Discourse and Communication for Sustainable Education

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Editorial

This issue is devoted to papers dealing with Reorienting University Curricula to Address Sustainability (RUCAS) – a Tempus funded project. In the first paper, the authors, Nelly Kostoulas-Makrakis and Vassilios Makrakis from the University of Crete, Greece, present the experience to integrate the concept of sustainable development at the University of Crete. This paper provides a framework with the constituencies of a sustainable university and is based on the results of two research surveys. The authors assess the processes, strategies and practices for turning the University of Crete into a sustainable university.

In the next paper, Heba El-Deghaidy from Suez Canal University, Egypt, reports on a study dealing with Egyptian science teachers’ experiences from a course that has been infused with sustainable development issues. In this action research project, pre-service teachers were involved in experiencing, reflecting, conceptualising, constructing, acting and transforming attitudes, methods and content.

Nancy Kanbar, from Notre Dame University – Louaize, Lebanon, follows with a paper posing the question: Can education for sustainable development address challenges in the Arab region? In her paper, the focus is placed on examining business students’ attitudes and competences on education for sustainable development (ESD) in her institution. The main findings reveal that relatively high numbers of students are not aware of their responsibilities for environmental problems, which imply the necessity for a revised curriculum where courses are restructured to inform students of their responsibility for their environment and the quality of life.

The next paper presented by Vassilios Makrakis from the University of Crete looks into the relationship between scientific and technological progress, political beliefs and environmental sustainability based on a large international study. The results show that none of the sample country respondents identified themselves as optimists concerning the impact of science and technology on society and environment. The no-stance and the pessimistic attitudes towards technology and science seem to derive from the human and environmental costs associated with science and technology development. A strong connection was also found between environmental consciousness and attitudes towards the role and impact of science and technology on society.

Michele Biasutti and Alessio Surian from the University of Padova, Italy, report on a student survey of ESD competencies from five faculties. They examined the relevance of factors and the differences between students of different areas considering also how to infuse ESD principles in university curricula.

Omar Ramzy and Rasha Wahieb from Heliopolis University for Sustainable Development, Egypt, continue with a paper entitled “Branding the green education: Challenges facing implementation of education for sustainable development in Egypt”. The results of this paper indicate that there is a positive relationship between high cultural resources along with early childhood awareness and ESD adoption and infusion. The paper also highlights the importance of ESD brand associations offered as a service product.

In the next paper, Talal Salem and Jacques Harb from Notre Dame University – Louaize, Lebanon, state that there is a growing need to incorporate sustainable development principles into engineering education. In their paper, they identify engineering competencies within the Faculty of Engineering at Notre Dame University – Louaize and examine the means to shift towards sustainability. The survey they carried out
revealed some weaknesses that the Faculty of Engineering needs to address for a successful implementation of sustainable practices.

Reorienting an educational psychology course to address sustainability is the topic of the next paper presented by Nehal Lotfy Khalil from Suez Canal University Ismailia, Egypt. This paper focuses on the integration of sustainability to educational psychology students. The results of the study show significant positive impacts on students’ knowledge of and attitudes towards sustainability.

Environmental science curriculum is the theme of the next paper presented by Layla Khalaf-Kairouz from Notre Dame University – Louaize, Lebanon. This paper shows the need for strengthening the interdisciplinary nature of environmental science with special reference to managerial, communication and, most importantly, ethical competences.

This thematic issue closes with a paper dealing with the dissemination of ESD in the political science programmes at the Notre Dame University – Louaize, Lebanon, presented by Georges Labaki. The author argues that sustainable development is a continuous process of change requiring painful choices resting on political will. In particular, he examines the developments needed to engage with sustainable development in the field of political science.
In this paper, we look at the University of Crete experience to integrate the concept of sustainable development across all its operations. Through a review of current sustainability practices of universities worldwide, this paper has identified a number of principles for developing a sustainable university. These principles are then used as a framework for analysing the sustainable initiatives being implemented at the University of Crete in the context of the Reorient University Curricula to Address Sustainability (RUCAS) project – an EU-Tempus initiative. This effort has been backed-up by two research studies, which indicate the urgent need for institutionalising sustainability across all university functions.

Key words: sustainable university, RUCAS, Tempus, the University of Crete, education for sustainability

Introduction: The quest for sustainability in higher education

In recent times, the world is facing a series of sustainability challenges, including extreme poverty, racism, unfair trade, climate change, loss of biodiversity, violation of human rights and so on. For the purposes of this study ‘sustainability’ is defined broadly as “making informed, contextual and conscious decisions driven by the principles of solidarity, justice, accountability, equity and transparency for the good of present and future generations, locally and globally and acting upon those decisions for advancing social, economic and environmental wellbeing” (Makrakis, 2011, p. 411). Given the complex nature of the sustainability challenges and the concept of sustainability, it becomes imperative that education should play a critical role in the promotion of 1) social and economic justice; 2) ecological integrity and 3) the well-being of all living systems on the planet. Agenda 21, the international action plan drawn up at the United Nations (UN) Conference on the Environment and Development and its followed up UN Conference Rio+20 identified education as a catalyst to building a more sustainable future driven by these three imperatives. The concept of education for sustainability could be broadly defined as “the learning needed to maintain and improve our quality of life and the quality of life of generations to come. It is about equipping individuals, communities, groups, businesses and government to live and act sustainably, as well as...
giving them an understanding of the environmental, social and economic issues involved” (Makrakis, 2011, p. 411).

In line with this, many universities around the world have taken initiatives to make their campuses more sustainable (Leal Filho, 2010ab). One important initiative is the Talloires Declaration initiated by the Association of University Leaders for a Sustainable Future that has been signed by over 350 university presidents and chancellors in over 40 countries. Other initiatives include the Kyoto Declaration of the International association of Universities, the Copernicus Charter of the European Association of Universities and the Luneburg Declaration. However, with a few exceptions, the majority of the declarations and action plans have never been fully implemented (Leal Filho, 2011). Despite all sustainability initiatives implemented in universities, colleges and technological institutions around the world, only a few have included sustainability in their mission statement (Velázquez, Mungia, Platt, & Taddei, 2006), and a few successful examples of comprehensive large-scale curriculum change related to sustainability can be evidenced (Harpe & Thomas, 2009; Makrakis, 2012a). It is also evident that most universities are tackling sustainability issues in a compartmentalised manner, where sustainability is confined to specific courses, often isolated from research and other campus operations (Mcmillin & Dyball, 2009).

Our internet-based review of more than 30 universities in the United States of America and Europe regarding their initiatives towards sustainability revealed that an increasing number of leading universities have committed themselves to take actions towards a sustainable university. However, although they do recognise more inclusive definitions of sustainability, in practice issues of economic and social sustainability are in the margin. The focus is placed on environmental issues, such as investing in greener buildings, greener practices and products, reducing waste, saving energy and water and to a lesser extent on ways of engaging staff and students in curriculum revision to address sustainability. The role of staff and students in helping to establish more environmentally and sustainable universities is the key driver that cannot be underestimated. It is promising, however, that a smaller but increasing number of universities infuse and/or introduce courses and units in the form of minors, majors and graduate degrees dealing with sustainability studies. Universities can optimise their role as drivers for change with regard to sustainability by adopting a ‘whole-of-university’ approach. This approach explicitly links research, educational, operational and outreach activities that are key components of a sustainable university (Mcmillin & Dyball, 2009).

The constituencies of a sustainable university

Together with the involvement of universities in sustainability actions, worldwide discussions have been initiated in defining the constituencies of a sustainable university. The discussions have been linked to questions concerning the transformative role and function of universities. Transforming universities into more sustainable institutions necessitates rethinking of what we are doing on essentially four key university functional and interlinked constituencies: a) curriculum, teaching and learning; b) research and development; c) institutional/administrative operations and d) partnerships and outreach. These are driven by the three realms of sustainable development: 1) social and economic justice; 2) ecological integrity and 3) the well-being of all living systems on the planet through an integrative and cross-cutting manner (Figure 1).
When it comes to curriculum, as Sterling (2004) maintains, sustainability is not just another issue to be added to an overcrowded curriculum, but a gateway to a different view of curriculum, of pedagogy, of organisational change, of policy and particularly of ethos. Sustainability issues can be implemented within the curriculum, using three different strategic decisions: 1) creating new courses, minors, majors and postgraduate degrees specific to sustainability; 2) revising existing courses to include new course content addressing sustainability and 3) integrating experiential, constructivist and transformative (ExConTra) teaching and learning methodologies in both new and revised courses to address sustainability. The ExConTra learning paradigm is associated with educational approaches such as inquiry and discovery-based learning, service learning, place-based learning and reflective/reflexive learning, all of which are associated with teaching methods and strategies that are suitable to education for sustainability (Makrakis & Kostoulas-Makrakis, 2012). For instance, place-based learning and instruction is primarily intended to motivate through a humanistic and scientific engagement with outdoor and field-based activities on local sustainability issues (Ault, 2008; Gruenewald & Smith, 2008; Smith & Sobel, 2010). Similarly, service-learning is a teaching and learning method that connects meaningful, community service experiences with academic learning, personal growth and civic responsibility (Shumer & Duckenfield, 2004; Simons & Cleary, 2005). Both of these methods are values-driven approaches, designed to advance experiential, constructivist and transformative learning goals together with locally identified social, economic and environmental objectives. Inquiry-based learning is often described as a cycle or a spiral, which implies formulation of a question, its investigation, data analysis and creation of a solution. It also provides opportunities for students to develop
real-life skills; learn to cope with controversial problems as well as deal with changes and challenges (Alberta Learning, 2004). Discovery learning is an inquiry-based method that takes place in an experience-based problem-solving situation, where the learner is confronted with an open-ended, ill-structured and authentic (real-world) problem (Hai-Jew, 2008; Balm, 2009; Alfieri, Brooks, Aldrich, & Tenenbaum, 2011). It is associated with cooperative learning, with instructors acting as facilitators rather than transmitters of information. Such a method is also connected to case-based learning, where students analyse case studies of historical or hypothetical situations that get involved in solving problems and/or making decisions (Carroll & Borge, 2007; Lee, Lee, Liu, Bonk, & Magjuka, 2009). All of these methods are based on the principle that students experience, construct and transform their own versions of reality rather than simply absorb versions presented by others. From a sustainability perspective, these methods help to transform unsustainable actions and reconnect people to the natural and cultural world of which they are an organic part.

**Research and development**

Research and development is a critical function in higher education institutions. Tackling the sustainability challenges implies a redefinition of mainstream research and development policies that contributed to the degradation of the natural world. An emphasis should be placed on the transformative dimension of research as sustainable development can only be realised through a far-reaching transformation of the situation humankind finds itself in at the beginning of the third millennium (Jaeger, Tabara, & Jaeger, 2011). New dynamics that have emerged in higher education in the past decade due to the sustainability challenges and the universities’ involvement in various global sustainable development initiatives have helped to start redefining research and development. Such trends are more visible to establishing collaboration with community and industry/corporations, the collaboration between research centres within and between other universities, opening positions for PhD research dealing with sustainability issues and so forth.

**Institutional and administrative operations**

Another major area of change would have to be institutional and administrative operations. The university administration has a very significant impact on both the academic and organisational/operational decisions that include curricula, academic programmes, building design, operations and maintenance, recycling, waste and energy, including issues related to ensuring the health, safety and well-being of staff and students, professional incentives and so forth. Most of the universities that have endorsed international declarations and initiatives for turning their institutions into sustainable universities have established centres or offices of sustainability that are charged with the coordination of their efforts.

**Partnerships and outreach**

Although educational institutions are often criticised for not opening their doors to the community, those involved in education for sustainability have taken initiatives to bridge
the gap. Universities are now being challenged to respond to local, regional and global environmental and societal challenges when approaching sustainable development. A growing trend on community-university partnerships in research, learning and knowledge mobilisation is evident around the world. The last ten years have therefore seen a stepping up of activities relating to partnerships and outreach for sustainability. Worthy of attention are the United Nations University (UNU) accredited regional centres of expertise (RCE) which focus on partnership learning and action for sustainability, as well as the UNESCO Chairs’ Network on Education for Sustainable Development.

The case of the University of Crete

Background: The University of Crete

The University of Crete (UOC) established in 1973 is the principal higher education institution on the island of Crete, Greece, and one of the most academically reputable ones, ranked amongst the top 500 universities in the world. It is a multi-disciplinary, research-oriented institution, located in the cities of Rethymnon and Heraklion. Since its establishment, it has developed considerable research activity and has undertaken innovative initiatives that reflect its dynamic development. The University of Crete has 13,141 students (11,011 at the undergraduate level and 2,130 at the postgraduate level), more than 900 faculty members and researchers as well as approximately 240 administrative staff on both campuses. The University of Crete in the Session of the Council of all Greek Universities’ Rectors has jointly undersigned the Charter of Greek Sustainable Universities that embraces the principles of sustainable development, international treaties and the results of international conventions and is committed to promote the infusion of sustainable development in the Greek universities. In 2008, a UNESCO Chair on ICT in Education for Sustainable Development was established at the University of Crete. The Chair has taken initiatives to establish a North-South Network, including various university institutions to promote sustainability. It has also initiated the establishment of the RCE Crete, (Regional Centre of Expertise on ESD) acknowledged by the UNU.

Mapping up the current situation

In turning the University of Crete into a sustainable university, a first attempt was to map out what the current situation is in terms of what knowledge, skills and values/attitudes concerning sustainability students of various disciplines get from their study programmes and, second, to review the processes and practices undertaken at the University of Crete with respect to sustainable development. The results presented in this paper are based on two surveys. The sample of the first survey comprised 790 students from four faculties carried out in the 2010/2011 academic year. The second survey comprised 189 final year students from the Department of Primary Education in the context of a RUCAS – Tempus project in the academic year 2011/2012.

One of the key issues studied in the first survey was concerned with students’ anthropocentric and biocentric attitudes. Anthropocentrism literally means human-centred, whereas biocentrism means life-centred. Anthropocentric individuals assign intrinsic value to humans alone or assign a significantly greater amount of intrinsic
value to humans than to non-human species (Curry, 2006; Brennan & Lo, 2008). Statements such as: Environmental problems can be solved by advances in technology or through the protection of wealth in a free market and by a better redistribution of wealth and by changes in our life style all fall into a materialist and anthropocentric attitude since they give primacy to human activity. From this perspective, non-human beings are important only to the extent that they affect humans or can contribute to human well-being. To put it simply, individuals driven by anthropocentric values tend to see the physical environment as a means to support their materialist needs (Curry, 2006). This is in contrast to individuals who bear biocentric values and extend moral values to non-human species, ecosystems as well. The anthropocentric-biocentric attitudinal scale used in this study was adapted from Haigh (2007) and has similarities with the New Environmental Paradigm questionnaire (Dunlap, Kent, Van Liere, Mertig, & Jones, 2000). The final scale consisted of 14 variables out of 20 initially constructed with a Cronbach’s reliability α equal to 0.77 (Table 1). Responses were coded as ‘strongly disagree’ = 1, ‘disagree’ = 2, ‘uncertain’ = 3, ‘agree’ = 4 and ‘strongly agree’ = 5. The social-psychology literature on behavioural research has established attitudes as important predictors of behaviour, behavioural intentions and explanatory factors of variants in individual behaviour (Eilam & Trop, 2012).

Table 1. The Cronbach’s reliability test results for anthropocentric-biocentric attitudes

<table>
<thead>
<tr>
<th>Anthropocentric and biocentric variables</th>
<th>Scale mean</th>
<th>Scale variance</th>
<th>Corrected item/to cor</th>
<th>Squared mult. cor</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>36.03</td>
<td>70.14</td>
<td>0.267</td>
<td>0.174</td>
<td>0.767</td>
</tr>
<tr>
<td>V2</td>
<td>36.76</td>
<td>66.16</td>
<td>0.411</td>
<td>0.275</td>
<td>0.754</td>
</tr>
<tr>
<td>V3</td>
<td>36.91</td>
<td>65.21</td>
<td>0.403</td>
<td>0.246</td>
<td>0.755</td>
</tr>
<tr>
<td>V4</td>
<td>36.75</td>
<td>64.80</td>
<td>0.443</td>
<td>0.233</td>
<td>0.751</td>
</tr>
<tr>
<td>V5</td>
<td>37.36</td>
<td>65.12</td>
<td>0.461</td>
<td>0.277</td>
<td>0.749</td>
</tr>
<tr>
<td>V6</td>
<td>36.69</td>
<td>63.75</td>
<td>0.473</td>
<td>0.261</td>
<td>0.747</td>
</tr>
<tr>
<td>V7</td>
<td>36.86</td>
<td>65.97</td>
<td>0.465</td>
<td>0.240</td>
<td>0.750</td>
</tr>
<tr>
<td>V8</td>
<td>37.43</td>
<td>65.10</td>
<td>0.512</td>
<td>0.332</td>
<td>0.745</td>
</tr>
<tr>
<td>V9</td>
<td>37.33</td>
<td>63.43</td>
<td>0.549</td>
<td>0.372</td>
<td>0.742</td>
</tr>
<tr>
<td>V10</td>
<td>36.02</td>
<td>70.80</td>
<td>0.214</td>
<td>0.163</td>
<td>0.771</td>
</tr>
<tr>
<td>V11</td>
<td>37.26</td>
<td>64.10</td>
<td>0.530</td>
<td>0.367</td>
<td>0.743</td>
</tr>
<tr>
<td>V12</td>
<td>36.29</td>
<td>68.95</td>
<td>0.285</td>
<td>0.118</td>
<td>0.766</td>
</tr>
<tr>
<td>V13</td>
<td>36.30</td>
<td>70.74</td>
<td>0.188</td>
<td>0.092</td>
<td>0.775</td>
</tr>
<tr>
<td>V14</td>
<td>35.77</td>
<td>72.45</td>
<td>0.152</td>
<td>0.116</td>
<td>0.775</td>
</tr>
</tbody>
</table>

Another important composite variable studied in the first survey was concerned with sustainability actions, which are hypothesised to be related to sustainability attitudes. Ten sustainable actions were selected mostly referring to environmental sustainability. The actions included energy saving, purchase of environmentally friendly products, buying local products, donations and voluntarism. Responses are coded as ‘never’ = 1, ‘sometimes’ = 2, ‘often’ = 3, and ‘very often’ = 4. A Cronbach reliability analysis was performed, which revealed a score of α = 0.72 (Table 2). The relationship between
attitudes and actions (behaviour) has been well discussed since the 1980s. Much of the research in this area is built on the ‘theory of reasoned action’ and ‘planned behaviour’ (Ajzen, 1991, 2002). Central to this theory is the idea that individuals possess an array of personal values, and each of these values is held with differing ranks or weights which serve as criteria for judging the suitability of particular behaviours. For instance, an individual who strongly agrees with the strong anthropocentric statement that human beings have the right to exploit Nature for their own profit is expected to be less likely engaged with conservation actions or behaviours (for instance, energy saving, purchase of environmentally friendly products) than an individual who strongly disagrees with the statement, assuming other characteristics are identical. In this example, the statement represents a value or belief that humans are in the centre (anthropocentrism) and the degree of agreement or disagreement measures the attitude strength and consequently may function as a predictor to future behaviour. This ethic or value also assumes that the earth’s resources are perceived as unlimited and can be either replaced naturally and/or tackled through technological advances. This is in contrast to a sustainable ethic which assumes that humans are a part of the natural environment and that they feel unhappy when the natural ecosystem is violated. The important role of the acquisition of sustainable behaviour is often explained by the assumption that changes in sustainable behaviour on a personal level can lead to changes in sustainability on a societal level (Eilam & Trop, 2012). A biocentric orientation towards the environment will thus result in a higher level of pro-environmental intentions than anthropocentric attitudes.

Table 2. The Cronbach’s reliability test results for sustainable actions

<table>
<thead>
<tr>
<th>Sustainable actions</th>
<th>Scale mean</th>
<th>Scale variance</th>
<th>Corrected item/total cor</th>
<th>Squared mult. cor</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>21.89</td>
<td>19.17</td>
<td>0.394</td>
<td>0.324</td>
<td>0.694</td>
</tr>
<tr>
<td>V2</td>
<td>21.85</td>
<td>18.93</td>
<td>0.432</td>
<td>0.334</td>
<td>0.687</td>
</tr>
<tr>
<td>V3</td>
<td>21.85</td>
<td>20.44</td>
<td>0.297</td>
<td>0.097</td>
<td>0.711</td>
</tr>
<tr>
<td>V4</td>
<td>21.46</td>
<td>21.17</td>
<td>0.192</td>
<td>0.044</td>
<td>0.730</td>
</tr>
<tr>
<td>V5</td>
<td>21.51</td>
<td>20.43</td>
<td>0.356</td>
<td>0.212</td>
<td>0.700</td>
</tr>
<tr>
<td>V6</td>
<td>21.90</td>
<td>19.91</td>
<td>0.496</td>
<td>0.289</td>
<td>0.680</td>
</tr>
<tr>
<td>V7</td>
<td>21.56</td>
<td>19.52</td>
<td>0.533</td>
<td>0.376</td>
<td>0.673</td>
</tr>
<tr>
<td>V8</td>
<td>21.66</td>
<td>19.39</td>
<td>0.483</td>
<td>0.316</td>
<td>0.679</td>
</tr>
<tr>
<td>V9</td>
<td>21.87</td>
<td>21.20</td>
<td>0.303</td>
<td>0.124</td>
<td>0.707</td>
</tr>
<tr>
<td>V10</td>
<td>22.40</td>
<td>20.81</td>
<td>0.356</td>
<td>0.193</td>
<td>0.700</td>
</tr>
</tbody>
</table>

In the second survey, a sample of 187 students from the final year of their studies in the Department of Primary Education taken randomly from those attending obligatory classes participated in the RUCAS – Tempus international survey of 11 universities with a total sample of 3 757 students (Makrakis, Kostoulas-Makrakis, & Kanbar, 2012). In this paper, we will focus on the variable dealing with Sterling’s four-type typology of preferences towards the role and function of university. Sterling (2001) poses three central questions in this context: What is education for? What is education? and Whose education? In relation to the first and second questions, Sterling contributes to that debate by suggesting four functions or roles of education: 1) to replicate society and
culture and promote citizenship (the socialisation function); 2) to develop students’ full potential (the liberal function); 3) to prepare students for the labour market (the vocational function) and 4) to encourage change towards a fairer society and better world (the transformative function). Sterling suggests that sustainable education is about reconciling all four functions, but stresses that a transformative paradigm which values, sustains and realises human potential is of critical importance (Sterling, 2004, 2008). A transformative learning paradigm based on experiential and critical constructivist conceptions of learning goes beyond instrumental and utilitarian learning conceptions that prevail in higher education institutions.

Results

In the first survey, 790 undergraduate students responded to the question: When you hear the word combination ‘sustainable development’, what of the following words comes to your mind? 71% of the respondents indicated the concept of environment, 16% indicated society, 9% – economy and 4% – culture. This implies that the concept of sustainable development is largely defined in the context of the environment. Also, the great majority of students (89%) consider that sustainability should be taken into serious consideration in the university activities; however, only 27% have been taught something about environmental sustainability and sustainable development, and only 15% have done an assignment relevant to sustainable development in a course or seminar. However, when asked to indicate the most critical problem at the University of Crete, the respondents revealed that financial support of students’ activities comes first (42%), followed up by the university image (32%), while environmental issues such recycling (30%), water waste (9%) and energy save (22%) revealed a lower consideration.

Students’ anthropocentric-biocentric perceptions

When it comes to students’ anthropocentric vs biocentric attitudes, the results presented in Table 3 show a relatively strong commitment to the ethics of biocentrism, with an average biocentric attitudes mean score 3.7 in contrast to 2.6 of the anthropocentric attitudes. A statistically significant impact of participating in education for sustainability courses on the formation of anthropocentric attitudes has been revealed, t (786) = -4.5 at p < .0001. It implies that the higher the knowledge on sustainable development issues, the lower the anthropocentric attitudes. The paired samples t-test revealed a statistically significant difference between anthropocentric and biocentric attitudes with a mean difference -1.10, standard deviation 0.80 and t (786) = -38.3 at p < .0001. More specifically, there is relatively strong support (mean scores 3.5) for the anthropocentric notions that most environmental problems can be solved by advances in technology and that technology offers the means to restore environmental disasters, but less support is shown for the notion that most environmental problems can be solved through the production of wealth in a free market (mean 2.7) and even less support for the notion that “economic growth is more important than tackling environmental problems” (mean 2.3). There is also weaker support (mean scores 2.1) for anthropocentric ideas suggesting that human beings have the right to exploit Nature for their own profit and that other living organisms are subordinate to those of human beings, but there is more support (mean score 3.2)
to the anthropocentric notion that human welfare is the most important concern for human society. Similarly, there is relatively more support (mean score 3.2) to the anthropocentric notion that most environmental problems can be solved by changes in our lifestyle, but not to sacrificing environmental quality if this benefits human society as a whole (mean score 2.2). It is true that anthropocentric views can be used to justify human’s exploitation of natural and non-human world. However, it should also be noted that such exploitation does not account to all currents of anthropocentrism. A soft anthropocentrism, for instance, is reflected in the notion of ‘shallow ecology’ as contrasted to a strong biocentrism that is reflected to the notion of ‘deep ecology’ movement (Drengson, Devall, & Schroll, 2011).

Table 3. The anthropocentric and biocentric attitudinal results

<table>
<thead>
<tr>
<th>Anthropocentrism vs biocentrism</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>uncertain</th>
<th>agree</th>
<th>strongly agree</th>
<th>mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most environmental problems can be solved by advances in technology.</td>
<td>3</td>
<td>26</td>
<td>3</td>
<td>55</td>
<td>13</td>
<td>3.5</td>
</tr>
<tr>
<td>Most environmental problems can be solved through the production of wealth in a free market.</td>
<td>15</td>
<td>39</td>
<td>17</td>
<td>21</td>
<td>8</td>
<td>2.7</td>
</tr>
<tr>
<td>What I can do in my country has little effect on foreign people’s life quality.</td>
<td>16</td>
<td>39</td>
<td>4</td>
<td>34</td>
<td>16</td>
<td>2.8</td>
</tr>
<tr>
<td>Most environmental problems can be solved by changes in our lifestyle.</td>
<td>10</td>
<td>28</td>
<td>4</td>
<td>46</td>
<td>12</td>
<td>3.2</td>
</tr>
<tr>
<td>Human beings have the right to exploit Nature for their own profit.</td>
<td>39</td>
<td>35</td>
<td>3</td>
<td>17</td>
<td>6</td>
<td>2.1</td>
</tr>
<tr>
<td>On my own, I cannot do considerable things to protect the environment.</td>
<td>25</td>
<td>38</td>
<td>1</td>
<td>24</td>
<td>12</td>
<td>2.6</td>
</tr>
<tr>
<td>Humans have the right to adapt the natural environment to their own needs.</td>
<td>30</td>
<td>33</td>
<td>4</td>
<td>33</td>
<td>10</td>
<td>2.8</td>
</tr>
<tr>
<td>Human welfare is the most important concern for human society.</td>
<td>7</td>
<td>31</td>
<td>7</td>
<td>41</td>
<td>14</td>
<td>3.2</td>
</tr>
<tr>
<td>The rights of other living organisms are subordinate to those of human beings.</td>
<td>37</td>
<td>41</td>
<td>5</td>
<td>12</td>
<td>5</td>
<td>2.1</td>
</tr>
<tr>
<td>It is OK to sacrifice environmental quality if this benefits human society as a whole.</td>
<td>40</td>
<td>33</td>
<td>4</td>
<td>15</td>
<td>8</td>
<td>2.2</td>
</tr>
<tr>
<td>Human beings are the ‘crown of all creation’.</td>
<td>21</td>
<td>31</td>
<td>5</td>
<td>29</td>
<td>14</td>
<td>2.8</td>
</tr>
<tr>
<td>Technology offers the means to restore environmental disasters.</td>
<td>4</td>
<td>23</td>
<td>9</td>
<td>46</td>
<td>18</td>
<td>3.5</td>
</tr>
<tr>
<td>Human beings are merely a ‘cog in the machinery of Nature’.</td>
<td>4</td>
<td>11</td>
<td>11</td>
<td>53</td>
<td>21</td>
<td>3.7</td>
</tr>
<tr>
<td>Economic growth is more important than tackling environmental problems.</td>
<td>31</td>
<td>41</td>
<td>5</td>
<td>16</td>
<td>7</td>
<td>2.3</td>
</tr>
</tbody>
</table>
Students’ sustainability actions

Of the 10 actions students were asked about, the one that scored the lowest was that of “doing any form of voluntary work” (mean 1.8), followed up by “giving money to poverty charities”, “acting for the well-being of others” and “switching off unnecessary lights in class”, all with the same mean score 2.3 (Table 4). Students scored higher on the action of “preferring to read texts on the computer screen” (mean 2.8) and “preferring to buy local products” (mean 2.7). In general, students’ involvement in sustainability actions is considered relatively low (mean 2.5). It has also been revealed that in general left-oriented students are slightly more active towards the environment than more conservative students [F (685) = 4.0, p < .05]. Breaking the actions related to energy saving that is a hot issue at the University of Crete, according to students’ academic discipline, the results presented in Table 5 show that students fall mostly in the least categories.

Table 4. Sustainable action statements and frequencies

<table>
<thead>
<tr>
<th>Action statements</th>
<th>Never (%)</th>
<th>Sometimes (%)</th>
<th>Often (%)</th>
<th>Very often (%)</th>
<th>Mean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch off unnecessary lights in class</td>
<td>22</td>
<td>40</td>
<td>22</td>
<td>16</td>
<td>2.3</td>
</tr>
<tr>
<td>Switch off unnecessary lights in WCs</td>
<td>26</td>
<td>32</td>
<td>22</td>
<td>20</td>
<td>2.4</td>
</tr>
<tr>
<td>Type on used papers</td>
<td>21</td>
<td>37</td>
<td>25</td>
<td>17</td>
<td>2.4</td>
</tr>
<tr>
<td>Prefer to read texts in the computer</td>
<td>13</td>
<td>30</td>
<td>25</td>
<td>32</td>
<td>2.8</td>
</tr>
<tr>
<td>Prefer to buy local products</td>
<td>8</td>
<td>35</td>
<td>35</td>
<td>22</td>
<td>2.7</td>
</tr>
<tr>
<td>Act for the well-being of others</td>
<td>13</td>
<td>50</td>
<td>28</td>
<td>9</td>
<td>2.3</td>
</tr>
<tr>
<td>Buy environmentally friendly products</td>
<td>7</td>
<td>38</td>
<td>38</td>
<td>17</td>
<td>2.6</td>
</tr>
<tr>
<td>Think of environment/health when you do shopping</td>
<td>13</td>
<td>37</td>
<td>33</td>
<td>17</td>
<td>2.5</td>
</tr>
<tr>
<td>Give money to poverty charities</td>
<td>12</td>
<td>52</td>
<td>26</td>
<td>10</td>
<td>2.3</td>
</tr>
<tr>
<td>Do any form of voluntary work</td>
<td>40</td>
<td>44</td>
<td>12</td>
<td>4</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Breaking the actions related to energy saving that is a hot issue at the University of Crete, according to students’ academic discipline, the results presented in Table 5 show that students fall mostly in the least categories.

Table 5. Energy saving actions by students’ discipline

<table>
<thead>
<tr>
<th>Students’ environmental actions</th>
<th>Switch off unnecessary lights in class</th>
<th>Switch off unnecessary lights in WCs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never (%)</td>
<td>Sometimes (%)</td>
</tr>
<tr>
<td>Department of Primary Education</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Sciences</td>
<td>17</td>
<td>37</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>22</td>
<td>47</td>
</tr>
<tr>
<td>Department of Philosophy and Social Studies</td>
<td>29</td>
<td>38</td>
</tr>
</tbody>
</table>
Table 6 shows that students of sciences have scored much higher on the action of “preferring to read texts in the computer screen” than students of any other discipline. A possible explanation for science students’ higher rating to prefer reading in the computer screen could be attributed to their subject and not deriving from a biocentric orientation and value. Saving energy and reusing paper for printing are two key actions that highly contribute to environment protection.

Table 6. Sustainability actions to re-use and save paper by students’ discipline

<table>
<thead>
<tr>
<th>Students’ environmental action in:</th>
<th>Type on used papers</th>
<th>Prefer to read texts in the computer screen than type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never (%)</td>
<td>Sometimes (%)</td>
</tr>
<tr>
<td>Department of Primary Education</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>Sciences</td>
<td>15</td>
<td>41</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>22</td>
<td>35</td>
</tr>
<tr>
<td>Department of Philosophy and Social Studies</td>
<td>21</td>
<td>36</td>
</tr>
</tbody>
</table>

Students’ preferences to university role and function

Assessing the students’ preferences towards Sterling’s (2001) typology of higher institutions’ roles and functions, the results presented in Table 7 show what values are dominant and what directions are needed to be taken. In total, there is a clear trend towards the transformative function that sees a university as an agent of change towards a fairer society and better world, regardless of the country the students come from. More specifically, 42% of students indicated a preference towards the transformative function, that is, a university which encourages change towards a fairer society and better world instead of replicating society and culture and promotes citizenship (6%). When taking into consideration the students’ country, perceptions of preferences are spread between the liberal and the transformative function. Italian and Irish students indicated a clear preference to the liberal function, in contrast to the Greek students (56%) and Jordanian (46%) students who were oriented towards the transformative function. It is interesting to note that the Egyptian students’ preferences are situated between the socialisation (28%) and the transformative (37%) function while a more balanced preference is revealed between the vocational, liberal and transformative function among Lebanese students.
Table 7. Students’ preferences towards the role and function of universities

<table>
<thead>
<tr>
<th>Perceived functions for universities</th>
<th>Total (%)</th>
<th>Greece (%)</th>
<th>Italy (%)</th>
<th>Ireland (%)</th>
<th>France (%)</th>
<th>Sweden (%)</th>
<th>Egypt (%)</th>
<th>Jordan (%)</th>
<th>Lebanon (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To replicate society and culture and promote citizenship – the socialisation function</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>28</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>To train people for future employment – the vocational function</td>
<td>21</td>
<td>17</td>
<td>24</td>
<td>15</td>
<td>14</td>
<td>9</td>
<td>17</td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>To help people develop their potential – the liberal function</td>
<td>31</td>
<td>26</td>
<td>46</td>
<td>50</td>
<td>42</td>
<td>46</td>
<td>18</td>
<td>24</td>
<td>37</td>
</tr>
<tr>
<td>To encourage change towards a fairer society and better world – the transformative function</td>
<td>42</td>
<td>56</td>
<td>29</td>
<td>35</td>
<td>43</td>
<td>44</td>
<td>37</td>
<td>46</td>
<td>32</td>
</tr>
</tbody>
</table>

Discussion and conclusion

The planet has currently reached an ecological point that necessitates a fundamental clarification and revision of human attitudes and behaviours towards sustainability. This crucial stage entails significant changes in the prevalent system of social, economic and cultural values that have led to the earth’s degradation. Higher education plays a unique and critical role in making a healthy, just and sustainable society. Failing to take action may risk imposing significant costs on current and future generations and possibly widening the economic disparities among and within nations all over the world. The results presented show that there is need to address all the constituencies of a sustainable university.

In terms of teaching, learning and curriculum, students’ relatively strong support for the anthropocentric notions that most environmental problems can be solved by advances in technology and that technology offers the means to restore environmental degradation, shows a need to redefine the concept of technological progress and contribute to bridging the gap between technological progress and societal values. Kemp and Soete (1992) discuss that some of the present trajectories of technological change have reached their environmental limits and there is need for them to be replaced by environmentally-friendlier trajectories. However, they point out that such transitions are not easy and are usually hindered by technical, economic and institutional barriers since the new trajectories have not benefited from ‘dynamic scale and learning effects’ and because the ‘selection environment’ is adapted to the old regime. This reinforces the need for adopting transformative teaching and learning methods. An interesting result of a revised curriculum is often a change in teaching style. From our experiences in the RUCAS project, faculty involved in revising their courses to address sustainability and implement the revised courses into their classes have moved from lecture approaches to more student-centred methods engaging students in the teaching and learning processes, such as clarifying own values, critical thinking, envisioning, service learning and discovery learning. The recent establishment of the network of social solidarity from students at the Department of Primary Education is an initiative that would highly contribute towards voluntarism.
Service-learning experiences include the processes of investigating community needs, preparing for service, action and reflection.

Our current economic model assumes and appears to blindly advocate that technology and free markets can be the main drivers of human progress and development, thereby also overcoming challenges such as alleviating poverty (Nair, 2012). Technology has not alleviated the daily struggle of millions of people and children who face hunger and malnutrition, who have been displaced by the floods due to climate change and profit-driven deforestation, who have no access to education, water and other basic human needs. An international and comparative study among student-teachers from Finland, Greece, Sweden, Japan and Holland (Makrakis, 2012b) shows that none of the sample country respondents identified themselves as optimists concerning the role and impact of science and technology on the society and the environment. The no-stance and the pessimistic attitudes towards technology and science seem to derive from the human and environmental costs associated with science and technology development. These results indicate that society and education, in particular, should place higher critical concerns about scientific and technological issues and their relation to the development of a sustainable society.

Students’ disagreement with the notion that economic growth is more important than tackling environmental problems is indicative of the need to see alternatives to the gross national product (GNP) as the only measurement of a nation’s progress. It has been for long recognised that the GNP is misleading as an indicator of the welfare of a nation, and many initiatives have been taken to develop more adequate measures of well-being, such as the genuine progress indicator (GPI) that considers consumer’s point of view rather than the monetary value of GNP and adds the value of benefits such as volunteer work, which was found to be the least rated action among students at the University of Crete (Colman, 1998; Talberth, Cobb, & Slattery, 2007). Another reaction to replace the current global, profit-driven economic system, measured by GDP, with a new system, is the gross national happiness (GNH), coined by the Fourth King of Bhutan, Jigme Singye Wangchuck in the 1970s. The GNH concept implies that sustainable development should take a holistic approach towards notions of progress and give equal importance to non-economic aspects of well-being. GNH is based on a comprehensive list of conditions that lead to human happiness and well-being. They include measures of satisfaction with life and the health of citizens, community vitality, social support networks, access to education and to the arts, protection of the environment, and governance (Priesner, 2012; Ura, Alkire, Zangmo, & Wangdi, 2012). Lately the four pillars have been further classified into nine domains: psychological well-being, health, education, time use, cultural diversity and resilience, good governance, community vitality, ecological diversity and resilience and living standards.

Another aspect related to teaching, learning and curriculum that the results of the two surveys imply is the need to promote communication between academic disciplines. Universities need to become open institutions, thus avoiding fragmentation and over-specialisation, which had a negative impact to sustainability. No longer disciplinary knowledge and courses that function independently of real-life needs can cope with the sustainability challenges. The common thread seems to be an interdisciplinary approach and an understanding that sustainability is woven into all disciplines in undergraduate majors and the institutionalisation of minor degrees’ concentration. Currently, there are no study programmes at the University of Crete providing an undergraduate unit
that integrates an interdisciplinary set of courses in subjects such as pedagogy, policy analysis, economics, the social and natural sciences to address the need to build a sustainable region and society. Also, the isolation in the higher education institutions from the labour market and stakeholder guidance in course design and content has placed sustainable development courses in a marginal position. A multi-stakeholder-driven model for modernising higher education curricula is needed, taking into consideration the urgent need for building university-community partnerships.

Introducing minors as supplements to undergraduate majors in the University of Crete and other Greek universities would be a critical step to the integration of interdisciplinary sustainability curricula and reversing the compartmentalised nature of higher education. Although interdisciplinary teaching and learning is being discussed at the University of Crete, in practice, there is lack of interdisciplinary perspective and motivation among teaching staff and students. Interdisciplinary collaboration is essential for modernising higher education, and it is a necessary condition for responding to the students’ preference of a transformative role and function of a university.

In terms of research and development, tackling the sustainability challenges implies a redefinition of mainstream research and development policies that contributed to the degradation of the natural world. There is no concrete policy at the University of Crete towards this issue, although there are individual initiatives from teaching staff. For instance, the RUCAS – Tempus project that it is coordinated by the University of Crete is such an initiative which brings together 12 universities from the European Union and Middle East to reorient university curricula to address sustainability. This project has received a recognition award by the UNU for its contribution to reorienting learning approaches towards sustainability in institutions of higher education. Another project coordinated by the University of Crete was the ICT-enabled Education for Sustainable Development project also funded by the European Commission that resulted in the development of a M.Sc. programme on ICT in Education for Sustainable Development. It is worth pointing out the establishment of a research group working on PhD theses focusing on sustainability issues such as climate change at the Department of Primary Education within the UNESCO Chair ICT in Education for Sustainable Development.

Another major area of change would have to be institutional and administrative operations. Although educational institutions are often criticised for not opening their doors to the community, those involved in education for sustainability have taken initiatives to bridge the gap. The University of Crete has a policy for opening its doors to inter-institutional cooperation, but there is scepticism regarding opening its doors to the private sector for cooperation. There is, however, a need to redefine the University of Crete policy in order to bridge the gap between academic knowledge and societal demands. Signing of a declaration such as the Charter of Greek Sustainable Universities is seen as a strong indicator of commitment to sustainable development as well as an advocacy mechanism for translating the commitment into an action plan for a sustainable campus. This implies that declarations should be realised through concrete policies and actions, as well as to facilitate, encourage and reward individual teaching staff initiatives.

While the University of Crete is facing serious economic problems, energy is misused and students’ sustainability actions are low. In an effort to reduce the large amount of energy currently generated from non-renewable resources such as oil, natural gas and coal, the University of Crete should take initiatives to provide awareness sessions, especially for new students, about energy saving and sustainability. The policies of the
University of Crete should also be taken into account considering actions on relying less on fossil fuels and turning to renewable energy resources, such as wind and solar power. Other sustainability actions should be directed to university dining service demanding the use of locally-grown and organic food. A composting system on campus should be also considered. In order to reduce food waste from ending up in the garbage, the dining service could collect waste food to send it to a local pig farm for feed and in cases of remaining food to send it to local food-charity banks. There is also a strong need to adopt a policy which ensures that copy paper used on campus contains at least 30% recycled materials and urge administrative offices, instructors and students to use online materials, and ask faculty members to make their courses paper-less by having students hand in their assignments online. Advocate through the university campus the slogan “Use less, recycle the rest”. There are already departmental policies for donating computers from the various labs once they are no longer in use and give them to the community so that others can use them. There is also need to place bins for recycling across the campus. For institutionalising sustainability in the campus, developing Centres for Sustainability can be seen as instrumental in helping the University of Crete to turn into a sustainable university.

Finally, establishing partnerships and having an outreach orientation is very critical in turning the University of Crete into a sustainable university. Combining academic theory with practical real-life experience, service learning and other suitable to education for sustainability methods provide students with a broader and deeper understanding of the course content, foster their civic engagement into their place and community. Higher education that fails to develop learners beyond the acquisition of instrumental and utilitarian knowledge does not function in accordance to the values and principles assumed for a sustainable university. It becomes essential that universities should be involved in effective partnerships with non-formal and community-based institutions and other stakeholders, including local governments and small and medium sized enterprises to create sustainable development initiatives and bridge the gap between university and community.

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EDUCATION FOR SUSTAINABLE DEVELOPMENT: EXPERIENCES FROM ACTION RESEARCH WITH SCIENCE TEACHERS

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Abstract

This study reports on Egyptian science teachers’ experiences in collective action research projects with a focus on education for sustainable development (ESD). Science teachers were enrolled in a study course “Teaching Strategies” that had been revised with a focus on sustainability. The course was introduced in the spring semester of the academic year 2011/2012. Throughout the course, 29 teachers worked in groups to develop projects that promote sustainable development through classroom teaching practices that encourage involvement with local communities around school premises. The framework that guided the study was based on experiential, constructivist and transformative learning theories known collectively as ‘ExConTra’. A mixed methods methodology was used where teachers’ responses to three open-ended reflective questions produced qualitative data that were analysed by identifying themes and patterns. The author developed two quantitative instruments: a Concept Mapping Rubric and a Sustainable Development Questionnaire. The former was to probe the cognitive organisation participants had in relation to the concept of sustainable development before and after developing the action research projects. The latter instrument was used to identify participants’ attitudes towards teaching for ESD and their knowledge of classroom pedagogical practices. Statistical data analysis using Statistical Package for the Social Sciences indicates that teachers in their post-tests had developed: better cognitive organisation for the concept of sustainable development; positive attitudes towards teaching for sustainable development and ESD classroom teaching practices. Involvement in the action research projects where teachers were experiencing, reflecting, conceptualising, constructing, acting and transforming within the context of ESD may be responsible for these results where there are promises to help achieve successful implementation to include ESD in science education.

Key words: education for sustainable development, science teachers, Egypt, action research
Introduction

One of the fashion words found in recent literature is that of education for sustainable development (ESD). Its roots can be traced back to the 1990s at the United Nations conference in Rio de Janeiro. Since then, there have been major developments towards ESD, specifically the emphasis on ESD in the Earth Summit 2002, the United Nation’s Declaration of the Decade of Education for Sustainable Development (DESD) in 2005–2014 and in Rio+20 United Nation’s conference on sustainable development in June 2012. In general, sustainable development (SD) is perceived as the vision for a better world in which environmental, social, economic and cultural considerations are balanced. ESD, therefore, presents a tool for achieving this vision and improving quality of life. With this in mind, a new vision of education is formed, a vision that helps understand the world by addressing the complexity and interconnectedness of daily problems, locally and globally.

There is a strong evidence to suggest that the Arab countries, including Egypt, are lagging behind in practices related to sustainable development (Esty, Levy, & Winston, 2003). There is therefore a need to find ways to promote ESD. Teacher education programmes, whether pre-service or in-service, could be a powerful start, especially through reorienting teacher education courses to address sustainability. Teachers are agents of change in any reform effort who will shape the knowledge, skills and values of future generations given the regional priorities and the need to modernise curricula to address ESD. Paradoxically, they are also viewed as major obstacles to change if their emphasis is only on factual and procedural knowledge at the expense of deeper levels of understanding (Prawat, 1992).

This study introduces science teachers to sustainable development and highlights the importance of teachers in promoting ESD practices in schools and among their students. The process of infusing sustainability among science teachers was enabled through the reorientation of a study course “Teaching Strategies” at one of the public universities in Egypt. The reoriented course was presented as a means to counteract more limited manifestations of this type of course that often focuses on “…the facts of their subject and not deal with associated social or ethical issues” (Levinson & Turner, 2001, p. 2), resulting in misrepresentations of the nature of science education.

Theoretical framework and literature review

The theoretical framework that guided this study was the ExConTra learning model (Makrakis & Kostoulas-Makrakis, 2012) where there is an emphasis on three major learning theories, namely, experiential, constructivist and transformative learning theory. The model consists of six independent but interconnected components. These are experiencing, reflecting, conceptualising, constructing, acting and transforming, all of which are found throughout the process of action research. Through action research, teachers are likely to become aware of their own beliefs and practices, expand their commitment to developing a variety of teaching methods and renew their interest in learning about teaching. It is therefore a means to systemic inquiry into daily teaching practices, where teachers reflect on teaching on a deeper level (Kraft, 2002). Through such activity, teachers’ roles change within a new perspective as they become active knowledge producers who continuously develop practical knowledge while solving
problems in practice (Schon, 1983; Darling-Hammond, 1996). Moreover, they become part of the educational reform process as they are empowered to change and initiate change and apply new ideas. Furthermore, action research can bridge the gap between theory and practice because it helps teachers to understand the purpose of educational research and, in turn, informs educational theory of the reality of the classroom (Briscoe & Wells, 2002). In addition, teachers are empowered by having ownership of their professional knowledge.

In the case of science education, there have been a number of attempts to identify the potential contribution of science curriculum to ESD (for instance, Wellington, 2003; United Nations Educational, Scientific and Cultural Organisation [UNESCO], 2004). There are suggestions that the aims of school science education need to be examined with respect to socio-scientific relevance in issues such as food scarcity and poverty and hence sustainable development (Holbrook, 2009). Others have seen ESD as one example of developing scientific literacy as the ‘21st century science’ that incorporates a number of sustainable development issues within its vision of scientific literacy (Summers & Childs, 2007). When it comes to science teachers, envisioning teaching as inquiry is a relevant perspective of the science discipline. Studies that support teachers’ involvement in action research on students’ learning include, for instance, Hammer and Schifter (2001) and van Zee, Lay and Roberts (2003), while those that are specifically related to science teachers and action research in terms of a means to professional development include, for instance, Ponte, Ax, Beijaard and Wubbels (2004). Action research in this study was used as a means for participants to reflect on their own practice and to understand and improve their practice and the situation in which they are practising. Through the process of engaging in action research, teachers gain deep insights into how they are working whilst looking forward to their future practices (Kraft, 2002) which enables them to ‘transform’ in their thoughts, feelings and actions in a paradigm shift.

Gedzune and Gedzune (2011) concluded that students through action research developed reflective skills on ecological consciousness and building sustainable and inclusive relationships with the world. In a study by Salite (2008), teachers’ research skills were developed by involving them in action research. Nonetheless, attitudes and values towards environmental issues were developed through active involvement in action research that allowed for active participation in the course activities and responded to different learning needs that impacted pre-service teachers’ transformative pedagogies (Pace, 2010). This insight is congruent with what sustainability opts for by calling for transforming to a new paradigm of thinking and acting. Action research therefore prompts a catalytic change for sustainability where teachers are likely to become aware of their own beliefs and practices, expand their commitment to developing a variety of teaching methods and renew their interest in learning about teaching. This is a role that teachers are not used to and need an effort to transform. In this new role teachers become researchers and active knowledge producers.
Context of the study

The springboard of this study is mainly the global demands on all nations to preserve resources for future generations and improve the quality of daily life. Moreover, there are demands to nurture the sense of solidarity nationally, regionally and internationally. This is especially the case in Egypt and other nations that witnessed the Arab spring which asked strongly for change and for improved quality of life. The Arab spring asked for the main concepts of sustainability based on social equality and respect for human rights that lead to quality of life. In order to fulfil such a vision, a systematic and holistic approach is necessary with a collaborative effort of a large number of people taking many small steps in the right direction towards a sustainable world.

In the Arab region, the vision of ESD is in line with the United Nation’s DESD global orientations (UNESCO, 2008). Through the UNESCO Regional Bureau for Education in the Arab States, the researchers administered a questionnaire in 14 Arab countries to document the status of ESD. The analysis of the responses illustrated the challenges facing the region. These challenges were classified into three main dimensions: economic, social and environmental. In each partner country of the 14 Arab countries, the Ministry of Education and Higher Education was informed of the follow-up and assessment of how to overcome these challenges. Although education is the first step towards a successful future and nurturing the human mind can foster a generation renowned for creativity, innovation, leadership and achievement, yet, education systems in the Arab countries are facing numerous challenges themselves, and this decreases their capacity to achieve the desired goals of ESD (UNESCO, 2008).

In Egypt, there are many decrees, especially those issued by the Ministry of Environment that foster one of the many dimensions of sustainable development, yet the
daily practices of the individuals are far from what the country needs. However, the author believes that education is the first step towards a successful future. ESD requires a combination of teaching strategies that together allow for transformative learning in a course with an ESD philosophy and practice. Visioning and creating new perspectives are important tasks because the transformative role of education is a key issue in ESD. Teachers’ actions will change as a product of reflecting and visioning, because such future action will take into account reflection on what has happened and use this as a means to envision a transformation that will create new solutions and new ideas. Action research is therefore perceived as an effective tool to foster such reflection and visioning in order to improve teacher competencies.

From the above, the expected pathway for any development is in the hands of the schools of education that act as a vehicle for any anticipated change, especially as Egypt is working towards achieving the goals of Education for All (EFA) and the Millennium Development Goals (MDGs). ESD would therefore seem an integral part of achieving these two global agendas.

Nonetheless, this study is an attempt to introduce ESD at one of the governmental universities in Egypt where SD is not commonly found in courses and curricula. Even where SD is found, there exists a narrow interpretation linked to environmental issues only. This is specifically the case for courses offered at the School of Education whether at the undergraduate or postgraduate levels for teaching methodology courses.

Statement of the problem

Considering the vital roles teachers have to prepare and develop pupil’s ability to become effective citizens in a sustainable society, teachers are required to apply practices that foster active and experiential learning approaches that are important for ESD. Courses offered at the School of Education, which is responsible for teacher education programmes and in-service training, seem to lack courses on ESD in its holistic and futuristic perspective. This result came from a preliminary analysis of the programmes offered at the undergraduate and postgraduate levels. Moreover, a questionnaire was administered to a group of 23 teachers attending a seminar at the Department of Curricula and Instruction in order to indicate their prior knowledge of the ESD to justify and document the need for a revised ESD course. The questionnaire consisted of 10 questions with a five-point Likert scale. The first part of the questionnaire consisted of questions directed to identifying teachers’ perception of SD, while the second part asked teachers about their ESD teaching practices. The Likert scale was as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. Results illustrated that the majority of the teachers responded negatively, as they either agreed or strongly agreed that they lack ESD knowledge. They also identified that their current teaching practices are not focused on ESD practices. Based on these results, it seemed central to fill in a gap in the courses presented at the School of Education in order to develop the teaching practices of a sample of in-service science teachers through reorienting a teaching strategies course offered to postgraduate science teachers if Egypt’s aims to achieve a sustainable future. Therefore, the study seeks to answer the following research question: What are science teachers’ experiences from their involvement in action research in the reoriented course in relation to ESD? A number of sub-questions were raised to formulate the stages of the study: What are science teachers’ perceptions of SD? What are science teachers’ attitudes towards
teaching for ESD? What are science teachers’ pedagogical practices for ESD? and How do science teachers perceive their experiences through developing action research in ESD?

This study aims to reorient the teaching strategies course by infusing ESD, engage science teachers in action research as a means to transformative learning, develop science teachers’ perceptions regarding SD and develop science teachers’ attitudes towards ESD and its pedagogical practices.

Methods

Research design

A mixed method approach with quantitative and qualitative data was employed. This was mainly in order to deal with the processes proposed at the different stages of the study that answer the research questions and address its main aims. The study set out to investigate the possible impact of involvement in developing action research in ESD as part of the reoriented course within the stated theoretical framework on participants’ perception of ESD in addition to their attitudes and pedagogical practices in class.

Profile of the participants

Convenience sampling was used to select participants of this study as they were enrolled in a compulsory course presented at the School of Education that the author of this study teaches. Demographic data were collected that specified gender, age range, years of experience in science teaching and experience with computers. There were nine male teachers and 20 female science teachers enrolled in the course.

Procedure

Reoriented course on ESD

The course was reoriented towards sustainability where the author made crucial decisions as to what to teach and how to teach. The purpose was to reorient the existing course ‘Teaching Strategies’ by adding content on ESD and mainly adopt teaching methodologies and assignments that address issues which are pertinent to ESD. The main method in revising the course was by the ‘infusion approach’ that permits to address sustainability by teaching the course with a different perspective and philosophy without changing the meaning and aim of the original version. Therefore, the course was guided by the author’s philosophy to change and reflect, taking into consideration that sustainability demands individual and social transformation, which involves a radical shift of awareness and worldview (Reason, 2007) or transformative changes in our frames of reference (Mezirow, 2000). To make sure that the reoriented course followed an acceptable structure in terms of course design, course objectives and description were then stated. There was a particular emphasis on the types of learning that ESD promotes within Delors’ (1996) report. In general, the course was based on the ‘ExConTra’ model where the author’s main philosophy was to get science teachers involved in reflective activities that could allow them to change and transform. The course was a four-hour weekly course offered in the spring semester in the academic year 2011/2012.
Science teachers were asked throughout the study to reflect on their perceptions towards SD and the critical issues that are witnessed in the local community and education system, particularly as aspects of ESD relate directly to science education and science literacy in addition to the social and ethical context of science in schools or what is termed as socio-scientific issues (SSI). Teachers were also asked to reflect on their classroom teaching practices and then develop action research projects to incorporate the main issues of SD in their daily pedagogical teaching. This was done purposely to provide teachers with opportunities for transformative learning as ‘agents of change’. As for the action research, this was done collectively through the use of Wikis as a tool for online communication and collaborative discussion. In general, technology can provide opportunities for learners to construct meaningful learning environments which can be applied to ESD such as: a) engaging and challenging learners; b) stimulating dialogue and social negotiation through new modes of social interaction; c) learning by exploring and discovering; d) doing and reflecting; e) constructing personal and collective representations of meaning; f) supporting discourse in dealing with real-life problems (Makrakis, 2011). Science teachers in this study developed research projects that started by identifying a focus of an ESD problem then going through developing action plans, data collection and finally reaching results, suggestions and final reflections. The whole process of the study consisted on the six components of the ExConTra learning model. The action research projects were analysed qualitatively according to rubrics developed by the author of the study. Pre- and post-test data were also collected in terms of their perspectives of the concept of SD and their teaching practices in regards to ESD. Quantitative data were analysed using Statistical Package for the Social Sciences (SPSS). Figure 2 shows the procedure of the study.

![Diagram](Image)
Instruments

Concept Mapping Rubric (CMR)

Participants were asked to construct a concept map of SD before engaging in the action research as a pre-test and at the end as a post-test. The concept maps were structured according to each participant’s chosen concepts and connections. The aim of this was to probe for the cognitive organisation that the participants had before and after developing the action research projects. Although there is extensive work on concept mapping such as that developed by Novak and Gowin (1984) and Cronin, Dekker and Dunn (1982), specific work on ESD by Ahlberg (2004), the author decided to use a grading system which analyses concepts under SD dimensions that are stated in the literature. The rubric also analysed the number of valid cross-links among concepts and the number of hierarchal levels. The reliability and validity of the rubric were determined by having a second rater. The raters scored concept maps and discrepancies between raters were discussed until near consensus was reached. As for the validity, this was determined by experts who helped decide on the construct validy. The lowest total score on the concept map was three while the highest was 12.

Sustainable Development Questionnaire (SDQ)

The SDQ was developed in light of previous studies, both inside and outside the Arab context. These studies were numerous: Summers, Corney and Childs (2004), Azapagic, Perdan and Shallcross (2005), Summers, Childs and Corney (2005), Kagawa (2007), Spiropoulou, Antonakaki, Kontaxaki & Sarantis (2007), Qablan, Abu Al-Ruz, Khasawneh and Al-Omari (2009). The questionnaire was divided into two scales. The first scale was developed in order to identify the participants’ attitudes towards teaching for ESD, while the second aimed to identify the participants’ classroom pedagogical practices. The former scale of the SDQ asked participants to respond to each statement by selecting one of five Likert style responses: strongly agree, agree, undecided, disagree and strongly disagree. There were both negative and positive statements that were placed randomly, where scores can range between 10–50. The participants were asked to select their responses according to the frequency of their classroom practices on a three-point scale: never, seldom, or frequently, where score ranged between 10–30. Content validity was determined by a panel of experts consisting of four science educators and two psychologists. Reliability coefficients of the attitude scale and ESD teaching practices were determined by 16 science in-service teachers where a reliability coefficients ‘item-total statistics’ were calculated, alpha = 0.87 and = 0.73 respectively. The author investigated the participants’ attitudes as studies in the literature identified the influence of science teachers’ beliefs and attitudes on their teaching practices (Pajares, 1992; Haney, Czerniak, & Lumpe, 1996). As it is presumed that teachers apply ESD teaching practices in their own classes, attitudes and beliefs were therefore a concern of this study.
Reflective Questionnaire (RQ)

Open-ended questions were developed to document the participants’ views on how they perceived their experience in developing action research in ESD. Responses to the questions were analysed qualitatively in order to identify the underlying themes. The questions were as follows: How do you view the collaborative action research experience that you were involved in? How did your engagement in action research impact you personally? How did your engagement in action research impact you professionally?

Results and discussion

The results are presented under four subtitles that reflect the four research questions.

Research question one

The first research question: What are science teachers’ perceptions of SD? A blank sheet was given to participants to construct their concept maps of SD in a time limit of twenty minutes before developing their action research projects. The same task was done again after developing the action projects. Participants were graded using the proposed grading system in this study. A dependent t-test analysis with 95 per cent confidence using SPSS version 19 shows that the final mean is greater than the initial mean. This entails that the participants’ involvement in the action research had a positive impact on the conceptual knowledge construction on SD which was better at the end of the research than at the beginning in terms of the number of concepts and the dimensions it represents. This reflects the theoretical framework ExConTra as it particularly emphasis the conceptualising and constructing components of the model. The mean and standard deviation of the pre- and post-concept mapping are as follows (Table 1).

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<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>p</th>
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<tbody>
<tr>
<td>Pre-test</td>
<td>4.4483</td>
<td>1.50205</td>
<td>-9.495</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Post-test</td>
<td>7.9310</td>
<td>1.86951</td>
<td></td>
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Statistical analysis shows that there is a statistically significant difference between the participants’ pre- and post-data on the SD concept mapping in favour of the post-data. In the pre-concept mapping analyses, the concepts that the participants related to SD were mainly in the environmental dimension, while in the post-analysis this changed rapidly into other additional dimensions. This finding is in line with that from studies such as Summers and Childs (2007) and Summers, Corney and Childs (2004). Social, cultural and economic dimensions were included in the participants’ post-concept mappings alongside the environmental. From the examples found were equality, democracy, freedom of speech, social responsibility, human right, green schools. Nonetheless, the significant increase in teachers’ perspectives on SD in the post-data can be due to the effect of the independent variable of the study, namely, the reoriented course and the action research that teachers were engaged in that provided for meaningful experiential learning, as part of the ExConTra model, on the key concepts and values of various SD dimensions. This finding aligns with what a study indicated that when professional
development is content-focused, connected to other aspects of teachers’ lives and coherent, it is more likely to have positive impact on teachers’ knowledge and skills than less coherent experiences (Garret, Porter, Desimone, Birman, & Yoon, 2001). This is what the action research projects seemed to advocate as it added meaning to science teachers responsibilities and roles. According to Makrakis and Kostoulas-Makrakis (2012) in their ExConTra model, for learners to make meaning, either individually and/or shared, they need to reflect on their own experiences, leading them to develop more abstract understandings of their experiences (conceptualising). Arriving at individual and shared meaning (constructing), learners need to get involved in a shared inquiry enriched through continuous reflection, re-conceptualisation and active experimentation. Other studies also acknowledged the role of action research in developing their participants’ SD knowledge (for instance, Corney, 2006). It is important to develop participants’ perspective of SD if they are expected to act as ‘agents of change’ in their schools and classroom contexts, hence the growth of research in studying teachers and lecturers’ perceptions of ESD (Reid & Petocz, 2006; Cotton, Warren, Maiboroda, & Bailey, 2007; Jones, Trier, & Richards, 2008). To conclude this point, Smith (2009) emphasised the importance of the way teachers interpret ESD and how it will affect the way that they teach it.

Research question two

The second research question: What are science teachers’ attitudes towards teaching for ESD? The quantitative data collected from all participants were analysed using SPSS version 19.0 software. Prior to analysis, descriptive statistics of all variables in the study were examined using frequencies and the minimum and maximum values for each variable were examined for the accuracy of data entry by inspecting out of range values, which did not show any outliers. Statistical analysis shows that there is a significant difference between participants’ pre- and post-data on the attitudes towards teaching for ESD scale in favour of the post-data (Table 2). It is important to develop positive attitudes, especially if teachers are expected to transfer their experiences in classroom and school contexts. In this case, if teachers are convinced about the importance of ESD practices, they can become ‘agents of change’ in their schools for an educational and political reform. They can also try to overcome the factors that inhibit the facilitation of ESD practices in schools and local communities. Acting as change agents, learners are empowered to transforming experience through critical reflection and active experimentation. When critical reflection is transformed into an action, it becomes praxis that turns learners able to function as agents of change (Makrakis & Kostoulas-Makrakis, 2012). By this role teachers are applying components of the ExConTra learning model specifically the acting and transforming components.

Nonetheless, the significant increase in teachers’ attitudes in the post-data can be due to their experiential involvement in the action research projects that link directly to science teaching. This finding supports what Cotton et al. (2007) found when 55% of their respondents agreed or strongly agreed that sustainable development was central to their teaching interests as respondents suggested imaginative and diverse teaching strategies that reflected the contested and exploratory nature of sustainable development. Qablan et al. (2009) in a Jordanian study also found that university teachers developed attitudes towards ESD teaching. In general, this study claims that a change in attitudes would seem essential for teachers to become agents of change.
Research question three

The third research question: What are science teachers’ pedagogical practices for ESD? Although teachers were not actually observed in the classroom, which is considered a limitation to this study, practices were indicated through teachers’ responses to the SDQ. Statistical analysis shows that there is a significant difference between participants’ pre- and post-data on their ESD classroom practices according to responses from the second scale in the SDQ (Table 3). This result emphasises the components of the ExConTra learning model as teachers seem to be interested in experiencing, acting and transforming ESD in their science classroom teaching practices. By referring back to the literature, vitality of teaching for sustainability is supported by Posch and Steiner (2006) and Filho and Santos (2005) who stated the importance of initiating and applying new approaches in teaching for sustainable development. The main emphasis in ESD practices lies in a paradigm shift from teacher-centred approaches that seem to dominate science classes to those which encourage active and participatory learning as stated by Tilbury (2011).

Table 3. T-test analysis on pre/post data from participants’ ESD teaching practices (n = 29)

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<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>p</th>
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<tbody>
<tr>
<td>Pre-test</td>
<td>20.8621</td>
<td>4.24873</td>
<td>-7.093</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Post-test</td>
<td>26.2759</td>
<td>1.77073</td>
<td></td>
<td></td>
</tr>
</tbody>
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Research question four

The forth research question was: How do science teachers perceive their experiences through developing action research projects in ESD? A reflective questionnaire with open-ended questions was designed to investigate science teachers’ experiences while developing their action research projects. Analysis of teachers’ responses required a coding process based on the qualitative findings. The main purpose of the analysis was not to quantify data but to find themes and patterns across teachers’ responses. In general, the projects that the science teachers developed emphasised the key aspects related to ESD. The teachers developed seven projects in total, where four teachers were involved in each group except for one group that had five teachers. Wikis was used as a means for communicating, discussing, decision making and developing the action research projects. It was also a means to uploading and sharing material related to their ESD projects whether it were text or videos. The process of developing the ESD action plans and the use of technology where based on all six components of the ExConTra learning model: experiencing, reflecting, conceptualising, constructing, acting and transforming.
Two main themes were identified in relation to the analysis of responses to the question: *How do you view the collaborative action research experience that you were involved in?* These were identified as the ‘social theme’ and the ‘change theme’.

**Social**

The social theme that emerged from the data was the benefits of collaborating with colleagues in developing their action research projects. The science teachers in their group collectively determined the focus of the research and collaboratively shared and discussed aspects via online Wikis. By the end of the course, all groups completed their ESD research and presented their projects to the rest of the cohort. All teachers indicated that they had valuable learning opportunities by sharing ideas throughout the process. They repeatedly mentioned that they learned from each other about various aspects of teaching and how to infuse ESD in their practices and schools. In particular, the teachers found that each one felt a spirit of community. The point on collegial support echoes findings from previous studies such as Briscoe and Wells (2002), Burbank and Kauchak (2003) and Kraft (2002) and seems an essential component for supporting teachers’ learning and professional development. One teacher, for instance, mentioned, “I really enjoyed and learned from everyone in the course.” The other teacher said, “The interaction that we had was valuable. We shared ideas that we could use in the classroom and how to bring sustainable development into reality.” However, another teacher mentioned the difficulty of working in groups at first, then showed how this soon disappeared throughout the work, “It was really difficult at first, then soon we started to cope and understand each other and commit to our task.”

**Change**

In the literature, there is documented evidence that ‘change’ is difficult to achieve with teachers as they seem to resist it quite often. However, teachers need to be persuaded of the need to change their teaching practice and be allowed the chance to acquire the knowledge so that the idea of change and transformation matures in them and motivates a change of attitudes (Connelly & Clandinin, 1988). An indication that this had happened to participants in this study is that ‘change’ was a key finding in the analysed data, as teachers stated that they had ‘changed’ or will continue to ‘change’ in one way or another. Data revealed that as the teachers’ knowledge changed, so did their teaching practices. Some of the teachers linked ‘change’ to their practices and professional development while others referred to ‘change’ in terms of their skills and values especially towards ESD as a new topic to their repertoire. However, most teachers not only recognised their ‘change’ but also discussed the struggle it took in order to change. Others felt good about the ‘change’ they made but felt they could have done more, given the time and energy. Examples of teachers’ responses are: *Action research and the logical thinking needed for it changed my professional practices by changing my thoughts from just theoretical ideas on paper to concrete practices applicable in the real world; I also have more confidence to make positive change; Since action research works in cycles, modifications are necessary, as well as encouraged. There is no fear of not getting it right the first time; I know that my actions can bring about change, not only to myself, but to my school, too; I developed reflective skills necessary for my work as a*
revolutionary teacher who wants to change for the better; I have to be positive to make change for the better and not to give up.

**How did your engagement in action research impact you personally?**

Three themes were identified through analysing responses to this reflective question. Science teachers indicated that the action research helped develop 1) knowledge; 2) skills and 3) values and dispositions that were beneficial on the personal level. In the knowledge theme, teachers developed concepts such as: democracy, social responsibility, equity, fair trade, citizenship, economic satisfaction and consumer right. In the skills theme, teachers’ responses were mainly about the skills they developed and dispositions towards aspects related to ESD. It seemed that the process of going through action research helped to develop thinking skills such as positive thinking, scientific thinking, critical thinking, creative thinking, research skills, future planning and reflective thinking. Other skills were also developed such as communication skills, organisation skills, internet search skills, decision making, problem solving, freedom of speech and self-assessment. From the values and dispositions that were commonly identified as being developed: a better acceptance of the other, appreciation of human rights, tolerance and appreciation of community service. The following are examples from teachers’ quotes from the identified themes:

- I am more aware of my actions and the effects they have on my environment and others while engaged in action research; Acknowledging the importance of biodiversity and behaviours positive to the environment; This project has made me change even at home; I am aware and concerned about resources so I am trying to manage and consume water, energy and food better; Involvement in action research made me apply reflective thinking in my daily life.

**How did your engagement in action research impact you professionally?**

Three themes were also identified through analysing responses to this reflective question: 1) knowledge; 2) skills and 3) values. Knowledge related to sustainable development and relevant research that could be applied with students at various stages in addition to the experiences of other countries in ESD in order to identify what could be done in Egypt, if applicable. Identify ways of making use of all resources, especially material for everyday use that could be designed for teacher aids in the classroom. Through the developed projects, teachers realised that there is a great need to establish a link between school administrators and the local community. One teacher stated, “I have now updated knowledge in my field that can help develop myself and my students.” Another teacher mentioned, “I can change students’ behaviour, especially in aspects of sustainable development and everyday practices.” One more teacher stated, “Increase the effectiveness of science teaching and therefore the achievement levels of my students.”

In terms of the values and dispositions that were developed by the teachers, these were accepting students’ individual differences, development of positive relations with students and appreciation of a respectful learning environment. Teachers went on to developing through their proposed projects students’ ESD awareness and behaviour and disseminating this to the local community. They even valued the use of technology in their teaching. An example of this theme was what one teacher stated, “Accept students comments and ideas wilfully.”

The skills varied from lifelong learning skills that relate to the ‘change’ teachers had identified before and hands-on application of action research that helped link theory
to practice in a realistic way. Also teachers mentioned the use of Wiki and how it helped in formalising their ideas and suggestions for providing for ESD in their own schools. Examples from teachers’ quotes are as follows: I have learnt to review and assess my own teaching; I have learnt how to infuse ESD in terms of its teaching practices and the application of reflective thinking; I have learnt how to manage waste in the school; I now understand that action research is a valid means to solving educational problems in schools and providing for concrete suggestions through action plans that are realistic and hands-on; I see myself as responsible for solving everyday problems in the class, as I have a positive role in the profession.

Emphasis on developing reflective practices in teaching was the highlight of several responses. The process of action research encouraged the teacher researchers to reflect about the art and science of teaching. Sagor (2000) believes that an important purpose for action research is “building the reflective practitioner” (p. 7). Danielson and McGreal (2000) view reflection as a critical aspect of professional growth. Teachers described the introduction of new teaching strategies as they responded that their teaching practices had changed through involvement in the action research projects. Many said that the research project helped them to develop new strengths in teaching and add to their existing repertoire of instructional methods. This was based on their understanding and appreciation of the Earth Summit that advocates for student-centred teaching and respecting the five pillars of learning identified by (Delors, 1996). One teacher wrote, “Yes, my teaching has changed as a result of the action research. My science teaching will surely not be the same as before as now I will link science with sustainable development issues.” Teachers also mentioned that the action research process made them more confident to try these new strategies. Ferrance (2000) and Sax and Fisher (2001) found similar results; action research gives teachers more confidence in their own work. Teachers appeared empowered and confident with regards to daily and future pedagogical practices and decisions.

Conclusion

The significance of this study hinges upon the voices, viewpoints and experiences of science teachers’ engagement in action research. The research empowered the teachers to take the role of active participants in the research process and helped them develop and critically analyse and reflect on their own knowledge about teaching and ESD in their schools and subject areas. While engaging in this work, teachers came to trust their own ability to construct knowledge, improve their practice and feel that they have a positive impact as agents of change in their school context and with classroom teaching practices in relation to ESD. Findings from this study suggest that for collaborative action research to be effective at empowering teachers, teachers need to join with other passionate teachers to explore ways to voice freely their concerns, develop action plans and enact their plans for change. Action research was a valid means to experiencing, reflecting, conceptualising, constructing, acting and transforming science teachers in ESD. Through action research, science teachers’ conceptual organisation of the SD developed further, and teachers’ attitudes towards ESD in addition to their classroom pedagogical practices improved in the post-test. The author therefore recommends including action research in teacher education programmes, particularly where teachers work collaboratively together and where the six components of the ExConTra learning
model can be applied. With such a view on action research, teacher education programmes will fulfil their accountability for transforming teaching practices for successful educational reform.

The true change factor that influenced science teachers in this study was the philosophy and methodology of the course rather than its content, where the assignments and action research provided opportunities for active engagement in learning that changed their attitudes and values towards SD, their teaching for ESD and therefore was a transformative experience.

Acknowledgement

This work has been developed within the framework of the RUCAS (Reorient University Curricula to Address Sustainability) project that has been funded from the European Commission (European Commission, TEMPUS – No. 511118-2010-GR-JPCR). The content of the paper reflects the views of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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CAN EDUCATION FOR SUSTAINABLE DEVELOPMENT ADDRESS CHALLENGES IN THE ARAB REGION? EXAMINING BUSINESS STUDENTS’ ATTITUDES AND COMPETENCES ON EDUCATION FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY

Nancy Kanbar
Notre Dame University – Louaize, Lebanon

Abstract

The population growth together with the unsustainable consumption pattern is putting increasing stress on the planet’s natural resources. The increasing realisation that humans are harming the environment is taking the form of a global movement intended to change behaviour towards sustainability, now recognised as a framework that links humans to nature. Continuous exploitation of natural systems in the Arab region leads to environmental damages that negatively affect human well-being. This article presents a case study from the Reorient University Curricula to Address Sustainability (RUCAS) Tempus project funded by the European Commission. It highlights the results of an empirical study in the Faculty of Business Administration and Economics (FBAE) at Notre Dame University – Louaize (NDU) in Lebanon. The main objective is to assess the need for education for sustainable development (ESD) through an examination of students’ attitudes and competences with the aim of reorienting university curricula to address sustainability. A framework based on the pillars of learning set by UNESCO was developed to measure ESD attitudes and competences. The main findings reveal the need to reorient university courses to address sustainability issues. Attitudes questions suggest that relatively high numbers of students are not aware of their responsibilities for environmental problems, which imply the necessity for a revised curriculum where courses are restructured to inform students of their responsibility for their environment and the quality of life. The results show that the disciplinary competences are significantly lower than the five pillars of learning (general competences) which indicate that the FBAE needs to reorient its curricula to infuse ESD into its programmes through the development of effective pedagogical approaches, teaching methodologies as well as learning materials.

Key words: education for sustainable development, attitudes and competences, pillars of learning, environmental challenges, business students, the Reorient University Curricula to Address Sustainability (RUCAS) Tempus project
Background

Environmental resources, ‘common’ in nature, are being unsustainably used causing a large-scale environmental crisis. Our current global problems are caused by three crises: the financial crisis, food problem and climate change. The world is suffering many problems with serious threats to human well-being and sustainability (Costanza, 2011a). There is a clear need to change the status quo of the world through sustainable development (SD). Sustainability is an evolving paradigm that necessitates an understanding of the interconnections and interdependencies among ecological, economic and social systems (Schmuck & Schultz, 2002; Kemp, Parto, & Gibson, 2005; Munier, 2005; Von Der Heidt & Lamberton, 2011). The United Nations Educational, Scientific and Cultural Organisation (UNESCO) views SD as having a different vision of the world (UNESCO, 2005). Reframing the way humans view nature as an essential component to our social and economic well-being is needed to build a sustainable future for the next generations (Costanza, 2011b). The sustainability paradigm is emerging as a megatrend affecting policies at all levels of governments, businesses as well as educational institutions (Lubin & Esty, 2010). We need a new way to view humanity and the rest of nature, a shift in moral values and new commitments of the future generations to finding sustainable solutions. With the significant increase in the global threats, education has a fundamental role to play in personal and social development (Delors, 1996). Since education is a motor for change, the great task educators are called for is to provide the new generation – students across all disciplines – with a vision of education that seeks to empower them to assume responsibility for creating a sustainable future, and this is education for sustainable development (ESD) by definition.

ESD: Its roots, objectives and characteristics

According to UNESCO (n.d.), though ESD can be seen as associated with the many SD-related educations, it has its roots in environmental education (EE). The founding documents are the Tbilisi Declaration for EE and Chapter 36 of Agenda 21 for ESD. In October 1977, the world’s first intergovernmental conference on EE took place in Tbilisi, Georgia. This event and the subsequent publications continue to provide the blueprint for the development of EE (UNESCO, 1978). In June 1992, the United Nations (UN) organised a conference on environment and development (UNCED), the Earth Summit at Rio de Janeiro, Brazil. The outcomes of the Rio agreements were combined in Agenda 21, a major action programme setting out what nations should do to achieve SD in the 21st century. There were implications for EE throughout this document, particularly in Chapter 36 that established the basis for action in EE for SD. One of the major outcomes of the conference for educators is the recommendation that environment and development education should be incorporated as an integral part of learning (UN, 1992).

During the post-Rio decade, conferences and meetings which focused on SD and the role of education continue to emphasise the need for capacity-building and continuous engagement in sustainability. In recognition of the importance of ESD, the United Nations General Assembly, through its Resolution 57/254, in December 2002, declared a Decade of Education for Sustainable Development (DESD) (2005–2014) and designated UNESCO as the lead agency. Since the launching of the DESD, many sustainability
Can education for sustainable development address challenges in the Arab region?

Issues have been integrated in education. The UNESCO framework of the DESD scheme suggests that ESD requires the integration of all dimensions of SD including social, environmental, cultural and economic. Through ESD plans, students should acquire various skills (critical and creative thinking, communication, conflict management and problem-solving strategies as well as project assessment) to actively contribute to the life of society, be respectful of the Earth and life in all its diversity and be committed to promoting democracy and peace (UNESCO, 2005). To achieve those objectives, the DESD focuses on (a) promoting quality education and encouraging citizens to live sustainably; (b) reorienting education programmes to focus on the development of knowledge, skills, perspectives and values related to sustainability; (c) building awareness of the concept of SD through community education and the media, in order to make it possible to develop enlightened, active and responsible citizenship locally, nationally and internationally; (d) providing practical training and continuing education to teacher trainers, pre-service and in-service teachers in making SD a reality (UNESCO, 2005; Spiropoulou, Antonakaki, Kontaxaki, & Bouras, 2007). In addition, the DESD exerts concerted efforts to create synergies with other global initiatives, such as the United Nations Millennium Development Goals (MDGs), the United Nations Literacy Decade and the Literacy Initiative for Empowerment (LIFE). In declaring these global initiatives, the international community clearly recognises that a change towards SD and a better quality of life start with education.

Rationale: The need for ESD in the Arab region

Efforts to ensure SD in the Arab region are challenged by increased demands on already constrained natural resources. If Arab countries maintain their slow trajectory towards SD, an estimated 124 million people in the Arab region will lack access to basic sanitation in 2015, with about half of these living in the Arab least developed countries (Economic and Social Commission for Western Asia [ESCWA], 2010). The global environmental challenges are becoming significant obstacles to human well-being, a situation that calls for the redirection of national development policies that highlight sustainability. Because threats to the environment are threats to development (World Bank, 2012), the growing environmental challenges in the Arab region are negatively impacting sustainability at all levels.

Population in Arab countries is estimated to be about 395 million people by 2015 (the United Nations Development Programme [UNDP], 2009). The rapid increase in population, together with the changing consumption patterns, put strong pressures on the carrying capacity of already fragile Arab lands (Abahussain, Abdu, Al-Zubari, El-Deen, & Abdul-Raheem, 2002). The population growth problem is accompanied by intensive urban migration, creating burdens on infrastructure and resulting in congested and unhealthy living conditions in many Arab cities. Additionally, population growth and socio-economic development have generated a considerable increase in water demands. While the population in the Arab region accounts for five per cent of the world population, this region is the source of less than one per cent of the world’s renewable fresh water (ESCWA, 2010). Water shortage and deteriorating water quality are the most significant challenges that confront well-being in the Arab region (UNDP, 2009). Population increase, land-use and land cover change and climate change are expected
to contribute to accelerated water scarcity and desertification. The majority of Arab lands are dominated by drylands, and a major challenge in these ecosystems is desertification. “Desert has swallowed up more than two-thirds of total land area of the region” (UNDP, 2009, p. 3). This has reduced the availability of arable land, leading to reduction in agricultural production, malnutrition, poor health, poverty and sometimes creating social and political conflicts. Another challenge in many Arab cities is the air pollution level that exceeds World Health Organization (WHO) standards and negatively affects the economic and health sectors of Arab population (Arab Forum for Environment and Development [AFED], 2011). The Arab region is already the most water-scarce region in the world, which makes it among the most vulnerable to the impacts of climate change (Arab Climate Resilience Initiative, 2010). Climate change may cause problems in many ways, such as worsening of the water shortage problem, reducing agricultural production, intensifying urban migration, causing further losses of biodiversity, reducing levels of economic activity and threatening human well-being (UNDP, 2009).

Facing the increasingly significant environmental problems and in an effort to achieve ESD objectives in the Arab region, in the period 2006–2007 the UNESCO Regional Bureau for Education in the Arab States in Beirut (Lebanon) has carried out a study to explore mechanisms to be adopted in order to ensure sustainability in the region. The study identified many SD challenges in the Arab region and revealed that Higher Education Systems in the region are facing major problems that are adversely affecting their ability to achieve sustainability (Makrakis, Kostoulas-Makrakis, & Kanbar, 2012). According to the UNESCO report (2007), “there is no evident progress in DESD implementation, be it regional or national, in the Arab region” (p. 60) – an alarming finding for all Arab countries. The Arab Millennium Ecosystem Assessment report comes out recently to show that efforts to ensure sustainable development in the Arab region are hindered by many ecosystem challenges (Kanbar, in press).

Objectives

With a lack of progress in implementing ESD in the Arab region, it is timely that Arab countries regard education as the cornerstone to achieve the goals of sustainability. This article intends to explore ESD-related issues in higher education in the Arab region. The research presents a case study from the FBAE at NDU in Lebanon to assess the need to reorient university curricula to address sustainability. It reports the results of the RUCAS Tempus project. In investigating this topic, this main objective of the study is to assess the need for ESD through an examination of the ESD students’ attitudes and competences with the aim of reorienting university curricula to address sustainability. This objective will be achieved by answering the following research questions: What are the sources of information about SD students have used? What kinds of actions have students done lately for SD reasons? What teaching and learning methods are being currently used in our university programmes? What are the current attitudes and ESD competences that students currently have?

These research questions will be answered by drawing on the results of an empirical study among 227 undergraduate students in the FBAE at NDU, which was designed based on the five pillars of learning set by the UNESCO, as described in the next section.
Can education for sustainable development address challenges in the Arab region?

RUCAS conceptual framework

Based on the UNESCO recommendation that educational programmes of universities in terms of curriculum and teaching methods should infuse ESD to sensitize students and other stakeholders towards sustainability, the RUCAS Tempus project was born in October 2010. RUCAS comes at the middle of the DESD, and its relevance is strengthened by the Bonn Declaration held in Germany in 2009 in which it was declared that action should be taken to re-orient education and training systems to address sustainability concerns through coherent policies at national and local levels (UNESCO, 2009). The concept of sustainability requires educational institutions to rethink their missions and to restructure their courses, research priorities, community outreach and campus operations. Within this context, a number of European higher education institutions (HEIs) who have developed expertise in the field of ESD have joined efforts with six HEIs from Lebanon, Jordan and Egypt along with active NGOs to form a consortium whose aim is to revise university curricula to address sustainability. The ESD issues raised by the UNESCO Regional Bureau for Education in the Arab States study fit into the development strategies of the three Arab countries participating in RUCAS. Further, ESD, as an inter-disciplinary area, covers many prioritised disciplines both nationally and regionally. The RUCAS project adopts a multi/inter-disciplinary and systemic approach that aims to design and implement a model that underlines sustainability issues into higher education curricula and develop resources to support university teaching staff and management to embed sustainability across curricula in the disciplines of educational sciences, social sciences, business and economics, engineering and applied sciences.

With the evolving and interdisciplinary nature of the concept of sustainability, ESD is based on the principles and values that underlie SD, and it deals with four dimensions of sustainability: environment, society, culture and economy (UNESCO, 2007). ESD uses a variety of pedagogical techniques that promote participatory learning and higher-order thinking skills. It is locally relevant and culturally appropriate; it is based on local needs, perceptions and conditions, but acknowledges that fulfilling local needs has international consequences. ESD promotes lifelong learning and engages formal, non-formal and informal education. It addresses content, taking into account the context, global issues and local priorities. It builds civil capacity for community-based decision making, social tolerance, environmental stewardship and a good quality of life. ESD programmes reflect the distinctive environmental, social, cultural and economic conditions of each locality. In spite of their differences, all programmes should be based on five fundamental pillars of learning to provide quality education and foster SD (four as set out in the Delors’ report (1996) and the fifth pillar added by UNESCO). Thus, achieving SD requires:

- recognition of the challenge of sustainability (learning to know);
- acting with determination (learning to do);
- collective responsibility and constructive partnership (learning to live together);
- the indivisibility of human dignity (learning to be);
- individual and collective actions (learning to transform oneself and society).

According to the Delors’ report (1996), learning to know emphasises learning to learn, so as to benefit from the opportunities education provides. Learners build their knowledge, values, cognitive skills and reasoning in order to develop critical thinking, acquire tools for understanding the world and sustainability issues. Learning to do entails
acquiring the competence to deal with a variety of situations and to work in teams. It is about knowledge, values and knowing how to actively engage in order to be an actor as well as a thinker, understand and act on global and local SD issues, acquire technical and professional training, apply learned knowledge and be able to act creatively and responsibly. *Learning to live together* is about developing an understanding of other people and an appreciation of interdependence in a spirit of respect for the values of pluralism, mutual understanding and peace. This pillar of learning has to do with knowledge, values, social skills and social capital for international, intercultural and community cooperation in order to work together in increasingly multi-cultural societies; develop an understanding of other people and their histories, traditions, beliefs and values; tolerate, respect and celebrate difference and diversity in people; respond constructively to the cultural diversity and economic disparity around the world and be able to cope with conflict situations. *Learning to be* emphasises the development of one’s personality and the ability to act with greater autonomy, judgment and personal responsibility. It assumes that each individual has the opportunity to develop his/her full potential, and it is based on the principle that education is for enabling individuals to learn, seek, build and use knowledge to address local and global problems. This pillar of learning relates to knowledge, values, personal skills and dignity for personal and family well-being in order to see oneself as the main actor in defining positive outcomes for the future, encourage discovery and experimentation, acquire universally shared values, develop one’s personality and be able to act with greater autonomy and personal responsibility. As for the fifth pillar added by UNESCO, *learning to transform oneself and society*, it recognises that individuals working separately and together can change the world and that a quality education provides the tools to transform societies, because of the way it equips humans with knowledge, values and skills for transforming attitudes and lifestyles. Achieving SD requires individual and collective actions, active citizenship, future thinking, responsible lifestyles and sharing of resources. ESD empowers people to assume responsibility for creating and enjoying a sustainable future. This reflects a synergy of cognitive, practical, personal and social skills to bring about sustainability in order to promote behaviours that minimise our ecological footprint; be respectful of the Earth and life in all its diversity; act to achieve social solidarity and promote democracy.

**Research methods**

**Subjects**

Students were selected from the FBAE at NDU for two main reasons. First, FBAE is the largest faculty at NDU in terms of numbers of students and faculty members. Second, it has been suggested in the literature that conventional curricula of business schools reproduce socially and ecologically unsustainable values of affluent consumer society (Von Der Heidt & Lamberton, 2011). Businesses, main polluters and consumers of natural resources, are major causes of unsustainability (Intergovernmental Panel on Climate Change [IPCC], 2007). Thus, to ensure a transition to sustainability requires business graduates to acquire competences as an essential component of a real solution. It is at the university level that graduates can gain these competences.
To examine ESD attitudes and competences for business students, questionnaires were distributed to different faculty members in the FBAE who teach classes that encompass different business concentrations; mainly economics, finance, accounting, management, marketing and human resources. Thus, a cluster of classes was selected to cover all the students in the FBAE. A representative sample of 250 students was targeted. The response rate was 90.8% yielding 227 usable responses. Respondents were reminded that their responses are totally voluntary and strictly confidential. No monetary incentives were offered.

Study instrument

A framework to measure ESD students’ attitudes and competences was developed to be used as a guide for the design and validation of ESD-related competences for students at the university level (Makrakis et al., 2012). The clusters adopted for the general competences were based on the Delors’ report (1996), which recognises the four pillars for education: 1) learning to know; 2) learning to do; 3) learning to be and 4) learning to live together. We also added ‘learning to transform oneself and society’ that has been introduced by UNESCO as the fifth pillar. A pilot test with a group of 177 students from four faculties (Faculty of Business Administration and Economics (FBAE), Faculty of Natural and Applied Sciences (FNAS), Faculty of Humanities (FH) and Faculty of Engineering (FE) was undertaken at NDU to test the clarity of instructions, appropriateness of the response set and face validity of the items. The questionnaire was finalised, and 3 757 students from the 12 participating universities in RUCAS were surveyed to examine the extent to which ESD attitudes and competences were acquired by students before starting the infusion of sustainability issues in the curricula. This article reports the results of the survey for the sample of undergraduate students at the FBAE at NDU (227 students).

The questionnaire consisted of six pages of questions to be completed mainly by Likert scale response statements, yes/no items and ranking questions. It asked about the country and the institution where the survey was conducted, it asked about the student’s discipline and gender. It included questions on SD courses taken by the student; asked the student to rank the sources of information related to SD, rank the actions the student has done lately for SD reasons and rank the different teaching and learning methods that are being currently used in the university programmes. Additionally, the questionnaire attempts to assess the respondents’ preference of the four functions of education, namely, to replicate the existing society and culture, to train people for future employment, to help people develop their potential and to encourage change towards a fairer society and a better world. Current students’ attitudes towards ESD were measured using ten Likert scale items. The five pillars of learning (ESD general competences) were measured using fifty-four Likert scale items specifically designed for this study to include the five pillars of learning. Finally, eighteen items measure ESD disciplinary competences (business/economics in the case of this study) that students currently have.
Measurement of key variables

Based on the conceptual model of the study, many variables are included to explore how they are causally prior to ESD students’ attitudes and competences. These variables include gender, questions that ask students whether they have taken courses or assignments that deal with SD issues, sources of information related to SD, actions students have done lately for SD reasons and different teaching and learning methods that are being currently used in university programmes. Dichotomous (0, 1) dummy variables were created for gender and variables about courses or assignments that deal with SD issues. As for ranking the sources of information related to SD, students were asked to give a rank of 1 to the most used source. Zero was entered if no rank was given. Students were also asked to select all the actions they had done lately for SD reasons. Here, a dichotomous scale was used where zero was entered if the action was not selected and 1 if the action was selected. For the ranking of the different teaching and learning methods used in university programmes, students were given a list of ten methods and they had to rank them from one to ten with one being the most frequently used. A value of zero was given in the case of no rank.

Students’ ESD attitudes were assessed through a series of items in the survey on a six-point rating scale (strongly disagree, moderately disagree, slightly disagree, slightly agree, moderately agree and strongly agree). Also, a six-point rating scale (not at all, poor, fair, good, very good and excellent) was used to assess general and disciplinary competences. Attitude scales and competence scales (for the five pillars of learning) were constructed by adding together all non-missing responses and dividing by the number of valid responses. This resulted in scales in the same range as the original variables (1–6). For all scales, the higher the values, the more the individual adheres to that attitude or competence. The scale was reversed for some attitude items to ensure all items follow the same direction, where a higher score means pro-environmental attitudes. All questionnaires were carefully edited to confirm that there were no obvious outliers. Responses were entered into Statistical Package for the Social Sciences (SPSS) statistical data editor. A quality check was conducted and statistical diagnostics that measure central tendencies and dispersion was applied to the data.

Main findings

Students’ profile and ESD literacy

The analysis of the data revealed that 49.3% (n = 112) of the students were females and 49.3% (n = 112) were males. Only three students did not respond to the gender question. The majority of the respondents (75.3%) have taken a course that includes some issues relevant to SD, and many respondents (58.6%) have taken a course that relates directly to SD. A percentage of 57.3% have done a course assignment or project that concerns SD.

When asked about the sources of information related to SD, the majority of the students (68.7%) ranked the internet as the most used source of information about SD they had used. Thirty per cent of the sample ranked university courses as the second most important source of information related to SD. A relatively smaller percentage (27.8%) ranked newspapers as the third source of information about SD. A small per-
Can education for sustainable development address challenges in the Arab region? A percentage (8.4%) noted that TV is the fourth source. An even smaller percentage (7%) gave an unclassified answer suggesting that publications/brochures and magazines, events such as conferences, fairs/exhibitions and festivals; as well as conversations with friends/family and colleagues might be ranked as the fifth, sixth and seventh source of information related to SD respectively. Radio and special interest groups were ranked eighth and ninth respectively (Table 1).

Table 1. Sources of information about SD students have used

<table>
<thead>
<tr>
<th>Source of information</th>
<th>Not ranked (%)</th>
<th>Ranked 1st (most used source) (%)</th>
<th>Ranked 2nd (%)</th>
<th>Ranked 3rd (%)</th>
<th>Ranked 4th (%)</th>
<th>Ranked 5th (%)</th>
<th>Ranked 6th (%)</th>
<th>Ranked 7th (%)</th>
<th>Ranked 8th (%)</th>
<th>Ranked 9th (%)</th>
<th>Ranked 10th (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>22.9</td>
<td>10.6</td>
<td>12.8</td>
<td>27.8</td>
<td>7.5</td>
<td>3.1</td>
<td>2.6</td>
<td>3.1</td>
<td>1.8</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>The internet</td>
<td>5.7</td>
<td>68.7</td>
<td>13.7</td>
<td>6.6</td>
<td>3.5</td>
<td>0.9</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University courses</td>
<td>18.5</td>
<td>22.5</td>
<td>30.0</td>
<td>13.7</td>
<td>5.3</td>
<td>5.3</td>
<td>0.4</td>
<td>2.6</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV</td>
<td>20.3</td>
<td>20.7</td>
<td>18.1</td>
<td>21.1</td>
<td>8.4</td>
<td>4.0</td>
<td>2.2</td>
<td>1.3</td>
<td>3.5</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Publications/brochures/magazines</td>
<td>20.3</td>
<td>12.3</td>
<td>19.4</td>
<td>20.3</td>
<td>6.2</td>
<td>7.0</td>
<td>6.2</td>
<td>3.1</td>
<td>3.1</td>
<td>1.8</td>
<td>0.4</td>
</tr>
<tr>
<td>Events (conferences, fairs/exhibitions, festivals, etc.)</td>
<td>28.6</td>
<td>4.4</td>
<td>17.2</td>
<td>19.8</td>
<td>4.8</td>
<td>4.8</td>
<td>7.0</td>
<td>4.8</td>
<td>4.8</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Conversations with friends/family/colleagues</td>
<td>21.6</td>
<td>15.9</td>
<td>17.2</td>
<td>12.8</td>
<td>6.6</td>
<td>4.8</td>
<td>4.4</td>
<td>7.0</td>
<td>4.4</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>The radio</td>
<td>30.0</td>
<td>3.1</td>
<td>10.1</td>
<td>21.1</td>
<td>4.8</td>
<td>5.7</td>
<td>6.2</td>
<td>6.2</td>
<td>6.6</td>
<td>5.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Special interest groups (for instance, NGOs)</td>
<td>29.5</td>
<td>6.6</td>
<td>10.1</td>
<td>21.1</td>
<td>2.2</td>
<td>4.4</td>
<td>4.0</td>
<td>4.4</td>
<td>5.3</td>
<td>11.0</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Table 2 suggests that the top three sources of information about SD issues are: the internet (68.7% ranked it number one), university courses (22.5% ranked them number one) and TV (20.7% ranked it number one). When asked about the second rank, the order of these top three sources of information changed; university courses have now the highest percentage, followed by TV and then the internet. The third rank places TV first, followed by university courses and then the internet.

Table 2. The top three sources of information about SD according to rank one as shown in Table 1

<table>
<thead>
<tr>
<th>Source of information</th>
<th>Rank 1</th>
<th>Rank 2</th>
<th>Rank 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>The internet</td>
<td>156</td>
<td>68.7</td>
<td>31</td>
</tr>
<tr>
<td>University courses</td>
<td>51</td>
<td>22.5</td>
<td>68</td>
</tr>
<tr>
<td>TV</td>
<td>47</td>
<td>20.7</td>
<td>41</td>
</tr>
</tbody>
</table>
**Actions students have done for SD reasons**

Students were asked to select all the actions they had done lately for SD reasons. Of the nine actions they were asked about, only three sustainable actions were selected by the majority of the students (about half the sample or more). Results show that 74.4% of the students indicated that they switched off unnecessary lights, 67% indicated that they used energy saving light bulbs, and about half of the sample (49.8%) indicated that they donated money to charities. A large percentage of students (87.7%) did not refuse to take a plastic bag from the supermarket, 80.2% did not do any form of voluntary work in their community. In addition, 75.3% have not purchased eco-labelled and fair products, 72.2% have not recycled cans, glass or paper. Furthermore, 69.6% have not used carpooling. Also, 54.2% have not purchased environmentally friendly products (Table 3).

**Table 3. Actions done during the past month for sustainable development reasons**

<table>
<thead>
<tr>
<th>Have you done any of the following actions during the past month for SD reasons?</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switched off unnecessary lights</td>
<td>74.4</td>
<td>25.6</td>
</tr>
<tr>
<td>Purchased eco-labelled and fair-trade products</td>
<td>24.7</td>
<td>75.3</td>
</tr>
<tr>
<td>Recycled cans, glass or paper</td>
<td>27.8</td>
<td>72.2</td>
</tr>
<tr>
<td>Used carpooling</td>
<td>30.4</td>
<td>69.6</td>
</tr>
<tr>
<td>Purchased environmentally friendly products</td>
<td>45.8</td>
<td>54.2</td>
</tr>
<tr>
<td>Did any form of voluntary work in your community</td>
<td>19.8</td>
<td>80.2</td>
</tr>
<tr>
<td>Donated money to charities</td>
<td>49.8</td>
<td>50.2</td>
</tr>
<tr>
<td>Refused to take a plastic bag from the supermarket</td>
<td>12.3</td>
<td>87.7</td>
</tr>
<tr>
<td>Used energy saving light bulbs</td>
<td>67</td>
<td>33</td>
</tr>
</tbody>
</table>

Cross tabulations and Pearson’s chi-square results show that some actions are dependent on gender, mainly purchasing eco-labelled and fair-trade products, donating money to charities, refusing to take a plastic bag from the supermarket and using energy saving light bulbs with male students stating that they performed more of these actions for SD reasons (Table 4).

**Table 4. Chi-square test for the different SD-related actions across gender**

<table>
<thead>
<tr>
<th>SD-related actions</th>
<th>Gender</th>
<th></th>
<th></th>
<th>X²-test</th>
<th>Fisher’s exact test</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>% of total</td>
<td>Count</td>
<td>% of total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switched off unnecessary lights</td>
<td>No</td>
<td>24</td>
<td>10.7</td>
<td>33</td>
<td>14.7</td>
<td>0.220</td>
</tr>
<tr>
<td>Yes</td>
<td>88</td>
<td>39.3</td>
<td>79</td>
<td>35.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchased eco-labelled and fair-trade products</td>
<td>No</td>
<td>92</td>
<td>41.1</td>
<td>77</td>
<td>34.4</td>
<td>0.029</td>
</tr>
<tr>
<td>Yes</td>
<td>20</td>
<td>8.9</td>
<td>35</td>
<td>15.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Sequel to Table 4 see on p. 51.*
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Sequel to Table 4.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled cans, glass or paper</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.296</td>
<td>0.148</td>
</tr>
<tr>
<td>Yes</td>
<td>27</td>
<td>12.1</td>
<td>35</td>
<td>15.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>85</td>
<td>37.9</td>
<td>77</td>
<td>34.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used carpooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>81</td>
<td>36.2</td>
<td>74</td>
<td>33.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>31</td>
<td>13.8</td>
<td>38</td>
<td>17.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchased environmentally friendly friendly products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>No</td>
<td>61</td>
<td>27.2</td>
<td>62</td>
<td>27.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>51</td>
<td>22.8</td>
<td>50</td>
<td>22.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did any form of voluntary work in your community</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.401</td>
<td>0.20</td>
</tr>
<tr>
<td>No</td>
<td>93</td>
<td>41.5</td>
<td>87</td>
<td>38.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>19</td>
<td>8.5</td>
<td>25</td>
<td>11.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Donated money to charities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.061</td>
<td>0.031*</td>
</tr>
<tr>
<td>No</td>
<td>64</td>
<td>28.6</td>
<td>49</td>
<td>21.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>48</td>
<td>21.4</td>
<td>63</td>
<td>28.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refused to take a plastic bag from the supermarket</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.025</td>
<td>0.012*</td>
</tr>
<tr>
<td>No</td>
<td>104</td>
<td>46.4</td>
<td>92</td>
<td>41.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>7.1</td>
<td>20</td>
<td>8.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used energy saving light bulbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.118</td>
<td>0.059*</td>
</tr>
<tr>
<td>No</td>
<td>43</td>
<td>19.2</td>
<td>31</td>
<td>13.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>69</td>
<td>30.8</td>
<td>81</td>
<td>36.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Teaching and learning methods

The questionnaire included a list of ten teaching and learning methods, and students were asked to rank them according to their frequency of use at the university. From their responses summarised in Table 5, lecturing came in first at 66.1%, interactive engagement came in second at 29.5%, project-based learning was in the third place at 20.7%. A careful examination of the percentages shows some kind of competition over the ranks given by the students to the other various methods. This could be due to the fact that students are not familiar with those methods, such as inquiry-based, case-based instruction, interdisciplinary teaching, problem-based learning, tech-supported instruction, placed-based learning and discovery learning. This result was expected, and this is why an explanation of the different methods was provided to the students; however, the analysis still shows mixed results about the ranks.

Table 5. Teaching and learning methods used in the courses

<table>
<thead>
<tr>
<th>Teaching and learning methods</th>
<th>Not ranked (%)</th>
<th>Ranked 1st (%)</th>
<th>Ranked 2nd (%)</th>
<th>Ranked 3rd (%)</th>
<th>Ranked 4th (%)</th>
<th>Ranked 5th (%)</th>
<th>Ranked 6th (%)</th>
<th>Ranked 7th (%)</th>
<th>Ranked 8th (%)</th>
<th>Ranked 9th (%)</th>
<th>Ranked 10th (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturing</td>
<td>5.7</td>
<td>66.1</td>
<td>12.3</td>
<td>8.8</td>
<td>2.2</td>
<td>0.4</td>
<td>0.4</td>
<td>1.8</td>
<td>0.4</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Project-based learning</td>
<td>13.2</td>
<td>25.1</td>
<td>26.4</td>
<td>20.7</td>
<td>7.5</td>
<td>2.2</td>
<td>3.1</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interactive engagement</td>
<td>22.0</td>
<td>13.2</td>
<td>29.5</td>
<td>15.0</td>
<td>6.6</td>
<td>7.5</td>
<td>2.2</td>
<td>1.3</td>
<td>2.2</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Case-based instruction</td>
<td>15.9</td>
<td>18.9</td>
<td>26.0</td>
<td>16.3</td>
<td>7.0</td>
<td>6.2</td>
<td>2.6</td>
<td>2.6</td>
<td>1.3</td>
<td>2.2</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Sequel to Table 5 see on p. 52.
Inquiry-based learning 24.2 14.1 18.1 16.3 7.5 6.6 4.0 3.1 3.5 1.8 0.9
Interdisciplinary teaching 31.7 9.7 17.6 12.3 3.5 4.0 6.6 5.3 4.4 1.8 3.1
Problem-based learning 21.6 12.3 19.4 17.6 7.0 4.0 5.7 6.6 2.6 1.3 1.8
Tech-supported instruction29.5 10.6 15.4 13.7 3.5 4.0 5.3 5.3 7.5 4.4 0.9
Placed-based learning 36.1 6.2 8.4 17.2 3.1 4.4 2.2 1.8 4.0 9.3 7.5
Discovery learning 33.0 7.5 7.0 20.7 3.5 4.0 3.5 0.9 2.6 7.0 10.1

Table 6 suggests that the top three teaching and learning methods listed according to those ranked in first position as the most widely used are: lecturing (66.1% of the students ranked it number one), project-based learning (25.1% ranked it number one) and case-based instruction (18.9% ranked it number one). When asked about the second rank, the order of these top three teaching and learning methods has changed; project-based learning is the first, followed by case-based instruction and then lecturing. The third rank places project-based learning first, followed by case-based instruction and then lecturing.

Table 6. The top three teaching and learning methods according to rank one as shown in Table 5

<table>
<thead>
<tr>
<th>Teaching and learning methods</th>
<th>Rank 1</th>
<th></th>
<th>Rank 2</th>
<th></th>
<th>Rank 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Lecturing</td>
<td>150</td>
<td>66.1</td>
<td>28</td>
<td>12.3</td>
<td>20</td>
<td>8.8</td>
</tr>
<tr>
<td>Project-based learning</td>
<td>57</td>
<td>25.1</td>
<td>60</td>
<td>26.4</td>
<td>47</td>
<td>20.7</td>
</tr>
<tr>
<td>Case-based instruction</td>
<td>43</td>
<td>18.9</td>
<td>59</td>
<td>26.0</td>
<td>37</td>
<td>16.3</td>
</tr>
</tbody>
</table>

To enhance learning about SD issues, different teaching methodologies should be used in the classroom, which does not seem to be the case in the present study. The majority of the students indicated that lecturing is the most used teaching method. Lecturing is definitely most helpful to disseminate information quickly to a large audience. However, it should be combined with other teaching methods in order to facilitate students’ involvement, develop analytical, collaborative and communication skills and encourage critical thinking – all needed in ESD.

Preferred function of education

Students were asked about the four functions of education they prefer most. Nobody responded ‘to replicate the existing society and culture’, 24.2% selected ‘to train people for future employment’, 41.4% answered ‘to help people develop their potential’, and 33% chose ‘to encourage change towards a fairer society and a better world’. Three respondents did not answer the question. Chi-square test showed no significant difference between males’ and females’ responses on that particular question.

These results are interesting in that not one student responded ‘to replicate the existing society and culture’. This is a remarkable finding proving that the students are conscious of the necessity to transform and change the existing society. Students mostly prefer that education plays a role in helping people to develop their potential, followed by encouraging change towards a fairer society and a better world.
ESD attitudes

Students’ ESD attitudes were assessed through a series of 10 items in the survey (Table 7). The majority of the respondents (81.5%) agree that people should be prepared to make sacrifices to improve the quality of life for others. Also, 76.2% agree that everyone should look after themselves rather than rely on the government for help. The answers revealed that a large percentage of the students (59.9%) disagree with the statement: *There is little connection between the protection of the environment and people’s quality of life.* Despite the recent global financial and economic crisis and the high level of unemployment, 66.1% disagree with the statement: *Economic growth and increased employment are more important than protecting the environment.*

Table 7. Students’ attitudes towards ESD

<table>
<thead>
<tr>
<th>Attitudes</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>People should be prepared to make sacrifices to improve the quality of life for others</td>
<td>3.1</td>
<td>4.0</td>
<td>11.0</td>
<td>26.0</td>
<td>27.3</td>
<td>28.2</td>
</tr>
<tr>
<td>Everyone should look after themselves rather than rely on the government for help</td>
<td>4.4</td>
<td>7.9</td>
<td>11.0</td>
<td>16.3</td>
<td>28.6</td>
<td>31.3</td>
</tr>
<tr>
<td>There is little connection between the protection of the environment and people’s quality of life (R)</td>
<td>36.1</td>
<td>13.7</td>
<td>10.1</td>
<td>13.2</td>
<td>12.3</td>
<td>13.7</td>
</tr>
<tr>
<td>Economic growth and increased employment are more important than protecting the environment (R)</td>
<td>22.9</td>
<td>22.9</td>
<td>20.3</td>
<td>15.0</td>
<td>13.7</td>
<td>4.8</td>
</tr>
<tr>
<td>There is very little someone like me can do to protect the local environment (R)</td>
<td>16.7</td>
<td>18.5</td>
<td>20.7</td>
<td>18.5</td>
<td>14.5</td>
<td>9.3</td>
</tr>
<tr>
<td>What I do in this country has little effect on the quality of life for people in other countries (R)</td>
<td>13.7</td>
<td>15.9</td>
<td>22.0</td>
<td>18.9</td>
<td>15.9</td>
<td>11.9</td>
</tr>
<tr>
<td>What other countries do to improve or destroy the environment is none of our business (R)</td>
<td>55.1</td>
<td>17.6</td>
<td>10.6</td>
<td>7.9</td>
<td>4.0</td>
<td>4.8</td>
</tr>
<tr>
<td>The third world or less developed countries should deal with their own problems and not look to the world for help (R)</td>
<td>34.4</td>
<td>16.7</td>
<td>15.0</td>
<td>11.0</td>
<td>11.9</td>
<td>9.3</td>
</tr>
<tr>
<td>There is very little someone like me can do to protect the global environment (R)</td>
<td>18.9</td>
<td>18.1</td>
<td>22.5</td>
<td>18.9</td>
<td>12.8</td>
<td>7.9</td>
</tr>
<tr>
<td>The governments’ priority should be to improve the quality of life for people in this country rather than other countries (R)</td>
<td>4.4</td>
<td>4.0</td>
<td>15.4</td>
<td>13.2</td>
<td>18.1</td>
<td>44.1</td>
</tr>
</tbody>
</table>

The negative and positive poles of the scale are: ‘strongly disagree’ and ‘strongly agree’

(R): reversed score
A relatively high percentage (42.3%) agrees with the statement: *There is very little someone like me can do to protect the local environment.* Also, 39.6% of the students agree with the statement: *There is very little someone like me can do to protect the global environment.* Only 51.6% disagree with the statement: *What I do in this country has little effect on the quality of life for people in other countries.* The results show that a relatively high number of students are not aware of their personal responsibilities towards local and global environmental problems. The majority (83.3%) disagree with the statement: *What other countries do to improve or destroy the environment is none of our business.* In addition, 75.4% agree with the statement: *The government’s priority should be to improve the quality of life for people in this country rather than other countries.* And, 66.1% disagree with the statement: *The third world or less developed countries should deal with their own problems and not look to the world for help.* The majority (75.4%) do care for the improvement of the quality of life in their country and do not care for other countries. These findings suggest the need for a revised curriculum, a more effective education process where courses are restructured to inform students of their responsibility towards the environment and the quality of life of individuals in other countries.

The mean score for the attitudes items was computed. It was found to be 3.924 for the study sample. A one-way ANOVA was conducted to check if there is a difference between female and male students in their ESD attitudes. P-value was found to be 0.017 (< 0.05) suggesting that there is a significant statistical difference between the mean attitudes across gender. It is important to note that the higher mean score indicates more pro-environmental attitudes. The female students are found to have a higher mean attitude (4.0175; SD = 0.5841) compared to male students (3.8284; SD = 0.5913). While only 5.3% of the sample show mean attitude less than 3; 94.7% scored 3 or greater. It was found that 50.2% of the sample show mean ESD attitudes less than 4, and 49.8% had mean ESD attitudes at 4 or greater.  

**ESD competences**

Students were asked about their general and disciplinary ESD competences. The survey included twelve items for each of the clusters *learning to be* and *learning to do*. Also, it comprised ten items to assess each of the *learning to live sustainably*, *learning to know* and *learning to transform* clusters. As for the disciplinary competences, they were assessed by 18 items. The mean score was computed for the different five pillars of learning items, in addition to the disciplinary business competences. The competence clusters were categorised in such a way that those who have a mean competence greater or equal to three are considered to have ‘good’ ESD competences in the different clusters. It was found that 98.7% of the total sample of the students show *learning to be* competences ≥ 3; 97.3% show *learning to live sustainably* competences ≥ 3; 97.4% show *learning to know* competences ≥ 3; 97.8% show *learning to do* competences ≥ 3; 99.1% show *learning to transform* competences ≥ 3. As for disciplinary competences, 97.3% show business competences ≥ 3. This classification of competences was not very insightful. Another way to classify competences was computed such that mean competences less than two are considered as ‘poor’, those between two and 3.99 are considered as ‘good’, and those between four and six are considered as ‘very good’ (Table 8). Of the total sample of students, only one student (0.4%) showed ‘poor’ *learning to do* competences. The majority of the students show ‘very good’ competences with 82.4% for the *learning
Can education for sustainable development address challenges in the Arab region?.. to be cluster, followed by 75.8% for learning to know, 74.8% for learning to transform, 74% for learning to do and 72.1% for learning to live sustainably. For the disciplinary competences, 68% showed 'very good' competences suggesting that more efforts need to be done to enhance business competences.

Table 8. Mean ESD competences

<table>
<thead>
<tr>
<th>Mean competence (valid %)</th>
<th>Learning to be</th>
<th>Learning to live sustainably</th>
<th>Learning to know</th>
<th>Learning to do</th>
<th>Learning to transform</th>
<th>Disciplinary business competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 to 1.99 (poor)</td>
<td>-</td>
<td>-</td>
<td>0.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>From 2 to 3.99 (good)</td>
<td>17.6</td>
<td>27.9</td>
<td>24.2</td>
<td>25.6</td>
<td>25.2</td>
<td>32.0</td>
</tr>
<tr>
<td>From 4 to 6 (very good)</td>
<td>82.4</td>
<td>72.1</td>
<td>75.8</td>
<td>74.0</td>
<td>74.8</td>
<td>68.0</td>
</tr>
</tbody>
</table>

A one-way ANOVA was conducted to check if there is a difference between female and male students in their ESD competences. The means for the two gender groups are displayed in Table 9. ANOVA did not show any statistical difference between the two gender groups on the five general pillars of learning. However, P-value was found to be 0.005 (< 0.05) for the disciplinary business competences suggesting that there is a significant statistical difference between the mean disciplinary competences across gender. The female students have a lower mean business competences (4.21; SD = 0.78) than male students (4.49; SD = 0.72).

Table 9. Cross tabulations of competences across gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Learning to be</th>
<th>Learning to live sustainably</th>
<th>Learning to know</th>
<th>Learning to do</th>
<th>Learning to transform</th>
<th>Disciplinary business competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Mean 4.60</td>
<td>4.42</td>
<td>4.44</td>
<td>4.41</td>
<td>4.57</td>
<td>4.21*</td>
</tr>
<tr>
<td></td>
<td>n 112</td>
<td>111</td>
<td>112</td>
<td>112</td>
<td>111</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>SD 0.75</td>
<td>0.78</td>
<td>0.77</td>
<td>0.80</td>
<td>0.82</td>
<td>0.78</td>
</tr>
<tr>
<td>Male</td>
<td>Mean 4.61</td>
<td>4.46</td>
<td>4.48</td>
<td>4.53</td>
<td>4.55</td>
<td>4.49*</td>
</tr>
<tr>
<td></td>
<td>n 112</td>
<td>112</td>
<td>112</td>
<td>112</td>
<td>112</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>SD 0.71</td>
<td>0.75</td>
<td>0.76</td>
<td>0.71</td>
<td>0.72</td>
<td>0.72</td>
</tr>
<tr>
<td>Total</td>
<td>Mean 4.60</td>
<td>4.44</td>
<td>4.46</td>
<td>4.47</td>
<td>4.55</td>
<td>4.35</td>
</tr>
<tr>
<td></td>
<td>n 224</td>
<td>223</td>
<td>224</td>
<td>224</td>
<td>223</td>
<td>222</td>
</tr>
<tr>
<td></td>
<td>SD 0.73</td>
<td>0.76</td>
<td>0.76</td>
<td>0.76</td>
<td>0.77</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Finally, among the competence clusters, a paired t-test was performed to find the mean differences of the different competence clusters (Table 10). Results of the paired t-test for the different competence clusters suggest the following significant statistical mean differences:

a) learning to live sustainably (4.44) < learning to be (4.60);

b) learning to know (4.46) < learning to be (4.60);
c) learning to do (4.47) < learning to be (4.60);
d) learning to live sustainably (4.44) < learning to transform (4.55);
e) learning to know (4.46) < learning to transform (4.55);
f) learning to do (4.47) < learning to transform (4.55).

There is no statistical difference between the means for:
g) learning to know and learning to live sustainably;
h) learning to do and learning to live sustainably;
i) learning to do and learning to know;
j) learning to be and learning to transform.

As for the disciplinary competences, t-tests show clearly that the disciplinary competences are significantly lower than the five pillars of learning, which suggest that the FBAE at NDU needs to emphasise the disciplinary ESD competences in its curricula.

Table 10. Paired t-test among the competence clusters

<table>
<thead>
<tr>
<th>Competence</th>
<th>Learning to live sustainably</th>
<th>Learning to know</th>
<th>Learning to do</th>
<th>Learning to transform</th>
<th>Business competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mean, standard deviation)</td>
<td>(4.60; 0.73)</td>
<td>(4.44; 0.76)</td>
<td>(4.46; 0.76)</td>
<td>(4.47; 0.76)</td>
<td>(4.35; 0.76)</td>
</tr>
<tr>
<td>Learning to be</td>
<td>4.731</td>
<td>3.721</td>
<td>3.577</td>
<td>1.052</td>
<td>5.696</td>
</tr>
<tr>
<td></td>
<td>(4.60; 0.73)</td>
<td>(4.44; 0.76)</td>
<td>(4.46; 0.76)</td>
<td>(4.47; 0.76)</td>
<td>(4.35; 0.76)</td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.605)</td>
<td>(0.481)</td>
<td>(0.010)*</td>
<td>(0.052)*</td>
</tr>
<tr>
<td>Learning to live sustainably</td>
<td>-0.519</td>
<td>-0.706</td>
<td>-2.609</td>
<td>1.955</td>
<td>-0.220</td>
</tr>
<tr>
<td></td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.010)*</td>
<td>(0.025)*</td>
</tr>
<tr>
<td>Learning to know</td>
<td>-0.220</td>
<td>-2.260</td>
<td>2.932</td>
<td>-0.107</td>
<td>2.932</td>
</tr>
<tr>
<td></td>
<td>(0.826)</td>
<td>(0.025)*</td>
<td>(0.004)*</td>
<td>(0.036)*</td>
<td>(0.002)*</td>
</tr>
<tr>
<td>Learning to do</td>
<td>-2.107</td>
<td>3.119</td>
<td>5.279</td>
<td>3.119</td>
<td>5.279</td>
</tr>
<tr>
<td></td>
<td>(0.036)*</td>
<td>(0.002)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
<td>(0.000)*</td>
</tr>
</tbody>
</table>

Implications for ESD teaching and learning methods

The analysis of the teaching and learning methods used at the university seems to imply that only few methods are used; namely, lecturing, project-based learning and case-based instruction. It is important to use various teaching methodologies in classrooms in order to improve learning about SD issues. The evolution to hybrid forms of teaching methodologies renders teaching compatible to the ESD objectives and principles. It is true that lecturing is most appropriate and efficient when introducing large numbers of students to a particular field of study. It gives students the information not elsewhere available; it summarises, synthesises and organises for the students the content of numerous articles and books helping them to learn by listening to the ideas of others; it allows sharing of information, the logical succession of ideas and eventually promotes the formulation of solutions (Kam-Fai, 1973). However, in order to infuse ESD more efficiently, other teaching and learning methods need to be enhanced in universities.
Project-based learning, for instance, is crucial to address complex SD topics as it is a student-centred experiential learning approach by nature. This method requires the learners’ initiatives and independent investigation, it can also involve the local community and mobilise its resources (Frey, 1986; Scoullos & Malotidi, 2004). Case-based instruction is an active, learner-centred model that is used to facilitate the development of reasoning skills and to connect classroom teaching to real world scenarios. This method can be used to teach content, engage students with factual data and provide opportunities for learners to position themselves in professional decision-making situations. Through this process, they develop analytical, collaborative and communication skills (Hartfield, 2010). Inquiry-based learning offers many opportunities to examine the complexity of SD issues. This method stimulates students’ curiosity and encourages them to actively explore and seek out new evidence to support their own response to the problem (Kahn & O’Rourke, 2005).

As the nexus between society and environment becomes more apparent, so the notion of integration across disciplines becomes essential. Interdisciplinary learning methods help students collaborate with other professions that ‘see’ things from a different perspective. Many reports indicate that these methods are necessary to approach the most critical current global challenges; including climate change, sustainability, energy and public health (Borrego & Newswander, 2010). Interdisciplinary learning methods require cooperative learning and are based on the principles of constructivism and experiential learning, by which learners experience working across many disciplines and construct new ideas and concepts. These methods greatly promote many of the core ESD principles as they advocate pluralism of ideas and methods and bring learners out of the ‘box’ of their discipline to develop an appreciation for diverse ways of thinking.

As for problem-based learning, it is used to engage students in becoming active in the learning process. It is characterised by learning via contextualised problem-setting based on real conditions. Complex problems from the real world are used as a stimulus for learning and developing personal competences (Scoullos & Malotidi, 2004). Information and communication technologies (ICTs) or tech-supported instruction encompasses a very large spectrum of information handling tools, including traditional tools like radio, television and telephone up to the most sophisticated satellite, internet and wireless technologies (Reddi, 2004). ICT-enabled learning brings about implications within the ESD framework with regards to the shift from a teacher-centred approach to a learner-centred approach. E-learning brings about the appreciation of multi-disciplinarity and of cross-fertilisation between different disciplines and technological know-how.

Placed-based or service-learning integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility and strengthen communities (Seifer & Connors, 2007). While servicing their communities, students increase their academic achievement, apply scientific knowledge, develop communication skills, foster social responsibility attitudes and develop active citizenship in areas such as public safety and the environment. Service-learning method is a transformative process as it can provide students with ‘transformational learning experiences’. The integration of ESD techniques in service learning is a common practice within formal education.

Discovery learning involves an instructional model that focuses on active, hands-on learning opportunities for students (Dewey, 1916/1997; Piaget, 1954, 1973). With discovery learning, students are actively seeking new knowledge and are engaged in prac-
tical activities that are real problems requiring solutions. This method motivates learners and allows them to seek information that satisfies their natural curiosity (Castronova, 2002). Bicknell-Holmes & Hoffman (2000) describe three main characteristics of discovery learning as 1) exploring and problem solving to create, integrate and generalise knowledge; 2) encouraging students to learn at their own pace and 3) integrating new knowledge into the learner’s existing knowledge base. Discovery learning allows students to interact with their environment by manipulating objects and wrestling with controversies. ESD aims at developing meta-cognitive skills and motivation which are main principles of discovery learning strategy. Applying discovery learning substantially promotes ESD.

Conclusion

The study results indicate that the research participants, FBAE students at NDU, consider the internet as the most used source of information about SD. University courses were ranked second with only 30% of the students giving them this rank. Only 22.5% of surveyed students gave the university courses the first rank as a source of information about SD issues. If we acknowledge that HEIs are among the key institutions that can contribute to proposing solutions for sustainability issues (Saadatian, Binti Dola, Salleh, & Mohd Tahir, 2011), the findings of this study suggest a real need to reorient university curricula to improve ESD, so that courses featuring the development of sustainability skills are seen as providing information for students, rather than as a redundant fashionable option.

The findings of this study suggest that students do not perform actions for SD reasons. Male students are more likely ‘to do’ SD-related actions than female students. In making SD a reality, it is essential ‘to do’ actions related to sustainability. Reinforcing knowledge about SD is important in education; however, it is also important to help students move from ‘knowing’ to ‘doing’. One of the learning pillars, learning to do, focuses on the ability of the learner to put what is learned into practice. It is about knowing how to act for active and responsible engagement in order to take actions related to global and local SD issues. Reorienting existing university curricula to address ESD, emphasising the five learning pillars, is necessary to equip graduates with knowledge, skills, perspectives and values of sustainability and to assume responsibility for creating a sustainable future. By integrating sustainability into major activities of educational institutions, universities can help prepare students to take actions to face the complex, dynamic and uncertain future. New curricula need to promote a sense of both local and global responsibility so that students reflect on new lifestyles (new actions) which combine well-being, quality of life and respect for nature and other people.

The analysis of the ESD attitudes shows a mean attitude of 3.924 for the study sample with the female students having a slightly higher mean attitude than male students. The attitudes mean ranges from 2.4 to 5.3. If we consider those who have an attitude mean of 4 to have favourable ESD attitudes, we can conclude that about half of the sample (50.2%) shows mean ESD attitudes less than 4, and 49.8% had mean ESD attitudes at 4 or greater than 4. Additionally, the results show that a relatively high number of students are not aware of their personal responsibilities towards local and global environmental problems. These findings suggest the need for a revised curriculum to address sustainability, a more effective education process where courses are restructured to infuse ESD and enhance students’ responsibility towards their environment and the quality of life of individuals in their local communities as well as in other countries.
The analysis of the general competences reveals that the majority of the students show ‘very good’ competences ranging from 72.1% for learning to live sustainably to 82.4% for the learning to be cluster. The results of the paired t-test for the different competence clusters suggest that learning to live together sustainably has the lowest mean and learning to be has the highest mean. Revised curricula are needed to enhance the learning to live together sustainably competences. This pillar highlights the interdisciplinary nature of ESD. It addresses the critical skills that are essential for a better life where all have equal opportunities to develop themselves and to contribute to their well-being. As for the disciplinary competences, 68% of the sample showed ‘very good’ competences suggesting that more work needs to be done to enhance disciplinary competences. The results of ANOVA show that female students have a lower mean for the business competences than male students. Additionally, t-tests show that the disciplinary competences are significantly lower than the five pillars of learning. We acknowledged earlier that students and academicians are or will be the future leaders of the society. If we admit that business schools are responsible to prepare students for careers tailored towards a greener economy, business schools need to reorient their curricula to infuse ESD into their programmes through the development of effective pedagogical approaches and learning materials.

Generally, the results obtained from this study suggest that it is time that Arab countries realise the profound association between the environment and development. The many environmental challenges in Arab countries can well put this region of the world beyond its resource limits, threatening its long-term ability to support life and contributing to increasing human vulnerability. It is important for governments in the Arab region to develop national educational strategies for SD to help new generations face the complexities of the global challenges. “Education for sustainable development is not an option but a priority” (UNESCO, 2005, p. 4). ESD is transformational education at heart, and it aims to influence education towards effectively addressing global challenges. ESD has many drives including empowering learners to realise their individual potential as well as contributing to social transformation. Education is asked to create a balance between environmental, societal, cultural and economic considerations in order to ensure a better quality of life. The UN system sees an alternative future out of the crisis in terms of a ‘green economy’ with ESD as the best educational framework for addressing global problems (Von der Heidt & Lamberton, 2011). The Interagency Statement of the United Nations system of 25 June 2009 entitled “Green Economy: A Transformation to Address Multiple Crises” clearly states that “the shift towards a green economy requires education for sustainable development” (UNESCO, 2010, p. 2). Creating green economies and sustainable societies requires more than technological advancements, it necessitates a transformation in attitudes, competences and behaviours to prepare younger generations for a sustainable future.

Humans will not be able to solve today’s problems with the same approaches that created them. Einstein argued that we cannot resolve problems from within the same mindset that created them (Irwin, 2012). What kind of future should education prepare learners for? ESD has a lot to contribute answering this question. The results of this study are insightful in that when asked about the function of education that students prefer, no one answered ‘to replicate the existing society and culture’. The most selected students’ responses to this question went for ‘to help people develop their potential’ and ‘to encourage change towards a fairer society and a better world’. This is an interesting
implication confirming that students are aware of the need for a change, for a societal transformation in our world. In order to achieve this, we need to put the world on a more SD-oriented path. A holistic and ecological worldview is needed to create sustainable solutions. Expanding information, expanding involvement: these are keys to comprehend the complexity of this world and to 'change'. Working together, as educators, governments, businesses and citizens, we can deepen our understanding of sustainability issues and enable the present generations to participate in passing along a safe, healthy world to our children and grandchildren.

Acknowledgement
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SCIENTIFIC AND TECHNOLOGICAL PROGRESS, POLITICAL BELIEFS AND ENVIRONMENTAL SUSTAINABILITY

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University of Crete, Greece

Abstract

With the development of science and technology, a basically optimistic ideology of progress has emerged. This deterministic attitude has been challenged in recent decades as a result of harmful side-effects generated by the way technology and science have been approached and used. The study presented here is a part of a larger international and comparative study dealing with global/environmental issues related to political orientation, science and technology. 3,080 pre-service teachers from Finland, Greece, Sweden, Japan and Holland answered a closed-end survey instrument. The results of this study show that none of the sample country respondents identified themselves as optimists concerning the impact of science and technology on society and environment. The no-stance and the pessimistic attitudes towards technology and science seem to derive from the human and environmental costs associated with science and technology development. A strong connection was found between environmental consciousness and attitudes towards the role and impact of science and technology on society. These results indicate that society and education, in particular, should place higher critical concerns about scientific and technological issues and their relation to the development of a sustainable society.

Key words: science, technology, political beliefs, environmental sustainability

Introduction

In the latter half of the 20th century, we witnessed a growing awareness of an ecological crisis and depletion of the natural resources. With the coming of the new millennium, it is imperative to take into serious consideration the 1987 report of the World Commission on Environment and Development (WCED) for increasing consciousness and action towards sustainable development. The report defined sustainable development as a “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 8). However, the Brundtland definition raises a number of questions, such as: How does one define ‘needs’ as opposed to ‘wants’ in different contexts? The intergenerational approach of sustainable development should be appreciated, but we cannot know what future needs exist or how needs are evaluated, and we cannot know how today’s actions are valued one generation later (Lippert, 2004). Despite the simplicity, ambiguity and broadness of the
Brundtland definition, it has generated hundreds of other definitions and popularised the quest for sustainable development. The emergent definitions usually reflect a range of discourses in sustainability that are often related to the concepts of ‘weak’ versus ‘strong’ sustainability or ‘shallow’ versus ‘deep’ sustainability. ‘Shallow’ or ‘weak’ sustainability is often associated with neo-liberal approaches to the economic growth model, while strong and deep sustainability is often associated with deep ecology. The basic notion of weak/shallow sustainability is that it conceptualises the non-human world not in biophysical terms but in terms of its economic value (Hediger, 2004; Dietz & Neumayer, 2007) in contrast to strong/deep sustainability which sees the triptych of environmental integrity, social/economic equity/justice and the well-being of human and non-human world as a whole.

The concept of sustainable development is also often associated with the strong ties forged between science and technology. The word ‘technology’ encompasses essentially three meanings: 1) tools and instruments to enhance human ability to shape nature and solve problems; 2) knowledge of how to create things or how to solve problems and 3) culture related to our understanding of the world, our value systems (Vergragt, 2006). In contrast to technology, science is seen as a system of acquiring knowledge, deductively and/or inductively using various methodologies. Current perceptions of science and technology see them both as inter-dependent and not linear. Indeed, the boundaries between modern science and technology have become blurred and technology as a system, as a science, as a ‘manner or style’ of thinking is not neutral (Muffoletto, 1996; Breschi & Catalini, 2009). It is seen as a cultural form which has perceived functions and benefits (Lederberg, 1997; Klein & Kleinman, 2002; Bissell, 2010). The ways in which a technology is used cannot be understood without understanding how that technology is embedded in its social context (Nye, 1997; Bissell, 2010).

Looking into the literature, a deep-ranging ambivalence of the roles of technology in regard to sustainable development can be observed. On the one hand, technology is regarded as a problem for sustainability and as a cause of environmental degradation, but, on the other hand, it is also considered as a solution of sustainability problems (Vergragt, 2006; Grunwald, 2009, 2012). It is argued that, while scientific knowledge has led to remarkable advances that have been of great benefit to humankind, at the same time, applications of scientific advances have led to social imbalances, economic disparities, climate change and environmental degradation (Hassan, 2001). World-wide experiences indicate that environmentally sustainable economic growth is difficult to be achieved if development is approached only in capital terms (Goodland, Daly, El Serafy, & von Droste, 1991; Bhaskar & Glyn, 1995; Makrakis, 2012). There are increasing concerns that natural resources are being destroyed by an increasing world population which tends to use its technology to generate non-sustainable economic development. As a reaction to deterministic beliefs, more people tend to believe that scientific and technological advances create more problems in society than those they are supposed to solve (Vergragt, 2006). Indeed, most of the pessimistic notions concerning science and technology have focused upon its human and environmental costs while the optimistic ones are anchored in the notions of technological determinism and instrumentalism. It seems that the rationalistic progressivism which sees science and technology as a solution for every global societal problem cannot be sustained as positive effects often seem to coexist with the negative effects. In this sense, the long-term protection of the environment is, therefore, not primarily a technical problem but rather a social and moral problem.
that can only be solved by drastically reducing the strong influence of materialistic values (Huesemann, 2001).

In general, environmental values are expected to influence profoundly the way people think about their relation to the earth. Schultz’s (2000) study showed that empathising with nature increases people’s awareness of their interconnectness with nature, thereby increasing the saliency of biospheric values. It has been noticed that environmental consciousness is growing at a rapid pace, and research findings substantiate a widespread acceptance of various versions of environmentalism (Dunlap & Scarce, 1991; Dunlap, 1992, 1995; Mass, 2006). The concept of environmental consciousness used here refers to specific psychological factors related to individuals’ propensity to engage in pro-environmental behaviours, incorporating also other factors or psychological constructs that are habitually associated to them, such as beliefs, values, attitudes, knowledge (Kormos-Koch, 2007; Sanchez & Lafuente, 2010). Aoyagi-Usui, Vinken and Kuribayashi (2003) found that the structure of environmental values in Asian countries differ from those in Western countries. They have reported that in the Netherlands and the United States of America (the USA), environmental values were linked with altruistic values that are perceived as being contrary to traditional values. In Japan, Thailand and Philippines, environmental values were linked with both traditional and altruistic values.

In spite of worldwide popularity and well-reasoned calls to action, there is a large gap between environmental attitude and behaviour worldwide (De Oliver, 1999; Yamada, 2008). It has also been found that information, knowledge, concern and awareness can predict little of the variability in most forms of environmental behaviour (Ryland, 2000). Numerous studies show that the existence of people’s environmental concerns, and their intentions for taking environmental actions remain descriptive since these did not link to actual behaviours (Economic Commission for Latin America and the Caribbean [ECLAC], 2000). The expected correlations between support for the new environmental paradigm, distrust of science and technology, post-material values and concern for environmental conditions were found to be partially supported by the results of a Swedish study (Gooch, 1995).

Research has been also directed towards examining the relation between environmentalist commitments and political orientations. Studies have found a positive relation between environmental concern/values and left/liberal politics (Salazar & Alper, 2002). In the USA, for instance, people who support Democrats and Liberals are more concerned about environmental quality than those who support Republican and Conservative counterparts (ECLAC, 2000). A similar trend also exists in Great Britain where the right-wing Tory, Conservative Party, is placing a less importance to environmental issues than left wing Labour and Liberal Democrats (ibid.). It is generally perceived that pro-environmental values may cohere with environmentalists’ political ideas, although some have argued that environmentalism is independent of the left/right ideology. In this sense, the prevalence of environmentalism may be compatible with varying political ideological orientations, although those who support more radical political standpoints would seem to express higher environmental consciousness. It has been found that the relationship between a conservative political orientation and a strong environmental concern is positive while the relationship between this political orientation and membership in an environmental organisation is negative (Skogen & Strandbu, 2000). However, the more comprehensive critical stance found in environmental organisations is still related to a radical political ideology (ibid.). Therefore, political ideology may not be
necessarily a pre-requisite for being environmentally concerned, and differences in cultural
and historical context must be taken into consideration in relating political ideology to
environmental concerns.

An understanding of the principles of ecology, science and technology and an
adoption of an environmental ethic seems to be very crucial today. The reason why the
connection of science and technology with environmental sustainability is so important
today is that humanity is entering a critical era in which teacher education is expected
to play a critical role (Nicolaides, 2006). Basic to education for sustainable development
efforts is the production of an informed citizenry capable of making crucial decisions
about current problems and issues and taking personal actions as a result of these decisions.
Previous research shows that a remarkable amount of courses offered in teacher training
do not fully consider the demands of an integrative thinking, neither the ecological,
economic and social aspects of education for sustainable development (Henze, 2000;
Makrakis, 2012). There is thus need to transform teacher education towards education
for sustainability (Down, 2006; Makrakis, 2006) which can provide a normative frame-
work for educational innovation and research (Posch & Steiner, 2006). The research
presented in this paper constitutes a part of an international and comparative study
that aimed to explore global/sustainability issues in teacher education. In particular,
the study described here aimed to examine the influence of political orientation and environ-
mental consciousness on perceived attitudes towards science and technology. It was
hypothesised that

- pre-service teachers who place strong emphasis on nature and ecological
  awareness will be more conscious of the harmful aspects of science and
technology;
- pre-service teachers who hold more radical ideological and political views
  will exhibit higher environmental consciousness than those who hold more
  conservative political views.

Method

Subjects

The survey population consisted of first year and last year pre-service teachers in Finland,
Greece, Holland, Japan and Sweden. The countries were chosen mainly on the basis of
cultural contrast, an important factor in comparative and international research. All
possible strategies to increase the representativeness of this international and comparative
study were adopted. In Japan, the technique of stratified random sampling was used at
the institutional level on the basis of geographical distribution and the size of the institu-
tion. Through this technique, one-fourth of all Japanese teacher education departments
and institutions were sampled. Two-thirds of the teacher education institutions in Finland,
Greece and Sweden and half of the institutions in Holland, representing all geographical
areas, made up the final sample. Altogether, 53 university institutions were included:
seven from Finland, six from Greece, twenty from Holland, nine from Japan and eleven
from Sweden. In each institution, the survey instrument was distributed to one, two or
more course classes, depending on the size of the class and the structure of the institution.
In total, 3 080 pre-service teachers answered the questionnaire: 381 from Finland, 358
from Greece, 792 from Sweden, 1 056 from Japan and 493 from Holland.
Instrumentation and data analysis

A closed-end survey instrument developed for this comparative study was used to collect the data. In this part of the study, only variables pertaining to the hypotheses addressed are included, that is: a) political orientation; b) environmental consciousness and c) attitudes towards science and technology. Political orientation was measured by a single variable on a five-point scale, indicating one more conservative and five more radical. The other major scale of measuring concern on environmental issues was constructed on the basis of eight items. Some of the items included in the environmental consciousness scale were of the type that: people should not worry about turning the lights in a hotel room because the cost is included in their bill, humankind was created to rule over nature, environmental pollution constitutes a specific form of violence, reducing pollution and environmental damage is more important than increasing our living standards, our country’s industrial and material gains cannot be justified if they come at the expense of the environment and so on. The reliability analysis of the items indicated a Cronbach’s alpha reliability coefficient equal to 0.64, enough to be accepted as a reliable scale. The scale of measuring attitudes towards the impact of science and technology was constructed on the basis of 14 items. These items included notions that scientific and technological progress has increased tensions between nations, that much of the anxiety in modern society is due to scientific and technological development, that scientific and technological advances do more harm than good, that science and technology is the cause of many of the world’s problems and so on. The reliability analysis supported the inclusion of all the items in the measurement model of the science and technology construct with a very high Cronbach’s alpha reliability coefficient equal to 0.88. Data analysis included univariate statistics, one-way ANOVA and multiple comparison Duncan tests.

Results

Indicators of main examined variables

Descriptive statistical analysis indicated that the level of concern for environmental issues was high among pre-service teachers across the five countries ranging from 3.8 to 4.3 on the five-point scale (Table 1). It was revealed that Scandinavian pre-service teachers (Finnish and Swedish) scored higher than other country groups, with a significance level at $p < 0.01$. These results denote a positive attitude towards the need for environmental sustainability.

While environmental consciousness seems to be well established across all the countries examined, the data analysis showed that none of the country samples exhibited optimistic views concerning the impact of science and technology on society. More specifically, Finnish, Dutch and Swedish pre-service teachers are identified within the ‘undecided or uncertain’ category (mean rate between 2.9 and 3.1) of the science and technology scale (Table 1). The category ‘Uncertain’ most probably implies a shaded and two-sided position and not necessarily an ignorant attitude. Indeed, issues of environmental concern related to scientific and technological applications often involve trade-offs between conflicting values in which there is no clear view of positive or negative. Interestingly, Greek and Japanese pre-service teachers have clearly discerned
a pessimistic attitude towards science and technology (mean rating less than 2.9). In terms of political orientation, on average, pre-service teachers are placed on centre and moderate radical lines.

Table 1. Subject types according to environmental consciousness, political orientation and attitudes towards science and technology

<table>
<thead>
<tr>
<th>Pre-service teachers’ country</th>
<th>Total number</th>
<th>Environmental consciousness mean rating</th>
<th>Type</th>
<th>Political orientation mean rating</th>
<th>Type</th>
<th>Science-technology attitudes mean rating</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>381</td>
<td>4.1</td>
<td>Proenv</td>
<td>3.2</td>
<td>Radical</td>
<td>2.9</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Greece</td>
<td>358</td>
<td>3.8</td>
<td>Proenv</td>
<td>3.0</td>
<td>Center</td>
<td>3.3</td>
<td>Pessimist</td>
</tr>
<tr>
<td>Holland</td>
<td>493</td>
<td>3.8</td>
<td>Proenv</td>
<td>3.3</td>
<td>Radical</td>
<td>3.0</td>
<td>Uncertain</td>
</tr>
<tr>
<td>Japan</td>
<td>1036</td>
<td>3.8</td>
<td>Proenv</td>
<td>2.9</td>
<td>Center</td>
<td>3.3</td>
<td>Pessimist</td>
</tr>
<tr>
<td>Sweden</td>
<td>792</td>
<td>4.3</td>
<td>Proenv</td>
<td>3.1</td>
<td>Center</td>
<td>3.0</td>
<td>Uncertain</td>
</tr>
</tbody>
</table>

a Mean rating on a 5-point scale where 1 = strongly disagree and 5 = strongly agree.
b Mean rating on a 5-point scale where 1 = more conservative and 5 = more radical.
c Mean rating on a 5-point scale where 1 = strongly disagree and 5 = strongly agree.
d Subjects considered pro-environmental (proenv) when mean rating > 3.1, anti-environmental (antenv) < 2.9 and uncertain (uncer) between 2.9 and 3.1.
e Subjects considered radical (radic) when mean rating > 3.1, conservative (conserv) < 2.9 and center between 2.9 and 3.1.
f Subjects considered optimists (optim) when mean rating < 2.9, pessimists (pess) > 3.1 and uncertain (uncer) between 2.9 and 3.1.

Multiple comparison analysis

With the development of science and technology, a basically optimistic ideology of progress had emerged, which saw science and its applications as the pre-eminent tool of culture that could solve many global problems facing humanity. This contradicts with the serious concern expressed about the global consequences of human activity and in the way scientific and technological advances are used. As it has been pointed in the introduction, those who exhibit pro-environmental consciousness and actions usually hold anti-science/technology attitudes, arguing that science and technology have been used to serve the interests of anti-environmentalists. The multiple comparison analysis showed that respondents who were more concerned with environmental issues had expressed more negative or pessimistic attitudes towards the impact of science and technology on society and environment (Table 2). It has been also revealed that pre-service teachers who had more radical political views were found to be more concerned about environmental issues (Table 3).
Scientific and technological progress, political beliefs and environmental sustainability

Table 2. Multiple comparison Duncan test of science-technology attitudes by environmental consciousness

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean Soc-Tech</th>
<th>Envr. Consc. Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>FINLAND</td>
<td>2.35</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2.80</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3.00</td>
<td>4 *</td>
</tr>
<tr>
<td></td>
<td>3.40</td>
<td>5</td>
</tr>
<tr>
<td>GREECE</td>
<td>2.96</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3.26</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3.36</td>
<td>4 *</td>
</tr>
<tr>
<td></td>
<td>3.38</td>
<td>5</td>
</tr>
<tr>
<td>HOLLAND</td>
<td>2.57</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2.93</td>
<td>3 *</td>
</tr>
<tr>
<td></td>
<td>3.19</td>
<td>4 * *</td>
</tr>
<tr>
<td></td>
<td>4.71</td>
<td>5 * * *</td>
</tr>
<tr>
<td>JAPAN</td>
<td>3.84</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3.84</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3.84</td>
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<td></td>
<td>3.84</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3.84</td>
<td>2</td>
</tr>
<tr>
<td>SWEDEN</td>
<td>2.75</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2.75</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3.01</td>
<td>4 *</td>
</tr>
<tr>
<td></td>
<td>3.35</td>
<td>5 * *</td>
</tr>
</tbody>
</table>

Note: (*) Denotes pairs of groups significantly different at the P < 0.50 level

It has been also revealed that pre-service teachers who had more radical political views were found to be more concerned about environmental issues (Table 3).

Table 3. Multiple comparison Duncan test of environmental consciousness by political orientation

<table>
<thead>
<tr>
<th>Country</th>
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Note: (*) Denotes pairs of groups significantly different at the P < 0.50 level

Finnish sample does not denote pairs of groups significantly different at the P < 0.50 level
Discussion

It has been argued here that a clear understanding of the principles of ecology, science and technology and an adoption of an environmental ethic seems to be very crucial today. The results of this international and comparative study focusing on pre-service teachers’ perceptions of the impact of political orientation and attitudes towards science and technology as well as on environmental consciousness do not sustain the belief that science and technology can provide effective solutions to many environmental problems.

An instrumental and deterministic attitude towards science and technology has been challenged in recent decades as a result of harmful side-effects generated by the way science and technology have been approached and used. None of the sample country respondents identified themselves as optimists concerning the impact of science and technology on society and the environment. The no-stance or the pessimistic attitudes towards science and technology seem to derive from the human and environmental costs attributed to the instrumental use of scientific and technological development. The results verify the hypothesis stated that there is close connection between environmental consciousness and attitudes towards the role and impact of science and technology on society and environment. In other words, the higher the degree of respondents’ environmental consciousness, the more pessimistic stance on science and technology. It has also been verified that those who identify themselves more in the radical political spectrum hold less optimistic attitudes to science and technology and their vision of ecological degradation is becoming increasingly prominent. It is also worth pointing out that Scandinavian pre-service teachers were found to be more sensitised to environmental sustainability principles and ethics than pre-service teachers from other European countries and especially from Japan. As it could be expected in a region whose countries served as model welfare states, there has been a strong concern with environmental issues on the part of the state. This strong state/regional interest in environmental issues was compounded in the Swedish case by an early ‘ideological’ incorporation of environmentalism on the part of the established political parties, especially those of the green and the social democratic party. In general, the perceived environmental sustainability principles and ethics among all the pre-service teachers representing the selected European countries and Japan have shown increased environmental concern.

What are the implications of these findings in teacher education? How should the science and technology curriculum be structured and its teaching organised so as to give insights into the environmental and multi-faced impact of science and technology in modern society? How should we instil in young people a feeling of global and environmental consciousness? Efforts to promote global environmental sustainability issues related to science and technology in elementary and secondary schools will not succeed unless educators know what education on science and technology related to global societal and environmental issues is, why it is an important part of education in the school curriculum and how to integrate such a perspective in the curriculum. The results of the present study show the need to develop a critical and constructive attitude towards science and technology. Also, in addition to practice on specific science and technology skills, class activities should integrate one or more objectives related to global societal and environmental concerns. Since sustainable development education draws upon many disciplines, an interdisciplinary approach seems to be needed, focusing on the interrelation between social, ecological, environmental and cultural aspects of sustainability (Dale &
Newman, 2006; Makrakis, Gkotzos, & Larios, 2012; Makrakis, Larios, & Kalianzti, 2012). Such an inter/trans-disciplinary perspective is very critical in approaching science and technology in school education, especially in their connection to sustainability.

The argument for emphasising a global/sustainability education perspective in dealing with science and technology is based on a primary goal of elementary and secondary schools – education for responsible citizenship. Education for responsible and co-responsible citizenship in an increasingly complex technological society requires that students be able to synthesise and apply knowledge from many disciplines. Techno-sciences can, and should, serve as vehicles for a sustainable future and global understanding, especially through using web-based technologies (Makrakis, 2010). It has been found, however, that the potential of using techno-science as languages that can convey meaning and evoke emotions which could raise learners’ social consciousness and social responsibility is ignored (Makrakis & Kostoulas-Makrakis, 2005). If current patterns of attitudes towards science and technology persist and if ecological sustainability is an appropriate vision of the future, there is a need for a move towards an alternative curriculum and teaching/learning paradigm. Current international research indicates that teaching and learning approaches such as placed-based learning, which is the most relevant with education for sustainable development pedagogy, along with inquiry-based learning and problem/project-based learning are the least used in higher education teaching, even in teacher education (Makrakis, 2012). The ethical issues behind science and technology should also be amalgamated with the thesis that teaching and learning is an ethical and political praxis. As Holland, Mulcahy, Besong and Judge (2012) state, “the ethical-values bases of learners and educators effectively filter the way in which the cognitive experience is created and the manner in which the individual learner makes sense and/or constructs meaning within the learning environment” (p. 40). Critical and reflective thinking is acknowledged as one of the key skills and processes in the field of education for sustainability. Kostoulas-Makrakis’ (2010) model on transformative learning towards sustainability uses critical reflection at the epicentre of such a process. Participants get engaged in discourse and critical self-reflection, using various activating events and disorienting dilemmas, through which they come to critically examine their personal views and, therefore, open themselves to alternative views and practices (Dovros & Makrakis, 2012). A detailed comprehensive response to this is well beyond the scope of this paper, but the results of this survey suggest that critical education for sustainable development is needed. This implies that the objectives should focus on critical consciousness and the development of appropriate competence and skills related to social and environmental action.

**Acknowledgement**

The research on which this paper is based was carried thanks to a Research Fellowship at the Hiroshima University awarded by Canon Foundation. I am also thankful to all those scholars from the 53 institutions in the five countries who helped in the administration of this research endeavour as well as the respondents.
 References:


Scientific and technological progress, political beliefs and environmental sustainability


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THE STUDENTS’ SURVEY OF EDUCATION FOR SUSTAINABLE DEVELOPMENT COMPETENCIES: A COMPARISON AMONG FACULTIES

Michele Biasutti and Alessio Surian
University of Padova, Italy

Abstract

The paper reports research employing a quantitative approach to investigating the competences of university students about educating for sustainable development (ESD). Participants were 467 bachelor students of the following five areas: social sciences, educational sciences, applied sciences, engineering and health sciences. The Student Survey of Education for Sustainable Development Competencies was employed. Internal consistency and factor structure of this questionnaire were investigated by assessing Cronbach’s alphas and by performing exploratory factor analysis. Data were subjected to ANOVA for comparing the students of the five faculties. The relevance of factors and the differences between students of different areas were discussed considering also how to infuse ESD principles in university curricula. The aim is reorienting university study programmes in various faculties to prepare students about sustainable development issues.

Key words: higher education, student competencies, education for sustainable development survey, quantitative approach, reorienting university programmes

Background


- education that allows learners to acquire the skills, capacities, values and knowledge required to ensure sustainable development;
- education at all levels and in all social contexts (family, school, workplace, community);
- education that fosters responsible citizens and promotes democracy by allowing individuals and communities to enjoy their rights and fulfil their responsibilities;
- education for life-long learning;
- education that fosters the balanced development of the individual.
Within this international scenario, Haigh (2005) highlights the needs for higher education to green the university curriculum (Jones, Selby, & Sterling, 2010; Rieckmann, 2011). Scott (2009) explores what environmental education researchers might learn from the previous 30 years of work and presents some of the current challenges in doing and using research. Scott (2009) suggests that greater openness to new approaches should be promoted, as well as different ways of thinking and working, more understanding across cultures and a stronger research focus on understanding the relationship between sustainability, society and learning. According to Scott (2009), there are two main reasons for the environmental education community to reach out to other researchers and users of research, especially to policy makers:

According to Scott and Gough (2010), higher education (HE) students’ experience is quite different from that in schools as HE courses tend to focus on specialist and discipline-specific matters, rather than on the broad-based, community and citizenly, focus that we’ve seen with schools. Although there are attempts to broaden this out (…) doing so remains problematic, as does making sense of the currently fashionable, but rather unfocused, talk about sustainability literacy as some common entitlement of all higher education students (p. 3738).

Scott and Gough (2010) also stress that universities value the pursuit of knowledge and must, therefore, insist on its present and ongoing incompleteness – in the face of those who, for whatever reason, wish to extrapolate to final, general truths. Sustainable development refers to all aspects of our intellectual lives and will require us to husband what we know, eschew glib certainties and confront the future with an open, learning orientation (Scott & Gough, 2010).

The purpose of the current study is to add some missing data in this scenario considering the competences self-perceived by students about ESD. Such kind of competences are fundamental because they orient the students behaviours and attitudes involved in the university study (Biasutti, 2010, 2012). A sufficiently large number of participants will be considered in this research employing quantitative data collection techniques.

The current research

The objective of the current research was to compare university students of different areas in their competences about sustainable development (SD). The aim was to explicate some of the indications which appeared in the background literature and reject how the differences between faculties and degree organisation could affect the students’ conceptions. The current research compares students’ competences about ESD in the following five areas: social sciences (educational psychology and social psychology bachelors), educational sciences (primary teacher education), applied sciences (biology, chemistry, agriculture bachelor), engineering (environmental engineering bachelor) and health sciences (medicine). It involves a large number of participants and employs quantitative data collection techniques with parametric statistical analysis.
Research question and hypothesis

Based on a review of the literature, the study was implemented on the basis of the hypothesis that university students have different competences about ESD depending on the faculty they represent. In detail, the following research question was considered: Are there any significant differences between students in their ESD competences in relation to ESD attitudes, learning to be, learning to live together sustainably, learning to know, learning to do, learning to transform oneself and society?

Method

A quantitative study design was used for collecting data in this research. In order to obtain responses from a large participant group, a questionnaire with closed questions was used.

The questionnaire

The questionnaire Student Survey of Education for Sustainable Development Competencies (SSESDC) was developed especially for this research by the research team directed by professor Vassilios Makrakis within the framework of RUCAS Tempus project. The questionnaire is composed of several parts including attitudes towards ESD and the following five pillars: learning to be, learning to live together sustainably, learning to know, learning to do and learning to transform oneself and society.

The first part is composed of demographic questions such as gender and questions about previous experiences related to SD: if students have taken a course that relates directly to sustainable development, if students have taken a course that includes some relevant issues to sustainable development and if students have done a course assignment or project that concerns sustainable development. Also, the sources of information about sustainable development used by students were considered, such as newspapers, the internet, university courses, TV, etc.: the actions taken during the past month for sustainable development reasons, such as switched off unnecessary lights, purchased eco-labelled and fair-trade products, recycled cans, glass or paper, used carpooling, purchased environmentally friendly products, etc.

The most frequently used teaching and learning methods in students’ courses were considered, including lecturing, project-based learning, interactive engagement, case-based instruction, inquiry-based learning, interdisciplinary teaching, problem-based learning, tech-supported instruction, placed-based learning, discovery learning. Also the functions of education most preferred by students, such as to replicate the existing society and culture, to train people for future employment, to help people develop their potential, to encourage change towards a fairer society and a better world were assessed, as well as the attitudes towards ESD.

The main part of the survey evaluated the students’ ESD competences about the following five pillars: learning to be, learning to live together sustainably, learning to know, learning to do and learning to transform oneself and society. The last part of the survey concerns the following specific areas: applied sciences, educational sciences, health sciences, business/economic, engineering, social sciences. A different set of questions was proposed in relation to each area.
The questionnaire was constructed considering the prior literature and closed questions were used. In most of the parts, a set of statements was presented, and participants were asked to express agreement or disagreement on a six-point Likert scale (1 = not at all, 2 = poor, 3 = fair, 4 = good, 5 = very good, 6 = excellent). In order to provide construct validation, a panel of experts were asked to comment on the questionnaire. Revisions based on these comments were included in the final version of the questionnaire.

Participants and procedure

Participants were 467 students enrolled in the last year in several degree courses in a north-east Italian university. The students’ distribution in the five areas was as follows: social sciences: 142; educational sciences: 69; applied sciences: 102; engineering: 85; health sciences: 69.

Participants were invited to fill in the questionnaire at the end of a university lesson, without consulting each other. Participants were informed that the questionnaire would remain anonymous, and they were encouraged to give accurate and truthful answers. The aim of the research was specified as to elicit students’ competences about several aspects of ESD. It took an average of 40 minutes to complete the questionnaire.

Results

The collected data consisted of participants’ responses to the SSESDC. SSESDC generated quantitative data which were analysed using statistical analysis such as descriptive statistics and Cronbach’s alpha. In these sections, the authors present only the results in reference to the following six scales which were considered monofactorial: attitudes, learning to be, learning to live together sustainably, learning to know, learning to do, and learning to transform oneself and society. An ANOVA was also conducted with gender and faculties as independent variables. For all analyses Statistical Package for the Social Sciences (SPSS) 17.00 for Windows was used.

Reliability Cronbach’s alpha

The reliability analyses were determined by measuring the internal consistency of each scale of the six scales calculating the Cronbach’s alpha. Alpha coefficients for the five pillar scales ranging from .861 to .901 were well above the .70 standard of reliability with the exception of the attitude scale which had a Cronbach’s alpha of .604. Since the 10-item attitude scale involves several key sustainability issues, and it did not reach the 0.70 standard of reliability, it should be further investigated whether an item reduction would increase the scale reliability while still providing useful information. The Cronbach’s alphas for the five UNESCO pillars scales were as follows: learning to be .861; learning to live together sustainably .871; learning to know .891; learning to do .901; learning to transform oneself and society .888.
ANOVA

An ANOVA was conducted for each of the following scales of the questionnaire: attitudes, learning to be, learning to live together sustainably, learning to know, learning to do and learning to transform oneself and society. Independent variables were the following: gender and faculty.

With regard to the independent variable faculty, the differences between participants resulted in statistically significant differences for the following four scales of SSESDC: attitudes $F = 7.91$, $p < .01$; learning to live together sustainably $F = 4.59$, $p < .01$; learning to know $F = 3.91$, $p < .01$; learning to do $F = 3.38$, $p < .05$.

The results informed us that we had an overall significant difference in means for the five faculties in the four scales, but we do not know where those differences occurred. A follow-up analysis was performed with the Bonferroni multiple comparisons of means post-hoc test, which allows us to discover which specific means differed assessing the significant differences between faculties for each scale. Some differences were found.

As far as the scale “Attitudes” is concerned, statistically significant differences were found between:

- “Engineering” (mean = 3.1; SD = .65) and “Applied sciences” (mean = 2.80; SD = .63) ($p < .05$);
- “Engineering” (mean = 3.1; SD = .65) and “Health sciences” (mean = 2.77; SD = .56) ($p < .05$);
- “Engineering” (mean = 3.1; SD = .65) and “Social sciences” (mean = 2.62; SD = .64) ($p < .01$).

As for the scale “Learning to live together sustainably”, statistically significant differences were found between: “Social sciences” (mean = 3.92; SD = .83) and “Health sciences” (mean = 3.46; SD = .76) ($p < .01$).

As for the scale “Learning to know”, statistically significant differences were found between:

- “Engineering” (mean = 3.77; SD = .76) and “Educational sciences” (mean = 3.67; SD = .74) ($p < .05$);
- “Applied sciences” (mean = 3.73; SD = .73) and “Educational sciences” (mean = 3.67; SD = .74) ($p < .05$).

As far as the scale “Learning to do” is concerned, statistically significant differences were found between:

- “Applied sciences” (mean = 3.89; SD = .75) and “Educational sciences” (mean = 3.55; SD = .66) ($p < .05$);
- “Engineering” (mean = 3.89; SD = .70) and “Educational sciences” (mean = 3.55; SD = .66) ($p < .05$).

With regards to the independent variable “Gender”, the differences between participants resulted in statistically significant differences for the following three scales of SSESDC: 

**Attitudes**: $F = 15.55$, $p < .01$ with female mean = 2.7, SD = .62 and male mean = 2.94 and SD = .64; 

**Learning to know**: $F = 9.54$ ($p < .01$); female mean = 3.51; SD = .79; male mean = 3.73; SD = .74;
Learning to do: $F = 4.25$ ($p < .05$) female mean = 3.72; SD = .72; male mean = 3.86; SD = .71.

No statistically significant differences have been found for the other three scales.

Discussion

Several significant differences between students of different areas in their competences about sustainable development were found.

With regard to the differences between faculties, a more enhanced pro-sustainability attitude was determined among engineering students who show a significant advantage when compared through the Bonferroni multiple comparisons of means post-hoc test with applied sciences, health sciences and social sciences students. It is worth mentioning that the engineering students who participated in the research have a specific environmental focus and are therefore more familiar with issues of sustainability.

In a similar way, it was to be expected that social sciences students would show an enhanced pro-social profile. This is true, although the only group of students who are significantly less socially oriented when compared to social sciences students are health sciences students.

Educational sciences students seem to privilege the social dimension over the knowledge and the “to do” dimensions of sustainability when compared to engineering and applied sciences students who score significantly higher on the learning to know and learning to do scales. It must be noted that these knowledge and do scales favour technical contents related to global and environmental issues who are less familiar to students of educational sciences.

It must be noted that no significant differences were found for the learning to be scale. Concerning this scale, generally students consider themselves quite able (3.97 on a 1–6 scale) to adopt sustainable lifestyle and to have a concern and an awareness concerning global sustainability issues.

No significant differences were found either for the learning to transform scale (where students on average rate themselves 3.84 on a 1–6 scale).

Concerning gender differences, a significant male advantage was found concerning the attitudes, learning to know and learning to do scales. It must be noted that the faculties of engineering and applied sciences that scored significantly higher than education science faculty on these scales have also a significantly higher percentage of male students.

While the score that students attribute to themselves on a 1–6 scale is relatively low on average for the attitudes scale (2.78), such self-assessment is more optimistic concerning their ability to live together in a sustainable way (3.74), to know ESD contents (3.68) and to do (3.86). Beyond the significant differences that were found by this research across faculties, these data support the view that there can be an identity of interest between higher education and sustainable development (Scott & Gough, 2010). In addition, they are a significant snapshot of students’ attitudes and competences at the bachelor level. How should higher education institution follow-up such scenario and introduce elements of critical thinking and critical pedagogy that are essential to foster responsible attitudes in this field? Buchan, Spellerberg and Blum (2007) show that at postgraduate level, sustainability education is often embedded within single-
discipline subjects, rather than being taught per se as a separate subject. There are only a few reports in the literature (Eagan, Cook, & Joeres, 2002) on subjects which combine the following three features: at postgraduate level; interdisciplinary; based on an international view of sustainability.

**Implications for future developments**

In this paper, the students’ perspectives about their competences on ESD were collected adopting a quantitative methodology. Results provided evidence of the students’ differences in the various faculties for the following five UNESCO pillars: learning to be, learning to live together sustainably, learning to know, learning to do and learning to transform oneself and society.

The results of the current study have implications for this research field. It could be interesting to revise the university curricula infusing ESD principles according to the students characteristics which emerged in the current research. In addition, in further research it could be verified if the revised curricula are more effective than standard programmes by adopting an experimental design with two groups, for contrasting the effects and the results of the two courses.

**Acknowledgement**

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BRANDING THE GREEN EDUCATION:
CHALLENGES FACING IMPLEMENTATION OF EDUCATION FOR SUSTAINABLE DEVELOPMENT IN EGYPT

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Abstract

Due to the scarcity in natural resources and the demand for green labour and economy, education for sustainable development (ESD) gained a great importance in developed countries, let alone developing ones. From this point of view, this paper is studying the possibility of infusing ESD in Egypt after one and a half years since January 2011 youth revolution. A primary data gathering method was conducted within a sample of 79 young undergraduate people (67 from the American University in Cairo and 12 fresh graduates from conventional educational systems). The results indicated that there is a positive relationship between high cultural resources along with early childhood awareness and ESD adoption and infusion. Also, Spearman’s rank association test showed a negative relationship between ESD infusion and the satisfaction level of the current conventional curriculum. On the other hand, Spearman’s rank association test showed that $\alpha$ is greater than 0.05; accordingly, there was no correlation between ESD infusion if introduced within the curriculum of an existing well-established university than if introduced as the final outcome of a new university specialised in ESD. The paper highlights the importance of ESD brand associations offered as a service product. After validating the hypothesis, the author discusses the findings and provides solid recommendations for ESD infusion in Egypt.

Key words: education for sustainable development, green education, branding, cultural resources

Introduction

Education for sustainable development (ESD) is the main platform for the new millennium. This paper discusses the diffusion of ESD from a marketing perspective. ESD is both a challenge and an opportunity. It is a challenge to promote ESD due to the limited cultural resources in Egypt as well as in other developing countries. Neither parents nor students would understand the real value of ESD. Nevertheless, the gains and opportunities are more likely to offset the expected difficulties. From a positive angle, different reputable organisations are endorsing ESD. Eventually, this positive global outlook could generate progressive public support and awareness.
Marketing efforts hand in hand with all other public relation activities would highlight and distinguish ESD from other conventional educational systems. This paper will provide a thorough analysis of the Egyptian education system. The analysis of previous academic studies will identify the literature gap, thus raising the importance of this study. The paper is an empirical analysis that aims to generate a vivid model for ESD adoption in Egypt and other culturally similar countries. The paper is composed of three dimensions: identifying ESD brand elements and investigating these attributes as people processing service type; undertaking a survey to validate our theoretical model and drafting the recommendations of ESD adoption and suggesting future research. Our aim is to elaborate on the most suitable marketing strategy for ESD diffusion. Within this context, a model will be created for enhancing ESD infusion. The practical and theoretical background along with the research methodology will identify the paper limitations. The major objective of this paper is to provide a full-validated model for ESD adoption.

Sustainable development stands for meeting the development needs of present generations without jeopardising the ability of future generations to meet their own development needs. Sustainable development does not focus solely on environmental issues, but broadly captures the different dimensions of development. Traditionally, sustainable development is conceptually considered in terms of three main pillars.

- Environmental sustainability is defined as the ability of the environment to continue to function properly indefinitely. The goal of environmental sustainability is to minimise environmental degradation and to stop and reverse the process that leads to environmental degradation.

- Economic sustainability is defined as the way to achieving economic growth whilst respecting environmental limits, finding ways to minimise damage to the natural world and making use of the earth’s resources in a sustainable way.

- Social sustainability is defined as a compilation of actions and efforts to promote development that does not deplete the stock of social and human resources but rather contributes to the enhancement of their potential. The social pillar also refers to the concept of “building sustainable and harmonious communities” (GHK in association with Danish Technology Institute, T., 2008, p. 10).

Education is a prerequisite for promoting the behavioural changes and providing all citizens with the key competences needed to achieve sustainable development. Success in revising unsustainable trends will, to a large extent, depend on high-quality education for sustainable development.

Education and training should contribute to all three axes of sustainable development, namely:

- **the social perspective** – education and training strengthen social cohesion by investment in human capital;

- **the economic perspective** – education and training contribute to building a knowledge society based on sustainable economic growth and

- **the environmental perspective** – education and training are crucial for changes in citizens’ behaviour on issues such as consumption, transport, use of sustainable energies, etc. (GHK in association with Danish Technology Institute, T., 2008).
ESD is a complicated process that requires collaboration of different partners to introduce. ESD is a holistic orientation that necessitates coordination of different stakeholders to ensure environmental preservation as well as social and economic development. An understanding of sustainable development begins in early childhood. The diffusion of ESD is not limited only to universities. Schools, faculties, non-governmental organisations (NGOs), farmers, manufacturers, service providers and others have a vital role for ESD diffusion (Likon, Asunta, Rihtaršič, & Korče, 2011). ESD is a vision to empower people to meet future challenges. Out of this importance, the United Nations (UN) declared 2005–2014 as the UN Decade of Education for Sustainable Development (DESD). Since education for sustainable development is composed of economic, social, cultural and environmental issues, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) was asked to lead the decade.

Reorienting universities to address sustainable development is essential to equip graduates with the necessary skills, knowledge and sustainability values to meet the future challenges. ESD is multidisciplinary, also including human rights and climate changes. Based on this context, the Reorient University Curricula to Address Sustainability (RUCAS) project was established to assist university staff and management in Egypt, Lebanon and Jordan to infuse ESD in higher education curricula (Stockholm University Institute for International Education, 2011).

In 2008, the Danish Technology Institute and Technopolis group had identified the types of learning and context of ESD curricula (GHK in association with Danish Technology Institute, T., 2008).

- Formal learning occurs within an organised and structured context (for instance, formal education institutions, such as schools, colleges, vocational training institutes and universities) and follows a particular structured design. It typically leads to a formal recognition (diploma, certificate). In those cases, the issues of sustainable development tend to be inserted in the curriculum of the institution.
- Non-formal learning is embedded in planned activities that are not explicitly designated as formal learning, but which contain an important learning element, such as vocational skills acquired at the workplace.
- Informal learning results from daily life activities related to work, leisure, free time, etc. This type of learning is sometimes referred as experiential learning. Generally, it does not lead to certification.

Our assumption is that the full curriculum of ESD should initially be introduced in the Egyptian education system through both public and private universities to ensure infusion. The education system in Egypt is divided into four main categories: public, which refers to schools and universities owned by the government; Azhary, which refers to schools and universities that are owned by the government but provide education on Islamic religious basis; private/language, which are privately owned schools and universities; international, like International General Certificate of Secondary Education and American Diploma. Graduates of Azhary and public schools are not considered a part or even a potential target market for ESD. Pupils enrolled in those schools are barely satisfying their basic necessities. They are called survivors with low financial resources and innovation capabilities. Their personal characteristics make them very loyal to traditional providers/products (Consulting Business Intelligence, 2012). Private education expenses are far beyond the survivors’ limited financial ability. Parents who send their
offspring to other regular private/language schools could afford the private education fees, but would definitely face extreme cognitive hardships to understand ESD core value. The assumption is based on the limited cultural resources in Egypt.

Usually, the middle class segment is psychologically dominating the high uncertainty avoidance range (Hofstede, 1998). This means that the middle class segment avoids taking risks and hates ambiguity. They prefer to buy common or traditional products and depending on their peers, relatives and personal experience for buying high involvement products or fateful products. Based on this analysis, most of the middle class segment prefers traditional private universities. Thus, the diffusion of ESD in Egypt will encounter extreme challenges as perceived by students and parents who are affiliated to private language schools. This assumption is based on launching ESD as a new product for a new university. On the other hand, we would relax this assumption a little if ESD were being introduced as a new programme in an already well-established university like the American University in Cairo (AUC) or the German University in Cairo (GUC).

Nevertheless, if ESD is being introduced as a new programme in existing private universities, students’ perception could be more positive than if being introduced in a newly-born university that is specialised in ESD. Based on this assumption, some efforts could be made to attract international school graduates to join ESD in well-established universities.

Advocates could promote ESD as an experience to shed light on its unique competitive advantage and to sharpen its distinguished market position. A potential position could be established on branding the customer experience. Most of international school graduates are targeting the AUC as the crème de la crème university in Egypt. Studies showed that young adults and teenagers are blindly imitating their peers. It is not likely that ESD will flourish in its early stages, but, for sure, there is a wide opportunity for ESD growth. Egypt is facing many environmental challenges and a growing need for practising green economy to ensure social and economic development, particularly after January 2011 revolution. The paper assumes that conventional, vocational, private and public schools and universities lack the essence of ESD (the American University in Cairo, 2012).

**Research problem**

Students and parents will face cognitive dissonance to understand the full value of education for sustainable development – a fact that hinders its full diffusion in Egypt. The term ‘cognitive dissonance’ is used to describe the feeling of discomfort that results from holding two conflicting beliefs. When there is a discrepancy between beliefs and behaviours, something must change in order to eliminate or reduce the dissonance (Kendra, 2012). Referring to this definition, students and parents will face a feeling of discomfort in their beliefs and behaviours to judge on a sustainable education as compared to the traditional conventional education curriculum.

**Branding education for sustainable development**

The American Marketing Association (AMA) defines a brand as a name, term, sign, symbol or design, or a combination of them intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of other sellers
Branding the green education: Challenges facing implementation of education for..

(Lake, 2012). Brand associations and beliefs are deeply rooted in customers’ minds. Brands are like people with their own personalities. Brand associations are the attributes or images of the brand. Branding strategies are deeper than the functional or practical part of the brand. Branding is too much into the intangible attributes or characteristics of the brand (Keller & Lehmann, 2006).

A strong brand creates consumer preference for the product/service behind the brand. It provides increased revenues and market share, increases the company’s market value, prevents new competitors from entering the market and creates a unique and differentiated company image.

ESD has different brand associations with different effects on consumers. Freedom, responsibility and passion are the main pillars of ESD brand’s associations. From these pillars, other brand associations are likely to evolve, such as nature, energy, community, arts, culture, development, innovation, natural resources, humanities and major environmental issues. Therefore, ESD allows for a holistic orientation for branding the education experience. This experience will be practised through building students’ unique personalities as a result of industry internships and community service activities. Thus, we assume that ESD brand associations represent its value proposition that distinguishes its brand personality.

The present paper investigates if brand associations could come from outside the world (McCracken, 1986) to present a meaningful picture or it would be difficult for Egyptians to understand ESD branding themes. The paper assumes that ESD and its tangible and intangible associations represent a cultural meaning and a positioning strategy. As mentioned previously, due to the limited cultural resources in Egypt, it is expected that parents and students will face extreme hardships to understand ESD concept. Thus, the following hypotheses are formulated: (1) high cultural resources are positively correlated with ESD infusion; (2) early childhood awareness increases the possibilities of ESD adoption; (3) there is a positive correlation between ESD diffusion if introduced within the curriculum of an existing well-established university rather than if introduced as the final outcome of a newly-established university; (4) there is a negative relationship between ESD infusion and satisfaction level of current conventional curriculum.

High cultural resources are positively correlated with ESD infusion

To validate a long-standing marketing concept, Aaker (1999) affirmed that brand personalities and traits are only important if these traits are reflecting customers’ personality and characteristics. People like to own and use products that reflect their self-concepts. This has been evident in the statement “we are what we have”.

Some areas which have not been investigated yet are related to the education type and its correlation with specific cultural understanding. Another important dimension that the previous literature did not provide is to identify the cultural attributes and the branding elements for promoting education for sustainable development. Needless to say, by identifying the appealing ESD brand associations, all other following tactics will be much easier to carry on. The authors of this study agree with Aaker (1999) that brand image plays a role as a symbolic value and could strongly influence the buyer’s choice.
Customers’ values and brand associations are two sides of one coin. Such values, if appropriately understood, will have a great impact on identifying the appealing associations for promoting ESD. Having said that, establishing the fitting ESD brand image would definitely influence purchasing and consumption curves. In fact, desired images and personal status are shaped in early childhood. This paper assumes that if ESD theories and practices are embedded in core curricula at primary schools, it will be well perceived by the target audience. Pupils’ personal traits will be anchored around ESD brand salience.

Early childhood awareness increases the possibilities of ESD adoption

On another note, if ESD is part of a well-established university curriculum, it would be infused easier than if being introduced as a standalone curricula in a new university. It would lead to the hypothesis as related to a positive correlation between ESD diffusion. There is a positive correlation between ESD diffusion if introduced within the curriculum of an existing well-established university rather than if introduced as the final outcome of a newly-established university.

Based on the nature of ESD curricula, it is to be positioned on sophistication, future orientation, progression, culture and fun. This positioning theme is in alignment with ESD branding elements and, at the same time, fits with the characteristics of ESD target audience. Another branding attribute that needs further illustration is people as part of the service factory. Universities, in general, are providing intangible services. People in service factories are embedded in the branding character of any serious service provider (Tschirhart, Christensen, & Perry, 2005). ESD as a pure intangible product is located at the far end of the service spectrum. Consumers in pure intangible services count more on the service branding attributes prior to purchase and consumption. Depending on branding attributes to evaluate, the service prior to consumption has a rationale point. Services are very hard to evaluate prior to consumption. Therefore, branding elements help customers to expect the service value before consumption (Rao & Ruekert, 1994). ESD falls within the range of the experience attributes that entail trying the service first to evaluate it after consumption. Some services have the credential attributes that are making it difficult to evaluate the service even after consumption.

Sekem

Sekem is a hieroglyphic word which means vitality. It is also a very well known Egyptian company for its holistic self-sustained nature. Sekem is composed of diversified companies that represent a solid and integrated supply chain based on sustainability. One of Sekem’s strategic business units is Heliopolis University (HU) for Sustainable Development. HU is introduced in the Egyptian market as part of the Sekem group. Based on Sekem’s success and achievements in addressing sustainable development challenges, Heliopolis University will be positioned as an extension for Sekem brand associations. Thus, Sekem will form co-branding alignment with HU to utilise another market opportunity represented in ESD (Rao & Ruekert, 1994). Sekem and HU co-branding is a pure example of intangible complimentary offers based on relevant brand associations. It is wise to establish co-branding only if the offers are relevant and fitting with each other. This scenario is best described by referring to IBM and Intel co-branding strategy. Sekem
and HU co-branded strategy is relevant and makes the most sense since both are addressing sustainability but from different dimensions. Sekem is offering tangible real goods, such as organic foods, and it is contributing positively to the society and community through various developmental projects. Whereas HU provides ESD services, so both are very well associated together. Based on this assumption, co-branding might also foster the infusion of ESD in developing countries.

A valid reason for co-branding in general and for ESD particularly is when a second brand is needed to signify quality (Rao & Ruekert, 1994; Park, Jun, & Shocker, 1996). If the new brand attributes are not sufficient to convey the brand meaning or to deliver the quality promised, then co-branding is one option to signify value and quality and thus satisfaction. Based on the previous discussion, the following hypothesis is addressed:

There is a negative relationship between ESD infusion and satisfaction level of current conventional curriculum.

As mentioned previously, ESD is a hard to grasp concept in limited cultural resource societies; hence, co-branding with a well-established meaningful brand could facilitate the launching process and convey the brand promise. The point is to reduce consumers’ cognitive dissonance especially in information processing service. Co-branding strategy is one solution for handling customers’ anxiety or concerns. Also, brand alliance is crucial when partners face scarce resources. As a matter of fact, resources are not limited to tangible resources but intangibles as well. An unknown brand is a resource deficiency that needs to be complimented by being affiliated to a strong brand (Tschirhart, Christensen, & Perry, 2005). Universities could overcome ESD brand deficiency by partnering with stakeholders and institutions that are well perceived in sustainable development or are highly ranked in any other related field.

On another note, ESD is a people processing service; therefore, university employees are part of the final output. In order to maximise the final output, employees as administrators and faculty members must buy into the norms and principles of sustainable development. It is a matter of being holistically committed to the ESD marketing promise. The more the service is located at the far end of the intangibility spectrum, the more the personnel will represent a big portion in the service brand (Bateson, 1995; Riley, 2000).

Theoretical framework

The main objective of this paper is to identify the most influential independent variables which impact ESD infusion in Egypt and to identify the impact of the demographic structure as a moderating variable on ESD adoption. Based on the statistical measures, the researchers aim to validate the hypothesis.

The initial model includes four independent variables (high cultural resources; ESD early childhood awareness; ESD embedded curriculum in a well-established university; education satisfaction) and a demographic component (age, gender, education level, income level and internet literacy). The dependent variable is the acceptance and the infusion of ESD in Egypt. The authors conducted an empirical study to investigate the validity of the model. Based on the secondary sources and empirical data gathering, the final model is provided (Figure 1).
Importance of education for sustainable development infusion

Our economic activities led us to face unprecedented challenges. These challenges exceeded the environmental spectrum to assault our personal health. Tremendous threats as indicated by the multiple financial and economic crises prove that the conventional economic models are vulnerable and weak (International Greening Education Event, 2011). No doubt that ESD is the most promising path to utilise the limited global resources and to generate green labour generations. Yet, the constraints faced to promote ESD may hinder its adoption. Hence, the authors aim to reach the following objectives: identifying existing and potential bottlenecks for ESD adoption in the Egyptian education system; identifying the target market for ESD; sorting ESD competitive advantages; indicating the most appropriate marketing tactics to deal with threats and opportunities facing ESD providers and providing a concrete model for ESD infusion.

The analytical part of the paper focuses on identifying the threats and the limitations for infusing ESD in Egypt. It specifically focuses on the investigation of the infusion of ESD in private universities. The questionnaire measures students’ perception if ESD is to be introduced as part of current university curricula or offered by a specialised ESD university.

Method and sample

The data is gathered through primary data collection method in which the snowballing and the judgmental sampling approaches were used. A questionnaire was used as the only data collection instrument. Only quantitative close-ended questions were utilised to obtain the results. Validity of the questionnaire was tested with Cronbach’s alpha,
using Statistica Package for the Social Sciences (SPSS). The hypotheses and the proposed model were validated using Spearman’s rank association test and ANOVA test.

The chosen sampling method was non-probability sampling, using the snowball technique as the most appropriate to the given research conditions. The students’ database of the AUC in Cairo represented the main sample frame. Elder generations were included in the study by using the judgmental sampling approach. The chosen sampling method was non-probability sampling, using the snowball technique as the most appropriate to the given research conditions. The sample size is 79 young people (67 AUC undergraduates and 12 fresh graduates from conventional education systems). The sample includes 62% females and 38% males. 70% of the respondents are younger than 24 years. It should be noted that most of the respondents have either no previous knowledge or a very basic knowledge of ESD.

**Education satisfaction and ESD**

The results indicated that 80% of the satisfied students prefer to study ESD in well-established universities and 41.1% of the satisfied students are willing to specialise in ESD in their current universities. Moreover, 25% of the satisfied students are willing to continue studying ESD at the postgraduate level. As for the unsatisfied students, 65% of them prefer to study ESD in a well-established university, and 87% of the unsatisfied students are willing to specialise in ESD in a well-established university. Also, 78.3% of the unsatisfied students are willing to continue ESD at the postgraduate level. As for ESD quality, 59% of the satisfied students believe that well-established universities will ensure ESD, and 51% of the unsatisfied students felt the same. However, 73.9% of the unsatisfied students are willing to join a new university specialised in ESD compared to only 35.7% of the satisfied students. And this brings us to the opportunity available in the higher education market for new universities to enter with the specialty of sustainable development as its core programme.

Heliopolis University (HU) for Sustainable Development – the first non-profit university in the Middle East declaring sustainable development as its overall guiding principle and specialisation. It is based on a renewed understanding of the university concept, in which teaching, research and practice are integrated with each other. What differentiates it from other universities is its vision for sustainable development through empowering students to create new ideas that meet fertile ground for further research and teaching.

As previously mentioned, the curriculum of a university with an ESD context has to be different. In HU, both core and specialist programmes were developed according to the streams related to sustainable development, which are engaging in context, raising consciousness, assimilating content, making a contribution (www.hu.edu.eg).

The core programme includes the four streams: nature and community (balancing inner and outer nature through discovering deep ecology, philosophy and psychology); social sciences (widening knowledge through learning about politics, human rights and social research); the arts (deepening personal development through engaging in music, acting and speech, eurhythmy and fine arts); languages, communication and enterprise (understanding cultures through studying English, German and Arabic (www.hu.edu.eg/).

Incorporating the importance of branding in ESD, HU depended on the three pillars of sustainable development by designing a curriculum that reflects social, economic and environmental perspectives, not only the traditional curriculum of conventional universities.
Education category and ESD

Both private and public school students prefer to enrol in a well-established university for learning ESD, but it is apparent that the number of private school students who prefer a well-established university surpasses the number of public school students (77.8% compared to 57.1%). On another note, 13.9% of private school students prefer to join new universities specialised in ESD, compared to 0% of public school students. Also, a very small portion of private school students 2.8% did not indicate that well-established universities would encourage ESD in a more sophisticated way in comparison with new universities specialised in ESD. As for the public school students, 42.9% did not see that either. Public school students who indicated their interest to join a new university specialised in ESD reached 57.2% as compared to 45.9% of private school students. 54.4% of private school students accepted the idea of continuing the studies on ESD in their current universities, compared to 85.8% of public school students.

Gender and ESD

In general, it seems that females are more open to ESD than males. Comparing males and females’ attitude towards ESD, we found that 90% of males prefer to study ESD in a well-established university, and 76.7% of them indicated that well-established universities will encourage ESD. This finding has a direct impact on their decision to join a new university that specialises in ESD. Whereas 30% of them decided that they would not join a new university for obtaining ESD, even in their current universities.

On the other hand, females are more open to studying ESD in both well-established and new universities. The percentage of females who prefer to study ESD in well-established universities reached 67.3%. Only 44.9% of the females think that well-established universities are better than new universities specialised in ESD. Thus, only a small percentage (14.3%) would refuse to join a new university specialised in ESD. On another note, 63.3% of females are accepting ESD, and 44.9% of females would continue postgraduate studies in ESD.

High culture resources and ESD

The results indicate that there is a positive relation between high culture resources and the tendency to select a well-established university offering ESD. Moderate cultured participants indicated that they might join a new university specialised in ESD.

Reliability analysis

According to Weiss (2011), there will be an excellent internal consistency of the scale components if the reliability test outcome is .90 and above, high internal consistency if the outcomes are between .90 and .70, moderate internal consistency if the outcomes are between .70 and .50 and low internal consistency if the outcomes are below .50. Table 1 shows that all variables of the model are of moderate to high internal consistency.
Table 1. Results of reliability test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cronbach’s alpha</th>
<th>Number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early childhood awareness</td>
<td>.760</td>
<td>4</td>
</tr>
<tr>
<td>University establishment</td>
<td>.531</td>
<td>2</td>
</tr>
<tr>
<td>Education satisfaction</td>
<td>.575</td>
<td>2</td>
</tr>
<tr>
<td>High cultural resources</td>
<td>.506</td>
<td>5</td>
</tr>
<tr>
<td>ESD adoption and infusion</td>
<td>.501</td>
<td>3</td>
</tr>
</tbody>
</table>

Hypothesis validation

H1. High cultural resources are positively correlated with ESD infusion

H01 is rejected, and H1 has been accepted since Spearman’s rank association test shows a positive relationship between high cultural resources and ESD adoption and infusion; the relation strength is shown by the correlation coefficient 0.310 with a very high significance as $\alpha$ is less than 0.01 (Table 2).

H2. Early childhood awareness increases the possibilities of ESD adoption

H02 is rejected, and H2 has been accepted since Spearman’s rank association test shows a positive relation between early childhood awareness and ESD adoption and infusion; the relation strength is shown by the correlation coefficient 0.242 with a very high significance, as $\alpha$ is less than 0.05 (Table 2).

H3. There is a positive correlation between ESD infusion if introduced within the curriculum of an existing well-established university rather than if introduced as the final outcome of a newly-established university

H03 is accepted, and H3 has been rejected since Spearman’s rank association test shows that $\alpha$ is greater than 0.05 (Table 2).

H4. There is a negative relationship between ESD infusion and satisfaction level of current conventional curriculum

H04 is rejected, and H4 has been accepted since Spearman’s rank association test shows a negative relationship between ESD infusion and satisfaction level of current conventional curriculum; the relation strength is shown by the correlation coefficient -0.294 with very high significance as $\alpha$ is less than 0.01 (Table 2).

Based on this Spearman’s rank association test results, the model should be altered to be as shown below (Figure 2).
Table 2. Spearman’s rank association test results

<table>
<thead>
<tr>
<th></th>
<th>Early childhood and previous awareness</th>
<th>ESD adoption and infusion</th>
<th>University establishment</th>
<th>Education satisfaction</th>
<th>High cultural resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.C.</td>
<td>1</td>
<td>.242*</td>
<td>0.078</td>
<td>0.101</td>
<td>0.039</td>
</tr>
<tr>
<td>Sig.</td>
<td>.</td>
<td>0.032</td>
<td>0.492</td>
<td>0.378</td>
<td>0.735</td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>C.C.</td>
<td>.242*</td>
<td>1</td>
<td>-.294**</td>
<td>.310**</td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td>0.032</td>
<td>.</td>
<td>0.574</td>
<td>0.009</td>
<td>0.005</td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>C.C.</td>
<td>0.078</td>
<td>0.064</td>
<td>1</td>
<td>0.085</td>
<td>.312**</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.492</td>
<td>0.574</td>
<td>.</td>
<td>0.456</td>
<td>0.005</td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>C.C.</td>
<td>0.101</td>
<td>-.294**</td>
<td>0.085</td>
<td>1</td>
<td>-0.155</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.378</td>
<td>0.009</td>
<td>0.456</td>
<td>.</td>
<td>0.172</td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>C.C.</td>
<td>0.039</td>
<td>.310**</td>
<td>.312**</td>
<td>-0.155</td>
<td>1</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.735</td>
<td>0.005</td>
<td>0.005</td>
<td>0.172</td>
<td>.</td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 2. Validated model
ANOVA Analysis

ANOVA test results show a valid significance of the model (Table 3). This means that it is not due to a chance.

Table 3. ANOVA test results

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of squares</th>
<th>df</th>
<th>Mean square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>12.279</td>
<td>3</td>
<td>4.093</td>
<td>8.705</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>35.265</td>
<td>75</td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>47.544</td>
<td>78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Early childhood and previous awareness, High cultural resources, Education satisfaction  
b. Dependent variable: ESD adoption and infusion

In the model summary, adjusted R square shows that the model explains 22.9% of the population variations (Table 4).

Table 4. Model summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R square</th>
<th>Adjusted R square</th>
<th>Std. error of the estimate</th>
<th>R square change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.508a</td>
<td>0.258</td>
<td>0.229</td>
<td>0.68571</td>
<td>0.258</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Early childhood and previous awareness, High cultural resources, Education satisfaction  
b. Dependent variable: ESD adoption and infusion

Discussion

As the results indicate, the respondents either do not have any previous knowledge about ESD or have a very basic knowledge about it. These findings are very challenging in Egypt since creating awareness about ESD seems like a prerequisite for ESD infusion. Needless to say that ESD infusion would have been much easier if ESD were embedded in school curricula. This relation has been proven as a positive relation between ESD previous knowledge and ESD infusion.

It was expected that satisfied students would prefer to study ESD in a well-established university and to specialise in ESD in their current university. This finding indicates that ESD as a science by itself is acceptable. Also, the results indicated that only 65% of the unsatisfied students are willing to study ESD in a well-established university compared to 80% of their satisfied counterparts. The justification is clear since unsatisfied students are more open to obtain ESD in a new university specialised in ESD as they are already dissatisfied with their current university.

Both satisfied and dissatisfied students believe that well-established universities will encourage ESD in a more sophisticated way in comparison with new universities specialised in ESD. 73.9% of the unsatisfied students are willing to join a new university
specialised in ESD compared to 35.7% of the satisfied students. The analysis of these results reveals the following cultural analysis. Egypt is ranked high in the uncertainty avoidance range; thus, people are not risk-takers. Also, Egypt as a developing nation suffered from authoritarian regime for more than 30 years. This is a fact that justifies Egypt’s position as a high power distance country. One of the very interesting traits of high power distance societies is that people feel more comfortable to join well-established institutions that have formal rules and regulations to follow; even if these guidelines are not convincing.

On another note, ESD has a potential market share or market equity since 78.3% of the dissatisfied and 25% of the satisfied respondents indicated that they would be interested to study ESD in postgraduate studies. Assuming that people understood the basics of ESD, we can confirm that infusing ESD in Egypt is likely to happen without serious challenges. But, still, it is apparent that ESD infusion will face some resistance if it is being introduced in a new university specialised in ESD. To avoid this resistance, new universities should promote high quality of education as it is the number one feature that affects university selection. Results indicate that students prefer being enrolled in ESD programmes offered by well-established universities and not by a new university specialised in ESD. The number of public school students who are willing to join a new university specialised in ESD represented 57.2%. This percentage surpassed the number of private school students 45.9%. However, public school students are not qualified to be included as primary target group for private education enrolment since they cannot afford the university annual tuition. Fortunately, both public and private school students are willing to continue postgraduate studies in ESD.

Females are more open to adopt ESD than males. In general, the results indicated that females are accepting ESD as an idea. Females more than males are willing to join a new university specialised in ESD. Also, the number of males who indicated that well-established universities would be better than specialised universities in providing ESD is greater than females. This finding proves again that females are accepting ESD in principle regardless of who is providing it. It proves also that females are more risk-takers than males. Probably females are more open to the nature, environment, arts, culture, community engagement and development than males. However, males and females agree and strongly agree that ESD should be included in school curricula.

Highly cultured people prefer to study ESD in well-established universities. Spearman’s rank association test showed a positive relationship between high cultural resources and studying ESD in a well-established university. The relation strength is shown by the correlation coefficient 0.312 with very high significance, as $\alpha$ is less than 0.01. Highly cultured people think that well-established universities are better in providing ESD than new universities. This means that highly cultured students could be considered as the primary target market for ESD programmes if offered by well-established universities and new universities specialised in ESD as well.

**Recommendations**

The most competitive advantage for ESD providers is the quality of education. Both public and private universities should consider the education quality as the most appealing feature for students when selecting a university. The second appealing feature for students is the type of education provided by the university. Needless to say that ESD is considered
a unique education type that deserves to be highlighted to attract students’ attention. Let alone that the type of education is one of the most important features affecting university selection, promoting this new type of education will help promoting the university providing it. The reputation of the university came as the second appealing feature for students. That is why offering ESD in well-established universities is attractive for moderate and highly cultured students. As discussed in the literature reviews section, new universities specialised in ESD should maintain strong affiliations with well-respected brands that are relevant to ESD. Well-established and newly-specialised universities should not emphasise the uniqueness of ESD curricula. Students do not consider the curricula as an appealing feature, and they ranked it as number four. On the contrary, students appreciate the nature and type of education more than the curricula. Based on this finding, it is strongly recommended to emphasise the uniqueness of ESD as a new education type without touching the nature of the courses and the curriculum mechanism.

Universities and other academic institutions must generate appropriate awareness campaigns for infusing ESD. It has been proven that there is a solid correlation between early childhood and previous awareness and ESD infusion. Conventional school graduates are the primary target market for new universities offering ESD in Egypt, not international school graduates. The results indicated that international school graduates are satisfied with their education system and thus aim to continue their education in the same well-established institution. Even among international and other highly ranked private school graduates ESD is mainly being considered if offered by a well-established university, not a new university specialised in ESD. Thus, new universities that specialise in ESD should target conventional school graduates as their primary target market. As for the international school graduates, they are the secondary target market for new universities specialised in ESD.

On the other hand, the primary target market for a well-established university that offers ESD is the international and other upscale school graduates in Egypt. The secondary target market is represented by the conventional school graduates. This should affect private universities specialising in ESD as they should seek funds from organisations caring about the environment to finance scholarships for public school students who have a particular interest in ESD. Moreover, universities should focus on gaining females’ attention as a potential target market. This recommendation is for both well-established and new universities. Cultured students are the main target market for ESD. Promoting ESD should take place in cultural centres and other places visited by moderate and highly-cultured students. Libraries and other culture events would be good places for reaching cultured audience. The material used for ESD promotion should give a special attention to ESD as a different type of education, and, at the same time, it should be communicated through cultured communication channels.

Future research

The same research should be conducted for a larger sample size. A comparison study should be made between Egypt and other countries, especially those that already infused ESD in their curricula. Investigating the launching process that other ESD universities pass through would be an advantage for potential universities. Assessing brand impact on ESD infusion is another future area for investigation. Also identifying the appropriate fit between the education type and its brand associations should be investigated in
future work. Another relevant topic would be measuring the assumed ESD brand associations to cultured people. It is also important to measure the infusion of ESD in the Middle East and North Africa region as well as the interest of international higher education institutions in partnering with a newly-established university to infuse ESD.

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EDUCATION FOR SUSTAINABLE DEVELOPMENT: ASSESSMENT OF THE CURRENT SITUATION AT THE FACULTY OF ENGINEERING OF NOTRE DAME UNIVERSITY – LOUAIZE

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Abstract

There is a growing need to incorporate educational sustainable development (ESD) principles into engineering education. This paper identifies engineering competencies within the Faculty of Engineering at Notre Dame University – Louaize and the means to shift towards sustainability. ESD tools are used to carry the analysis, keeping in mind the Faculty of Engineering accreditation system ABET, incorporated as the Accreditation Board for Engineering and Technology, Inc., requirements. A survey of the current situation was conducted based on seven key areas: curriculum, research and scholarship, operations, faculty and staff development, outreach and service, student opportunities, administration, mission and planning. The survey revealed some weaknesses that the Faculty of Engineering needs to address for a successful implementation of sustainable practices. ESD is integrated in two selected engineering courses. At the beginning of the course, a questionnaire is used to assess the knowledge, behaviour and attitudes of students. Results show that students currently understand the importance of ESD, but they have a weak knowledge of the relationship between the environment and sustainable future and a bad understanding of sufficient living economy principle. The analysis showed also the need to introduce new courses of sustainability. Nevertheless, the proposed amendment to the curriculum ought to be carried in conjunction with the Faculty of Engineering accreditation system ABET. A wide dissemination of ESD throughout the entire engineering programme will help promoting sustainability. Besides, the infusion of ESD can be implemented within a common engineering course – a mandatory course for all engineering students following ABET amendment procedures.

Keywords: engineering, education, curriculum development, sustainability, competences

Introduction

The world is facing current and future environmental and social challenges. Over the past decade, sustainability strongly emerged as the new paradigm of development. Climate change, energy resources, water scarcity, air and water pollution are among the new challenges for humanity. In this context, higher education can be the tool for achieving sustainability (United Nations Educational, Scientific and Cultural Organi-
sation [UNESCO], 2006). The institution of higher education is the central forum where leaders and decision makers can exchange views (Bekessy, Burgman, Yencken, Wright, Filho, Garden, & Rostan-Herbert, 2002). Therefore, profound changes in higher education programmes are necessary to integrate the concepts of sustainability in the programmes and prepare the new generations to deal with a rapidly changing and less predictable global system (Sipos, Battisti, & Grimm, 2008). The reoriented programmes must take into consideration the many and complex facets of local environmental, economic and societal conditions. However, it is a challenging task to redesign curricula to achieve sustainability by preparing graduates with the necessary knowledge and values, a capacity for critical thinking and the motivation to deal with diverse problems associated with unsustainable situations. At the heart of this challenge is the lack of understanding the concept of sustainability as a basis and the need to develop curricula based on concepts related to sustainability rather than the traditional set of concepts related to each discipline (Sibbel, 2009). In order to raise the education for sustainable development to this level, the academic structure of study must be changed to introduce sustainable development as a transversal skill in all majors, defining the skill as the students’ capacity to internalise and apply sustainable solutions to all aspects of their professional life: technological, environmental and social aspects.

In this context, Notre Dame University – Louaize (NDU) has engaged in partnership with a number of higher education institutions from Greece, Ireland, France, Jordan, Lebanon and Egypt in a radical reorientation of the curricula in order to enable the new generation of professionals to be more efficient in operating the transition towards a sustainable society and act to influence it. The project, entitled “Reorient University Curricula to Address Sustainability” (RUCAS), consists of developing resources to involve faculty members, review of curricula, capacity building and establish a network for support. The areas of curriculum revision are numerous: educational and social sciences, engineering, information technology and applied sciences. For each discipline, students’ competences are developed and will be validated after. The support system consists of an education for sustainable development (ESD) curriculum review toolkit, a virtual centre for curriculum reform in each partner institution and a series of seminars aiming at training faculty members to implement ESD into their own courses. The target is to reach more than 40% of the study programmes to address ESD in every partner institution (RUCAS, 2011).

This paper describes the advances achieved at the Faculty of Engineering of NDU and discusses some ideas for future action. At the Faculty of Engineering, students’ competencies to address ESD have been assessed. A survey based on the approaches developed by University Leaders for a Sustainable Future (ULSF) was used to analyse the current situation and to point to some challenges and strategies for integrating sustainability into the curricula (ULSF, 2009). Finally, two engineering courses were selected for a pilot study on infusing sustainability concepts. The students’ knowledge, attitudes and skills before attending these courses are measured and will be used to assess the students learning at the end of the course.

Competencies for engineering in addressing ESD

Engineers have a major role to play in the enhancement of sustainable future. Most of these challenges require engineers to be able to design and construct sustainable systems that address current needs, without compromising future generations. Traditionally,
Engineers have always been at the vanguard of social development. So it is their responsibility to contribute to the solution of food shortage, water management and decent shelter for the world population, while using the least amount of existing resources. This cannot be accomplished using the current conventional techniques. It is true that some little progress in conservation, recycling and awareness has been reached yet. The path to reach the above goal is long if a breakthrough in clean technology is not made soon.

The traditional method of engineering education is deemed to fail if not substantially reshuffled and rethought. The outcome of an extremely slow process of modernisation will certainly create a new revolutionary method of education, transforming the existing to obsolete ones. A holistic approach comprising a wider knowledge base in the social, political and life sciences in addition to physical sciences and mathematics must be entailed (Chau, 2007). However, integrating learning experiences addressing these goals in engineering programmes involves many challenges, including stating operational learning outcomes for sustainability knowledge, skills and attitudes for a particular programme, making a contextualised interpretation of the concept, curriculum design issues, such as creating separate courses on sustainability and integrating such topics in other courses (Wedel, Malmqvist, Arehag, & Svanstrom, 2008). In order to produce the change in this direction, there is a growing interest in the ‘competence approach’ as change agents to implement ESD, assess the progress of its implementation and advance thinking and practice of cross-boundary transformative sustainability in higher education (Mochizuki & Fadeeva, 2010).

Within the framework of the RUCAS project, there is an opportunity to address students’ competence as part of the well-known five general pillars: learning to be, learning to live together sustainably, learning to know, learning to do and learning to transform oneself and society (UNESCO, 2006). However, the project gives each discipline a foundation to develop its own specific set of competencies. In the meantime, the competencies defined for engineers can allow for a more creative educational thinking process.

Certain courses are more prone to incorporate the notion of sustainable development than others. However, introductory courses can include a general knowledge of sustainability and sustainable development in engineering. The objective is to induce all graduates, especially in the fields far from sustainable development (SD), to carry this valuable luggage during their practice and train them to the notion of learning to live together sustainably.

Ethical responsibilities are part of a professional track. Graduates in developing countries have a serious challenge in facing corruption. The awareness of the importance to be dedicated to the professional and ethical responsibilities should be cultivated in the spirits of the emerging generation. Regardless of the type of practice, the first line of defence to counter corruption is the personal virtues related to ethics. Nevertheless, this skill needs to be nurtured in school, due to its complexity and multiple faces. Engineers will then need to nurture the notion of transforming themselves and their entourage in order to inculcate ethical behaviour around.

Engineers have always been dealing with leadership skill. The type of engineering profession does include design and execution. The execution part is mainly a skilled management process. Academic engineering programmes aims at building up future leaders, cultivating the notion of leadership skills for sustainable engineering design to counter-balance the loss of our resources.

In designing systems, engineers need to promote the application of environmentally friendly technology versus resource intensive technology that used to pollute, create
social injustices and disrupt communities. Eco-friendly solutions are given priority in industry research and development, as well as academic research. Use of the techniques, skills and modern engineering tools necessary for environmentally sound engineering practice needs to be given priority in teaching to live together sustainably.

Several engineering schools are seeking programmes’ accreditation from the Accreditation Board for Engineering and Technology (ABET), either in preparation for a first assessment or renewal. Per ABET standards, designing a system, component or process to meet desired needs is achieved within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability (www.ABET.org). Learning to know and to conceive such system needs to be imbedded within our teaching.

Teamwork is also the issue to be promoted within ABET guidelines. Working in multidisciplinary teams in engineering practice is also encouraged among students to adapt current technology to sustainable lifestyles. This effort is mainly pursued among senior students developing their final year projects. Their teaming together is a means to learning to do things together with joint efforts and combat individualism and selfishness.

While engineering education gets busy focusing on technical features, the system often encourages faculty and students to omit addressing the global picture of understanding the impact of technology on society and nature and learning to transform oneself and society. This is mainly due to the type of teaching cloistered within classroom walls. Besides, understanding how different cultural, social and political contexts impact design is also part of the technical teachings. It also includes the analysis of the impact of engineering and technology on individuals, organisations and society, including ethical, legal, security and global policy issues after implementation. Engineering education needs to incorporate the formation of future engineers capable of listening closely to the demands of citizens and other stakeholders, in order to let them have a say in the development of infrastructures. Also the discussion of social and psychological aspects of environmental behaviour change (for instance, why and how people change or do not change) in relation to engineering practices is useful. Finally, engineering students should be introduced to the United Nations Millennium Development Goals at an early stage, as being the framework to plan their future. The engineering educational system which is unsuccessful in training its students to become visionaries is a stagnant one doomed to failure.

Current situation at the Faculty of Engineering at NDU

Within the framework of the RUCAS project, the Faculty of Engineering has conducted a study to investigate and understand the current practices and policies related to sustainability. The aim was to document the environmental sustainability of teaching, research and operational practices at the faculty level. A questionnaire survey based on the approaches developed by ULSF has been carried out. Seven key areas were examined: curriculum, research and scholarship, institutional operations, faculty and staff development and rewards, outreach and services, students’ opportunities and institutional mission and structure. The main outcomes of the assessment show the following:

Curriculum. The programme includes several courses related to sustainability. Most of these courses are offered by the Department of Civil and Environmental Engineering. Undergraduates are required to take more than one course on issues related to environ-
mental engineering or sustainability. However, the number of courses addressing sustain-
ability compared to the total number of offered courses is relatively small. Minimum
effort is made to educate students about the role of the institution in its social and
ecological systems.

Research and scholarship. It is roughly estimated that around 20% of faculty
members are doing research on sustainability issues. The estimated percentage of faculty
members that would be interested in doing more teaching and research is considered to
be around 50%. Examples of research activities in this area are journal and conference
articles on water pollution and on integration of renewable energy in buildings. The
Faculty of Engineering has also an affiliated research centre, the Water Energy and
Environment Research Centre, which aims to investigate the water and energy resources
and the state of environmental situation in Lebanon and the Middle East and North
Africa region. However, the interaction between the centre’s activities and the students’
education at the Faculty of Engineering needs to be strengthened for a better interaction
among disciplines and for facilitating interdisciplinary research. Public policy issues in
particular are not considered to be well addressed by the Faculty of Engineering.

Operations. Current practices at the Faculty of Engineering in terms of implementing
sustainability in operations are very limited. A campus energy audit and proper retrofits
are inevitable. Although some recycle bins for papers do exist, they are not efficiently
used, the cleaning staff lack awareness and training. Indeed, many of them are usually
collecting and mixing papers with the regular trash. However, few signs showing the
commitment of the Faculty of Engineering to sustainability can be visualised at NDU.
They include green space and trees, recycle bins and non-smoking signs inside buildings.
But many current practices show unsustainable behaviours: lots of cars on campus,
lights left on in empty classrooms and offices, students smoking inside buildings and
inadequate heating and cooling regulation within the edifice. In general, there are very
few efforts to integrate operational practices related to sustainability into educational
and scholarly activities. A recent project consisted of designing a sustainable extension
to the Faculty of Engineering building and laboratories. In this project, the staff from
physical plant worked directly with students.

Faculty and staff development and rewards. Current criteria for hiring and promotion
for faculty are mainly focused on teaching, scholarships and services. Sustainability is
only explicitly considered as a criterion for some relevant positions, such as the need to
recruit for an environmental engineering faculty member at the Department of Civil
and Environmental Engineering. In recruiting or promoting staff, the contribution to
sustainability is not directly recognised. Professional development opportunities to
enhance understanding, teaching and research in sustainability do exist. Seminars and
conferences are organised by the students’ chapters of engineering professional societies,
in addition to the distribution of available soft and hard copies of journals of renewable
energy, energy efficiency and movies on sustainable construction and air pollution.

Outreach and service. Few examples of partnership between the Faculty of Engineering
and other local and international faculties and organisations exist. The participation of
the staff in a European project on renewable energy in developing countries (Ressol-
Medbuild) can be cited. Also the staff are teaming up at the university level with other
colleagues in reorienting the programmes to address sustainability, in collaboration
with international partners, and the RUCAS project is a vivid example. The Faculty of
Engineering also participates occasionally in organising conferences on sustainability.
A conference on renewable energy for developing countries is a recent example (www.ressol-medbuild.eu). Raising awareness through participation in public events can also be viewed as an important activity to serve the community (www.cbd.int/idb/2012/celebrations/lb/).

Students’ opportunities. Students’ chapters of international professional engineering societies promote sustainability by organising students’ events and inviting speakers on campus to address environmental issues. The extent of involvement of student groups in sustainable initiatives is dependent on the interests of the executive committees and their mandates.

Administration, mission and planning. Sustainability is an integrated part of the mission and vision of the Faculty of Engineering. Yet, the Faculty is not clearly implementing sustainability in its strategic planning. The Faculty of Engineering needs to reinforce its commitment by first acting as a role model to students and creating, for instance, a task force in place to facilitate sustainability or by dedicating some positions for sustainable practices. Current visibility of sustainability in the Faculty of Engineering is limited to organising seminars, inviting guest speakers and projecting target movies on environmental topics.

Finally, the building of the Faculty of Engineering is a negative example for energy efficiency and green construction and represents a weakness in terms of educating for sustainability. A green renovation needs to be planned in order to offer students a live demonstration of sustainability.

Pilot study: Infusing sustainability into two engineering courses

Sustainability can be viewed as a woven focus of engineering education compared to other disciplines. Therefore, the Faculty of Engineering is in a strategic position to play an important role at the university level in that area. Engineers with environmental background are a valuable asset to the Faculty of Engineering. The best way to prepare engineering students for a sustainable future is to provide them with a fundamental education in basic sciences, engineering fields, society and the important systemic understanding of the broad linking amongst them (Chau, 2007). Redesigning the curricula at the Faculty of Engineering to incorporate sustainability is not an easy task, since the existing one is very condensed, and the addition of new material might require sacrificing other essential material. The shift in the programme should be made in a way to introduce sustainability concepts in a generic manner. The students should be made aware of the significance of environmental constraints in any design activity.

Within the framework of the RUCAS project, the chosen strategy by the Faculty of Engineering is to infuse appropriate sustainability concepts into existing courses. Two typical courses were selected first for a pilot study: the study course “Soil Mechanics, an Introduction to Foundation Engineering” and the study course “Concrete Design”. Traditionally, the study course “Soil Mechanics, an Introduction to Foundation Engineering” used to incorporate applications related to structural foundations. To infuse sustainable development, examples from groundwater and soil pollution are introduced. For instance, hydraulic conductivity of soil is now related to the propagation of pollutants in soil and groundwater, with discussions on the methods of remediation. A part related to geohydrology covers applications on water management, such as dams and groundwater wells.
The course “Concrete Design” is conventionally oriented towards the safety and the economy of the design. A research-based project on sustainable concrete material and/or techniques is added to the course to provide students with the opportunity to learn about alternative sustainability principles that can be applied to engineering design.

A questionnaire developed for the RUCAS project was used to survey the students’ knowledge, understanding, attitudes and skills at the beginning of the two courses, using a 5-level score (highest = 5, medium = 3, lowest = 1). The questionnaire tries to investigate five main topics: environment and its relationship to sustainable future; consumption and sufficient living; good citizens in democratic society; value of different cultures and education for sustainable development.

The questionnaire was distributed to 71 students during the first lecture. The analysis of the results of the first forms revealed that medium to low score was obtained for the part on the relationship between the environment and sustainable future (Figure 1) and medium to low score was also recorded on the part of sufficiency principle. Medium to high score was obtained for the democratic society and the cultures of other societies parts; medium to high score – for the ESD part.

Figure 1. Results of questions surveying students’ knowledge and skills of the environment

Therefore, we can estimate that there is a need to focus on a better integration of environmental knowledge, values and ideas in the selected courses and to develop a prerequisite course that introduces the students to this topic. Another focus should be the integration on the concepts for sufficiency of living economy principle. As for the parts related to democracy and respect of other cultures, the score can be explained by the multiethnic nature of the Lebanese society, where the cultural interaction between 18 religions is very dynamic and the relatively democratic nature of the Lebanese system.
The result concerning ESD is a good sign that shows an acceptable level of students’ awareness of the importance of sustainability in education and their willingness to acquire the skills needed for SD. The challenge for the faculty is in developing the courses and the teaching methods of these concepts. To assess this first step, the same questionnaire will be redistributed at the end of the course to the same sample of students. This will help to evaluate the degree of success or failure of the infusion of sustainability in the selected courses and to fine tune the method used for a better infusion in a wider pool of engineering courses.

**Conclusion**

Most of the traditional engineering curricula are designed to provide students with a strong scientific knowledge, focusing mainly on the safety and efficiency of design, and the Faculty of Engineering of NDU is not an exception. However, this approach in engineering education is deemed to fail if not substantially reshuffled and rethought. Some courses related to sustainability are offered in the programme of the Faculty of Engineering, but they do not form an integrated part of the undergraduate education. The need to incorporate better the sustainability concepts within the curricula is a major concern to the Faculty of Engineering which is also seeking the ABET accreditation. Within the framework of the RUCAS project, the infusion of the principles of sustainable development into engineering education has been started at the Faculty of Engineering and will be improved and expanded in the near future, taking local and regional characteristics into account. A survey of the environmental sustainability of teaching, research and operational practices at the Faculty of Engineering reveals many weaknesses and shows that there is a need to revise the current practices and policies related to sustainability. The analysis of the questionnaire that was filled in by the students shows that in addition to infusing sustainability concepts, there is a need to develop a new core course that introduces the engineering students to the basic environmental knowledge, values and ideas. In conformity with ABET requirements, the course will be developed as a result of extensive students feedback, rubrics analysis and outcomes, alumni and employers feedbacks.

To conclude, NDU along with its partners in the RUCAS project has the opportunity to lead the way in developing the strategies and tools for infusing sustainability concepts in education and to provide a benchmark for other Lebanese Universities. The work described here is only a part of long on-going process at NDU to encourage ESD.

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REORIENTING AN EDUCATIONAL PSYCHOLOGY COURSE TO ADDRESS SUSTAINABILITY: A CASE STUDY

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Abstract

Due to the rapidly changing knowledge, teachers are supposed to teach their students ways of thinking and gathering information, not certain contents that would change shortly. In this sense, sustainability, which, in part, means the preparation of an individual who has the ability to practise critical thinking and to find creative solutions to the problems they face, is considered a must. This paper focuses on the integration of sustainability in curricula, specifically ways of introducing it to students in higher education institutions that provide highly specific and specialised knowledge and skills. So, this study presents a framework for reorienting a university course in the field of physiological psychology to address sustainability. The results of the quantitative analysis showed significant differences at the level of 0.001 between the pre- and post-testing of students’ knowledge of and attitudes towards sustainability in favour of the post-test. While results of qualitative analysis showed positive transformation of students’ practices health wise.

Key words: educational psychology, physiological psychology, education for sustainable education, higher education, teaching, active learning, green intelligence, health

Introduction

After long centuries of human life on earth, it is evident that the devastation of both natural ecosystems and the whole mankind is largely due to human interference (Wargo, 2009). It took many initiatives and legislations trying to prevent the conflict between human developmental activities and the well-being of the planet till the World Commission on Environment and Development was held in 1987. It defined the concept of sustainable development (SD) as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987).

The debates that followed the presentation of the sustainable development concept led to defining three main aspects of SD:

- economic: to produce goods and services on a continuing basis to maintain manageable levels of government and external debt and to avoid extreme sectorial imbalances which damage agricultural or industrial production;
• environmental: to maintain a stable resource base, avoiding over-exploitation of renewable resource systems or environmental sink functions and depleting non-renewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability and other ecosystem functions not ordinarily classed as economic resources;
• social: to achieve fairness in distribution and opportunity, adequate provision of social services including health and education, gender equity, political accountability and participation (Harris, 2003).

But due to globalisation, there have been threats to cultural diversities and identities of different countries all over the world. The protection and promotion of cultural diversity is vital to universal human rights, fundamental freedom along with securing ecological and genetic diversity (Nurse, 2006).

Also, some researchers and institutions have pointed out that a fourth dimension should be added to the dimensions of sustainable development, since the triple-bottom-line dimensions of economic, environmental and social do not seem to be enough to reflect the complexity of contemporary society. In this context, the Agenda 21 for culture and the United Cities and Local Governments (UCLG) Executive Bureau lead the preparation of the policy statement “Culture: Fourth Pillar of Sustainable Development”, passed on 17 November 2010, in the framework of the World Summit of Local and Regional Leaders – 3rd World Congress of UCLG, held in Mexico City.

It is notable that these four aspects are not independent; they are interrelated, and they affect each other. In this sense, learning activities should address these four aspects, whether separately or connectively, to attain the objectives of education for sustainable development.

Theoretical framework

One of the most significant outcomes of the Earth Summit was Agenda 21 that called for a global partnership for sustainable development (United Nations Educational, Scientific and Cultural Organisation [UNESCO], 1992).

Agenda 21 held responsible all the countries of the world for the well-being of the planet. There were many suggestions for promoting SD; chapter 36 of Agenda 21 was titled “Promoting education, public awareness and training”. However, McKeown (2002) stated that despite the repeated emphasis from the commission of sustainable development (CSD) on the importance of education in achieving SD, education for sustainable development (ESD) was not advancing more rapidly.

There was a need to plan education to focus on SD, so Delors (1996) proposed the main pillars of ESD as follows:

1. learning to know: means the ability to learn to acquire a taste for learning throughout life, develop critical thinking, acquire tools for understanding the world and understand sustainability concepts and issues;
2. learning to do: means the ability to be an actor as well as a thinker, understand and act on global and local sustainable development issues, acquire technical and professional training, apply learned knowledge in daily life and be able to act creatively and responsibly in one’s environment;
3. **learning to live together**: means the ability to participate and cooperate with others in increasingly pluralistic, multi-cultural societies, develop an understanding of other people and their histories, traditions, beliefs, values and cultures, tolerate, respect, welcome, embrace and even celebrate difference and diversity in people, respond constructively to the cultural diversity and economic disparity found around the world and be able to cope with situations of tension, exclusion, conflict, violence and terrorism;

4. **learning to be**: means the ability to see oneself as the main actor in defining positive outcomes for the future, encourage discovery and experimentation, acquire universally shared values, develop one’s personality, self-identity, self-knowledge and self-fulfilment and be able to act with a greater autonomy, judgment and personal responsibility;

5. **learning to transform oneself and society**: means the ability to work towards a gender neutral, non-discriminatory society, develop the ability and will to integrate sustainable lifestyles for ourselves and others, promote behaviours and practices that minimise our ecological footprint on the world around us, be respectful of the Earth and life in all its diversity, act to achieve social solidarity and promote democracy in a society where peace prevails (UNESCO, 2010).

ESD utilises the five pillars in planning and implementing educational and training activities to accomplish its goals.

Since psychology is the science of studying behaviour modification and how people can adapt to new ways of thinking, learning and living, there are many applications in psychology for educational for sustainable development (Simpson, 2005).

The study at hand attempts to address sustainability with its four main aspects through the infusion of some topics that reflect these aspects; the environmental aspect as well as the cultural one will be reflected in the study of the Nile basin treaty crises and its consequences upon Egypt’s share of the Nile water and the security of peoples’ needs. Attracting students’ attention to the Nile crises should be reflected in the students’ writings on the topic and the suggested solutions they might reach.

This problem of the Nile treaty also reflects to some extent the economic aspect of SD, in the sense that the treaty affects the amount of water allocated to Egypt, while almost 90% of the consumed water in Egypt comes from the Nile River. Students would also express their concerns about the consequences of the treaty in an economic sense through writing about the problem.

The social aspect of SD will be infused through introducing the concept of green intelligence which was proposed by Wargo (2009) to attract the attention to the fatal effects of environmental hazards on human health, especially children.

In a review that summarises knowledge of associations between child health and development outcomes and environmental exposures, the author included lead, methylmercury, polychlorinated biphenyls (PCBs), dioxins and related polyhalogenated aromatic hydrocarbons, certain pesticides, environmental tobacco smoke, aeroallergens, ambient air toxicants (especially particulate matter and ozone), chlorination disinfection by-products, sunlight, power-frequency magnetic fields, radiofrequency radiation, residential proximity to hazardous waste disposal sites and solvents. The adverse health effects linked to such exposures include foetal death, birth defects, being small for gestational age, preterm birth, clinically overt cognitive, neurologic and behavioural abnormalities,
subtle neuropsychological deficits, childhood cancer, asthma, other respiratory diseases and acute poisoning. Some environmental toxicants, notably lead, ionising radiation, ETS and certain ambient air toxicants, produce adverse health effects at relatively low exposure levels during foetal or child developmental time windows (Wigle, Arbuckle, Walker, Wade, Liu, & Krewski, 2007).

Based on the students’ knowledge of the previous facts, they would be motivated to look for further information about the bad/unhealthy practices that they do and that also contribute to a less green life.

An example of reorienting the curriculum towards sustainability, the Spanish acronym for Curriculum Greening of Higher Education (ACES) works in cooperation with universities that are aware of the concept of curriculum greening and that have previous experience in tasks related to this issue. Since 2000, this network carried out the project “Orienting curriculum of higher education studies towards sustainability: Designing interventions and analysing the process” (ALFA Programme, European Union, 2001–2003).

The institutions worked at three levels of action: subject matter, syllabus design and institutional participation. The ACES model is the first step in a long process for orienting higher education towards sustainability.

Sustainability can provide a context for classroom projects, allowing students to apply academic knowledge and skills in order to solve real problems and provide authentic community service. Infusing sustainability into the curriculum can result in students becoming more engaged in classroom learning, building twenty-first century skills and connecting to their community.

Reorient University Curricula to Address Sustainability (RUCAS) is yet another example of the projects that attempt to reorient the university curricula to address sustainability. It was motivated by the fact that higher education institutions (HEIs) in the Arab region face challenges related to the slow progress regarding the implementation of the Decade of Education for Sustainable Development (2004–2015) as declared by the United Nations General Assembly through its Resolution 57/254). In RUCAS, six HEIs from the European Union (EU) led by the University of Crete joined efforts with six HEIs from the Arab region along with UNESCO Regional Office. The overarching goal of the project is to help partner HEIs reorient their university curricula to address sustainability through capacity building of university staff, curriculum revision and implementation.

**Statement of the problem**

HEIs play a vital role in teaching and training most of the professionals who work after graduation in the various governmental and private institutions. But HEIs have specific programmes with specific course materials that produce a graduate with certain characteristics.

When SD was recommended to be infused through education, it was not possible to change the course content altogether, so reorientation of the existing curricula to address sustainability seemed to be a possible answer.

The process of reorientation was used in many studies and had positive outcomes. In 2000, as part of the initiative undertaken by the international network of teacher
education institutions associated with the UNITWIN/UNESCO Chair to reorient teacher education to address sustainability, Down (2007) introduced the concept of infusing education for sustainable development in the existing literature programme in the largest teachers’ college in Jamaica.

The literature programme is for pre-service teachers of the English literature and language at the secondary school level. The infusion process introduced major issues of sustainability and focused on that of violence in the Jamaican society.

Students found the programme meaningful and valuable. They commented that approaching literature in terms of sustainable development deepened their understanding and extended their knowledge of global and local issues. SD encompasses a vision that integrates environment, economy, society and culture.

Reorienting education also requires teaching and learning knowledge, skills, perspectives and values that will guide and motivate people to pursue sustainable livelihoods, to participate in a democratic society and to live in a sustainable manner (McKeown, 2006).

Based on the previous definition, the researcher attempted to infuse some aspects of ESD that influences students’ daily practices which affect their health in a bad way and guide them through the process of transforming those practices to be in line with the sustainable livelihood.

As UNESCO proposed a number of ESD characteristics that can be implemented in many culturally appropriate forms, the researcher chose the following as basis for the process of reorienting the course: using a variety of pedagogical techniques that promote participatory learning and higher-order thinking skills; promoting lifelong learning; being locally relevant and culturally appropriate; addressing content, taking into account context, global issues and local priorities.

Research questions

The study at hand attempts to answer the following questions: What is the impact of implementing an educational psychology course that was reoriented to address sustainability upon students’ knowledge of SD? What is the impact of implementing an educational psychology course that was reoriented to address sustainability upon students’ attitudes towards SD? What are the malpractices that prevailed among the students? and What is the effect of the reoriented course of physiological psychology on changing the students’ malpractices health wise?

The aim of the study

The present study aimed at reorienting the physiological psychology course that is taught to the second year students who major in psychology at the Faculty of Education, Suez Canal University. Then the impact of applying the reoriented course upon students’ knowledge of and attitudes towards sustainable development will be measured. The process of reorientation focused on one of the important local issues which is the Nile treaty. It was introduced to the students in the context of studying emotions and their consequences. The students were also required to write about their emotions of threat or fear and explain its physiological basis.
The study also aimed at introducing the students to the concept of green intelligence that focuses on the hazards that affects students’ health and how to control the intake of the hazardous substances. Utilising the gained knowledge about green intelligence, the study aimed at transforming students’ malpractices – health wise – into healthy ones.

Methods

Experimental design

The present study used the pre-post one experimental group design, in which a purposive sample was chosen. The instruments of the study were implemented once before and once after the application of the reoriented course.

The study also utilised a qualitative analysis in the observation checklists where the students gathered information about their healthy and unhealthy practices as a basis for transforming the malpractices into good ones.

The students were asked to fill in the observation checklist with all the malpractices they thought they were doing. After that, the researcher coded their responses and calculated the frequencies for all the responses. The responses with the highest frequencies were chosen to be the items of the second observation checklist.

Students were asked to fill in the checklist on daily basis and reported their progress at the begging of their weekly lecture.

At the end of the course, quantitative analysis was carried out to determine the differences between the measures at the beginning and the end of teaching the reoriented course.

Profile of the participants

Purposive sampling was used to select the participants of this study as they were enrolled in a compulsory course taught at the Faculty of Education by the researcher. The sample consisted of four male and six female students with the age varying from 17 to 19 years old.

Procedures of the study

The reorientation of the course included using active learning strategies where students were involved in carrying out research and collecting the content of the course materials. It also included environmental, economic and cultural topics related to the local cases in Egypt and its relation to the global level.

In the formal content description of the course, students were to learn about five major topics: the sensory organs, their anatomy, physiology, malfunctioning and abnormalities; cognitive processes; emotions of various natures, their physiology and disorders; theories of emotions; sleep nature, physiology and disorders. The process of reorientation of the physiological psychology course to address sustainability was divided into two main approaches: the infusion of the health aspect of sustainability and the infusion of the cultural and societal aspects of sustainability.
Infusing the health aspect of sustainability (fostering green intelligence)

No doubt that there were side effects of the 20th century prosperity, among which the change of the chemistry of the human body. People are exposed to thousands of chemicals that are recognised by the governments of the United States of America (USA) and the EU to be carcinogens, neurotoxins, reproductive and developmental toxins or endocrine disruptors that mimic or block human hormones (Wargo, 2009).

In 1999, the USA Centres for Disease Control and Prevention (CDC) reported that most individuals carry in their bodies a mixture of metals, pesticides, solvents, fire retardants and by-products of fuel combustion. Furthermore, children often carry higher concentrations than adults (Sexton, Needham, & Pirkle, 2004).

Green intelligence as a concept was introduced in Wargo’s (2009) book that holds the same title; it examines the effects of various pollutants on human health, potentials and abilities.

Many studies were carried out to examine the impact of environmental hazards on human health. For instance, lead poisoning has been associated with a significant increase in high school dropout rate and an increase in criminal behaviour (Markowitz, 2000).

In a study conducted in Shebin Elkom, Monofia governorate in Egypt, to assess the environmental lead level, to determine blood lead level ( BLL) among primary school children and to find out the relationship between BLL among studied children and their intelligence quotient (IQ), complete blood picture (CBC), hearing impairment and school performance, the results showed that the mean value of environmental lead (μg/m³) in urban school air was significantly higher than that in rural areas. BLL had a significant negative correlation with haemoglobin level and IQ; it was positively correlated with the hearing threshold. With increasing BLL, the school performance of children decreased significantly. The researcher concluded that exposure to lead would deteriorate IQ, school performance and hearing level of school children. Even in the absence of overt clinical manifestations of lead toxicity, lead intoxication should be among differential diagnosis in children presenting anaemia, intellectual impairment, poor academic performance and hearing impairment (Abdel Rasoul, Al-Batanony, Mahrous, Abo-Salem, & Gabr, 2012).

After explaining the previous facts to the students, there was an open discussion about the concept of green intelligence and how environmental influences may promote or hinders one’s genetic abilities. The participants were asked to keep a checklist in which they write down their eating habits, sleeping habits and their knowledge about what is healthy and what is not from their daily practices. For a whole week, the students were observing their behaviours and writing down their practices health wise. After collecting the students’ responses, they were classified into healthy and unhealthy ones. After calculating the frequency of each response, the malpractices that got the highest frequency were not having breakfast in the morning before going to the university; consuming excessive amounts of chips and soda; not practising any kind of sports (especially girls); staying up late; not having regular times for the three meals of the day; spending so much time on video games (mostly boys).

As the students were already learning about physiology of sleep and sleeping disorders in the course of physiological psychology, they were keen to know about their bad habits and motivated to change them into good ones. The same applies to the eating habits and their influence on their activeness and well-being.
An observation checklist with the six main misbehaviours was distributed among the students, the students were asked to fill in this checklist every day before going to bed, checking if they had done any of the mentioned behaviours.

At the beginning of the weekly lecture with the students, we had a 10-minute discussion in the feedback of each checklist and came up with recommendations for those who were not progressing as the others.

In general, the students’ evaluation of the six practices at the end of the semester was positive, but the change that was reported by most of the students to make them feel better was having breakfast before leaving home to the university. Most of the students reported being more active both physically and mentally throughout the day.

The infusion of the cultural and social aspects of sustainability

The process of reorienting the content of the physiological psychology course also took place through the infusion of materials that are driven from the local knowledge and the environmental aspect of sustainability.

As sustainable learning should not only be about learning sustainability issues, the term should be widened and broadened to include methods of sustaining our abilities to learn and sustaining the knowledge we learn. In this sense, the students were asked to write research papers that demonstrate how to collect data, how to gather knowledge about certain topic, how to analyse the collected knowledge and how to reach conclusions.

The students were to learn about various types of emotions and their physiological symptoms. To accomplish that objective, the students were asked to write down their emotions and bodily sensations during hearing the following essay:

In March 2011 (short after the Egyptian revolution), Burundi signed the Nile Basin Initiative (NBI), as the sixth country to sign. The agreement came into force without Egypt’s approval, thus depriving Egypt from its right in determining and approving all the projects that control water on the river banks. Egypt’s population of some 85 million draws about 90 per cent of its water needs from the Nile. Officials, for their part, warn that the alternative water agreement would be unable to provide Egypt’s growing population with its water needs beyond 2017.

The students reported feeling various emotions like worry, anxiety, shock, fear and a sense of injustice. The students also reported feeling various bodily sensations like speed breathing, heartache, headache and sweating. Students were asked to read this equation and think about the symptoms they felt trying to check if they were anxious or not: A threatening situation + knowing that you can’t handle it = anxiety.

Students were asked to answer the following questions in written research papers: What can Egypt do to stop worrying about the Nile water? Is it fair that Egypt takes the largest portion of the Nile water while other Nile basin countries suffer from draught? What are the best ways to achieve equity and sustain it between the Nile basin countries?
Instruments of the study

Closed sustainability questionnaire

The study implemented a 20-item self-reported questionnaire that assessed the students’ knowledge of (12 items) and attitudes towards (eight items) sustainability, the questionnaire used Likert’s scale of five responses: strongly agree, agree, undecided, disagree and strongly disagree. The questionnaire had acceptable degrees of validity and reliability (alpha = 0.88).

Observation checklists

Two observation checklists were designed and used in the study at hand; the first checklist was an opened one that was used to observe and write down the healthy and unhealthy behaviours the students did. The second checklist contained six behaviours that had the highest frequencies from the total responses of the students to the first observation checklist; the students were asked to check if they were doing them.

The reoriented course

The physiological psychology course is a compulsory course for the second year students majoring in psychology. The course was reoriented to address sustainability through infusing some of the local problems and fears the Egyptian society faces and also through infusing the health aspect in an attempt to transfer the students’ behaviours towards having a green intelligence, through eliminating the hazards of the environment they live in. The students are lectured on dangerous hazardous around them, how they should respond to them, what the best practices are towards becoming healthier.

Results of the study

The first question was: What is the impact of implementing an educational psychology course that was reoriented to address sustainability upon students’ knowledge of SD? Statistical Package for the Social Sciences (SPSS) was used to investigate the differences between the pre- and post-degrees of the students in the questionnaire that assessed the students’ knowledge of SD.

The results showed significant differences at the level of 0.001 between the pre- and post-testing of the students’ knowledge of sustainability in favour of the post-test. Table 1 shows the results of Mann-Whitney non-parametric test to investigate the differences between the students’ scores in the pre- and post-test of the closed sustainability questionnaire. It shows differences in the students’ knowledge about sustainability prior to and after implementing a reoriented course to address sustainability in favour of the students’ knowledge in the post-test. This result suggests that the reoriented course was effective in helping the students acquire more knowledge about sustainability. This finding goes in line with similar results from studies that utilised the process of reorientation towards sustainability (Down, 2007).
Table 1. Mann-Whitney analysis of the differences between groups in their knowledge of sustainability

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean rank</th>
<th>Sum of ranks</th>
<th>Z</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>1</td>
<td>5.50</td>
<td>55.00</td>
<td>-3.811</td>
<td>0.000*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>15.50</td>
<td>155.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td></td>
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</tr>
</tbody>
</table>

The second question was: What is the impact of implementing an educational psychology course that was reoriented to address sustainability upon students’ attitudes towards SD? Statistical SPSS was used to investigate the differences between the pre- and post-degrees of the students in the questionnaire that assessed the students’ attitudes towards SD. The results showed significant differences at the level of 0.001 between the pre- and post-testing of the students’ attitudes towards sustainability in favour of the post-test. Table 3 shows the results of Mann-Whitney non-parametric test to investigate the differences between the students’ scores in the pre- and post-test of the closed sustainability questionnaire. Table 2 shows differences in the students’ attitudes towards sustainability prior to and after implementing a reoriented course to address sustainability in favour of the students’ attitudes in the post-test. This result suggests that the reoriented course was effective in helping the students acquire more positive attitudes towards sustainability.

Table 2. Mann-Whitney analysis of the differences between groups in their attitudes towards sustainability

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean rank</th>
<th>Sum of ranks</th>
<th>Z</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitudes</td>
<td>1</td>
<td>5.50</td>
<td>55.00</td>
<td>-3.798</td>
<td>0.000*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>15.50</td>
<td>155.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td></td>
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</tr>
</tbody>
</table>

The third research question was: What are the malpractices – health wise – that prevailed among the students? The results of calculating the frequencies of the students’ observed malpractices showed that the students adapted many malpractices in their eating habits, sleeping habits and other behaviours. The researcher gathered the practices with the highest frequency. They were in total six behaviours: Not having breakfast in the morning before going to the university; consuming excessive amounts of chips and soda; not practising any kind of sports (especially girls); staying up late; not having regular times for the three meals of the day; spending so much time on video games (mostly boys).

The fourth research question was: What is the effect of using an observation checklist on changing the students’ malpractices health wise? The students were asked to report the frequency of practising the six behaviours in the checklist. There was feedback from the researcher, using encouragement, reinforcement and appreciation of commitment from the students to transforming their malpractices into good ones. The results of Wilcoxon analysis for the differences between measures of related samples showed that there were significant differences at 0.01 between the pre- and post-measures of malpractices in favour of the pre-measure, which means that the students reported practising fewer malpractices by the end of the course. Table 3 shows the results of Wilcoxon analysis.
Table 3. Wilcoxon analysis of the differences between groups in their healthy practices

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean rank</th>
<th>Sum of ranks</th>
<th>Z</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health2-health1</td>
<td></td>
<td></td>
<td></td>
<td>-2.844</td>
<td>0.004*</td>
</tr>
<tr>
<td>Negative ranks</td>
<td>10a</td>
<td>5.50</td>
<td>55.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive ranks</td>
<td>0b</td>
<td>.00</td>
<td>.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ties</td>
<td>0c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Health2 > health1
b. Health2 < health1
c. Health2 = health1

The table above shows the differences in the students’ healthy practices prior to and after implementing the reoriented course to address sustainability in favour of the students’ practices in the post-test. This result suggests that the reoriented course was effective in encouraging the students’ transformation towards more healthy practices.

Conclusion

The application of the reoriented course to address sustainability had a positive impact on the students’ knowledge about SD and ESD, attitudes towards SD and ESD. Moreover, raising the students’ awareness of the healthy practices had a positive impact on the students’ good practices health wise.

HEIs are considered to be important agents of change towards a sustainable world. But, due to the fixed programmes and curricula in most of the governmental universities, the suitable approach to address sustainability is reorienting the course towards sustainability, not changing it.

This case study attempted to reorient physiological psychology course to address sustainability, with the focus on the health and the cultural social aspects of sustainable development. The results showed enhancements in the students’ knowledge of SD and in the students’ attitudes towards SD. The results also showed that raising the students’ awareness of the healthy practices helped in their transformation towards adapting healthier behaviours.

The results of the study at hand should be carefully interpreted due to the small size of the sample.

Other studies should be carried out to verify the influences of applying reoriented courses in various fields of specialisation upon students’ knowledge about and attitudes towards SD and ESD.

Acknowledgement

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EDUCATION FOR SUSTAINABLE DEVELOPMENT
AT NOTRE DAME UNIVERSITY – LOUAIZE:
ENVIRONMENTAL SCIENCE CURRICULUM – A PRE-PHASE TO
THE RUCAS PROJECT ON EDUCATION FOR SUSTAINABLE
DEVELOPMENT

Layla Khalaf-Kairouz
Notre Dame University – Louaize, Lebanon

Abstract
The Faculty of Natural and Applied Sciences at Notre Dame University – Louaize, conscious to the need of experts in the emerging field of sustainability and to the role that an educational institution plays for the service of the community, introduced into the university curricula a major in environmental science. This paper will present the programme’s components, goals and implementation. The curriculum encompasses natural, social and managerial sciences, given the interdisciplinary nature of environmental science. Topical courses on water, soil and air pollution, environmental impact assessment and environmental ethics were designed, which integrate theory and practice. The graduates are prepared for managerial, communication and, most importantly, ethical competences to be able to implement best practices in environmental protection and play an active role in the community, especially the public, private, industrial and educational domains. At an inter-faculty level, the programme was successful in offering general education requirements courses on environment, sustainability and ethics, which helped in raising sustainability awareness among the students’ population and strengthened the inter-faculty community relationships. To the present, the main focus of the programme was on education and preparation of graduates for the job market. Research, community outreach and campus sustainability practices need to be further addressed. Therefore, primary efforts should be exerted to improve the outcomes at these domains, especially that the university now joined the international educational programme: RUCAS – Tempus project, which emphasises development and improvements at all the institution sectors.

Key words: education for sustainability, Bachelor of Science in Environmental Science, students’ competences, the Reorient University Curricula to Address Sustainability (RUCAS) Tempus project
Introduction

Environmental science is by definition the study of the interactions between the biological and physical components of the environment and how humans are affecting the earth’s natural systems (Miller, 2007). Being a part of the earth’s support system and a major role player on the globe make it clear that sustainability and environmental concerns should become a major responsibility in our social and professional lives to be able to face the recent local and global environmental challenges. The natural potentially non-renewable resources are being degraded through deforestation, desertification and wildlife habitat destruction. The mineral, energy and water resources are being poorly managed and depleted. The air, water and soils are being polluted through industrialisation, modern agricultural practices and toxic waste production. Climate change and ozone depletion are threatening globally the human population and the natural ecosystems. Most importantly, these changes are having severe impacts on our health as to life quality, morbidity and mortality.

In Lebanon, the local situation is not any better than on the global arena. Furthermore, in a country that suffered for more than thirty years from a civil war, the impacts on the environment were, unfortunately, well-marked on most of our environmental assets (Ministry of Environment, 2001). Solutions for a sustainable management of the natural resources and protection of the environment and human health necessitate professional intervention besides seeding the eco-citizen concept through awareness.

The Faculty of Natural and Applied Sciences (FNAS) at Notre Dame University – Louaize (NDU), conscious to the need of experts in this emerging field and to the role that an educational institution plays for the service of the community, introduced into the curricula a study course “Environmental Science”.

The programme effectively started in the academic year 1996/1997, as provided in the NDU – Louaize catalogue 1996–1997 (NDU, 1996). The originality of the programme at this year lied in the fact that it was new in Lebanon as it addressed more comprehensively environmental science rather than solely environmental health compared to the curricula offered at different Lebanese universities. The strength of the programme lies in the fact that our graduates have a comprehensive and well-balanced discipline-specific knowledge, have a sound multidisciplinary science foundation that allows them to pursue advanced studies in Lebanese universities or abroad and are ready for a wide job market range. To the present, the focus though is on developing the curricula and promoting the programme. Research, community outreach and campus sustainability practices need to be allocated further engagement.

In the year 2010, NDU joined the RUCAS – Tempus project “Reorient University Curricula to Address Sustainability”. An interdisciplinary team from the different faculties was called upon by NDU research board to prepare for the implementation of the project policies at the university. In this respect, this paper will elaborate on the programme’s components and its current implementation, and it will serve as a baseline for comparative assessment of the pre- and post-phases of the RUCAS – Tempus project on education for sustainable development (ESD) at NDU. This paper does not present an assessment of the programme as a whole. Though the number of the graduating students is still limited, our graduates are placed successfully at various environmental agencies. Within NDU, the programme showed a major success through the offered general education requirements (GER) courses, where multiple sections were opened each semester.
and the popularity of the environmental science courses encouraged the Sciences Department to continuously introduce new courses in this category.

Programme’s components

Environmental science is by nature interdisciplinary, integrating nature, technology and culture (Cunningham, Cunningham, & Woodworth Saigo, 2005). Therefore, the curriculum encompassed courses in:

- natural sciences: biology, chemistry, physics and geology;
- environmental science: water/soil/air pollution, environmental impact assessment, solid waste management and sustainable development, ecotourism, environmental health, environmental natural hazards, wastewater management, energy resources, environmental law and conservation of natural ecosystem;
- information technology sciences: computer science, geographic information systems and statistics;
- social and managerial sciences: ethics, law and economic and communication skills.

NDU adopts the credits system of education and is committed to the philosophy and standards of the American model of liberal arts education (NDU, 2012a). Therefore, the curricula are designed to offer a rich variety of general education study courses addressing social and cultural studies, philosophy and religion, citizenship and communication skills. The student is given freedom to choose from the set of GER courses as assigned by his/her major besides two free electives to their liking. The Bachelor of Science in Environmental Science requires the completion of 92 credits. Most of the courses of the major integrate theory and practice through laboratory and field work components. The students are equally encouraged to join training programmes in public and private sectors and non-governmental organisations (NGOs) (NDU, 2012b).

Programme’s mission

The mission of the environmental science programme at NDU is to provide high quality education in environmental science through rigorous interdisciplinary approach that emphasises the study of interactions between environmental processes and human behaviour, in addition to environmental problem solving. This is in consistency of both mission statements of NDU and the FNAS. The FNAS commits itself to meet the needs of undergraduate students in the respective scientific disciplines and to improve their scientific education emphasising on theory, laboratory work and research. Through quality teaching, research and outreach activities the FNAS is keen to develop and spread scientific and technological knowledge. The FNAS guides students to be ethical, innovative and lifelong learners who will be leaders in their professions and communities (NDU, 2012c).

Programme’s objectives

The environmental science programme at NDU endeavours to reach the following objectives:
• provide students with theoretical knowledge about the relationship between environmental processes and human behaviour through an understanding of basic sciences, including biology, chemistry, geology, physics and statistics, as well as various topics of environmental science, including pollution, health, law, resources conservation and management and environmental impact and risk assessment;
• assist students in developing practical skills in field surveying and laboratory work, including analysis of environmental problems, data collection, analysis and modelling of human-environment systems;
• offer a multidisciplinary learning environment promoting high-level cognitive thinking skills, including critical thinking, problem-solving skills and integrative skills;
• train students to be effective communicators, with computer literacy and managerial/leadership skills;
• prepare graduates for a successful career at various sectors: industrial, governmental/private and educational;
• prepare environmental science graduates for advanced study and research;
• cultivate in students high moral and ethical standards and values as integrity, responsibility, compassion and community service.

Programme students’ learning outcomes/competences

Competences are defined as a cluster of related knowledge, skills and attitudes that affect a major part of one’s job (a role or responsibility) that correlates with performance on the job that can be measured against some accepted standards and can be improved via training and development (Parry, 1996, as cited in Centre for Disease Control [CDC], 2001). Competences express the four pillars of education for the 21st century (learning to know, learning to do, learning to be and learning to live together) as stated by Delors (1996). Another pillar with a sustainable development dimension is added: learning to transform oneself and society (United Nations Educational, Scientific and Cultural Organisation [UNESCO], 2011) based on the fact that to achieve sustainable development, individual and collective actions are needed. The key competences as perceived by Brundiers, Wiek and Redman (2010) fit in three cluster categories 1) the strategic knowledge cluster encompasses the knowledge-based strategies that enable the transition from the current to a future sustainable state; 2) the practical knowledge cluster covers the implementation competencies that can bridge knowledge and action necessary for the transition towards a sustainable development; 3) the collaborative cluster is team-based and fundamental for developing collaboration with the various stakeholders in academia, decision-making agencies and civil society. Success in finding solutions for environmental problems lies in a sense of a strong bond with the people and the environment, which in the words of Brundiers et al. (2010), referring to previous researchers, needs engaging the heart along with the head and the hands. Mochizuki and Fadeeva (2010) point out that the institutions of higher education along with their stakeholders are developing an increasing interest in competence-based approaches in education, which can be the key to educational as well as societal changes towards sustainability.
Competences reveal what the students should know and do after completion of the learning process. Therefore, competences should be subject-specific and generic in nature. The subject-specific competences are the basis for the professional development. The generic competences, on the other hand, are common to all disciplines and address abilities that can be further acquired through experience and training (CDC, 2001; Public Health Agency of Canada [PHAC], 2008). Accordingly, the competences in the environmental science programme at NDU are categorised as follows:

**subject-specific competences:**
- key concepts about the environment through creative interdisciplinary approach: knowledge of basic concepts in biology, ecology, geology, hydrogeology, physics, chemistry, geographic information systems and statistics;
- the ecological systems and relationships between environmental processes and human behaviour, as well as local, regional and global perspectives of environmental problems and their solutions;
- sub-fields of environmental sciences, including environmental pollution, environmental impact assessment, sustainability, resources conservation and management, environmental health and geo-environmental hazards/risk assessment;

**analytical/research competences/skills:**
- strong analytical ability with an understanding of theoretical and applied knowledge;
- research skills (desk and field): analysis of environmental problems, assessment of environmental components, research plan;
- field analysis: field surveying, data collection, modelling of human environment systems;
- laboratory analytical know-how, compliance with international standards;
- problem-solving skills to be able to propose sustainable solutions aiming at pollution prevention, environmental protection and natural resources conservation;

**managerial competences:**
- demonstration of leadership skills and ability for collaboration in team-based projects, given the multidisciplinary nature of environmental science;
- design of environmental assessment studies based on extensive research, field observation, data collection/analysis, monitoring, find appropriate integrated solutions, execution with a good time management;
- data processing and representations and records compilation;
- assessment of the effectiveness of the implemented procedures on the ecosystem and human health;

**communication skills:**
- computer skills, good use of technology;
- appropriate reading and writing capabilities;
- ability to converse using appropriate scientific terminology;
- scientific advice to the policy and decision makers;
- data dissemination;
- public speaking: awareness campaigns, education, training to be able to involve the community in the implementation;
- good listening to the public concerns;
**ethical competences:**
development and demonstration of values such as integrity, responsibility, compassion and service;
contribution to the protection and conservation of natural systems from any aspect of environmental degradation as pollution, disintegration of ecological functions and resources depletion;
application of solutions that combine ecological, economical, social and ethical considerations, while respecting the local culture and values of the concerned communities;
motivation and services to the local community by initiating and participating in NGOs and spreading awareness on environmental issues;
respect of the others’ cultures;
self-commitment to the sustainability principles in one’s own actions;
active role in the community by being a responsible citizen: ecocitizen by excellence.

**Programme’s implementation: Teaching/research/outreach**

*Teaching: Major courses and GER courses*

The environmental science curriculum was continuously reviewed to fine-tune with the NDU requirements on the one hand and with the government educational regulations on the other hand. The teaching/learning materials were updated to reflect the latest scientific understanding of sustainability and to keep pace with the dynamism and scientific advancement of this emerging science. The focus besides content was also on the teaching methods. Information technology and well-equipped laboratories are major pillars in the teaching process.

The major courses alongside with the theoretical part include a laboratory component. Field work and trips are organised to combine theory with practice. Field visits to nature reserves, research centres and private or public agencies are planned to provide hands-on experiences on the management of different environmental industries in the country, which gives a clear understanding of the realities of sustainable management with its implementation successes or difficulties. Experts, government and private officials are invited to introduce innovative research in the field and to convey their own experiences.

Capstone courses such as, for instance, “Environmental Impact Assessment” are based on a field application. The senior projects, which are a major output of the students are research-oriented on environmental topics in the country. Numerous projects were presented and published at local and international conferences.

At an inter-faculty level, the programme was successful in offering GER courses on environment, sustainability, society, ethics and sustainable development. These courses are offered each semester for more than two hundred students from all the different faculties (Humanities, Arts and Engineering). This helped in raising awareness on sustainability among the highly heterogeneous students’ population. The objectives of the courses are for students to learn about environmental protection, develop a sense of belonging and appreciation for nature, be aware of daily practices and habits and become conscious about health protection. They are to apply the principles learned in class in everyday life. Van der Pluijm (2006) has drawn the attention to the fact that this category of courses provides the students with an early interdisciplinary knowledge that can help...
them decide on a major and plan for their future career. This was witnessed, especially by some civil engineering students that got specialised in disciplines related to sustainability issues and protection from environmental hazards as earthquakes engineering, mass wasting prevention and renewable energies, after they were introduced to these topics and their relevance to the country.

The students’ projects targeted discovering the link between their major and environmental science. They are to integrate their discipline specific skills to promote the concepts of sustainability. Therefore, the students are to invest their know-how in service of environmental issues. The interdisciplinary nature of the themes tackled strengthened the inter-faculty community relationships as public presentations and poster sessions were organised at the university level, which also enlivened the campus life, created strong cooperation among the faculty members and allowed for a wider project exposure to students’ population, faculty and staff.

Among some examples of students’ works are posters for an antismoking campaign on campus. The posters provide Arabic proverbs having suggestive meanings or lexical plays to insinuate the smoking dangers (Figure 1). The administration financed the printing of the posters, and they were posted all over the campus. Other projects included remodelling old clothes and furs to trendy designs, redesigning the classrooms to a friendlier environment, designing a website for the environmental science major.

The Faculty of Sciences offers also service courses to the other faculties among which is a course on physical geology for the civil engineering students. Presently, NDU joined the RUCAS – Tempus project, whereby sustainability concepts are to be infused within the course materials. A questionnaire elaborated by the RUCAS – Tempus project was distributed at the beginning of the course to assess the students’ knowledge, understanding and behaviour regarding sustainability, economic consumption, good citizenship in a democratic society, living together in a multicultural community and importance of ESD. The students’ sample consisted of 40 students. The results showed that a high percentage of students perceive the environmental awareness and its relationship to sustainable future as ‘low’, though they value environmental conservation. Also, a high percentage does not perceive the importance of production and consumption according to the sufficiency economy principle (Figure 2). Good citizenship, democracy, tolerance
to others are respected. The importance of ESD is regarded as essential (Figure 3). Based upon these survey results, the need to infuse sustainability concepts also into the core courses is important, and the students realise the role of education in this respect. Accordingly, the projects in the course were oriented towards sustainability issues related to geological concerns of relevance to civil engineering. This pilot study will be complemented by another survey at the end of the course for post-assessment.

Figure 2. Percentages of students perceiving the importance of sufficiency economy principle and consumption as low.

Figure 3. Percentages of students perceiving the environmental awareness and its relationship to sustainable future as low.

Research

The research conducted is mainly on water resources, environmental pollution and its impact on health and geoenvironmental hazards (Moarkech & Khalaf-Kairouz, 2007;
Khalaf-Kairouz & Shaban, 2008). A major current project is on air pollution. The research is conceived to generate data on the quality of the air in the neighbourhood of NDU campus, where a major fuel-fired power plant is located. A statistical analysis on the respiratory health of children in the area and a geographical information system study to spot the most representative sampling spots preceded the sampling phases. An interuniversity collaboration is initiated for a wider areal coverage. Research projects on pollution that is clearly perceived as having an impact on health is convincing to the local community, and it paves the way to its involvement especially in terms of support and funding. The long-term goal of the research is to establish along with other universities in the country a national air quality research unit to continuously monitor and disseminate information about the air pollution status. The resulting research findings will help the decision making in improved resources conservation, better land-use planning and health protection as they are relying on evidence-based data.

In order to address the local status of global environmental issues, the Department of Sciences at the FNAS organised a conference on climate change in Lebanon in the year of 2010. Lebanese scholars and experts in this field at various sectors were invited: water, health, forestry, media and NGOs (NDU, 2010).

Further, the FNAS hosted the 18th international science meeting of the Lebanese Association for the Advancement of Sciences (LAAS) on March 22–24, 2012. The meeting included a major track on environmental issues (NDU, 2012d).

**Outreach**

The outreach activities comprised development of public awareness. Public presentations and discussions were held for local communities and NGOs. These included reflections on quality of life, preciousness of nature, environmental conservation, ethics and sustainable development in relation to the local culture. Matsuura (2009) emphasises on the importance of traditional values and knowledge of the indigenous people as bases for achieving sustainability. Breidlid (2009), based on the African experience, states that local knowledge is important for the people’s self-esteem, it can contribute fundamentally to the education for sustainability in the developing countries in comparison to the western countries where the focus is on instructing the society to deviate from consumerism.

Schools were visited to elucidate to students the importance of an unpolluted environment and to instil in them at young age the eco-citizen culture. Schools were encouraged to create the so-called green clubs. Secondary schools were equally visited to promote the major of environmental science of NDU, brochures were distributed and clarifications about the course of studies were communicated.

Schoolchildren were invited to the campus of NDU to attend environmental exhibitions and get introduced to the facilities of NDU in order to attract them towards higher education for sustainability. Community outreach was also mediated through our students who attended the GER courses in sustainability. We can take pride that some students established environmental clubs in their districts, held lectures based on the course materials they acquired in class and communicated environmental knowledge to their clubs or scouts aided by audio-visuals borrowed from the university. They organised social events as trips to nature reserves. They aimed at raising awareness through an educated community, not only based on mere enthusiasm.
Discussion

The programme of environmental science at NDU is designed meticulously to equip the students with a solid background to become successful professionals. Therefore, our graduates can be recruited as consultants, environmental officers, academicians and researchers in the following domains:

- **public agencies**: ministries of environment, water resources and electricity, tourism, urban planning and municipalities;
- **industrial sector**: water and food industries, waste management, wastewater treatment, pollution remediation and environmental auditing;
- **engineering companies**: environmental impact assessment, remediation techniques, protection from environmental hazards, mining and energy;
- **environmental and health institutions**: human environmental health and safety;
- **wildlife protection associations**: nature reserves, forests, wildlife management, recreational parks and ecotourism;
- **educational and research institutes**: research centres and schools.

NDU offers a teaching diploma in sciences as currently the environmental science discipline is implemented in secondary school education programmes.

In fact, though the number of our graduates is still small, they are successfully pursuing careers in major Lebanese or foreign environmental agencies, in engineering firms, in the Ministry of Environment and in schools, which is reported through the alumni communications.

This ample range of working sectors makes it imperative that the graduates possess wide-ranging skills and qualities, which define their proficiency at the work place. The role of education is to enhance the development of students’ competences which assure a successful professional career. Underwood (2008) also stressed that institutions are to prepare well the students for employment and citizenship in a world defined by environmental challenges. Therefore, the competences targeted by the programme range from subject-specific and analytical competences to management and communication skills to ethical competences. The competences and objectives of the programme are equally in line with the five pillars of UNESCO for education in sustainable development and cover the essential characteristics of ESD as defined by UNESCO (2005).

The mission and objectives of the programme are compatible with the Bologna Process (the Rectors’ Conference of Finnish Universities of Applied Sciences [ARENE], 2007) requiring that education prepares for employability and citizenship. The social dimension is met by the FNAS mission of lifelong and student-centred learning, research and innovation.

Interdisciplinary integrated sustainability curriculum is proven very successful with respect to combining environmental, social, technical and economic aspects (Bacon, Mulvaney, Ball, DuPuis, Gliessman, Lipschutz, & Shakouri, 2010). Van der Pluijm (2006) described the experience of the University of Michigan in introducing the global change curriculum and a minor as very successful due to the interdisciplinary nature of the included courses, which captures students’ interests. Copeland (2009) pointed out that the environmental science programmes are proliferating in American universities; the number of students enrolled is equally growing as more and diversified career opportunities are available. Therefore, the campuses are working on their green images on and off-campus in terms of research, ecological restoration and environmental respon-
sibility to the surrounding community and solutions development to pressing environmental challenges. Scores from several categories, including course offerings, environmental practices and policies, are compiled. Some institutions take on projects outside their campus and make strategic long-term plans that render the campus virtually having a carbon-neutral footprint (Underwood, 2008). Comparatively, this makes NDU and the FNAS specifically successful in terms of curricula and courses development. Research, community outreach and campus sustainability practices, on the other hand, should be further addressed. Students’ involvement can be more active and engaging through service learning projects to the community. This fosters the students’ ethical and social responsibilities and reveals to them the relevance of technology for the service of society (Chen, Vanasupa, London, & Savage, 2006). Students’ output at NDU is revealed in the senior projects of the students majoring in environmental science. These tackled various topics on local environmental concerns. With regard to students’ opportunities, they are to the present limited to timid shares in research assistantship. The social life on campus gave the chance for a green club to be founded, which, in fact, had an intermittent output totally dependent on students’ engagement. On the other hand, the students with different backgrounds who have registered in the GER courses showed good commitment and enthusiasm to projects related to sustainability as assigned by their registered courses.

The administration support to the programme has been full at the level of the faculty deanship, especially that the dean carries on the responsibility of convincing the administration of the university to introduce the programme into the curricula. In this respect, the higher administrative body, in turn, showed full support. Kritzek, Newport, White and Townsend (2011) allocate a major importance to ‘the visionary campus leader’ in the phases of evolution of sustainability initiatives on campus. The leader with a clear understanding of the principles of sustainability will executively give priority to sustainability in the university goals and strategic plans. Hopkinson & James (2010), while illustrating the case of the University of Bradford in embedding ESD into the sciences curricula, referred to the importance of having the professionals and accreditations bodies perceiving seriously the importance of education in sustainable development.

The environmental research at NDU is being equally supported at both the financial level and with respect to upgrading the science laboratories and purchasing equipment specific for environmental research.

In the year 2010, NDU joined the international education programme: RUCAS – Tempus (Reorient University Curricula to Address Sustainability). The project emphasises development and improvement at the following institutional sectors: curriculum, research and scholarships, operations, faculty and staff development and rewards, outreach and service, students’ opportunities and administration mission and planning (University Leaders for a Sustainable Future, 2009). The dimensions discussed above represent the FNAS. The discussion did not include the achievements regarding sustainability education in the other six faculties of the university, which is beyond the scope of this paper. Therefore, the sustainability accomplishments of the FNAS, though they reflect to some extent those of the institution, do not alone represent the university as a whole. In this respect and from the perspective of the FNAS in terms of the curriculum, a major step has been achieved. As to research and scholarships, outreach and service and students’ opportunities dimensions, these can be improved by the university administration support. Major efforts should be exerted at the level of planning, faculty and staff develop-
ment and rewards. Kritzek et al. (2011) recommend this approach as it lifts the spirit of the organisation and improves its execution. Greening the campus with respect to the campus operations and practices also needs more executive procedures. These domains can become implemented solely by a decision at the university administration level.

Conclusion

The programme of environmental science at NDU offered by the FNAS prepares graduates for a successful future career, trains them to acquire skills at the personal, managerial and information technology levels with an emphasis on ethics and values. The programme provides them with a sound foundation in the natural and socio-economic sciences with an application to solving environmental problems.

It allows for concentration flexibility as the students can choose elective courses from different disciplines, enabling to build concentrations within the major or at the interdepartmental level. Hands-on experience is gained from laboratory work, research projects, field trips and practical experience is acquired from training in environmental organisations and volunteer extracurricular activities with NGOs. The environmental science graduate is able to implement best practices in environmental protection and play an active role in the community. Our graduates have been placed effectively in varied environmental agencies. GER courses served at raising environmental awareness among the non-major students’ population. Sustainability is equally addressed in the service courses.

To the present, the main focus of the programme was on education and preparation of the graduates for post-graduate studies and the job market. After that, NDU joined the RUCAS – Tempus programme; it committed itself to the embodiment of the sustainability at many levels. Key achievements have been already accomplished in curricula development and teaching. Research, outreach and student opportunities need to be further addressed. Major efforts are to be exerted at the level of campus practices, faculty and staff development and planning. At the academic level, the university has achieved a major step. This success can be sustained though by a further engaged campus-community and planning in order to render the education for sustainability sustainable.

Acknowledgement

This work has been developed within the framework of the RUCAS (Reorient University Curricula to Address Sustainability) project that has been funded from the European Commission (European Commission, TEMPUS – No. 511118-2010-GR-JPCR). The content of the paper reflects the views of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

References:


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EDUCATION IN THE NEW ERA: THE DISSEMINATION OF EDUCATION FOR SUSTAINABLE DEVELOPMENT IN THE POLITICAL SCIENCE PROGRAMMES AT NOTRE DAME UNIVERSITY – LOUAIZE

Georges Labaki
Notre Dame University – Louaize, Lebanon

Abstract

Sustainable development is continuous process of change requiring painful choices resting on political will. This paper examines the developments needed to engage with sustainable development in the field of political science through the following: the reform in political science programmes to cope with the need for sustainable development in terms of governance, advocacy and other related issues; the need to use a holistic approach in education; the re-examination of the prevailing ideologies and market-oriented economies; the introduction of education for sustainable development at the Faculty of Political Science of Notre Dame University – Louaize in terms of a global approach of education, curricula design, teaching and implementation.

Key words: political science, public policy, education for sustainability, curricula design, advocacy, holistic approach of education

Introduction

The world has been confronted with very serious social and environmental challenges over the past 50 years. These include climate change, poverty and inequality, high consumption lifestyles and a growing world population. However, governments have been extremely slow to address these issues. One of the obstacles to change has been the unwillingness or inability to integrate social and environmental concerns in the development of policies and practices. Sustainable development (SD) is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987). The term became more used in the prevailing public policies during the past ten years. The three pillars of SD are considered to be environment, economy and society. There is a solid correlation between political science and education for sustainable development (ESD). For the latter, it is a major tool for adoption of new ideologies and public policy for the promotion of sustainable development. Political science programmes can play a major role in the promotion of the concept of SD and of a new way of thinking that incorporates these pillars and provides at least a starting point for a new stage of political change.
Nowadays, education is a prime lever for social change as described by United Nations Educational, Scientific and Cultural Organisation (UNESCO) in the implementation plan for the Decade of Education for Sustainable Development (DESD). ESD enables people to foresee, face up to and solve the problems that threaten life on our planet (UNESCO, 2005). Thus, there is a need to reorient education towards sustainable development (UNESCO, 2008).

The focus of this paper will be on the dissemination of ESD at the Faculty of Political Science, Public Administration and Diplomacy (FPSPAD) at Notre Dame University – Louaize and on how politics as a discipline can contribute to ESD and vice versa. ESD requires a comprehensive approach to educational reform and the integration of the objectives, concepts and learning experiences of ESD into syllabi and teaching programmes as well as interdisciplinary inquiry and action. The infusion of ESD in political science programmes of the above-mentioned faculty involved the adoption of a number of steps, mainly: clarification of the boundaries between political science and sustainable development; review of the theoretical and ideological framework of political science; challenges of infusion of ESD in political science programmes; redefining the vision and the values of the above-mentioned faculty, review of the study courses; syllabi re-writing; new teaching methodologies and the introduction of new degrees and minors oriented towards SD.

Scope of political science and SD

The term ‘politics’ is derived from the Greek word ‘polis’ which means ‘city-state’. The modern view of political science lays a crucial emphasis on its being the study of power and authority, and the political system. Politics as a process seeks to allocate resources authoritatively and to set up public policies. The American Political Science Association (2012) defines political science as the study of governments, public policies and political processes, systems and political behaviour. The sub-fields of political science include political theory, political philosophy, political ideology, political economy, policy studies and analysis, comparative politics, international relations and a host of related fields. On the other hand, the concept of SD is rooted in a kind of systems thinking that calls on us to look at the world as a whole through time and space.

Politics and SD have had little interaction to the detriment of both. Yet, there is little evidence of this within ESD literature. This is perhaps a reflection of a certain malaise within the education community where there seems to be tangible reluctance to engage with political change. In the case of SD, we would argue that SD advocates the need to have a good knowledge of political science because this is essential for implementing change. SD supporters should be able to influence existing political ideologies, use the political process to influence the legislative branch and learn how to act as a pressure group to influence public policies. It should be mentioned that ESD is not considered as a discipline in its own right but rather as a cross-disciplinary field.
Political obstacles to the implementation of ESD

From a political perspective, it is possible to identify several obstacles to the implementation of ESD. These include: the political time frame and elections, the vertical structure of governments, the public policy process, political will and the contradiction between international agreements and national interests.

Politics and elections

The political time frame is short. Governments tend to plan and decide with the next election in mind and the prospect of being re-elected. It is difficult for governments to make decisions that would be perceived as harmful politically in the next election. Thus, such difficult decisions are often delayed or modified in order not to upset the electorate. For instance, a decision banning logging or fishing, which may be needed for reasons of SD, are not adopted or considered during elections due to unemployment risks. Also, voters are well known for their short memory and their desire to see the immediate results of political decisions.

Structures of central governments

Another obstacle is the vertical structure of governments, which is divided into departments, each performing a specific mandate. For instance, the Ministry of the Environment is in charge of protection of the environment while, at the same time, the Ministry of Natural Resources is concerned with the exploitation of natural resources, and the Ministry of Agriculture is in charge of agriculture. Often, their prerogatives are contradictory and in conflict with each other. Moreover, they compete for funding from decision makers. Each ministry pursues its specific mandate, but ministerial departments do not have a global strategy, as it should be the case in sustainable development.

Understanding public policy

Public policy is another obstacle to SD. In modern democracies, politicians face competing and sometimes contradictory interests that require a process of mediation or a search for compromise as a response to a perceived problem. The result of this political process is that the change is almost always progressive. On the other hand, SD requires major changes and even dramatic reversals, a sort of change of direction. But politicians adjust public policy to their constituent interests and not necessarily to what needs to be done. Thus, public policy is embodied in laws, regulatory measures and funding priorities that have a strong impact on any issue.

Political process

In public administrations and agencies, most change is incremental because of competing or conflicting interests. Incremental change is slow and limited in terms of goals and objectives. A typical case is the attempt to pass a legislation to protect endangered species. Governments are lead to conclude reasonable compromises among the various conflicting interest groups. This is an example of the impact of politics on SD policy initiatives.
Table 1. Comparison between political science and SD

<table>
<thead>
<tr>
<th>SD</th>
<th>Politics</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD is interested in win-win situations</td>
<td>Win-lose situation</td>
</tr>
<tr>
<td>SD is concerned with long-term policies: leaders work for future generations</td>
<td>There are no permanent friends; there are permanent interests</td>
</tr>
<tr>
<td>Importance of planning</td>
<td>Change is incremental</td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td>Independent discipline</td>
</tr>
<tr>
<td>SD is based on the principles of equity, social justice, fair distribution of resources and community participation and promotes a shift in mental models.</td>
<td>Separate local from international perspective</td>
</tr>
<tr>
<td>SD is based on local needs, but acknowledges that fulfilling local needs often has international consequences; promotes life-long learning; addresses content, taking into account global issues; environmental concerns and quality of life; uses a holistic, as opposed to linear, approach</td>
<td>Short-term goals</td>
</tr>
<tr>
<td></td>
<td>Addresses expected results for the nation</td>
</tr>
<tr>
<td></td>
<td>Economic results</td>
</tr>
<tr>
<td></td>
<td>Case by case approach and division by topics, or issues, or geographic location</td>
</tr>
</tbody>
</table>

### The infusion of ESD in political science programmes

The infusion of ESD in political science programmes requires a fundamental ideological shift and not vernacular changes. This infusion of SD in the FPSPAD programme was focused on: ideology, the understanding of the nature of political institutions, the role of pressure groups in passing legislations and public policy making. All these elements exercise a significant impact on the prospects of sustainable development.

### Ideological shift

Ideology is a keystone to ESD for ideology is a comprehensive vision and a set of structured ideas proposed to society. Currently, SD pays only a limited attention to ideology and power relations. Or change takes place within the framework of ideology. Moreover, SD requires a fundamental ideological and paradigmatic shift in development of thinking from a market economy to a SD model. Academic programme of the Faculty of Political Science, Public Administration and Diplomacy – specially the new major and the study courses such as “Regulatory Politics” and “The Social Teaching of the Catholic Church” – were reviewed in order to reflect an ideological shift towards SD against the prevailing models and theories based on market-oriented policies, competition, mass production policies, maximising consumption, expanding industrialisation, privatisation, deregulation and globalised consumerism.
The focus on understanding the nature of political institutions and the legislative process

SD is limited in its understanding of the nature of power in the political system. Change requires understanding the nature of political and government institutions at the national and international levels. The kind of dynamic inherent to SD is in many ways outside the normal framework of political discourse. SD is based on long-term goals and objectives. On the contrary, politicians do not tend to think for the long term. Their actions are often shaped by the requirements of the electoral cycle. Understanding the nature of the political system and specially the legislative process can offer a remedy for the quest of change. After all, change has to be embodied in laws at the level of national and international treaties. The understanding of the legislative process, the power relations between the three branches of government and the nature of the legal and administrative barriers to change facilitates the passing of SD legislations. After all, it is all about legislations.

Understanding the public policy process

The policy process is another challenge to SD. Both politics and SD are concerned with change at the level of policy and practice. SD promotes action plans and helps in setting up public policies and is more action orientated in addressing the key challenges of our times, such as poverty reduction in the context of climate change. Yet, SD is limited in its understanding of power relations and the nature of barriers to change. For instance, there are still many tensions evident both within policy and practice between environmental and development issues. Politicians seem unwilling to grasp the implications for our future way of life. Yet, in modern democracies, the existence of such competing and contradictory interests requires a process of mediation or a search for compromise. The result of this political process is that the change is almost always progressive and step by step. On the other hand, SD requires major changes and a change of direction. In fact, governments are resistant to change and implement a small number of policies during their term.

Understanding the role of pressure groups and social movements

Understanding the role of pressure groups and social movements in shaping the policy process is essential. Political science offers to SD knowledge into the factors that govern the ability of pressure groups and social movements to pressure decision makers. Laws are always the end result of pressure groups and lobbying. These instruments include skills in lobbying, advocacy and developing policy papers, a better communication of policy issues and a greater participation of citizens in the policy process. Public pressure is a valuable tool for influencing politicians and forcing them to act upon it. At this stage, the implementation of SD still requires a considerable amount of political will, therefore public pressure in favour of sustainable policy decisions. An example of pressure group is provided by the case of a number of non-governmental organisations (NGOs) who lobbied governments to fulfil their commitments at the international level through the United Nations Commission for Sustainable Development (CSD), which was set up to monitor the progress of Agenda 21. The support of some governments has allowed the adoption of the UN Decade of Education for Sustainable Education 2005–2014 initiative.
The FPSPAD experience in ESD infusion

FPSPAD consists of three departments: the Department of International Affairs and Diplomacy, the Department of Political Science and the Department of Public Administration. The FPSPAD offers programmes leading to the degrees of Bachelor of Arts in International Affairs and Diplomacy, Master of Arts in International Affairs and Diplomacy, Master of Arts in International Affairs and Diplomacy – International Law Emphasis, Bachelor of Arts in Political Science, Bachelor of Arts in Political Science – American Studies, Bachelor of Arts in Political Science – Euro-Mediterranean Studies, Bachelor of Arts in Political Science – NGOs Emphasis, Master of Arts in Political Science, Master of Arts in Political Science – NGOs Emphasis, Master of Arts in Political Science – Comparative Law Emphasis, Bachelor of Arts in Public Administration, Bachelor of Arts in Public Administration – Criminal Justice Emphasis and Master of Arts in Public Administration. FPSPAD offers general education requirement courses for the other university disciplines.

New vision and values

The vision of FPSPAD was completely reviewed to match ESD goals and objectives. The following new principles were added: sustainable development, community service, an approach based on human solidarity, conflict resolution vs win-lose principles prevailing in international relations. This approach required a change of mind and a different look on the role of political in society. “The Mission of the Faculty of Political Science, Public Administration, and Diplomacy is to provide quality education that helps build in our students the characteristics of high intellect, moral integrity, enlightened citizenship, human solidarity and responsible leadership in the public and private sectors. We serve our community by enhancing awareness about human rights, the common good, sustainable development, and other basic precepts of democratic governance; and by connecting it to the rest of the world through educational networks of cooperation and original applied research” (Notre Dame University, 2012, p. 418).

On the other hand, the FPSPAD values were redefined and were based on “academic excellence, integrity, individual initiative, intellectual freedom and at the same time responsible citizenship and accountable leadership, human solidarity, conflict transformation and peace building, diversity, dialogue, and cooperation, subsidiarity, and Catholic Social Theory” (Notre Dame University, 2012, p. 424). Also, a mission statement was provided for every major in light of the faculty vision statement.

Curriculum reform

A complete review of all course syllabi was conducted based on the following principles: infusion of the five pillars of ESD, interdisciplinary approach (Political Science and Human Rights joint degree), strategies for influencing the institutional process and public policy, conflict resolution courses (win-win approach and not win-lose) and a focus on timely issues. Also new majors were introduced, such as: a joint degree in Political Science and Human Rights, a minor in Gender Studies, a Law degree oriented towards Advocacy and Civil Rights. Also, a certain number of courses related to ESD, such as environmental laws and regulations, modern ideologies, diversity, citizenship and social
and economic teaching of the Catholic Church, were introduced. Moreover, ESD is being infused in every new course or major. Appendix 1 reflects an example of a syllabi review.

**Major teaching guidelines**

The new teaching guidelines are focused on the importance of systems thinking when attempting to understand global economic, political and social issues. Systems thinking promotes holistic change and looks primarily at process, relationship, pattern and context as well as at the world as a whole. Also, there was an emphasis on using a variety of pedagogical techniques that promote critical thinking and participatory learning.

Teamwork was also recommended for it engages stakeholders in sustainability issues and actions and enhances the student’s ability to manipulate symbols and to acquire and utilise knowledge. Finally, the use of new virtual technologies helps in breaking the boundaries of space and time.

**Conclusion**

The introduction of ESD in the FPSPAD curricula is a continuous process requesting a change of mind and the breaking of the academic bunker mentality and programme segmentation. The present generations have the responsibility to improve the future generations’ life in order to achieve an economy in equilibrium with the environment by challenging the notion of the supremacy of the economy over other areas of social activity. Yet, these constraints call for a strong cooperation between ESD and political science in terms of innovative course development, interdisciplinary approach, a critical examination of prevailing economic theories and a broader use of political decision-making tools in the shaping of public policy.

**Acknowledgement**

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**References:**


Appendix 1. Example of syllabi review

IAF 641: Public International Law, Notre Dame University – Louaize, Faculty of Political Science, Public Administration and Diplomacy
Spring, 2012

Instructor: Dr Georges Labaki

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course description:</strong> The course deals with the sources and development of international law, with a special emphasis given to current trends and problems. A critical evaluation of contemporary problems of world order is provided, covering legal issues, war and economic development.</td>
<td><strong>Course objectives:</strong> The course deals with the sources and development of international law, with a special emphasis given to current trends and problems. A critical evaluation of contemporary problems of world order is provided, covering legal issues, war and economic development. Topics include: the role of the state in the current international legal system, treaties, peaceful solutions of problems, the preservation of natural resources, the law of the sea, the law of war, ethics and state credibility in the international system.</td>
</tr>
<tr>
<td><strong>Course objectives:</strong> Highly interactive, this course endeavours to help students accomplish the following learning objectives:</td>
<td></td>
</tr>
<tr>
<td>to provide a solid background in public international law and to become familiar with the strengths and weaknesses of public international law as an instrument of social organisation;</td>
<td>This course aims at providing the following learning objectives:</td>
</tr>
<tr>
<td>to provide ample opportunities for relating theories to realities through numerous case studies;</td>
<td>identify the sources, principles, concepts and law-making procedures which underpin the international legal system;</td>
</tr>
<tr>
<td>develop skills in critical, logical and structured reasoning within the context of public international law;</td>
<td>identify the techniques and procedures to further improve compliance with international environmental obligations at the national level;</td>
</tr>
<tr>
<td>understand the interplay between legal rules and politics.</td>
<td>understand the international environmental law negotiation process;</td>
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<td>examine and interpret the content of environmental laws treaties;</td>
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<td>differentiate the role of main factors involved in the development of international environmental law;</td>
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<td>understand the major legal challenges faced by the international community today;</td>
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<td>study the latest theories in public international law;</td>
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<td>analyse the distinctive norms/rules which regulate the international legal system and differentiate it from domestic law;</td>
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</tbody>
</table>

*Sequel to Appendix 1 see on p. 143.*
examine and evaluate the practical application of international law and its response to contemporary international issues.

Upon successful completion of this course, students will be able to:

**Learning outcome 1**
Demonstrate a good knowledge of the nature of the basic institutional structure of international society and of the nature of statehood

**Learning outcome 2**
Explain how international law is made and the relationship between international law and municipal law

**Learning outcome 3**
Demonstrate an awareness of the political, social, economic and other factors that affect international law-making processes

**Learning outcome 4**
Be able to explain what procedures are available for seeking to ensure that states comply with international law

**Learning outcome 5**
Demonstrate the ability to explain how the rules of public international law would apply to a particular case and to critically examine questions about a substantive area of international law

**Learning outcome 6**
Be able to analyse and critically evaluate the principles, sources and vocabulary of international law, and to use the special terminology of international law

**Learning outcome 7**
Demonstrate, when discussing and writing about any particular rule of international law, an ability to say whether the rule in question derives from a treaty or custom

**Learning outcome 8**
Be able to appraise and discuss the major influencing factors which have determined the scope and nature of international law as a legal system

**Learning outcome 9**
Evaluate the practical international legal implications on current events
Teaching methodologies

- Focus on systems thinking
- Use of a holistic, as opposed to linear, approach
- Enhancement of the student’s ability to manipulate symbols
- Enhancement of the student’s ability to acquire and utilise knowledge
- Encouraging students to work in teams
- Formal, non-formal and informal education
- Use of virtual teams around the world
- Use of new technologies breaking the boundaries of space and time

Reviewed topics in weeks

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<th>Introduction</th>
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<td>Development of law among nations</td>
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<td>Relationship between international law and municipal law</td>
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<td>The community of nations</td>
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<td>State credibility</td>
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<td>Recognition of states and governments</td>
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<td>4</td>
<td>State succession</td>
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<td>Rights of international legal persons</td>
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<td>Duties of states</td>
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<td>Respect of environmental treaties</td>
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<td>Obligations to abide by treaties fighting air, marine pollution, nuclear</td>
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<td>testing and hazardous waste</td>
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<td>6</td>
<td>Jurisdiction over persons under state law, extradition</td>
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<td>International criminal law</td>
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<td>Case studies: The International Criminal Court: The Special Court for Lebanon</td>
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<td>Title to territory</td>
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<td>Peaceful settlement of disputes</td>
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<td>Modern war, commencement effects, termination</td>
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<td>Laws of war</td>
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<td>War crimes</td>
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<td>Conclusion</td>
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<td><em>Final exam</em></td>
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