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Student teachers' conceptions of sustainable development: the starting-points of geographers and scientists

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Postgraduate student teachers' conceptions of sustainable development were elicited using a questionnaire completed by the entire cohort of geography ($N = 21$) and science ($N = 40$) students starting the University of Oxford Post Graduate Certificate in Education (PGCE) secondary course. Responses were analysed in three ways: (i) development of categories to capture features of sustainable development; (ii) scrutiny of individual responses for the presence or absence of key features (specifically environmental, economic and social factors); and (iii) in contrast to these grounded approaches, examination of the responses in light of a pre-specified framework. Notable findings were: (i) the large numbers recognizing the centrality of environmental (87%), economic (69%) and social (49%) factors—about a third highlighted all three factors (the geographers significantly more so than the scientists), while a further third mentioned two of them; (ii) when compared with the pre-specified framework, the aspects of sustainable development largely missing were to do with preservation of diversity, and with uncertainty and precaution in action; (iii) only one response contained an aesthetic element; and (iv) when comparing education for sustainable development with environmental education, the most frequent view identified the former as broader. The findings are related to contemporary literature in the field and some implications for PGCE learning are considered.

Keywords: *Sustainable development; Teachers; Understanding; Environmental education*

Introduction

Education for sustainable development (ESD) is a new part of the curriculum landscape for schools in England and Wales following the introduction of a revised version of the National Curriculum in September 2000 (DfEE/QCA, 1999). In the new curriculum ESD appears principally in three subjects, namely science, geography and citizenship. Furthermore, ESD is prominent in sections of the published curriculum setting out overall aims and values.

In science, ESD appears explicitly at key stages 3 and 4, although only under the small subsection 'Living things in their environment' (which, we note, rather

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underplays the huge breadth of science underpinning sustainable development!). In geography, 'Environmental change and sustainable development' is one of four major strands of the curriculum at key stage 3 (there are no statutory requirements for geography at key stage 4). The particular significance for citizenship is that ESD is identified as one of several areas which link 'knowledge and understanding' with 'skills of enquiry and communication' and 'participation and responsible action' (QCA, 2000, p. 20).

So ESD has arrived, but do teachers possess the knowledge and understanding to teach effectively in this new domain? Our concern in the present paper is to explore this issue in the context of *initial* teacher education, which seems particularly pertinent given the recent emphasis on the importance of subject-matter knowledge in teacher training (TTA, 2002). An important medium-term goal of our research is to use the findings to develop appropriate course inputs for the Post Graduate Certificate in Education (PGCE) course in science and geography. To do this in an informed way we, as course designers, needed to know the existing understanding and perceptions of sustainable development that new trainees bring with them to the PGCE course. Hence we conducted a small-scale study with the 2002/03 cohort, focusing mainly on personal understanding of sustainable development, perceived differences between ESD and environmental education, and the teaching of controversial subject-matter (an important issue for ESD). Available space precludes covering all of these areas in a single paper, so in the present contribution we set aside issues to do with teaching and concentrate on the first two areas. The research questions we seek to answer are therefore:

1. what is the existing knowledge and understanding of sustainable development possessed by PGCE geography and science students when they commence the PGCE course?
2. what are their perceptions of ESD in relation to environmental education?

A search of the literature revealed no existing studies in this area with trainee teachers. Hence the research can be regarded as a contribution to knowledge, as well as serving the purpose of our own course development goals.

Theoretical background

The literature on conceptions of sustainable development and ESD, and the relationship between the latter and environmental education, formed an important backcloth for the project and is therefore examined below. In addition, we consider recent developments leading to the inclusion of ESD in the National Curriculum for England and Wales and, in particular, a report from the government-established Panel for Education for Sustainable Development (PESD), which was influential in this curriculum innovation and played a key role in our research.

Conceptions of sustainable development

The term sustainable development has acquired wide international currency since it was initially stated in the document *World Conservation Strategy* (IUCN, 1980) and reinforced by the report of the World Commission on Environment and Development (WCED, 1987).

One of the first and still most widely used definitions is that proposed by WCED: *Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1987). However, although the term sustainable development is used widely by, among others, educators, economists and politicians, it is often interpreted differently by different interest groups (Scott & Gough, 2003).

The crux of the debate appears to be between those who view economic priorities and outcomes as dominant compared with those who adopt a broader interpretation. Rauch (2002), for example, points out how the sustainability debate has been criticized for 'its strong orientation towards an economic market philosophy and economic growth'. Elliot (1998) suggests that the dominant view equates development with economic growth and contrasts this with the ecologist's emphasis on 'production levels which can be borne by the ecosystem'. Bonnett (1999, 2002) rejects material and instrumental viewpoints in favour of an emphasis on 'human flourishing' and a 'right relationship with nature'. Sauvé (1996) draws attention to a typology of conceptions of sustainable development, contrasting free market and technological emphases with conceptions espousing alternative development based on changing social values to create sustainable communities ('living within our means') and the valuing of indigenous development (embodying notions of a collective subsistence economy rooted in cultural identity).

But while differing interpretations continue to be debated, we identify in the literature a growing consensus that sustainable development must be conceptualized at the very least in terms of three dimensions: environmental, economic and social. Indeed, Gough (2002) argues that 'we cannot hope to separate our understanding of the environment from our social and economic interactions with it', while Luke (2001) sees a need to 'abolish the artificial distinction between environment and economy/society/community'. This emphasis on the bringing together of environmental, economic and social factors has been influential in our own thinking and has informed one of the ways in which we analysed the data collected in our study.

Changing trends in defining sustainable development

As the previous section indicates, the concept of sustainable development is complex and contested. Following the emergence and increasing use of the term, many attempts were made at a definition which might be acceptable to the range of interest groups present in the environmental, economic and social (including educational and political) spheres.

More recently, however, discussions about sustainable development, and by extension education for sustainable development, have moved from a search for a universal

consensus to a position where there is acceptance of, and indeed encouragement for, varying definitions and approaches (e.g. Scott & Oulton, 1999). According to Sauvé (1996), such a more open approach can be regarded as 'a fuel for critical reflection, discussion, contestation and evolution', and as she subsequently notes (Sauvé 2002), 'identifying different paths to the goal seems to work well in promoting the idea of sustainable development'. The value of such plurality is clearly reiterated by Scott and Gough (2003) in their oral evidence to the House of Commons Audit Committee's recent enquiry into ESD, where they stated that learning by anyone in any walk of life has 'a role to play in engaging people with perspectives other than their own . . . and continuing learning is a core aspect of sustainable development, which is a process—not an end state'.

In the present study, these views were influential in the sense that we were certainly not looking for 'right answers' when asking student teachers to explain the meaning of sustainable development. But we were, of course, interested in comparing the views of these graduates with the evolving debate in the literature and whether the controversial nature of sustainable development was recognized.

Environmental education and ESD

Given the 'inherent dilemmas, uncertainties and confusions' concerning sustainable development (Rauch, 2000), it is hardly surprising that the notion of *education* for sustainable development is similarly open to debate. We can compare this state of affairs with the term *environmental education*, which has itself been continually open to various interpretations since its appearance at the time of establishment of the Council for Environmental Education (CEE) in 1968.

Attempting to clarify the relationship between these two concepts which themselves are variously interpreted is far from easy. Some authors (e.g. Sauvé, 2002) appear to view ESD as representing a current emphasis within environmental education. This view is also apparent in the writing of those (e.g. Fien, 1993; Huckle, 1993) who see an emphasis on issues of sustainability evolving through the conception of education *for* the environment—i.e. prioritizing understanding of the social, political and economic influences on the environment and promotion of student concern, responsibility and appropriate action. This idea of the continuity of environmental education and the evolution of ESD within it also seems to be present in Palmer's (1998) statement that 'perhaps the twenty-first century will herald a revised language of the relationship between people and the environment, and hence a new terminology for teaching and learning about it'. It may also be reflected in the PESD Report (see below), which states that ESD is often 'a matter of extending rather than replacing current thinking and practice'.

In contrast, some authors view ESD as qualitatively different from environmental education. This may well be associated with those who interpret environmental education as primarily concerned with the *physical* environment and with issues such as human impact, preservation and conservation. Such a qualitative difference may also be recognized in the writing of those who view ESD as sustainable education (e.g. Sterling, 2001), in which the focus extends to changing the educational

paradigm by redesigning the education system, and institutions 'doing better things' and 'seeing things differently'.

The point to be made here, perhaps, is that although the terminology may look new, any proposed distinction between ESD and environmental education is far from clear-cut. In exploring student teachers' views in this study, we were again not seeking 'right answers'. Rather, our purpose was to elicit these views for use as potential starting-points for future PGCE work in the area.

ESD in the National Curriculum for England and Wales

As noted in the Introduction to this article, the term sustainable development was included in the revised statutory National Curriculum introduced in England in 2000. Promotion of ESD is included in eight subjects in the section on Learning across the Curriculum, although it appears most prominently in geography, science and citizenship.

Predating this innovation, and following wide consultations and discussions, the PESD defined ESD as follows:

> Education for sustainable development enables people to develop the knowledge, values and skills to participate in decisions about the way we do things individually and collectively, both locally and globally, that will improve the quality of life now without damaging the planet for the future. (CEE, 1998)

Accompanying this definition, the Panel identified seven key concepts, or seven dimensions, which together form a framework for understanding sustainable development. These are: interdependence; citizenship and stewardship; needs and rights of future generations; diversity (cultural, social, economic, biological); quality of life, equity and justice; sustainable change (development and carrying capacity); and uncertainty and precaution in action.

This framework, although not appearing explicitly in the National Curriculum, was made widely available through a CEE publication (1998) and, subsequently, one by QCA (2002). Through our own earlier research we have been able to establish the considerable utility of the framework for both helping teachers expand their understanding of sustainable development and plan teaching in the domain (e.g. Summers *et al.*, 2003; Summers & Kruger, 2003).

Given the pedigree of the framework and the evidence for its value, it seemed important in the present study to compare this conceptualization of sustainable development with the conceptions of the student teachers in our study. Hence we later use the framework as one way of analysing these students' explanations of sustainable development, and hence exploring any gap between what is advocated by PESD and the views of our respondents.

Methodology

Sample and instrument

A questionnaire on sustainable development was given to all science ($N = 40$) and geography students ($N = 21$) following the Oxford University PGCE course at the

start of the 2002/03 academic year—i.e. the very beginning of the one-year teacher training programme. The questionnaire (see Appendix) consisted of (i) items designed to collect purely factual information, (ii) one five-point scale self-rating item and (iii) several free response boxes with space for students to write no more than a short paragraph. Since the questionnaire was administered during mandatory science and geography teaching sessions conducted by the research team, the return rate was 100%. Completion took place in silence and required typically 20 to 25 minutes.

The content of the questionnaire was derived from our knowledge of the relevant literature. So, for example, conceptualizations of sustainable development, the relationship between ESD and environmental education, and the stance teachers take when handling controversial topics were all known to be key issues in the field (see literature review, above). All of these areas were covered in the full questionnaire, although, as noted earlier, we confine ourselves in the present paper to the first two. The material on teaching will be reported at a later date.

Analysis

The meaning of sustainable development. The written responses to 'try to explain what is meant by sustainable development' were analysed in three ways: (i) development of categories to capture the features of sustainable development appearing in the responses of the sample as a whole, and counting their frequency of occurrence; (ii) scrutiny of individual responses for the presence or absence of certain key features (specifically environmental, economic and social factors); and (iii) in contrast to these grounded approaches, examination of the responses in light of a pre-specified framework—i.e. that set out in the CEE Report, described earlier.

(i) Categories capturing the features of sustainable development. Each response was read and the elements within it were added to a summary sheet to build up a list of all the elements in all the responses. Categories for coding the elements were then generated from this list. It was found that the 21 categories shown in Figure 1 could be used to code all of the data. These categories can be thought of as the various features present in the students' explanations of the nature of sustainable development.

The analytical process then involved examining each response and using the categories to code the elements present. Note that once a given category had made an appearance in a response, further occurrences of the same category in the response were not coded. In other words, the responses were coded for the *categories* present—each category could only occur once (even though its presence may have been supported by several elements). Since one response usually contained several categories, the number coded was far greater than the sample size.

This method of analysis was not used initially to make judgements about individual responses. Rather, it was employed to portray the frequencies of occurrence of the various features of sustainable development (the categories) in the sample as a whole, and in the geography students compared with the scientists (see later).

Figure 1. The 21 categories used to code elements in the responses

	PURPOSE		TIME SCALE
1	Improvement (progress, benefit)	14	Long term (long term strategies, over time, permanently, indefinitely)
2	Preservation (avoiding damage, not detrimental, protection, minimum negative impact, not detracting or taking away, not depleting)	15	The future
3	Conservation (use of renewable resources)		GEOGRAPHY SCALE/LEVEL
4	Balance (replacement, recycle, self-sustaining, replanting)	16	Global/all countries
		17	LEDCs only/focus on LEDCs
5	Meeting needs	18	Local
6	Self-sufficiency (independence)	19	Area/scale—undefined
7	Other (e.g. survival, saving the planet, awareness, management, consideration of impact)		
			CONTROVERSY
	NATURE of the development	20	Controversy (conflicting issues)
8	Environmental (resources)		
9	Economic (less debt, standard of living, inequalities)		AESTHETIC
		21	Aesthetic (maintaining beauty)
10	Social (preservation of cultures, quality of life, inequalities, political)		
	HUMAN FOCUS (who for)		
11	Human populations/people		
12	Future generations only		
13	Future and current generations		

Note:
Terms in brackets provide examples of alternative wording used in the responses which were coded under the particular category heading, e.g. for category 9 explicit use of the word 'Economic' (the category heading) resulted in coding in this category, but the terms 'less debt', 'standard of living' and 'inequalities' were also coded in the same category.

(ii) Individual responses: environmental, economic and social factors. In the earlier account of the literature, we pointed to a growing consensus that sustainable development involves a bringing together of environmental, economic and social factors. Hence it seemed important to examine the extent to which this was recognized by individual respondents. While the above elements analysis reveals the frequencies of environmental, economic and social factors (categories 8, 9 and 10) across the responses taken together as a whole, it says nothing about the extent to which *individual responses* were recognizing all three factors or some combination of them.

To capture this latter feature of the data each response was located in a segment of a Venn diagram (see later and Figure 3). This analysis was straightforward since the summary sheet described above already contained a list of coded elements in each response. Hence it was simply a matter of returning to this sheet and seeing which responses had contained elements in categories 8, 9 or 10. Responses containing mentions in all three categories appear in the centre of the Venn diagram where all

three circles overlap, responses mentioning just environmental and economic elements appear in the top overlap, and so on.

(iii) Using the CEE Report framework. Since this report was produced by a group set up to advise on the introduction of ESD into schools in the context of the National Curriculum, it seemed pertinent to examine how the rather detailed conceptualization of sustainable development given in that document compared with the views of the student teachers in this study. Hence each written response was considered holistically to see which of the seven CEE dimensions were present (see later and Table 2). The occurrence of a dimension was counted only once per response.

The difference between ESD and environmental education. Each written response explaining why education for sustainable development was thought to be the same as, or different from, environmental education was examined and categories developed for coding the data. The final category system is shown in the results section (see later and Table 3). Occasionally, a particular response contained aspects requiring coding in more than one category, and so the overall frequency count across the categories was greater than the sample size.

The coding process

In this study, all of the work requiring generation of categories and allocation to categories was carried out by the authors working together as a team, in three-way discussions at face-to-face team meetings. The validity of the data analysis therefore relies on the credence given to the judgements made by three experienced teacher educators with considerable experience of research in science, geographical and environmental education. We provide examples of responses and their categorizations at various points in the paper to enable readers to appraise our decisions.

Results

The meaning of sustainable development

Seventeen of the 21 geographers reported that they had studied sustainable development as part of their formal education, compared with 17 of the 40 scientists: this is statistically very significant (chi-square = 12.51, d.f. = 1, $p < 0.001$). Given this, it is perhaps not surprising that the geography students' rating of their personal understanding of sustainable development was significantly higher than that of the science students (see Table 1: chi-square = 4.75, d.f. = 1, $p < 0.05$).

(i) Features of sustainable development. Figure 2(a) shows the overall results of the elements analysis using the categories elaborated earlier, while Figure 2(b) compares

Table 1. Contingency table for chi-square analysis of self-ratings of understanding of sustainable development (see Questionnaire, in Appendix); ratings of 'very good', 'quite good' and 'reasonable' have been grouped as 'satisfactory' and 'little' and 'none' as 'less satisfactory'

	Geography	Science
Satisfactory	17	21
Less satisfactory	4	19

Chi-square = 4.75, d.f. = 1, $p < 0.05$.

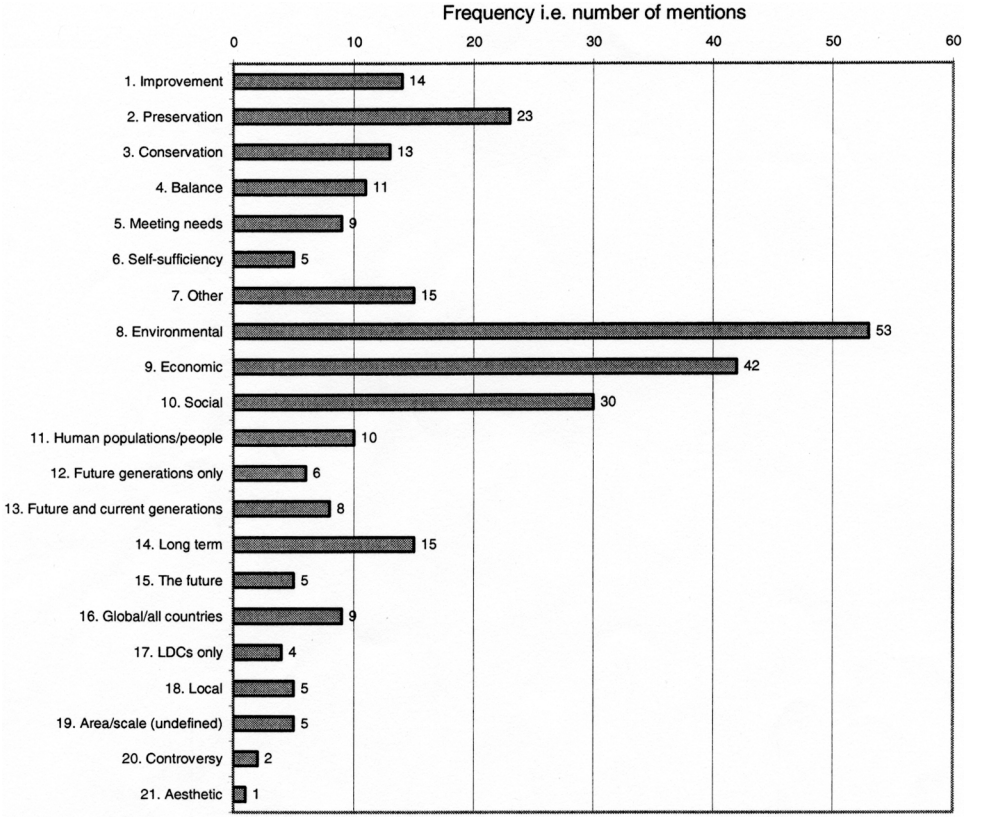

Figure 2(a). Frequency of occurrence of the categories (features of sustainable development) across the whole sample

the percentages of geographers and scientists within each category. Some interesting features of these findings are set out below.

- A large number of respondents recognized the centrality of the environment as a focus for sustainable development and the importance of economic and social factors. These were the three most populated categories. Some examples of responses coded in all three of these categories are as follows (with evidence supporting the categorizations in italics):

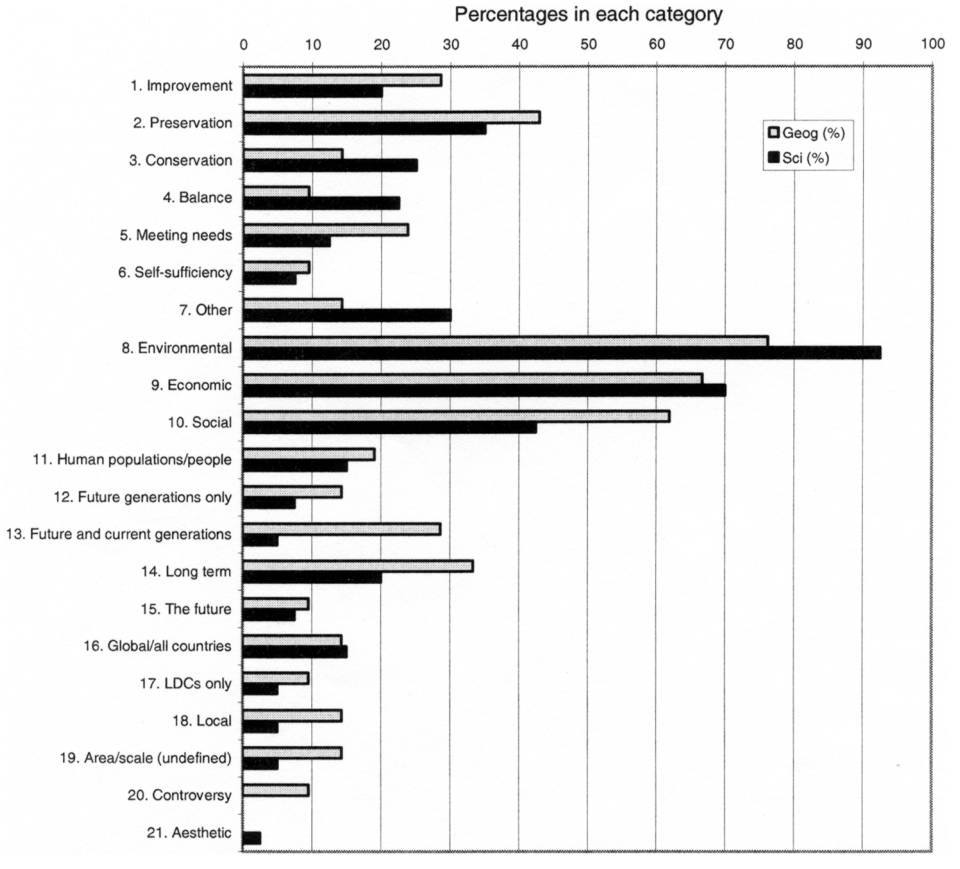

Figure 2(b). Percentages of geographers and scientists in each category

> The development of the world, a country or a region *economically*, *environmentally* or *socially* which involves a long-term strategy that can be implemented at the grass-roots level. (Respondent R10, Geographer)
>
> Continuing *economic* and *social* progress which does not damage the *environment* and which hopefully allows the improvements made to be available to all and allow future progress which is environmentally sound. (R14, Geographer)
>
> Managing change and progress by combining issues from *social*, *environmental* and *economic* development, using appropriate local knowledge, in a way that produces maximum gain and minimum undesirable impact on each of the three strands. (R45, Scientist)

- While about two-thirds of the geographers and of the scientists recognized the economic aspects, there was a definite trend for the former to identify the social dimensions and the latter to emphasize the environment; e.g.:

> Promotion of economic and *social development* in a way that allows the next generation the same chances as your own generation. (R18, Geographer)
>
> *Environmental awareness*: how humans *interact with the environment* and the factors that have an influence on the environment. Also, the processes which help to *improve the environment*. (R34, Scientist)

However, these trends did not reach marked levels of statistical significance (chi-square tests yielding $p < 0.2$ and $p < 0.1$ respectively). In the case of the economic aspects, the geographers tended to mention the word explicitly more frequently, whereas for the scientists allocation to this category was often through inference—e.g. our coding rules specified that '*use* of resources' (frequently brought up by the science respondents) implied an economic as well as environmental dimension.

- The above-mentioned focus on the environment was echoed in the well-populated categories which identified principal purposes of sustainable development as preservation and conservation; e.g.:

  > Sustainable development is the idea that countries should try to develop in the most efficient way possible to *preserve natural resources* for future generations. (R7, Geographer)
  >
  > The use and management of resources in such a way that supply will not be exhausted and production can be maintained. This has a human and an ecological angle as there is a necessity to both meet human needs now and in the long term and to *conserve natural resources*. (R33, Scientist)

- Only a very few students pointed out the global nature of sustainable development, while four (two geographers and two scientists) had the misconceived view that it was an issue only for less economically developed countries (LEDCs); e.g.:

  > Helping *the countries of the Third World* develop in such a way that they are not dependent on the developed world . . . (R12, Geographer)

- There were a larger number of geographers than scientists in the 'future and current generations' category (five compared with one), accounted for by the more frequent use of the WCED definition (see above) by the former.

- A greater number of geographers than scientists highlighted the long-term nature of sustainable development issues (one-third compared with one-fifth).

- Some interesting categories emerged which we had not anticipated, but which seem valid. So, for example, a need for balance (category 4) and the value of self-sufficiency (category 6) were both mentioned on several occasions:

  > To me it means *finding a balance* between the demands for development and environmental protection, not wholly the latter (admittedly determining where this balance lies can be a very controversial issue). (Category 4, R1, Geographer)
  >
  > Development in terms of a progression or change (social, educational, political) which is able to sustain a suitable level/quality of life in a particular country *without help (capital) from other countries*. (Category 6, R46, Scientist)

- Only two respondents made any reference to controversy and conflict (an important category theoretically, which is why it is not subsumed under 'other').

- Only a single response contained an aesthetic element:

  > Continuing to feed and provide shelter for, and to enrich scientific and cultural knowledge for, all the peoples of the earth whilst minimizing damage to the diversity of life on the earth and *maintaining its beauty.* (R50, Scientist)

An interesting way of comparing the geography and science students is to calculate

a *richness factor* for each group—i.e. the average number of features (categories) per student in the responses of the geography group compared with the science group. This yields 108/21 = 5.14 for geography and 177/40 = 4.42 for science. Hence the explanations of the geographers were rather more elaborated and tended to identify a larger number of aspects of sustainable development than those of the scientists.

(ii) Individual responses: environmental, economic and social factors. The results of the analysis which placed each response in a segment of a Venn diagram to show whether environmental, economic and social factors were present are shown in Figure 3. Responses illustrating these allocations are as follows:

> Development which will be of benefit in the future, and is managed in such a way that considers the *environmental* and *economic* effects. (R44, environmental and economic, Scientist)
>
> *Economic, social and political* improvement through means that enable these improvements to be made on a long-term basis. (R20, economic and social, Geographer)
>
> Development that takes into consideration the long-term and wider implications of the *impact on environment* and resources. (R48, environmental only, Scientist)

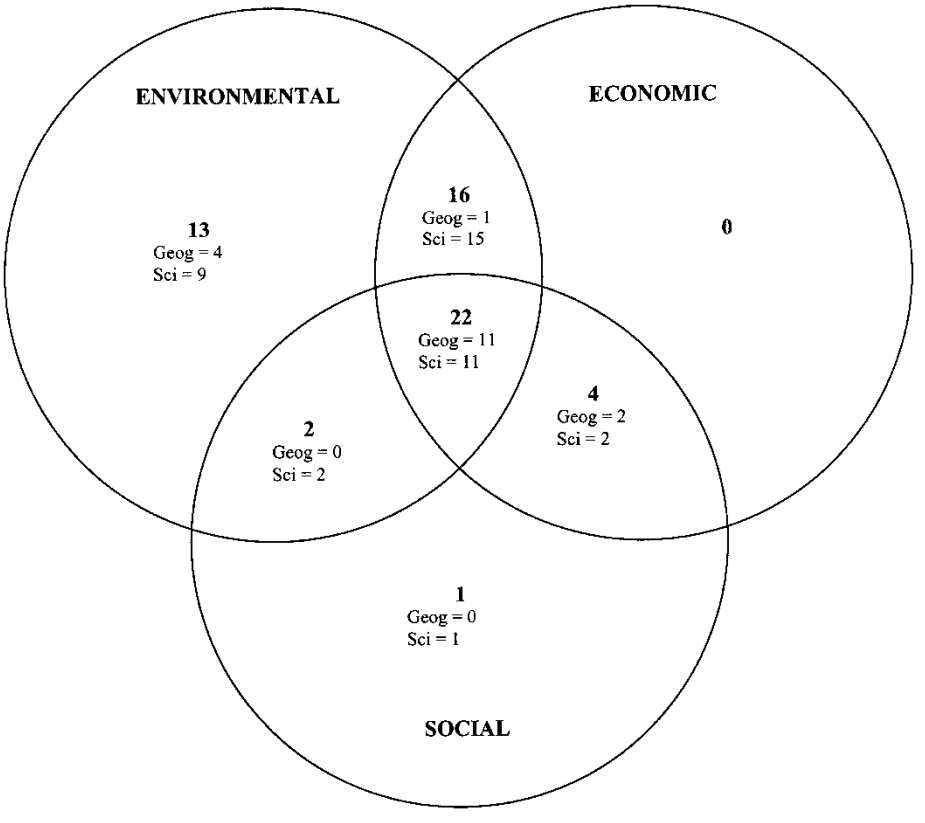

Figure 3. The numbers of individual responses mentioning environmental, economic or social factors, or various combinations of these

> The improvement in living conditions of a country/area in such a way that it doesn't cause harm to future generations. (R61, social only, Scientist)
>
> *Continuing to feed and provide shelter* for, and to enrich *scientific and cultural knowledge* for, all the peoples of the earth whilst minimizing damage to the *diversity of life on the earth* and maintaining its beauty. (R50, social and environmental, Scientist)

It should be noted that explanations of three geographers contained no mention at all of any of the three factors under consideration, and are therefore not coded on the Venn diagram. In contrast, all of the scientists made mention of at least one of these factors.

An important finding of the analysis becomes apparent when the central segment is examined. This shows that the explanations of 11 of the 21 geographers compared with just 11 of the 40 scientists contained references to all three features of sustainable development. This difference is significant at the $p < 0.05$ level, thus supporting the view that there is a greater awareness among geographers of environmental, economic and social considerations.

The Venn diagram also shows the greater preponderance of the environment as a concern for the scientists, but as stated in the previous 'features' analysis, this does not reach any marked level of statistical significance (chi-square = 3.23, d.f. = 1, $p < 0.1$).

(iii) The PESD framework. The frequency of occurrence of each PESD Report dimension across all of the written responses is shown in Table 2 for the whole sample and for the geographers and scientists separately. It should be noted that the descriptions of the dimensions given in the table are taken from the Report and are not our own. These dimensions are elaborated further in the main body of the document to provide a fairly comprehensive interpretation of each one. In the coding process a dimension was considered to be present in a response if it contained (in our view) a clearly recognizable element of this full interpretation. The principal features of these findings are set out below.

- The most widely represented of the seven dimensions were 'Citizenship and stewardship' and 'Interdependence' (both a little more than three-quarters of the sample), followed closely by 'Sustainable change' (nearly two-thirds of respondents). Examples of responses displaying these dimensions (with the supporting evidence italicized) are:

  > *Living in a way which is not depleting the world's resources*, and enabling the next generation to also live that way. (Citizenship and stewardship, R30, Scientist)
  >
  > Environmental awareness—*how humans interact with the environment and the factors that have an influence on the environment (which are dependent on humans)*. (Interdependence, R34, Scientist)
  >
  > The improvement of situations through *the use of renewable resources rather than via resources used in a finite way*, and the wide impact this can have on improvement in ecological and social requirements of a population. (Sustainable change, R43, Scientist)

All three of these dimensions were present more frequently in the responses of the

Table 2. Frequency of occurrence of each PESD Report dimension in the written explanations of the meaning of the term 'sustainable development'

Dimension	Geographers $N = 21$	Scientists $N = 40$	Total $N = 61$
1. **Interdependence** People, the environment and the economy are inextricably linked at all levels from local to global	14 (67%)	32 (80%)	46 (75%)
2. **Citizenship and stewardship** The importance of taking individual responsibility and action to ensure the world is a better place	15 (71%)	34 (85%)	49 (80%)
3. **Needs and rights of future generations** Our own basic needs and the implications for the needs of future generations of actions taken today	9 (43%)	6 (15%)	15 (25%)
4. **Diversity** Respecting and valuing both human diversity—cultural, social and economic—and biodiversity	1 (5%)	1 (2%)	2 (3%)
5. **Quality of life, equity and justice** Global equity and justice are essential elements of sustainability and basic needs must be met universally	10 (48%)	12 (30%)	22 (36%)
6. **Sustainable change (development and carrying capacity)** Understanding that resources are finite and that this has implications for people's lifestyles, and for commerce and industry	12 (57%)	27 (67%)	39 (64%)
7. **Uncertainty and precaution in action** There are a range of possible approaches to sustainability and situations are constantly changing, indicating a need for flexibility and lifelong learning	0 (0%)	0 (0%)	0 (0%)

scientists than the geographers, but the differences were not statistically significant at the $p < 0.1$ level.

- The fourth most popular dimension was 'Quality of life, equity and justice' (more than a third of all respondents); e.g.:

> It includes *improved quality of life for all*, greater consideration of the environment, higher standards of living for all, economic improvement for all countries (especially Third World) which is appropriate and won't lead them into greater debt, and *the involvement of all people regardless of status*. (Quality of life, equity and justice, R2, Geographer)

  This time the frequency of occurrence was greater among the geographers (nearly half) than the scientists (somewhat less than a third). However, this difference, again, failed to reach significance at the $p < 0.1$ level. The tendency for geographers to recognize this dimension more readily corresponds with the greater prevalence of the 'Social' category in the earlier analysis identifying features of sustainable development (see Figure 2(b)).

- The one difference where there was a statistical difference between the two groups was in the case of 'Needs and rights of future generations', which received greater

mention among the geographers (chi-square = 5.78, d.f. = 1, $p < 0.02$). This is accounted for by the tendency for the latter to quote the WCED definition (or aspects of it) in their responses; e.g.:

> Sustainable development, in my opinion, is development which takes into account what currently exists and tries to improve or conserve this *in order to pass on our earth for the enjoyment of future generations.* (Needs and rights of future generations, R4, Geographer)

- However, the most striking and perhaps surprising feature of Table 2 is the almost complete omission of any mention of 'Diversity'. We had anticipated spontaneous expression of a need to preserve biodiversity, in particular, from the science students, given the wide media attention (and presumably academic attention) accorded in recent years to the decline in many biological species worldwide resulting from encroachment on, and degradation of, natural environments. But clearly, in the minds of these PGCE students, these concerns do not seem to surface in the context of sustainable development.
- 'Uncertainty and precaution in action' was not present in any of the 61 responses. On the one hand, it can be argued that this is surprising, since for geographers coverage of environmental issues in undergraduate courses increasingly includes 'a humanistic view involving perceptions, cultural contexts, and political viewpoints' (Corney & Middleton, 1996) and discussion of alternative theories and courses of action, while, in the case of science, media coverage of topical issues frequently highlights their contentious nature (e.g. the genetically modified foods debate). On the other hand, it can be argued that this is less surprising given that notions of uncertainty and precaution are not included explicitly in widely known definitions such as that of the WCED.

To conclude this section it is interesting to note that the average number of dimensions in a response was about 2.9, with virtually no difference between the geographers and scientists. There is no doubt that the conceptualization of sustainable development presented in the PESD Report is rather greater in scope than that articulated in the responses of these PGCE students.

The difference between ESD and environmental education

Two-thirds of the students (42 out of 61) ticked the box affirming that ESD and environmental education are different. This difference was more frequently asserted by geographers (17 out of 21) than by scientists (25 out of 40), although the significance of this result is low (chi-square = 3.21, d.f. = 1, $p < 0.1$).

Table 3 shows the categories and findings for the analysis of the explanations given by the students for their responses. The main features of this analysis are set out below.

- The most populated category, occurring in the explanations of 26 respondents, was that which portrayed ESD as broader than environmental education. This view was more prevalent among the geographers (11/21 = 52%) than the scientists (15/40 = 37.5%), although the difference does not reach significance at the 0.1 level.

Table 3. Categories and sub-categories used to code explanations of responses to the question: Do you think education for sustainable development is any different from environmental education?

Category	Geography	Science	Both
1. **ESD is broader than environmental education (or, conversely, the latter is narrower)**	**11**	**15**	**26**
• human factors	1	0	1
• economic factors	7	5	12
• social factors	6	6	12
• action and its consequences	3	7	10
• scale (e.g. global, all countries)	2	0	2
• environmental education is mainly about the physical environment	3	0	3
2. **Environmental education is broader than ESD**	**3**	**5**	**8**
• no reason given	1	5	6
• sustainable development is more specific	1	0	1
• sustainable development focuses on LEDCs, environmental education on MDCS and LEDCs	1	0	1
3. **ESD and environmental education are different**	**3**	**8**	**11**
• no explanation	1	1	2
• environmental education focuses on physical factors	1	2	3
• sustainable development is related to economics	1	1	2
• sustainable development has a more social content	1	1	2
• sustainable development focuses on LEDCs	0	1	1
• sustainable development is about the future/ action/practicalities	0	4	4
4. **ESD and environmental education are the same**	**2**	**5**	**7**
• no reason given	2	2	4
• think they are the same but not sure	0	3	3
5. **ESD and environmental education are related**	**3**	**8**	**11**
• explicit mention of overlap/interlinked/inter-related	3	6	9
• 'sustainable development is related to environmental conditions'	0	1	1
• 'understanding of the environment helps methods for sustainable development'	1	0	1

Note:
Numbers in sub-categories do not add up to main category numbers (in bold) since one response often contained more than one sub-category feature.

The ways in which ESD was considered to be broader are summarized in the sub-categories of Table 3, together with the frequencies of occurrence. The reasons most frequently given were to do with economic and social dimensions of sustainable development, and also its focus on action:

> I believe that sustainable development incorporates environmental education but is also about many other issues, such as sustainable *economic* development, and can also relate to many other *social* issues. (R2, Geographer)

> Sustainable development addresses *human beings as people*, e.g. their *health* and *income*, as well as the environment in which we live. (R28, Scientist)
>
> Although I'm sure that many topics overlap in the two, I think that sustainable development education is much more towards applied education, such as *what can be done about this*, rather than just learning about environmental issues. (R14, Geographer)

It is worth noting that these perceptions are in accord with much of the recent literature (see review, above), which has pointed to a growing consensus that sustainable development must be viewed holistically in terms of social, economic and environmental factors which cannot be disentangled. If we accept that some views of environmental education have tended to focus more narrowly on protection of the physical environment, then the perceptions of this group of students of sustainable development as a broader concern would seem entirely appropriate.

- Conversely, eight students felt that environmental education was broader than ESD. Of these, six gave no reasons, while the arguments given by the other two seem somewhat questionable (see Table 3).
- The categories describing ESD as *different* (for a variety of reasons other than greater breadth) or *related* to environmental education were both quite well populated. The latter 'related' category is interesting since the tick box did not allow for this—i.e. there was only the option to tick 'yes' (ESD and environmental education *are* different) or 'no' (they are not different). In fact the 11 respondents in this category ticked an even mixture of yes and no boxes, but in their explanations argued (mainly) for overlap and interlinkage rather than sameness or difference (see the sub-categories of Table 3); e.g.:

> *The two are related* as if educated about the world you live in you will be able to adapt methods of sustainable development more effectively. (R9, Geographer)

In the case of the 'ESD is different' category (for reasons other than greater breadth), two misconceptions emerge—i.e. that ESD focuses on LEDCs and that environmental education focuses on the physical environment; e.g.:

> *Environmental education is about the environment and its protection*. Education for sustainable development is about *helping lesser developed countries* to become more developed but not to the detriment of the environment. (R36, Scientist)

The literature would surely take issue with these views.

- While a small proportion of the sample felt that ESD and environmental education were the same, these responses either omitted explanations or admitted uncertainty about this view.

In summary, we can say that two-thirds of the sample thought that ESD and environmental education were different and the reasons given for this were, in our view, usually sound. The geography students tended to perceive a difference more readily than the scientists.

Discussion and implications

Encouragingly, nearly everyone in this sample of geography and science PGCE students identified valid features of sustainable development. Having said that, there are some features of the findings which clearly flag areas where further learning would be beneficial. Two areas, in particular, are apparent. First, the marked tendency of the geographers to be more aware than the scientists of the full scope of sustainable development, and especially that it embraces environmental, economic and social considerations. While this suggests a need to broaden the horizons of the scientists in particular, the fact that only half of the geographers identified all three factors indicates that this may be a useful target for both sets of students during the PGCE year.

Second, in terms of the sophisticated conceptualization of sustainable development advanced in the PESD Report, there is certainly room for both geographers and scientists to broaden their conceptualization of the domain. This is supported, for example, by the rather low average number of PESD dimensions per response (2.9 compared with seven dimensions in the full framework), and the very low numbers identifying 'Diversity' and 'Uncertainty and precaution' as relevant issues. One might add to this the almost complete absence of any mention of aesthetic considerations in the responses. The implication here is, again, a need to broaden conceptions of sustainable development, for both geography and science students.

We plan to achieve these goals through joint geography and science taught sessions in which a number of sustainable development 'topics' (e.g. climate change, species loss, energy use and supply) are examined from the perspectives of all seven PESD dimensions, and with a particular emphasis on drawing out some of the key environmental, economic and social implications. We anticipate here exciting opportunities for fruitful cooperation between geographers and scientists, with each group contributing different kinds of expertise in support of mutual learning.

Turning to the differences between environmental education and ESD, we outlined above how this has been the subject of some debate in the polemic literature. The prevailing view among these students, that ESD is broader than environmental education, is in accord with much of this literature, although some would argue that this does not do justice to some of the more progressive conceptions of environmental education which have emerged in some quarters over the past decade or so. The *practical* implication for us, as teacher educators, is perhaps to ensure we raise this issue explicitly with our students and help them develop a clearly thought-out view of the relationship between ESD and environmental education. Certainly, environmental education has been around in schools in one shape or another for many years, but it is not clear how much of this should count as ESD. Our goal is to produce well-informed beginning teachers who have thought critically about these issues and can therefore contribute usefully to the development of ESD in their schools.

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Appendix: The questionnaire

Extract from the questionnaire, showing the items relevant to this paper; the full instrument (seven questions) covered further areas, e.g. the teaching of controversial issues.

Sustainable Development Questionnaire

1. Age: ____ Gender (please circle): M F PGCE teaching subject: _____

   Did you study sustainable development as part of your formal education?

   Yes No (circle one)

   If yes, at what level (e.g. A-level, degree): _____

   If yes, in the box below describe briefly what you did:

2. How would you rate your personal understanding of sustainable development (tick one)?

very good	quite good	reasonable	little	none
☐	☐	☐	☐	☐

   In the box below, try to explain what is meant by 'sustainable development':

6. Do you think education for sustainable development is any different from environmental education?

   Yes No (please circle one)

   Try to explain your response:
