Evaluating Change in Students’ Environmental Values: The Impact of Environmental Learning in Undergraduate Design Courses

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ABSTRACT
Design increasingly matters in the context of climate change. Environmental problem solving across design disciplines is vital to ensure that certain problems of climate change are addressed and that more sustainable ways of living and working are created. However, sustainability is notoriously hard to define and has faced considerable challenges in its inclusion as part of design education, with further problems presented in evaluating any impacts on the environmental attitudes and behaviours of design students. In this practice paper, the "Design and the Environment" course delivered at the University of Newcastle is examined. The course is trans-disciplinary, delivering environmental content to mixed cohorts of design students. Using problem-based learning techniques, the course requires students to evaluate the consequences of their designs by performing a life cycle analysis/audit of their solution. In this research, experiences of the course are examined using a well-evidenced evaluation mechanism – the New Ecological Paradigm (NEP) – in order to observe the effects of this particular subject on the environmental values of a single cohort of students. This practice paper presents the results of this limited intervention, yet provides further issues for discussion and another starting point for future research on the inclusion of environmental awareness and sustainability in design education.

KEYWORDS
Design students, environmental education, New Ecological Paradigm (NEP), attitudinal change.

INTRODUCTION
It is widely noted that environmental concerns have dramatically increased among the public over the last few decades (Dunlap and Scarce, 1991; Thapa, 2001). Increasing awareness of both immediate environmental crises and long-term climatic change has led to changing environmental values and attitudes including the recognition of ecological limits and finite resources. Most agree that education plays a vital role in supporting such
attitudinal changes (Etzioni, 1993; Ikenberry, 1997). Indeed, evidence exists that exposure to just one environmental education course can alter students’ environmental attitudes (Benton, 1993; McMillan, 2004; Rowe, 2002) and potentially, their behaviours (Benton, 1993; Rickinson, 2001).

With this in mind, design education comes to the fore as a key area in which to support environmental awareness—with designers playing a crucial role in creating sustainable elements and products of our lived environment. Although design education has increasingly incorporated environmental principles over the last 15 years, there remains a need for courses that combine theoretical and practical advice on environmental design. Moreover, there needs to be continued evaluation of the impacts of environmental education on design students’ attitudes and values, and how this might affect the behaviours of future design professionals (Brezet and van Hemel, 1997; Stevels, 2001a). This is particularly important as sustainable design continues to expand as a profitable activity, with clients increasingly insisting upon environmental design and accountability in their suppliers.

Educating and training the next generation of designers, and their educators, is central to meeting this increasing demand for environmental design. Ultimately, the limits of sustainable urban development are defined by the level of creativity displayed by designers and their educators (Stevels, 2001b). A sustainable future is therefore dependent on a new approach to design education in which environmental thinking is second nature.

At the University of Newcastle, Australia the development of a course entitled "Design and the Environment" has been a response to the increasing demand for environmentally-aware design education. The course is a core component in the Bachelor of Technical Education degree program, and is being increasingly selected as an elective course by both full-time, on-campus students and part-time distance learners, and by students from other disciplines. The course embraces a multidisciplinary approach to sustainability, whereby students from different disciplines can come together to develop a shared understanding of the links between design decisions and their environmental consequences throughout the life of the asset. This flexible and multidisciplinary approach is generally considered to support the most effective sustainable design, and sustainability tools and metrics across diverse design disciplines (Hadorn et al., 2006; Levett-Therivel, 2004; Stauffacher et al., 2006). This approach also represents a paradigm shift; breaking down the traditional demarcation fostered by the ‘professionalism of design’ framework (Walker, 2006).

This practice paper observes the experiences of a single cohort of design students undertaking the course. Using the widely adopted evaluation metric, the New Ecological
Paradigm (NEP), the change pre- and post-course on these students’ environmental values and attitudes was measured across one semester. Additional questions were included post-course to assess the students’ perceived ability to combine ecological awareness into their design practices. From these results, a brief insight into how environmental awareness might be increased as part of design education is provided—offering scope for further, more in-depth assessment of the role of education in building and supporting environmental values as part of design study and practice.

COURSE EVALUATION: THE NEP AND ATTITUDINAL CHANGE

The “Design and the Environment” course has been informed by several key principles. First, the course design is underpinned by the role of the designer as central to shaping not only the appeal of an artefact but also the long-term costs and consequences of owning and operating it—for the owner, user and the wider community. Second, the course is designed so that members of a specific discipline identify appropriate boundaries to design problems associated with their discipline. This should include the nature of the environmental impacts, their assessment, and the generation of design alternatives that will minimise them. Third, it is accepted that the norms relating to design evaluation for one discipline (e.g. architecture) can reasonably be expected to differ somewhat from those of another discipline (e.g. textiles) in terms of techniques, availability of tools, and predicted rigour.

Student learning then is driven by a flexible approach that can be tailored to the needs of specific disciplines. This approach is supported in the assessment process, devised by way of a negotiated learning contract, which allows the individual student to design their own learning program within the confines of the course objectives. It is refined during the first ten weeks of study and when finalised, is used as the template against which the student’s assessment items are graded. Therefore, the assessments are tailored to suit specific groups’ needs, and to avoid the frustration around inappropriate and universal assessment items that are not relevant to students’ intended professions.

From previous course evaluations, it was found that students appreciate this flexible approach and the improved learning that it facilitates (Brewer et al., 2008). Moreover, students indicated that they value the exposure to life-cycle analysis techniques throughout the course, and their increased awareness of their role as designers of artifacts that have an environmental impact (Brewer et al., 2008).

Overall, the course has been designed to produce environmental generalists who develop a broadly shared understanding of what it means to be an environmentally aware designer. In the following section, the experiences of a single student cohort undertaking the course are discussed. As stated, the New Ecological Paradigm (NEP) is adopted pre-
and post-course to provide an indication of any changes in students’ attitudes and values around key environmental issues, together with additional questions specifically addressing the applicability of environmental values to design practice.

*The New Ecological Paradigm (NEP) approach*

The New Ecological Paradigm (NEP) was first developed in the mid-seventies as a tool to assess the ecological consciousness of the public (Dunlap and Van Liere, 1978). Whilst updated and revised in 2000 (Dunlap et al., 2000), the NEP has been regularly and widely used across diverse studies, demonstrating that the tool is a relatively reliable and valid measure of ecological attitudes and values (Ewert and Baker, 2001). Currently, the NEP contains a set of 15 items designed to ascertain respondents’ stance in relation to five hypothesised facets of an ecological worldview: the reality of limits to growth, anti-anthropocentrism, the fragility of nature’s balance, rejection of exceptionalism, and the possibility of an eco-crisis (Dunlap et al., 2000). The measurement tool uses a five-point Likert format, ranging from strongly agree (1), to strongly disagree (5).

Across the 15 items, there are eight odd-numbered statements that assert an attitude of environmental concern, such as, “We are approaching the limit of the number of people the earth can support”. There are seven even-numbered questions that suggest an opposite environmental attitude, such as, “Humans have the right to modify the natural environment to suit their needs”. Essentially, agreement with the eight odd-numbered items and disagreement with the seven even-numbered items indicates a pro-ecological view. This structure allows the aggregation of an individual’s responses into a single score by adding the Likert scale scores on the seven “not concerned” questions and subtracting the scores on the eight “concerned questions” (Anderson et al., 2007).  

Ultimately the NEP measures a set of beliefs that may be reflected in a range of other environmentally-aware attitudes and behaviours. Whilst supporting caution against a deterministic link between the NEP and behaviour it is likely that:

*...a pro-ecological orientation or “seeing the world ecologically,” reflected by a high score on the NEP Scale, should lead to pro-environmental beliefs and attitudes on a wide range of issues* (Dunlap et al., 2000: 428).

Therefore, the NEP is considered to be a relevant and effective tool for measuring ‘worldview’ environmental attitudes, and perhaps behavioural change over time (Shephard et al., 2009).

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1 The aggregation of individuals’ NEP results was not undertaken in this evaluation due to obvious ethical concerns around maintaining the anonymity of student respondents.
NEP RESULTS FOR “DESIGN AND THE ENVIRONMENT”

The NEP is used as part of a brief and initial observation of student experiences as part of the “Design and the Environment” course at the University of Newcastle. A single cohort of students was asked to complete the NEP questionnaire at the initiation and completion of the course. A total of 25 respondents participated in the pre-course assessment and 24 of these completed the post-course assessment (this represented 83% of the total students enrolled in the course). Additional questions were included in the post-course assessment to gauge the potential influence of the environmental course on students’ perceptions of their own future design practice.

The students’ responses were grouped into proportions who strongly agreed, agreed, neither agreed/disagreed, disagreed and strongly disagreed for each of the 15 NEP statements (see Table 1). As stated previously, responses that are pro-NEP should agree with the odd-numbered statements and disagree with the even-numbered statements. Table 2 presents a summarised version of these results across the 15 NEP statements and their associated categories (based on the environmental values they represent e.g. anti-anthropocentric, limits, eco-crisis). The table shows those statements which elicited a ‘pro-NEP’, ‘undecided’, or ‘anti-NEP’ response post-course, and also indicates any change in environmental awareness from pre-course results. The results reveal generally pro-NEP responses across the 15 statements, with 3 statements eliciting an increase in environmental awareness from pre- to post-course, 1 statement declining and the remainder generating broadly equivalent results across the duration of the course (including one statement that maintained an anti-NEP response both pre- and post-course).

Two of the statements that elicited increases in environmental awareness from pre- to post-course assessment concerned ecological limits—“we are approaching the limit of the number of people the earth can support”, and “the earth is like a spaceship with very limited room and resources”. Moreover, there was also some indications of positive change in perceptions of eco-crisis, represented in more strongly held disagreement with the statement “the so-called ecological crisis facing humankind has been greatly exaggerated”.
Table 1 – NEP results: proportion of students who agree/disagree with environmental statements²

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree Pre</th>
<th>Post</th>
<th>Agree Pre</th>
<th>Post</th>
<th>Agree Total Pre</th>
<th>Post</th>
<th>Neither Pre</th>
<th>Post</th>
<th>Disagree Pre</th>
<th>Post</th>
<th>Strongly Disagree Pre</th>
<th>Post</th>
<th>Disagree Total Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>We are approaching the limit of the number of people the earth can support</td>
<td>16</td>
<td>29</td>
<td>32</td>
<td>33</td>
<td>48</td>
<td>62</td>
<td>32</td>
<td>24</td>
<td>20</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Humans have the right to modify the natural environment to suit their needs</td>
<td>4</td>
<td>5</td>
<td>24</td>
<td>29</td>
<td>28</td>
<td>34</td>
<td>32</td>
<td>48</td>
<td>28</td>
<td>14</td>
<td>12</td>
<td>5</td>
<td>40</td>
<td>19</td>
</tr>
<tr>
<td>When humans interfere with nature it often produces disastrous consequences.</td>
<td>24</td>
<td>14</td>
<td>40</td>
<td>48</td>
<td>64</td>
<td>62</td>
<td>32</td>
<td>24</td>
<td>4</td>
<td>10</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Human ingenuity will insure that we do NOT make the earth unliveable.</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>19</td>
<td>16</td>
<td>19</td>
<td>52</td>
<td>52</td>
<td>32</td>
<td>24</td>
<td>5</td>
<td>0</td>
<td>32</td>
<td>29</td>
</tr>
<tr>
<td>Humans are severely abusing the environment</td>
<td>40</td>
<td>38</td>
<td>56</td>
<td>48</td>
<td>96</td>
<td>86</td>
<td>4</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The earth has plenty of natural resources if we just learn how to develop them.</td>
<td>32</td>
<td>29</td>
<td>40</td>
<td>43</td>
<td>72</td>
<td>72</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Plants and animals have as much right as humans to exist</td>
<td>52</td>
<td>43</td>
<td>32</td>
<td>43</td>
<td>84</td>
<td>86</td>
<td>12</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>The balance of nature is strong enough to cope with the impacts of modern industrial nations</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>16</td>
<td>5</td>
<td>60</td>
<td>57</td>
<td>24</td>
<td>29</td>
<td>84</td>
<td>86</td>
</tr>
<tr>
<td>Despite our special abilities humans are still subject to the laws of nature.</td>
<td>56</td>
<td>38</td>
<td>32</td>
<td>52</td>
<td>88</td>
<td>90</td>
<td>12</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The so-called “ecological crisis” facing humankind has been greatly exaggerated</td>
<td>16</td>
<td>0</td>
<td>36</td>
<td>14</td>
<td>52</td>
<td>14</td>
<td>28</td>
<td>38</td>
<td>20</td>
<td>38</td>
<td>0</td>
<td>10</td>
<td>20</td>
<td>48</td>
</tr>
<tr>
<td>The earth is like a spaceship with very limited room and resources</td>
<td>20</td>
<td>24</td>
<td>32</td>
<td>38</td>
<td>52</td>
<td>62</td>
<td>24</td>
<td>5</td>
<td>16</td>
<td>29</td>
<td>8</td>
<td>5</td>
<td>24</td>
<td>34</td>
</tr>
<tr>
<td>Humans were meant to rule over the rest of nature</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>4</td>
<td>10</td>
<td>24</td>
<td>29</td>
<td>48</td>
<td>33</td>
<td>24</td>
<td>29</td>
<td>72</td>
<td>62</td>
</tr>
<tr>
<td>The balance of nature is very delicate and easily upset</td>
<td>28</td>
<td>14</td>
<td>48</td>
<td>62</td>
<td>76</td>
<td>76</td>
<td>20</td>
<td>24</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Humans will eventually learn enough about how nature works to be able to control it.</td>
<td>4</td>
<td>0</td>
<td>24</td>
<td>24</td>
<td>28</td>
<td>24</td>
<td>16</td>
<td>10</td>
<td>28</td>
<td>48</td>
<td>28</td>
<td>19</td>
<td>56</td>
<td>67</td>
</tr>
<tr>
<td>If things continue on their present course, we will soon experience a major ecological catastrophe.</td>
<td>28</td>
<td>29</td>
<td>40</td>
<td>38</td>
<td>68</td>
<td>67</td>
<td>28</td>
<td>33</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

² This table also highlights the totals for those who agree (strongly agree and agree) and disagree (strongly disagree and disagree) so as to highlight those questions that are generally pro-NEP. Responses that are pro-NEP should agree with the odd-numbered statements and disagree with the even-numbered statements.
Table 2 – Environmental awareness post-course

<table>
<thead>
<tr>
<th>Student Ecological Awareness</th>
<th>Classification</th>
<th>Pro-NEP</th>
<th>Undecided</th>
<th>Anti-NEP</th>
<th>Change in awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>We are approaching the limit of the number of people the earth can support</td>
<td>Limits</td>
<td></td>
<td></td>
<td></td>
<td>Increased</td>
</tr>
<tr>
<td>Humans have the right to modify the natural environment to suit their needs</td>
<td>Anti-Anthropocentric</td>
<td></td>
<td></td>
<td></td>
<td>Decreased</td>
</tr>
<tr>
<td>When humans interfere with nature it often produces disastrous consequences.</td>
<td>Balance</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>Human ingenuity will insure that we do NOT make the earth unliveable.</td>
<td>Anti-Exemptionalism</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>Humans are severely abusing the environment</td>
<td>Eco-Crisis</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>The earth has plenty of natural resources if we just learn how to develop them.</td>
<td>Balance</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>Plants and animals have as much right as humans to exist</td>
<td>Anti-Anthropocentric</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>The balance of nature is strong enough to cope with the impacts of modern industrial nations</td>
<td>Balance</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>Despite our special abilities humans are still subject to the laws of nature.</td>
<td>Anti-Exemptionalism</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>The so-called “ecological crisis” facing humankind has been greatly exaggerated</td>
<td>Eco-Crisis</td>
<td></td>
<td></td>
<td></td>
<td>Increased</td>
</tr>
<tr>
<td>The earth is like a spaceship with very limited room and resources</td>
<td>Limits</td>
<td></td>
<td></td>
<td></td>
<td>Increased</td>
</tr>
<tr>
<td>Humans were meant to rule over the rest of nature</td>
<td>Anti-Anthropocentric</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>The balance of nature is very delicate and easily upset.</td>
<td>Balance</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>Humans will eventually learn enough about how nature works to be able to control it.</td>
<td>Anti-Exemptionalism</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
<tr>
<td>If things continue on their present course, we will soon experience a major ecological catastrophe.</td>
<td>Eco-Crisis</td>
<td></td>
<td></td>
<td></td>
<td>Equivalent</td>
</tr>
</tbody>
</table>
Interestingly, the categories that declined or displayed anti-NEP sentiments concerned issues of development, including the use of resources and the modification of the natural environment—evident in agreement with the statement “the earth has plenty of natural resources if we just learn how to develop them” and an increase in agreement with “humans have the right to modify the natural environment to suit their needs”. Both of these statements imply the ability to manipulate the environment, which may reflect the design and construction focus of the course and the discipline in which the students are based—disciplines that obviously centre on the design and composition of the built environment. This is clearly an area of design education that will need to be addressed in order to more effectively build in environmental awareness around the use of the natural environment and its resources.

Most of the other 15 statements evoked pro-NEP responses equally across pre- and post-course assessment. This may be a result of more generally accessible environmental education, a finding supported by proponents of NEP itself, who acknowledge the growing environmental awareness of the general public (Dunlap and Scarce, 1991; Thapa, 2001). Moreover, similar studies of environmental education courses have found that students do not necessarily become more “green” or “brown” as a result of environmental education, but rather develop less ambiguous and more articulate notions of environmental awareness that are much more difficult to measure as part of an overarching NEP framework (Anderson et al., 2007).

In this light, it is useful to examine the additional questions included in the post-course intervention which questioned the applicability of the environmental values and attitudes learnt in the course to practical aspects of their design work. Table 3 reveals that the vast majority of this class of students feel that they could undertake a sustainable house or product design (74% and 90% respectively), and could also justify any additional costs of such sustainable design to clients if required (81%).

Nearly all (90%) of the cohort also felt that they could effectively incorporate the principles learned in the course into their professional design practice. Moreover, the students expressed widespread support (85%) for the Life Cycle Analysis approach, which requires them to think about the outcomes and consequences of their design across a variety of domains, including the environment. The results from these additional questions post-course indicate suggest positive student perceptions of their ability to apply their environmental learning to their professional design practice.
Table 3 – NEP results: additional questions

<table>
<thead>
<tr>
<th>NEP Survey Results (Extra Questions): IDEA2461 Design and the Environment</th>
<th>Strongly Agree %</th>
<th>Agree %</th>
<th>Neither Agree or Disagree %</th>
<th>Disagree %</th>
<th>Strongly Disagree %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel I could undertake a sustainable residential house design, if the situation arose</td>
<td>19</td>
<td>57</td>
<td>14</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>I feel I could undertake a product design project utilising sustainable principles, if the situation arose</td>
<td>19</td>
<td>71</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>I believe that green pressure groups cannot influence environmental issues in product design</td>
<td>0</td>
<td>24</td>
<td>33</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>I believe that government legislation is not necessary in order to make society more environmentally sustainable</td>
<td>10</td>
<td>14</td>
<td>24</td>
<td>24</td>
<td>29</td>
</tr>
<tr>
<td>If called upon, I feel I have the knowledge to justify the additional cost of sustainable design features to other people</td>
<td>10</td>
<td>71</td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I feel that knowledge of Life Cycle Analysis should NOT be a required part of my degree</td>
<td>5</td>
<td>0</td>
<td>10</td>
<td>52</td>
<td>33</td>
</tr>
<tr>
<td>I will incorporate the principles I have learned in this course into my professional practice</td>
<td>29</td>
<td>62</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

CONCLUSIONS AND FUTURE RESEARCH QUESTIONS

The analysis presented as part of this research is limited—observing only one design student cohort across a single semester through the self-perceptions of students. Yet it is suggested that these findings offer a useful (if brief) insight into the environmental values and awareness of students enrolled in a design course that incorporates environmental education. The students demonstrated a high level of existing awareness of environmental issues—one that increased post-course across some key areas of the NEP scale. This supports notions of a general expansion in public awareness of, and education in, environmental issues, together with evidence that this course also develops and defines these environmental values through ongoing attention to advancing environmental knowledge. In addition, these findings also identify areas which need to be further addressed in environmentally-oriented design courses; namely, issues of development and resource use. Design and construction courses are predicated on advancing skills in the manipulation/use of the natural and built environment. Further education may be needed for students to develop the knowledge on how to effectively apply these skills in environmentally sensitive and complementary ways.
The findings generated are intended as an initial foray into further, more in-depth investigations on the advantages and limitations of design courses as vehicles for environmental education. It is suggested that assessments such as NEP provide a useful evaluation tool and could be effectively incorporated as a part of regular design course assessments, as a way of measuring change in environmental awareness. Longitudinal investigations may be particularly useful for monitoring student change over the entire duration of a design program. Together, more in-depth and ongoing assessments such as these would provide valuable indicators of the potential of students to produce environmentally-aware designs as part of their future work as design professionals—further reinforcing the benefits of incorporating environmental education as a core element of design programs.

REFERENCES


