The following extracts highlight these perceptions:

- A focus on self-development, that leads to individual independence: “Being educated to help oneself to have a comfortable lifestyle.”
- Developing citizens for civic responsibility: “Preparing the nation's citizenry for identifying, understanding, and valuing sustainable development. This is making the nations aware of sustainable development.”
- Engendering awareness of the importance of natural resources and acting to conserve/preserve natural resources: “Enlightening others to engage and participate in the act of preserving the natural resources that exist in the environment.”

- Responsive to national and global level developmental imperatives: “Strategies that educators would need to implement to train individuals to prepare for the 21st century. The 21st century is evolving and so educators will have to train individuals to be innovative and highly skilled to handle the changes effectively and remain competitive in the global community.”

Additionally, some students highlighted issues surrounding curricula development. In particular, these individuals spoke to the need to have teaching and learning embedded in formal and non-formal curricula. Further, they suggested that these curricula should be responsive to national and global imperatives, and the emerging job sectors in the country. One student expressed it as the “process of aligning curriculum and training to meet the needs of the developing sectors in the country.”

### *Post-Infusion*

After the infusion, students’ awareness of ESD was enhanced with their initial conceptualizations of the various facets outlined above broadened in the following ways:

- Students’ initial conceptualization of ESD as self-development later broadened into a focus on lifelong learning for all citizens. One participant indicated that ESD “should entail a process of lifelong learning for future and present generations.”
- Students’ conceptualization of ESD as encompassing citizenship development remained after the infusion process but there was a more explicit focus on the development of knowledge, skills, attitudes, and knowledge to facilitate this citizenship development. As articulated by one of the students, ESD “is incorporating principles of sustainable development in lessons so that students can acquire the required knowledge and skills that are needed to promote sustainable development in the society.”
- ESD is seen as acquisition of knowledge and skills to support the economic, environmental, and social dimensions of sustainability: “ESD allows individuals to make informed decisions and take responsible actions that promote economic viability, a peaceful society and a healthy environment for present and future generations.”

Additionally, students identified societal roles and actions in conserving these natural resources, extending this beyond formal education to non-formal education to include deliberately planned community-based activities that contribute to lifelong learning. Students also indicated that ESD should be seen as a response to national and global imperatives through the provision of inclusive and equitable quality education. Further, they offered that ESD requires a responsive curriculum that is facilitated through infusion and multidisciplinary approaches, as well as through formal and informal means. As one student pointed out, it “involves drawing from several areas/disciplines such as social sciences, humanities and the natural sciences.”

## Discussion

This study seeks to make a modest contribution to SDG 4.7 by exploring the role of education in promoting knowledge and skills for SD and ESD (Leicht et al., 2018). As noted by Shumba (2018), education and in particular teacher education must reorient everyone to understand SD. Based on pre-infusion narratives, the students in the six courses had foundational knowledge of SD and ESD. While it is difficult to quantify the level of students' enhancement caused by infusion, the post-infusion comments suggest that students' awareness of SD was enhanced. Based on the post-infusion data, students' conceptualizations of SD seemed to shift from discrete elements to a systems perspective of SD reflecting an integrated conception. The students' comments during post-infusion focused more on the responsibilities of meeting the needs of the present while being cognizant of the needs of the future generations. With respect to ESD, there also seemed to be a noticeable shift in students' perceptions, with students moving from a narrow focus on self or individual development to lifelong learning for all citizens, and from citizenship development to a more explicit focus on the knowledge, skills, and values needed to facilitate this citizenship development. Similar also to SD, students' post-infusion also spoke to the knowledge, skills, and values needed to pursue a more holistic vision of sustainability (ecological, social, economic dimensions). Based on the different means utilized to infuse content, it can be surmised that the different readings, videos, guest lectures, discussions, and other approaches worked to enhance students' awareness and knowledge.

Findings from this study relating to students' pre-infusion narratives on SD seem to align with research carried out by Burmeister and Eilks (2013), Summers et al. (2004), and Zhukova et al. (2020), whose studies indicated that teachers in their teaching focused largely on individual aspects of sustainability rather than the interdependence of all dimensions of sustainability. In terms of ESD, the pre-infusion narratives of the students neglected any dominant focus on ESD's transformative potential or skills and actions competencies, similar to the findings of Burmeister and Eilks (2013) and Jetly and Singh (2019), and the sentiment expressed by Qablam (2018) regarding teachers' lack of awareness of the transformative potential of ESD.

After the infusion process, the results showcased the enhancement of students' awareness of SD and ESD as a result of the infusion. With respect to SD, this is important since according to Krasny (2020) understanding interconnections between natural and social systems is important for environmental decision-making and understanding the complexities of planet earth.

Similar to Okręglicka's (2018) study of 300 Polish university students who experienced ESD infusion into their courses, this study confirms that teachers' increased familiarity with SD issues can occur through their university courses. Awareness and commitment to SD will depend on both competent and committed teachers who are motivated to act as change agents (Frisk & Larson, 2011). Further research would need to be undertaken by the authors to see if



the enhanced knowledge and awareness have worked to similarly enhance behavioural and action competencies amongst the students in the courses. Critical to the enhancement of students' understanding of SD is the role of academic staff as they represent the catalyst for change in university contexts through meaningful teaching (Barth & Rieckmann, 2012).

## Conclusion

The infusion of ESD into courses does have an impact on students' and educators' understanding and action competencies as evidenced by previous studies (e.g., Barth & Rieckmann, 2012; Biasutti et al., 2018) alongside this present study. In this study, ESD infusion enhanced students' awareness and knowledge of SD and ESD. Additionally, infusion allowed students to consider their individual roles and actions with respect to sustainability and ESD. With this in mind, this means that teacher education institutions must consider the following as part of their efforts to reorient teacher education specifically and education more broadly towards sustainability. Firstly, these institutions must work to enhance students' sustainability and ESD awareness through ESD course and program development, and infusion of ESD content into existing courses. Secondly, these institutions must support students' skills development and action competencies through pedagogical approaches such as project- and problem-based learning and community action projects that connect students with real-world contexts in which they can actualize and apply knowledge (Down, 2010). Thirdly, given the holistic nature of sustainability, as it encompasses ecological, social, economic, cultural, and governance components, inter- and multidisciplinary approaches must be used to ensure that different types of knowledge and skills are utilized and honed. It is the authors' hope that this study offers impetus for teacher educators working in the field of ESD.

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**Appendix: Data Collection Instrument**

This activity is designed to find out how much you know about the concepts identified in the circles below.

Please share your understanding of each concept identified below in the space provided.

Name:

Student ID:

Programme:

Subject/s you teach:

**SUSTAINABLE DEVELOPMENT**

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**EDUCATION FOR SUSTAINABLE DEVELOPMENT**

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**TEACHERS PROMOTING EDUCATION FOR SUSTAINABLE DEVELOPMENT**

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**WHAT I CAN DO TO PROMOTE EDUCATION FOR SUSTAINABLE DEVELOPMENT**

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