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Malaysian Primary Pre-Service Teachers' Understanding and Awareness of Environmental Knowledge

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1. Introduction

The quality of the environment is threatened by problems such as global warming, water pollution, fast decline of forests, and desertification (World Commission on Environment and Development (WCED, 1987). Global issues on environmental destruction have created space for more environmental related research to be conducted to overcome the notion that people's awareness over these issues is still at infancy. Due to this ignorance, human being continues to exploit the environment to an unprecedented scale to accommodate the expanding human needs and wants. According to the Millennium Ecosystem Assessment (MEA, 2005), over the past 50 years human activities have changed vital ecosystem services more rapidly extensively than in any comparable period of history. It is perceived that rapid growing demand for fuel, food, and water is likely to exacerbate the current problems. As the global population grows and standards of living improve, there will be increasing stress on the world's limited resources. Contemporary exponential increase in the price of crude oil further heightens this problem. Current degradation of natural environment has far-reaching consequences both to mankind and nature. This situation would require both present and future generations to use the earth's resources more efficiently and to produce less waste.

Education is recognized as one of the important tools to develop present and future citizens to live life in a sustainable manner. Education can illuminate incentives, showing people both how they could personally benefit from changing their behavior, and how they would suffer from a lack of change. Environmental Education (EE) is considered an essential component of the education for future citizens in order for them to be able to confront and deal with the current and emerging environmental issues. Through the process of EE, individuals obtain an understanding of the concepts of and knowledge about the environment. They also acquire experience, values, skills, understanding and the knowledge necessary to form judgments to participate in decision-making and to take appropriate action in addressing environmental issues and problems (Salequzzaman & Stocker, 2001; Bradley et al. 1999; Fien, 1997). This commitment to create awareness about the environment in the general population and changes in the human behavior must be made in order for individual and social groups to be actively involved, at all levels in working towards resolution of environmental problems (UNESCO-UNEP, 1990).

Orr (1994) argued that in order to develop care for the Earth among future leaders the natural environment should be recognized as part of education. The education should reflect the interconnections between the knowledge and the design of nature: ecology, culture and economy. The knowledge system for sustainable development explicitly addresses the complex interactions between people, resources, environment and development (McKeown & Hopkins, 2002). Education for sustainable development is a process of learning how to make decisions that consider long-term future of the economy, ecology and social well-being of all communities (McKeown & Hopkins, 2002). Sustainable development knowledge cultivates decision making ability, critical thinking and problem solving skills. Learners are empowered to participate in decision making and ethically address the problems they might encounter in their daily life. Teaching and learning in line with sustainability emphasize holistic, multi disciplinary approach in order to develop knowledge and skills needed for sustainable future as well as changes in values, behavior and lifestyles.

Researchers in environmental psychology do believe that there is a strong correlation between environmental knowledge and attitudes. As Tikka, Kintnen and Tynys (2000) noted acquisition of nature related knowledge determines the attitudes and behavior of an individual. Lianne (2005) observed significant positive effect of students' awareness of the environment and their knowledge of environmental concepts in her study. Similarly, a study by Yencken et al., (2000) as well as by Barrasa and Walford (2002) also indicate the existence of strong relationship between environmental knowledge and environmental behavior. Although the relationship between the cognitive component (knowledge), affective (attitudes) and behavior is complex and necessarily linear, researchers have shown that increasing individual's knowledge via environmental studies resulted in more positive attitudes. Some researchers (Hungerford and Volk 1990) in the field of environmental education have indicated that an extensive level of knowledge about environmental issues does result in a greater awareness and sensitivity toward the environment which inevitably leads to environmentally friendly behaviors (Hungerford and Volk 1990). Hence, the importance of Environmental Education (EE) in enhancing awareness towards the environment is undeniable.

2. Environmental Education (EE) in Malaysia

The importance of EE in Malaysia is highlighted in the National Policy on the Environment 2002. One of the key areas of the Green Strategies outlined in the policy is 'Education and Awareness'. The emphasis on Education and Awareness is in line with the recommendations of Agenda 21 (MOSTE, 2002). Among the strategies for Education and Awareness are to devise and introduce comprehensive formal and informal EE and training strategies and information dissemination programs; to integrate environment and development into educational activities from school to tertiary institutions of which relevant method and materials will be developed, to establish national centers for excellence for inter-disciplinary research and education in environment and development; to review education curricula at all levels to ensure a multidisciplinary approach with environment and development issues; to actively promote non-formal education activities at local and national levels; and to strengthen the role of media in disseminating environmental information. Generally, the promotion of EE in Malaysia is focused towards addressing environmental challenges such as littering, water pollution, air pollution and the degradation of biodiversity.

In terms of formal education, the Ministry of Education has developed a curriculum for EE and has implemented various teaching and learning strategies to enhance environmental awareness and internalize values on the importance of environmental protection. In line with the National Education Policy, 'Environmental Education across the Curriculum' was introduced in both primary and secondary schools in 1990s. The goals are to educate children who will love and care for the environment so that they will think and act wisely to preserve it and to be aware of sustainable development. EE is infused in each subject in schools, rather than taught as a single subject. The school curriculum focuses on educating the society to be more sensitive and concerned about environmental issues, to be knowledgeable, skilled and committed to act individually or collectively to address environmental issues. Teachers are required to integrate the concepts and components of EE across the curriculum at all levels. To facilitate the task for teachers, EE Curriculum Guidelines that include specific objectives, components and implementation strategies of EE at pre-school, primary and secondary levels are provided.

After years of effort to integrate environmental education, studies keep revealing that Malaysians in general and students specifically have not reached a certain desired level of commitment towards the environment. The importance of EE is not given due emphasis and so students do not really see the need to practice an environmental-friendly lifestyle (Nadeson & Nor Shidawati, 2005). A study by Sharifah and Hashimah Yunus (2006) showed that there is still considerable apathy among Malaysian students to engage pro-actively in environmental behaviors due to 'the very low environmental awareness within society.' Kim and Fortner (2006) asserted that teachers do not teach environmental issues even though they acknowledged the importance of teaching such issues. Beside external and logistic barriers such as lack of time, the teachers are perceived to have internal and personal barriers. This includes attitudes toward teaching environmental issues, environment related content knowledge and how to teach environmental issues (pedagogical knowledge). These factors determine how often the teachers integrate environmental issues in their teaching.

In order for students to have sound knowledge and good values towards environment, the knowledge base of teachers themselves is of great importance as good subject knowledge is essential for best teaching. However, as Petergem et al. (2007) illustrated, teachers lack insight into the complexities of EE issues and how their teaching might contribute to productive EE. Previous researches also showed that most teachers are unaware of the underlying theoretical issues concerning EE and the concept of sustainable development (Cross, 1998; Summers, Kruger, and Childs, 2000). EE requires special training and commitment because it needs a different focus and outlook that many prospective teachers have not experienced in their own education (Tilbury, 1997). Teachers cannot effectively address the goals and aims of EE solely by acquiring information about environmental issues and concerns. It is unrealistic to expect teachers without expertise to explore environmental concepts with students to foster holistic, regional, and global thought about the environment, rather than treating each topic or idea as an isolated, discrete entity (Stables and Scott, 2002). Thoughtful integration of concepts, ideas, pedagogy, and skills for EE should reach beyond subject area barriers to include the rich scope of knowledge included in many areas of study (McDonald and Dominquez, 2010).

Teachers play a pivotal role in shaping the children's lives. This is so because in the course of their careers, they interact with and reach many pupils. In so doing, they "help shape

each pupil's worldview, economic potential, attitude toward others in the community, participation in community decision-making, and interactions with the environment" (McKeown & Hopkins, 2002, p. 252). In the context of EE, educator's role is further stressed as they are identified as key in transforming EE into practice (Petergem, Blicek and Pauw, 2007). Hence, the quality of teacher training is of critical importance. Faculties of education have the potential to bring about change through the teacher education curricula, training of new teachers and professional development for practicing teachers, consultations with local boards, and often have influence with ministries of education (UNESCO, 2006).

2.1 Sustainable Development

Sustainable development (SD) is a difficult concept to define (Hopkins & McKeown, 2001). The World Commission on Environment and Development (1987) defined sustainable development as the *development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. SD reflects the relationship between the ecological environment and economic development process (Barbier, 1987). Economic development is the process where the needs of the people are fulfilled and sustained over time. SD according to McKeown et al. (2002) is a combination of three components: environment, economic and social. Accordingly, education that focuses on bringing SD into practice is ESD. ESD is a vision of education that seeks to balance human and economic well-being with cultural traditions and respect for the earth's natural resources. The ultimate target of education is to produce environmentally literate graduate, who is capable of evaluating thinking, make decisions, solve problems and take responsible actions accordingly.

SDCs are less discipline specific and more sustainable development related and reflect the interconnection between the subject matter with ecology, economy and society. It would be one possible way to have a holistic education which emphasizes connectivity and continuity among organism as articulated in Orr's ecology literacy.

Table 1 illustrates the 20 SDCs extracted from Yencken et al. (2000).

1	Carrying capacity	The capacity of ecosystems to support continued growth in population numbers, resource consumption, and waste production.
2	Steady-state economy	A non-growth economy in which the demands of resource consumption are in balance with resource supply and production.
3	Ecospace	The total amount of energy, land, water and other resources that can be used regionally or globally without environmental damage, disadvantaging the capacities of others to meet their basic needs or impinging on the rights of future generations.
4	Sustainable development	A process by which the needs of present generations can be satisfied without compromising the ability of future generations to satisfy their needs.
5	Ecological footprint	The area of land and water needed to support the total flow of energy and materials consumed by a community or population indefinitely.
6	Natural resource accounting	A strategy that helps a household, corporation or government calculate its real wealth, i.e. the value of total economic production minus the value of the natural and social capital consumed to achieve it.

7	Eco-efficiency	A strategy for maximizing the productivity of material and energy inputs to a production process whilst also reducing resource consumption and waste production and generating cost savings and competitive advantage.
8	Life Cycle Analysis	A management tool for identifying the net flows of resource and energy used in the production, consumption and disposal of a product or service in order to leverage eco-efficiency gains.
9	Sustainable consumption	The use of services and related products to satisfy basic human needs and bring a better quality of life while minimizing the use of natural resources and toxic materials as well as emissions of waste and pollutants over the life cycle of the service or product.
10	The 5 Rs	Reduce, reuse, renew, recycle and rethink!
11	Local-global links	The recognition that the consumption of a product or service in one part of the world is dependent on flows of energy and materials in other parts of the world and that this creates potential opportunities and losses economically, socially and environmentally at all points in the local-global chain.
12	Inter-dependence	The relationships of mutual dependence between all elements and life forms, including humans, within natural systems.
13	Biodiversity	The diverse and interdependent composition of life forms in an ecosystem that is necessary for sustaining flows of energy and materials indefinitely.
14	Interspecies equity	A consideration of the need for humans to treat creatures decently, and protect them from cruelty and avoidable suffering.
15	Intragenerational equity	A consideration of the need to ensure that all individuals and societies have access to the resources required to satisfy basic human needs and rights
16	Intergenerational equity	A consideration of the need to live off net resource production rather than environmental capital in order to enable future generations access a world that is at least as diverse and productive as the one each generation inherits.
17	Human rights:	The fundamental freedoms of conscience and religion, expression, peaceful assembly and association, which ensure access to democratic participation and meeting basic human needs.
18	Basic human needs	The needs and right of all people and societies for fair and equitable access to flows of energy and materials for survival and a satisfying quality of life within the limits of the Earth.
19	Media literacy	An appreciation of the role of the public media and marketing and advertising industries in creating perceptions of needs and wants and the skill to identify the roles the media may play in encouraging and undermining sustainable consumption.
20	Democracy	The right of all people to access channels for community decision-making.

Table 1. Sustainable Development Concepts (SDC) (adapted from Yencken et.al. 2000)

2.2 Theoretical underpinnings

This study is grounded on Orr's (1994) philosophical theory of ecological literacy. Ecology literacy emphasizes the relations between ecology, economy, culture and human. It places humans as integral parts of ecosystem and recognizes the impacts of relations between human and other species and environment. Ecology literacy is holistic, emphasizing connectivity and continuity with fewer divisions and disciplines, recognizing commonalities among organisms and promoting the strength that exists in diversity. Hence, overemphasis on economic development could create a distance between the natural environment and human (Orr, 1994; 2006) whereby the environment is viewed as a separate entity resulting in exploitation of the environment to a point of no return. This further leads to a weakening of the social and cultural structures.

Through this theory Orr further asserts that interaction amongst humans as most important in the educational experience and stressed that natural environment is a part of education. Education should reflect the interconnections between ecology, culture and economy. Interwoven experiences in these three domains are essential to develop care for the environment and influences in making decision regarding the use of the environment. At the same time, this approach helps to overcome the notion that global environmental destruction is the result of the work of educated people and not the ignorant ones. This is due to the fact that current education emphasized theories instead of values, concepts rather than human beings, abstraction rather than consciousness, answers instead of questions, ideology and efficiency rather than conscience (Orr, 1994). Orr further noted that successful implementation of this theory is ascribed to be in the hands of the teachers. Teachers inherently shape the minds of the learners through setting appropriate learning environments.

3. Purpose of the study

This study was conducted to investigate the primary pre-service teachers' awareness and understanding of SDCs and TECs.

4. Methodology

4.1 Design of the study

Both questionnaire survey and qualitative interviews were employed. The quantitative survey was conducted to elucidate the pre-service teachers' understanding of SDCs and TECs using the Questionnaire on Environmental Knowledge. In order to get insights into the quantitative survey outcomes and to evaluate the student teachers' awareness of environmental concepts interviews involving 20 participants were conducted. Purposeful sampling approach was used to identify the interviewees. The interviews were conducted informally according to the students' convenience and the interview questions were semi structured. The interviews were conducted two weeks after the students answered the questionnaire. The questions asked during the interviews are as follows: Have you ever come across the term ecological footprint? Do you have any idea what it means? If you were given an opportunity to integrate this concept in your teaching, how will you do it?

4.2 Participants

A total of 153 primary pre-service teachers (71 male and 72 female) enrolled in a teacher education institute were involved in this study. Their ages ranged from 19-21 years old and majoring in the sciences, mathematics, social sciences and languages. Upon completing the course these teachers will be awarded with a Bachelor of Teaching, Primary Education and will be appointed as primary school teachers. Prior to entering the teacher education institute these students had undergone six years of primary education and five years of secondary education under the Malaysian education system.

4.3 Instrument

Data were collected using the Questionnaire on Environment Knowledge (QEK). QEK possesses high internal reliability with alpha Cronbach value reported as .89 and validated on the appropriateness of the content by two experts (Karpudewan et al. 2009). QEK was originally developed by Yencken et al. (2000) and contained 12 items: 8 items evaluated the understanding of TECs and 4 items on SDCs. The modified version contained 20 items. The first item focused on investigating the pre-service teachers' level of awareness of the environmental concepts, 12 items evaluated their understanding of TECs and 7 on SDCs. For the purpose this study, only items that evaluated the understanding of environmental concepts were included. Thus, there were a total of 19 multiple choice questions whereby the students were required to identify the most suitable answer for each item/question. The subjects took 40 minutes to complete the questionnaire. The students' level of understanding of the concepts was computed using percentage values. Comparisons between understanding of TECs and SDCs were conducted using descriptive statistics such as the mean scores and standard deviation.

5. Results

5.1 Questionnaire survey

The outcome of the questionnaire survey is presented in Table 2. The frequency indicates the number of students who answered the item on the understanding of a particular environmental concept correctly.

The majority of the students managed to answer the questions on TECs correctly. A total of 143 (93%) students answered the question on *water pollution* correctly. This is followed by *haze* (105, 69%), *ozone layer* (90, 59%), *ecology* (88, 58%), *greenhouse effect* (75, 49%) and *solid waste accumulation* (60, 40%). According to Yencken et al. (2000), these concepts are categorized as TECs. The outcome of this study is similar to the study conducted by the same authors involving secondary school pre-service teachers (Karpudewan et al. 2009). Students seemed to have a good grasp of the TECs which could be explained by their primary and secondary school experiences prior to entering higher learning institutions. According to Abdul Rashid (2006) and Sharifah & Hashimah Yunus (2006) the traditional concepts have been integrated into the existing curriculum and additionally co-curricular activities with environmental themes which embraced traditional concepts were also conducted in schools (Ministry of Education, 2004). Another possible reason for the high level of understanding of traditional environmental concepts could be due to the frequency

Concepts	Frequency (n)	Percentage (%)
Water pollution	143	93
Haze	105	69
Ozone layer	90	59
Ecology	88	58
Greenhouse effect	75	49
Solid waste accumulation	60	40
Renewable resources	36	24
Global warming	34	22
Biodiversity	32	21
Deforestation	31	20
Carbon cycle	28	18
Interdependence	15	10
Sustainable development	13	8
Eco-efficiency	6	4
Carrying capacity	5	3
Ecological footprint	4	2
Precautionary principle	1	0.01
Intergenerational equity	1	0.01

Table 2. Outcome of questionnaire survey

of appearance of these concepts in the daily newspaper and television. The general public is constantly reminded of the importance of recycling their waste, how and where to recycle through advertisements in newspapers and television. News on forest being destroyed (deforestation), open burning, illegal logging, flash flood and toxic waste being illegally discarded into the rivers by irresponsible parties were constantly broadcast. With Malaysia being one of the main producer of palm oil, the issues of using palm oil to produce biodiesel has been strongly argued. Subsequently, the term renewable resource was mentioned frequently. In sum all this could account for the students understanding of TECs.

However, results in table 2 also indicate that students' understanding of SDCs are far below average. For example only 15 students (10%) could give the correct answer for the concept *interdependence*. This is followed by *sustainable development* (13, 8%) *eco-efficiency* (6, 4%), *carrying capacity* (5, 3%), *ecological footprint* (4, 2%), *precautionary principle* (1, 0.01%), and *intergenerational equity* (1, 0.01%). According to Yencken et al., (2000) these concepts are known as SDCs. SDCs are foreign and not found in the primary and secondary school curriculum. The results of this study is similar with the findings of another study conducted by Karpudewan et al., (2009), Spiropoulpu, Antonakaki, Kontaxaki and Bouras (2007), Yang, Lam and Wong (2010) and Jucker (2002). Karpudewan et al. (2009) earlier study showed that the Malaysian secondary school pre-service teachers' understanding of SDCs generally appeared to be at the minimal level. Spiropoulpu et al., (2007) reported Greece's primary pre-service teachers' holds misconception of conceptual meaning of the term 'sustainability' and these teachers are not familiar with these concepts. Jucker's (2002) internet survey involving participants of all the humanities faculties in Germany, The Netherlands, UK and Switzerland also found some unsustainable core characteristics such as eco-illiteracy.

Concepts	N	Range of scores	Mean scores	Standard deviation
TECs	153	1-12	8.45	6.067
SDCs	153	1-7	1.09	2.075

Table 3. Comparison of pre-service teachers understanding of TECs and SDCs

Table 3 shows the range, mean scores and standard deviation for the entire TECs and SDCs. There are a total of 12 TECs and 7 SDCs in the questionnaire. The scores for TEC ranged from 1-12 with a mean of 8.45 and the scores for SDC ranged from 1-7 with a mean score of 1.09. Understanding of SDCs appears to be below the average of 3.5 while understanding of TECs is noticed to be above the average value of 6. Accordingly, findings from this study indicate that relatively, pre-service teacher's understanding of TECs is higher than SDCs.

5.2 Interview outcome

Interviews were conducted with 20 students in order to further enhance the outcome of the quantitative survey and to elaborate on the student teachers' awareness of environmental concepts. Similar to the findings from the quantitative survey, interview results indicate that the majority of the participants were familiar with TECs while SDCs appeared to be foreign to them. The majority of the participants were also noticed to have a better understanding of TECs while understanding of SDCs appeared to be minimal. The following excerpts illustrate one student's understanding of SDCs.

Interviewer: Have you heard about the term sustainable development?

Student A: Sometimes in the newspapers.

Interviewer: Do you have any idea of the meaning the word?

Student A: Not very sure. But I think it got something to do with sustaining the environment.

Interviewer: Can you elaborate on what you mean by sustaining the environment?

Student A: I think it is like preventing pollution and conserving the environment.

The above discourse indicates this particular student is aware of the term sustainable development. However, the understanding of the meaning of term appears to be superficial. The student could not enhance or elaborate on the concept.

Another student perceived the idea of SDCs as abstract and held the misconception that it is only appropriate for SDCs to be integrated into science lessons but not in other subjects.

Interviewer: Do have any idea what is the meaning of ecological footprint?

Student B: I don't know the meaning exactly. But I suppose I can guess from the word itself.

Interviewer: Oh...that's good. What do you think then?

Student B: I think how much your daily actions contribute to the pollution.....

Interviewer: Okay...let me explain the real meaning. *The interviewer starts to explain the meaning of ecological footprint. After explaining the meaning the interviewer asked ... now is it possible to tell how you can integrate this concept in your teaching?*

Student B: I am not very sure. I think it best suits to be integrated in science teaching. It sounds very complex.

Student B indicated that he was not sure of the meaning and tried to guess the meaning from the words/terms. Even though he did not manage to arrive at a completely right answer, his answer reflected his idea of ecological footprint to a certain extent. To Student B, the term is complex and he had difficulties in understanding this concept. The vague understanding is further evidenced when he said that this concept is appropriate to be integrated only in the science curriculum.

6. Discussion

The results of the questionnaire survey showed that Malaysian primary pre-service teachers' understanding of SDCs is far lower than TECs. This is further supported by the interview findings which showed that not only did the pre-service teachers had a low understanding of SDCs some even stated that they were unaware of these concepts. On the contrary, the pre-service teachers' understandings of TECs were higher. A similar scenario has also been reported in other studies worldwide.

According to the theory of planned behavior, knowledge ultimately influences the intended behavior and final behavior to be performed (Ajzen and Fishbein, 1985). But why do global environmental problems persist when the level of understanding of environmental concepts exhibited by the pre-service teachers appeared to be high? This could probably be due to the fact that the knowledge that the students received has no influence on their attitudes and behaviors. The knowledge of TECs appeared to be proportional in nature rather than procedural, i.e., it is '*knowledge about the environment*' rather than '*knowledge on how to work for the environment*' (Fien and Tilbury, 2002). According to Fien and Tilbury (2002) proportional knowledge will not bring about behavioral change. Through this knowledge students learn about the environment. However, the holistic view of the environment relating to economy and society is not emphasized in the traditional environment concepts.

Improving understanding of SDCs which are more sustainable development related and less discipline specific would be a long term solution for the rising global environmental issues. Integration of SDCs into the subject matter will allow the learning to be extended beyond the four walls of the classroom. It provides an opportunity for the real world activities and scenario to be reflected in the teaching and learning process that takes place in the classroom. For example, when the primary school students were taught on the concept of living things in the science lessons an interdisciplinary approach would be appropriate for SDC to be integrated. The term *interdisciplinary* describes the interconnectivity of various living things in this world: animals, plants and humans. Integration of this term provides a platform for the teachers to discuss the importance of maintaining the interrelationships between the living things in sustaining the environment and preserving the social structure. Teachers could use examples of social structures being destroyed due to poverty, increased in population and also due to pollution.

The integration of SDCs is fundamentally grounded on David Orr's theory of ecology literacy (Orr 1994, 2006). Through this theory, Orr stressed the importance of considering natural environment as part of education. Education that reflects on natural environment inherently assists in restoring the social and cultural structure of a nation from being destroyed. According to Orr, the experiences from their own environment will shift from overemphasis of economic towards balance among economics, ecology and culture. Orr

further proposed that this could be implemented through outdoor activities and environmental education simultaneously suggesting that all education to be environmental education. Following Orr's suggestion, Mitchell and Mueller (2011) in their study have used outdoor learning environment to develop care and value towards nature and other living species.

In Malaysia, various federal and state government departments, the private sector, educational institutions and non-governmental organizations (NGOs) are actively promoting EE in both formal and non-formal arenas. The target groups are from all levels of society - teachers, students, government agencies, developers, restaurant operators, industries/factory owners and the general public. Non-formal EE activities planned and implemented includes environmental camps, talks, exhibitions, quizzes, workshops, seminars, tree-planting and radio shows. Environment-related events such as Malaysia Environment Week (21-27 October), Earth Day (22 April), World Environment Day (5 June), Wetlands Day (2 February) and Water Day (22 March) are also celebrated each year.

7. Conclusion

Global environmental crisis have created an expectation that improved understanding and awareness of ecological concepts would be one way of overcoming the growing crisis. This expectation is in parallel with the work of Hungerford and Volk (1990) and Hines, Hungerford, and Tomera (1987) whereby knowledge is perceived as antecedent towards environmentally responsible behavior. Paramount to this is the notion that school classes were found to be increasingly influential in the acquisition of knowledge about the environment (Fortner and Meyer, 1991). It is also suggested that simply relying on knowledge transfer will not bring about behavioral change (Frick, Kaiser and Wilson, 2004). According to Frick et al., (2004) it is essential to identify the types of knowledge that can promote behavioral change effectively and investigate the structure of this knowledge. The results of our study showed that the pre-service teachers have considerably high level of understanding and awareness of TECs but low on SDCs. SDCs provide a platform for the environment to be presented in a holistic manner. Teaching these concepts will allow for issues on the environment, economy and society to be appropriately integrated into the subject matter. This is in line with Orr's theory of ecology which emphasized the importance of natural environment to be embraced in education. The low/minimal level of understanding of SDCs by the students/preservice teachers suggest that it is timely appropriate to integrate these concepts into the teacher education curriculum.

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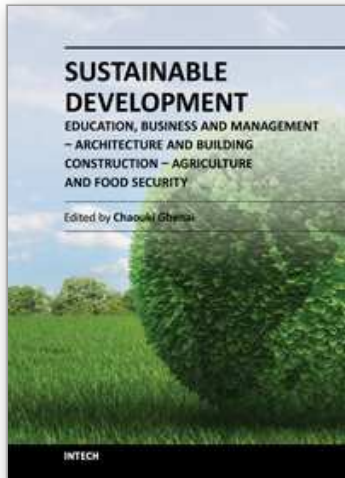
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Securing the future of the human race will require an improved understanding of the environment as well as of technological solutions, mindsets and behaviors in line with modes of development that the ecosphere of our planet can support. Some experts see the only solution in a global deflation of the currently unsustainable exploitation of resources. However, sustainable development offers an approach that would be practical to fuse with the managerial strategies and assessment tools for policy and decision makers at the regional planning level. Environmentalists, architects, engineers, policy makers and economists will have to work together in order to ensure that planning and development can meet our society's present needs without compromising the security of future generations. Better planning methods for urban and rural expansion could prevent environmental destruction and imminent crises. Energy, transport, water, environment and food production systems should aim for self-sufficiency and not the rapid depletion of natural resources. Planning for sustainable development must overcome many complex technical and social issues.

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