Learners and Learning in Environmental Education: A critical review of the evidence
Learners and Learning in Environmental Education: a critical review of the evidence

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SUMMARY Recent analyses of the field of environmental education research have highlighted its rapidly expanding size and increasingly diverse nature (e.g. Hart & Nolan, 1999). This article reports on a review of a particular part of this field—namely, recent empirical studies of learners and learning in primary or secondary school environmental education. The review focuses specifically on the nature and quality of the evidence generated by the work in this area. The concern with evidence is motivated by the tendency of previous reviews to focus on methodological trends more than research findings. Claims have also been made that environmental education theory and research have overlooked ‘the children who are the subjects of environmental education’ (Payne, 1998a, p. 20). This review contends that efforts to address such shortcomings need to be informed by a thorough and grounded understanding of what studies have, and have not, been undertaken on students and learning, and what is known, and not known, from the evidence that these studies have generated.

In its methods, the review seeks to be systematic, comprehensive and analytical. Its findings are based on careful scrutiny of over 100 journal articles, books and reports, published between 1993 and 1999. It proposes that the current evidence base on learners and learning can be understood in terms of six concentrations or nodes of evidence. Three of these are well established (students’ (i) environmental knowledge (ii) environmental attitudes and behaviours, and (iii) environmental learning outcomes), while three can be regarded as emerging (students’ (i) perceptions of nature, (ii) experiences of learning, and (iii) influences on adults). The recent research evidence and key messages associated with each of these nodes are discussed in successive sections of the review.

Overall, the review suggests that the evidence base on learners and learning, while considerable in size, is less diverse in terms of methodological and theoretical approaches than the wider environmental education research field within which it is situated. The evidence base also provides more information about students’ environmental knowledge and attitudes than about their educational experiences and preferences, and more about learning outcomes than about learning processes. These characteristics, however, are
not static. The research and evidence base on learners and learning is developing and changing as new foci emerge, bringing with them different methodological and conceptual approaches.

The review identifies issues and challenges arising from the recent evidence on learners and learning for research users, researchers and future reviews of the field. As well as highlighting possible practical implications of the research, it makes a case for studies focused more explicitly on learning and the role learners play within this process. It also suggests a need for user reviews as well as academic reviews in the field of environmental education.

1. Introduction

The last 30 years have seen growing international recognition that the challenges associated with environmental degradation and sustainable development have important implications for, and connections with, education and schooling (IUCN, 1970; UNCED, 1992). The concept of environmental education is now widespread in national educational policies (e.g. Kadji-Beltran, 1999), curriculum documents (e.g. QCA, 1999), curriculum development initiatives (e.g. OECD, 1995), and conservation strategies (e.g. IUCN/UNEP/WWF, 1991). Allied with this increasing recognition for environmental education has been a concomitant growth in the field of environmental education research. Recent descriptions of the field have highlighted its rapidly expanding size and increasingly diverse nature, particularly over the last 10 years (Palmer, 1998; Hart & Nolan, 1999).

In view of this growth and diversification, this review sees an important need for work focused on making sense of and critically analysing the field of environmental education research. Furthermore, in light of the tendency of previous reviews of the field to focus on methodological trends more than research findings, it is argued that there is a need for such analyses to approach the field as an evidence base: that is, to focus specifically on the nature and quality of the empirical evidence that has been generated within the field. This review attempts to do this for a particular part of the environmental education research field—studies of learners and/or learning in primary or secondary school environmental education.

The rest of this section explains the focus of the current review in relation to those previously undertaken in the area (Section 1.1), describes the procedures and processes by which this review was carried out (Section 1.2), and outlines the content and structure of the remainder of the article (Section 1.3).

1.1. Focus and Rationale

This review reports on current research evidence on learners and learning in the context of school-based environmental education. As described above, it constitutes a review of a particular part of the environmental education research field—namely, studies published between 1993 and 1999 that have investigated in some way learners and learning in the context of primary or secondary school education. For the purposes of the current review, this body of work has been termed environmental education learning research.

The aims of this review are threefold:
(1) To chart the nature of the current evidence base on learners and learning in environmental education in terms of its major foci, strengths and weaknesses.

(2) To identify key messages emerging from this evidence base for each of the major foci within the area, and assess the limitations of these in terms of empirical underpinnings and generalisability.

(3) To raise questions about the nature, quality and accessibility of recent environmental education learning research, and suggest priorities for future work.

The rationale for this undertaking is not as simple as a dearth of published reviews in the field of environmental education research. There have in fact been a number of publications over the last 10 years that have sought in some way to present and comment upon the research in this area. This review argues, however, that in spite of these there continues to be a crucial shortfall in these various accounts of the field, that is a lack of critical analysis of the evidence base.

One of the reasons for this is that several of the reviews that have been undertaken in the field have been either bibliographic in nature (Iozzi, 1981; Andrew & Malone, 1995; Marcinkowski & Mrazek, 1996; Wagner, 1997; Foskett & Marsden, 1998), or methodological in focus (Robottom & Hart, 1993; Williams, 1996; Palmer, 1998). Furthermore, those reviews that have been concerned to collate and analyse research findings have tended to do so for particular kinds of studies on very specific topics. Examples include reviews of research on: the affective domain (Iozzi, 1989); knowledge and affect (Zimmermann, 1996), knowledge and behaviour (Newhouse, 1990), interventions and behaviour (Zelezny, 1999), learning outcomes (Leeming et al., 1993), outdoor experiences and attitudes (Keighley, 1997), sources of environmental sensitivity (Chawla, 1998), and student understanding of global atmospheric issues (Boyes & Stanisstreet, 1996). These articles have provided useful overviews of recent research findings, often with detailed critical commentary and discussion of implications for practice (e.g. Iozzi, 1989). Their specificity of focus, however, has usually meant that they have discussed studies of a broadly similar methodological nature. (An important exception is Chawla’s (1998) review of research on sources of environmental sensitivity which discussed a variety of qualitative and quantitative studies).

In view of this situation, this review seeks to focus specifically on the nature of the research evidence in an area of the field that is broad enough to include studies with a variety of approaches and foci, but also focused enough to enable detailed examination and discussion of individual studies’ findings. Research on learners and learning is seen as an area that fulfils these requirements in that it represents a definable area within the literature that contains a variety of research topics and approaches.

This focus also responds to the growing recognition of the importance of research on students and their learning, both within the field of environmental education research (Payne, 1998a; Rickinson, 1999), as well as in educational research debates more generally (Erickson & Shultz, 1992; Cooper & McIntyre, 1996; Rudduck et al., 1996; Pollard et al., 1997; McCallum et al., 2000). Arguments made by such authors suggest ‘a lack of consideration in environmental edu-
cation theory and research practices about the children who are the subjects of environmental education’ (Payne, 1998a, p. 20), and a situation in educational research more generally where ‘virtually no research has been done that places student experience at the centre of attention’ (Erickson & Shultz, 1992, p. 467). This article contends that efforts to address such shortfalls need to be informed by a thorough and grounded understanding of what studies have, and have not, been undertaken on students and learning, and what is known and not known from the evidence that these studies have generated. This review aims to contribute to such an understanding in the area of environmental education.

The concern with research findings draws upon the notion of evidence-focused reviews, in particular Foster and Hammersley’s (1998, p. 610) argument that ‘the main channel of communication between researchers and lay people ought to be reviews of whole fields of research, rather than reports of single studies’. This is not to suggest an unproblematic acceptance of the concept of evidence-based practice or a simplistic view of the relationship between research and practice. Rather it is to argue for a concern for research evidence and what this might tell us in the field of environmental education.

Finally, this review seeks to complement Hart and Nolan’s (1999) recent analysis of the field. In adopting a similar time-scale for included studies, it aims to examine the field at a similar time in its development. However, in specifically focusing upon a particular part of the field, it is hoped that this review will be able to explore the findings of individual studies in more detail than was possible in Hart and Nolan’s wide-ranging analysis of the entire field. Indeed, the delineation of the scope and direction of this review was strongly informed by a lengthy discussion with one of the authors (Hart) of that review.

1.2. Methods

In a recent article on reviews of educational research, Bassey (2000, p. 25) distinguishes between three types of review: (i) annotated bibliographies—‘listings, probably alphabetically arranged, possibly in sections, of literature sources in a particular area with a very brief account of what claim to knowledge is made’; (ii) academic reviews—‘a critical and analytical account of the state of public knowledge of the topic (and noting areas of lack of knowledge)’, and (iii) user reviews—‘a form of professional paper which arises from an academic review and which is devised and written by researchers and users working together’. The current work constitutes an academic review, from which it is hoped user reviews might be subsequently generated.

As such, the current review has sought to be:

- **systematic** in terms of having clear criteria for the inclusion/exclusion of research studies, and a common framework for reviewing all included articles;
- **comprehensive** in scope through using a variety of searching techniques and checks; and
- **analytical** in terms of critically analysing the strength and validity of individual studies’ findings, as well as the evidence base as a whole.
### Table 1. The key dimensions of the review

<table>
<thead>
<tr>
<th>Overall focus:</th>
<th>empirical studies on learning and learners in the context of school-based environmental education</th>
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<tbody>
<tr>
<td>Time scale:</td>
<td>work published 1993–99</td>
</tr>
<tr>
<td>Age range:</td>
<td>primary and secondary age students (ISCED Levels 1–3)</td>
</tr>
<tr>
<td>Geographical scope:</td>
<td>international (only articles published in English)</td>
</tr>
<tr>
<td>Sources:</td>
<td>published articles, books and monographs, and government/international publications</td>
</tr>
</tbody>
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**These exclude:**

- publications that have no empirical component
- studies of environmental education not undertaken in or through schools
- studies of teachers, or adult learners or university students
- research published prior to 1993 or in languages other than English
- unpublished work such as doctoral and masters theses.

The procedures and processes by which these have been operationalised will now be explained in terms of the selection criteria, the search methods, and the review processes.

**Selection Criteria**

The key dimensions of the work were clearly defined at the outset (Table 1). These were driven by a number of considerations. Firstly, the focus on empirical work (that is, work that encompasses some form of first-hand inquiry and primary data) reflected the review’s concern with the evidence base. Publications that described environmental education programmes without any empirical evaluative discussion were therefore not included (e.g. Poland *et al.*, 1996; Silver, 1998). Secondly, the time period of 1993–99 was selected in order to examine the most recently published evidence, as well as to align with Hart and Nolan’s (1999) review of the field over a similar time period. Thirdly, several other dimensions—such as the exclusion of unpublished theses, and work in languages other than English—were driven by the pragmatics of a project which was designed to be undertaken over a 9- to 12-month period. Finally, the focus on environmental education research in the primary and secondary school context reflected a number of key factors. These included: ongoing policy debates about school-based environmental education in light of recent changes in the UK National Curriculum [1], the need to select a part of the field that was conceptually and practically manageable, and the reviewer’s research experience in the primary/secondary school context. This meant that research on any environmental education activity undertaken either in school or under the auspices of school (such as a residential field course as a school group) was included. What was excluded, then, were investigations of activities organised outside the school context such as summer outward bound programmes (e.g. Hattie *et al.*, 1997). The review also excluded research on environmental learning among university students (e.g. Smith-Sebasto, 1995) and beginning teachers (e.g. Payne, 1997).

The final point in relation to selection criteria is that there was no strict definition adopted for what would constitute environmental education research.
Rather (as described below) there was a focus on journals with environmental education in their title, and research reports with environmental education in their key words. In this sense, any work describing itself as environmental education research was relevant as long as it met the aforementioned selection criteria. The one exception to this was research reports about students’ knowledge of subject matter that was deemed not to be specifically environmental (for example, a paper published in an environmental education journal about young people’s knowledge of geographical mapping techniques).

**Search Methods**

Relevant literature was identified from a number of different sources. Bibliographic searches were undertaken, firstly, using several educational research databases (such as the British Education Index, ERIC, the Australian Education Index, and Child Data), as well as more specialist records (SIGLE for grey literature, and REGARD for ESRC projects). For all of these the key word ‘environmental education’ was used, in association with a number of other related search terms (Appendix 1). These yielded a large number of titles that were then selected manually on the basis of abstracts and descriptors. These database searches were supported by manual searches of the contents of key research journals in the field (Appendix 1) and previously published reviews and bibliographies (see Section 1.1), from which articles of potential relevance were identified and copied. A further source of information was researchers currently active in the field—requests for information for this review were communicated to researchers internationally via the FERN Environmental Education Research Network (UK and Eire), the Environmental Education Research email discussion list (international) and the web site of the North American Association of Environmental Education.

As well as these initial sources of information, the identification of materials was an ongoing process. Reading selected publications led to the identification of further references of potential relevance. Indeed this was one way of working towards comprehensiveness in the literature search, in that searching continued until no new citations arose from the reference lists of included articles.

The purpose of exploring all of these sources was to identify and collect publications that corresponded with the focus of this literature review. This involved searching and selecting on the basis of relevance. It is important to emphasise that there was no consideration of quality during this initial searching and selection process. Studies were only excluded if they did not correspond with the stipulated substantive focus or failed to match any of the key dimensions outlined above. In the end there were 110 publications included in this review, the vast majority of which were journal articles, along with a small number of books and research reports.

**Review Processes**

The selection of relevant materials was followed by the process of reviewing individual publications. As described earlier, in the interests of ensuring commonality and comprehensiveness in this process throughout the project, a review framework was devised (Appendix 2). This was adapted from a similar
framework used by the author during an earlier review of research on young people’s attitudes to education, employment and training (Morris et al., 1999). In the context of the current work, the framework was designed to generate information for three purposes:

1. **Cataloguing and reporting**—basic descriptive information (such as full publication details, geographical location and age of learners), as well as a category descriptor (concerning broad substantive focus of a study) were included in order to facilitate cataloguing and subsequent analysis and reporting of large numbers of studies;

2. **Evaluation**—as well as descriptive information, this framework was also designed to generate evaluative information about the depth of detail provided about the different aspects of each study (conceptual/theoretical framework, sample, methodology, validity measures, methods, main findings, key conclusions, and author’s view of implications), and any particular strengths and potential weaknesses that were apparent to the reviewer within the work as reported;

3. **Evidence base analysis**—the third purpose of the framework was to enable the generation of ideas about (i) the contribution that individual papers made to the evidence base (i.e. main findings, key conclusions, author’s view of implications, researcher’s view of implications), and (ii) cases of agreement and disagreement between the evidence generated by different papers (i.e. links).

In addition to serving these three purposes, the review framework was also devised to enable empirical studies, whether quantitative, qualitative and/or mixed methodologies, to be examined using a common process.

The process of reading and reviewing articles using the framework began as soon as the first references became available. Initially this occurred in an uncoordinated manner, in that articles were not examined in any particular sequence, just as they arrived. Before long, though, the growing number of relevant publications meant that the issue of sorting and categorising became a more pressing one. This marked the beginning of a categorising process that continued to evolve throughout the course of the review. This involved experimenting with ways of making sense of the evidence base through looking for patterns of commonality and differences between the substantive foci of individual studies’ findings.

The emphasis on the substantive foci of their findings, as opposed to their methodological approaches, was deliberate in light of the concern with the evidence base. This was reflected in the labels that were given to these emerging categories, all of which were phrased in terms of ‘Studies that generate evidence about [for example] students’ learning outcomes’. This differs from Hart and Nolan’s (1999, p. 5) groupings which distinguished categories such as ‘quantitative reports’, ‘qualitative research’ and ‘focused inquiries’. Rather than grouping studies using a certain methodological approach or focusing on a particular topic, the categories in this review constituted an area of the evidence base and the studies that contributed to this. Any one study could thus be recorded in several categories if its findings were relevant to several areas of the evidence base. For example, the findings of Connell et al.’s (1999) study of young people’s environmental attitudes in two Australian cities contributes to the evidence base.
in three areas: environmental knowledge, environmental attitudes, and environmental learning experiences.

The nature of the categories and their delineation will be discussed in full in Section 2. Suffice to say at this point that once these categories had been established and the majority of the references assigned to one or more of them, the articles were reviewed by category. The reason for reviewing the articles in this way was to facilitate the development of a more synthetic understanding of the findings pertaining to each of the major foci of the evidence base. It is important to emphasise that there was flexibility within this approach in that individual articles often raised questions about the distinctions between categories and necessitated alterations or refinements. This was seen as an integral part of the review process.

As mentioned earlier, an important aim of this review was not only to chart the evidence on environmental education learners, but also to analyse and evaluate its strengths and weaknesses. While such an objective is clearly a crucial one, it is also a problematic and challenging one, especially for a review encompassing studies of differing methodologies and conceptual orientations. In attempting to carry out this objective, three principles emerged as useful and important. These include:

1. *Critiquing from within*—a conscious effort was made to review pieces of work from within the research tradition (or paradigm) that the research had been conceived and undertaken. For example, correlational studies were considered in terms of positivist research traditions, while qualitative case studies were examined from the perspective of interpretivist inquiry. The concern was to examine how well the researchers had carried out what they had intended to according to the paradigm in which they were operating. The aim was not to critique articles in terms of the paradigm in which they had chosen to investigate a particular topic or question.

2. *Sensitivity to context*—care was taken to remain mindful of the situations in which research projects take place, and the difficulties that can often hamper such work. For example, certain criticisms levelled at an internationally funded research project might be quite unjustified in relation to a small-scale action research study by one teacher researcher. Furthermore, research reports differ depending upon their intended audiences, so that methodological details might be less of a priority in a publication for policy audiences, as opposed to an article for academic readership. This was another aspect of the context of research publications that was important to bear in mind during the review process.

3. *Distinguishing evidence*—while taking account of these two points, importance was also attached to trying to draw distinctions between evidence that seemed to be more reliable or conclusive, and evidence that appeared more questionable or preliminary. This involved, for example, distinguishing between claims based on empirical findings and those based on speculation about empirical findings, highlighting differences between statistically significant results and ones based on description of trends, and differentiating between survey findings based on very small samples and those based on larger representative samples.
The final part of the review process was the identification of key messages. This involved generating overarching summarising statements through reading, rereading and trying to synthesise the findings reported in each of the studies for a particular substantive focus. In seeking to identify key messages, attention was paid to trying to include all of the evidence available on a particular topic, as well as phrasing the summarising statement in a way that reflected the specificity and strength of the findings upon which it was based.

1.3. Report Structure

The next section provides an overview of the current evidence base on learners and learning, describing its general characteristics, and its substantive foci. This proposes that the evidence base can be understood in terms of six concentrations or nodes of evidence, three of which are well established (students’ (i) environmental knowledge (ii) environmental attitudes and behaviours, and (iii) environmental learning outcomes), and three of which can be regarded as emerging (students’ (i) perceptions of nature, (ii) experiences of learning, and (iii) influences on adults).

The ensuing three sections then outline the research and its key messages for each of the established nodes of the evidence base: learners’ environmental knowledge (Section 3); learners’ environmental attitudes and behaviours (Section 4); and learners’ environmental learning outcomes (Section 5). Section 6 then considers the research and key messages for the three emerging nodes of evidence relating to learners’ perceptions of nature, experiences of learning and influences on adults. The review concludes with a critical examination of the strengths and weaknesses of the evidence base, a discussion of the key themes emerging from the preceding sections, and a consideration of the implications arising from these for research users, researchers and future reviews of the field (Section 7).

2. An Overview of the Evidence Base on Learners and Learning in Environmental Education

This section presents an overview of the research published between 1993 and 1999 on learners and learning in environmental education, and considers the base of evidence that this has generated. After outlining a number of general characteristics of the evidence base (Section 2.1), the nature and foci of the three established, and the three emerging, nodes of evidence will be explained in Section 2.2.

2.1. General Characteristics

This section describes the current evidence base of environmental education learning research in terms of four general characteristics. These concern its size (large but unevenly focused), nature (methodologically homogenous), interconnectedness (generally fragmented), and stability over time (changing). It is hoped that these will help to contextualise the subsequent discussion about the individual nodes of the evidence base.
Size of the Evidence Base

The first point to make is that the amount of empirical evidence on environmental education learners and learning is considerable. There were over 100 pieces of different empirical research included within this review, illustrating the fact that work is being undertaken and published on school students and environmental education. It does not appear, therefore, that there is an overall acute shortage of empirical work in this area, and, in comparison with certain previous reviews (Iozzi, 1981; Andrew & Malone, 1995), it would seem that the amount of work in this area has grown markedly. This concurs with recent accounts of the dynamic expansion of environmental education research over the last decade (Palmer, 1998; Hart & Nolan, 1999), and Hart and Nolan’s identification of ‘students’ thinking’ and ‘children’s ideas’ as two developing foci within the field.

However, within this body of work, there are marked variations in the evidence available for different foci. At a general level, for example, there is far more evidence pertaining to learners than there is pertaining to learning. That is, there have been many more studies focused on investigating characteristics of school students (e.g. what kinds of environmental attitudes or knowledge they have), than there have been exploring the process or outcomes of environmental learning. This is reflected in the structure of the current review, which has two longer main sections concerned with learners (3. Evidence on Learners’ Environmental Knowledge, and 4. Evidence of Learners’ Environmental Attitudes and Behaviours), and one shorter section concerned with learning (5. Evidence on Learners’ Environmental Learning Outcomes). Furthermore, there are imbalances within the evidence on learners, and within the evidence on learning. Within the evidence on learners, there is much more information about students’ environmental ideas and perceptions, than there is about their educational experiences and preferences. Among the studies on learning, there is a marked predominance of evidence on learning outcomes, but very little about learning processes. As will be explained in Section 2.2, this unevenness in the evidence base is reflected in the existence of established nodes with considerable available evidence, and emerging nodes with far less evidence and research activity.

The Nature of the Evidence Base

There is considerable uniformity in the type of evidence currently available on learners and learning. As will be demonstrated in subsequent sections, the vast bulk of the evidence on the established nodes of the evidence base (such as learners’ environmental knowledge, attitudes and behaviours and learning outcomes) is quantitative in nature and positivist in foundation. Moreover, the qualitative evidence that is available is almost always grounded in interpretivist/constructivist, as opposed to critical or feminist/poststructural, epistemologies, and tends to relate to particular foci only such as students’ environmental perceptions and educational experiences. Overall, then, while there are a variety of methodological approaches evident within the area (including quasi experimental work, e.g. Leeming et al., 1997, quantitative surveys, e.g. Roper Starch Worldwide, 1994, correlational studies, e.g. Chan, 1996, mixed-method evaluations, e.g. Milton et al., 1995, qualitative case study,
e.g. Bonnett & Williams, 1998, and action research, e.g. Membiela et al., 1993), the incidence of quantitative approaches is far greater than any others, and the qualitative alternatives are generally all within an interpretivist framework (one exception is Barron’s (1995) feminist poststructuralist study of children’s positions in relation to environmental discourses).

There is also a high degree of conceptual uniformity within the evidence base in the sense that much of the research is underpinned by a passive view of students. Students in environmental education learning research tend to be individuals who are to be altered through educational programmes, or young people whose environmental attitudes and knowledge need to be understood in order that they can be more effectively changed through educational interventions. This is particularly marked in much of the research on students’ environmental learning outcomes, and environmental knowledge, attitudes and behaviour. It will become clear in later sections, however, that there are also examples of studies adopting a more active view of learners, particularly within the emerging nodes. These, though, remain less prominent across the evidence base as a whole.

Another area of homogeneity within the evidence base is the strong science education influence within much of the research. This is particularly marked in the evidence on students’ environmental knowledge and students’ learning outcomes, which have a strong tendency to focus on knowledge and understanding about the science of environmental issues and the learning outcomes of various science-based environmental education programmes. This reflects the disciplinary/professional background (science/science teaching) of many of the researchers that have generated this evidence, and the strong links that continue to exist between science education and environmental education. As described below, though, other work more recently has begun to broaden the scope of environmental education learning research beyond science.

Interconnectedness of the Evidence Base

Despite the considerable amount of research on learners and learning, the picture that emerges from examining the evidence base as a whole is that it is fragmented. That is, there is research on a variety of foci but there are few connections made in the literature between these concentrations of evidence. There are few cross-references made by individual studies to other pieces of work, there are few review-style articles seeking to present and synthesise findings from different studies, and there is little conceptual discussion between different kinds of approaches. This situation is particularly marked between studies that adopt different methodological approaches, in that there appears to be little consideration of quantitative evidence by qualitative researchers and vice versa. It would seem that methodological developments in the field have led to a diversification of foci as new aspects of learners and learning have been investigated, which in turn has brought with it a fragmentation (rather than a synthesising) of the evidence base as new evidence has been generated and presented in isolation from that already in existence.

Stability of the Evidence Base

This final characteristic highlights the dynamic and developing nature of the
evidence base. While there is unevenness of focus, methodological homogeneity, and fragmentation, these aspects are all changing and evolving. New foci, for example, are emerging and challenging some of the imbalances within the evidence base, such as students’ learning experiences (as opposed to outcomes), students’ influence on their parents’ environmental behaviours (as opposed to teachers’ influence upon their students’), and students’ perceptions (as opposed to scientific knowledge) of nature. With these emerging foci come different methodological approaches and conceptual frameworks that are reducing the methodological homogeneity.

Taken together, I would argue that these four characteristics highlight a crucially important point about recent research on learners and learning in environmental education—its apparent insulation from many of the changes occurring in the broader environmental education research field. The strong prevalence of positivist approaches, for example, is in definite contrast to recent descriptions of environmental education research more generally (Palmer, 1998; Hart & Nolan, 1999), which speak of an evolution ‘during the 1990s away from its roots in the dominant social paradigm towards a broader base of methodologies [including] positivist, interpretive/constructivist, critical and feminist/postmodernist perspectives’ (Hart & Nolan, 1999, p. 36). Such changes would appear to have been far less extensive in the sub-field of environmental education learning research. In view of this, I wonder whether the traditional predominance of quantitative approaches in the area during the early decades of environmental education research (Palmer, 1998, p. 103) has somehow insulated it from many of the field’s subsequent methodological developments because researchers with different methodological outlooks have focused their attention elsewhere. In other words, the methodological innovations of the 1990s have taken place by and large in areas other than those associated with learning and learners, for example, in areas such as teacher thinking (Fien, 1992; Hart, 1996), curriculum development (Elliott, 1994; OECD, 1995), school and community partnerships (Malone, 1996), and analysis/critique of texts (Gough, 1999). Having said this, there are of course some exceptions in the form of constructivist research on children’s environmental perceptions (e.g. Wals, 1994a), and naturalistic enquiries into children’s conceptions of nature as shaped by their sociocultural contexts (e.g. Payne, 1998a), and feminist poststructuralist analysis of children’s positions in relation to environmental discourses (Barron, 1995). However, I would argue that these are still very much in the minority of the work investigated for this review, which overall is more quantitative and less diverse than the wider environmental education research field in which it is situated.

2.2. Established and Emerging Nodes of Evidence

Turning now to the nature of the evidence base in more detail, this review proposes that this can be understood in terms of six concentrations or nodes of evidence, three of which are well established (established nodes) and three of which are more emerging (emerging nodes). A node of evidence refers to an accumulation of empirical evidence about a particular topic. As explained in Section 1, the identification of these nodes evolved in a tentative manner during the early phases of the review, with their distinctions and interrelations becom-
ing clearer with time. The clues to the nodes were in the titles of publications, the key words, and the terminology and conceptual explanation within the report. The distinction between established and emerging nodes lay in the amount of evidence available on a topic, the time span over which this had accumulated, and the manner in which the evidence was reported. Compared to established nodes of evidence, then, emerging nodes tended to be the product of fewer studies that had been undertaken more recently and were presented in a way that highlighted their distinctiveness to work already published. The three established nodes of evidence are:

(1) learners’ environmental knowledge;
(2) learners’ environmental attitudes and behaviours; and
(3) learners’ environmental learning outcomes.

The three emerging nodes, meanwhile, are:

(1) learners’ perceptions of nature;
(2) learners’ experiences of learning; and
(3) learners’ influences on adults.

What follows is a brief elaboration of the foci and characteristics of each of these nodes.

**Learners’ Environmental Knowledge**

This is the category with the most empirical evidence, and represents the product of research into:

- young people’s factual knowledge about environmental phenomena
- their understanding and misunderstanding of such phenomena
- the sources of young people’s environmental information.

Work on all three of these foci has been published throughout the time period of this review, reflecting this node’s established status. Such studies have tended to focus more on secondary school students than on primary school children. This is particularly marked in work on students’ factual knowledge where almost all investigations are of secondary students. There are, however, some studies on the environmental understanding/misunderstandings of younger aged children (e.g. Strommen, 1995; Palmer, 1995, 1999; Palmer *et al.*, 1996; Glazar *et al.*, 1998), and their sources of environmental information (e.g. Palmer, 1995; Bonnett & Williams, 1998).

The geographical scope of the research on environmental knowledge is wide ranging but also concentrated, with collections of work emerging from regions such as North America (environmental factual knowledge and information sources surveys), the UK and Europe (environmental understanding/misunderstanding studies), and South Asia and Australasia (environmental factual knowledge and information sources surveys). There are also a number of comparative research projects spanning the US/UK, the UK/Greece, the UK/Slovenia/Greece, and several countries internationally.

Within much of this work there is a very strong science education influence. The environmental phenomena that have been investigated are ones from school science curricula, the research participants are often from science teaching groups, and the implications drawn often take the form of strategies for science
teachers. Furthermore, an aim of much of the work is to investigate young people’s environmental factual knowledge and/or conceptual understanding in relation to what Boyes and Stanisstreet (1994, p. 313) term ‘present scientific understanding’.

Methodologically, this node of evidence is characterised by a predominance of quantitative data, mainly of a survey-generated nature. That is, much of the evidence is derived from questionnaire surveys (both fixed- and open-response) administered to particular samples of young people in order to assess the extent of their factual knowledge, the nature and extent of their conceptual understanding/misunderstanding, and/or the sources of their environmental information. There are, however, some examples of qualitative inquiry, in terms of interview-based studies of children’s ideas about certain environmental phenomena (e.g. Palmer, 1995, 1999; Strommen, 1995; Palmer et al., 1996; Glazar et al., 1998), and the sources of their environmental information (e.g. Palmer, 1995; Bonnett & Williams, 1998). These are all interpretivist in underpinning, in that they seek to develop phenomenological understanding of the perspectives of children through exploratory interviewing.

The vast majority of studies on environmental knowledge appear to share a rationale that is based on one or both of the following arguments:

• Improved insights into the nature, and sources, of students’ environmental knowledge are crucial because: (i) although environmental information is more accessible to young people today, ‘research would appear to support Gigliotti’s conclusion (1990) that “we seem to have produced a citizenry that is emotionally charged but woefully lacking in basic ecological knowledge”’; and (ii) informed decisions on environmental questions in the future will necessitate young people ‘to be equipped with a fundamental knowledge of basic environmental concepts and processes’ (Gambro & Switzky, 1996, p. 28).

• School pupils cannot be assumed to have a tabula rasa, but rather are likely to have considerable knowledge about the science of environmental issues developed through ‘informal sources such as personal observations and the media’. However, in line with work carried out in relation to other curriculum topics in science, this knowledge is likely to be ‘rather rigid and full of erroneous interpretation and models’ (Boyes & Stanisstreet, 1996, p. 187). An awareness of the nature, underlying patterns and origins of such pre-existing ideas should be helpful in designing more effective teaching strategies.

Learners’ Environmental Attitudes and Behaviours

This second established node of evidence also has a considerable number of studies related to it that have been published throughout the 6 years of this review. Such studies have focused on young people’s attitudes towards, and behaviours in relation to, the environment. These provide information about:

• the kinds of issues that students are concerned about (environmental concerns)

• the extent and nature of their environmental concern and/or indifference (environmental attitudes)

• the extent and nature of their involvement in environmentally responsible practices (environmental behaviours).
In addition, there is also evidence connected with each of these about the kinds of factors that are influential upon young people’s concerns, attitudes and behaviours.

Throughout all of this evidence, there is a stronger orientation towards secondary aged students, as opposed to younger primary school learners. With only a few exceptions (e.g. Cullford, 1994; Kwan & Miles, 1998), respondents are within the secondary school age range. In terms of geographical location, the available evidence is for young people in Europe (the UK, Germany, The Netherlands), North America (the US, Canada), South Asia (Hong Kong, Singapore) and Australia. This is most commonly from national-level surveys, but there are also cross-national comparisons, inter-city/cross-regional comparisons, and individual-school level investigations.

The work in this area is underpinned by arguments such as:

- an understanding of environmental attitudes is crucial because they are a precursor to pro-environmental behaviour, which is the ultimate goal of environmental education (Chan, 1996, p. 298);
- young people hold environmental attitudes and ‘to achieve success in environmental education teachers need to identify and draw on children’s opinions about environments’ (Kwan & Miles, 1998, p. 12);
- there is a need for investigations of certain underresearched groups of young people, such as students from disadvantaged areas in the US (Roper Starch Worldwide, 1994), and school age Australians (Connell et al., 1998).

Unlike the previous node on environmental knowledge, there seems to be less of an explicit science education influence within the evidence on environmental attitudes and behaviours. Only a small number are undertaken within the context of science-based environmental education focusing on environmental science topics and/or investigate the attitudes of students from environmental science courses (e.g. Lyons & Breakwell, 1994; Uzzell et al., 1995; Simmons, 1998). The majority seek instead to understand young people’s environmental concerns and behaviours in order to inform environmental education more generally (e.g. Roper & Starch Worldwide, 1994; Morris with Schagen, 1996; Bonnett & Williams, 1998; Connell et al., 1998).

The methodological approaches within this node show a preference for fixed-response questionnaire surveys, as opposed to open-ended interview studies. This is not to indicate a complete absence of qualitative studies of young people’s attitudes and behaviours (examples include Cullford, 1994; Bonnett & Williams, 1998; Kwan & Miles, 1998; Connell et al., 1999), but rather to highlight their relative rarity. The focus of the majority has consequently been on the extent, rather than the nature, of students’ environmental concern, attitudes and behaviours. Hence findings tend to be in the form of percentages of study samples that agreed or disagreed with certain attitudinal statements or behavioural descriptions.

**Learners’ Environmental Learning Outcomes**

The third established node of evidence comprises slightly fewer studies than either of the previous two nodes, although still represents a strong research focus throughout the time period of the review. Another difference with the two
preceding nodes is that this one encompasses evidence about the characteristics of learners in relation to environmental education programmes, rather than the characteristics of learners in isolation. In other words, it provides information about the outcomes of educational interventions in terms of the extent to which they bring about changes in students’ environmental knowledge, attitudes and/or behaviours.

The generation of evidence about learning outcomes has been motivated by the following kinds of arguments:

- there are many possible forms of environmental education, and ‘evaluation is important to determine which forms are most effective’ (Dettmann-Easler & Pease, 1999, p. 33);
- changes in individuals’ environmental knowledge, attitudes and behaviours are crucial goals for environmental education, and so are appropriate criteria for programme evaluation (e.g. Bogner, 1998, p. 18); and
- there is a need for particular kinds of evaluation, such as formative evaluation to provide feedback on a programme as it develops (Milton et al., 1995), confirmative evaluation ‘to define, measure and confirm the enduring benefits of a program’ (Hanson, 1993, p. 364), and qualitative evaluation to provide ‘a better understanding of how certain events can lead to [students’] affective development’ (Emmons, 1997, p. 328).

The kinds of educational programmes that have been investigated include residential field courses undertaken by school groups at outdoor education centres, as well as school-based initiatives focusing on particular content areas, learning strategies, or skills. The common feature among all of these is that they tend to be short-term innovations, rather than regular long-term practices. In other words, the focus of outcome studies is largely on developmental programmes and new initiatives, rather than ongoing everyday approaches to environmental teaching. Indeed there are only two studies that focus on the outcomes of regular environmental education provision within the mainstream school curriculum (Yeung, 1995; Simmons, 1998).

Many of these programmes are based primarily on environmental science and so, as with the work on environmental knowledge, there is a strong science education influence within the research evidence on learning outcomes. There is a mixture, though, of studies of primary and of secondary aged children. In terms of geographical location, much of the evidence pertains to initiatives within the US or Western Europe (Germany, The Netherlands and Switzerland), with a small number of studies relating to programmes in the UK, Belize, Mexico and South Korea.

The vast majority of studies have investigated whether and to what extent specifically designed educational interventions can yield desired changes in learners’ environmental characteristics. In methodological terms, such studies are almost universally ones that seek to evaluate the effects of particular educational treatments (independent variables) on students’ environmental knowledge, attitudes or behaviour (dependent variables) through some kind of quasi-experimental pre-test/post-test design. This means that much of the evidence available on outcomes is quantitative in nature and utilises outcome criteria that are tightly specified prior to the investigation. In other words, the research questions being asked are of a closed nature such as ‘To what extent
does treatment x change students' attitudes towards y?', rather than open questions such as ‘What impact does initiative x have upon y students?’ One exception is Emmons’ (1997) naturalistic case study of ten Belizean high school students during a 5-day environmental education course at a wildlife sanctuary.

A further point is that the evidence on learning outcomes generally does not encompass information about the kinds of factors or conditions that may determine effectiveness in environmental education initiatives. The exceptions to this include two studies that explored the processes, as well as the outcomes, of educational initiatives (Emmons, 1997; Mason & Santi, 1998), as well as investigations that have compared the outcomes of programmes with differing characteristics (Gutierrez de White & Jacobson, 1994; Farmer & Wott, 1995; Bogner, 1998; Dettmann-Easler & Pease, 1999).

Emerging Evidence on Learners’ Perceptions of Nature, Experiences of Learning, and Influences on Adults

As explained above, there are three more nodes of evidence within the research on learners and learning that are of a more emergent nature. These represent research foci that have begun to attract greater empirical attention during the time period of this review, and for which there is less currently available evidence compared with the established nodes. They also seek (in their different ways) to investigate new aspects of learners and learning through different kinds of conceptualisations and/or approaches. There is a strong emphasis, for example, on the voice of the student and seeking to understand how learners themselves perceive nature or make sense of environmental education. There is also a concern to explore processes such as students’ learning strategies or the ways in which they interact with their parents, in a way that conceives of learners as active agents, rather than passive subjects, in their environments, educational settings and family homes. In these ways, then, they can be seen to challenge established conceptualisations and ways of investigating learners and learning by emphasising perceptions (as opposed to knowledge), experiences (as opposed to outcomes) and influence on parents (as opposed to changes in their own attitudes and behaviours).

The first of these emerging nodes is the product of a small number of exploratory studies of students’ perceptions of nature. The earliest, and most comprehensive, example was a study of young adolescents’ perceptions and experiences of nature in the Detroit metropolitan area of the US (Wals, 1994a,b). This study has been complemented more recently by investigations with primary school pupils in Australia (Barron, 1995; Keliher, 1997; Payne, 1998a, b), and the UK (Bonnett & Williams, 1998). Together, these provide information about:

• the way young people perceive ‘nature’ and (to a lesser extent) ‘environment’; and
• some of the influences that may shape such perceptions.

The work in this area argues that: (i) it important for research to try to understand students’ experiences and perceptions of nature in order ‘to be able to adapt environmental education to the social and physical context of the school community’ (Wals, 1994a); (ii) ‘nature’ and ‘environment’ are contested terms and environmental education researchers and practitioners know very little, but
often assume a great deal, about how these are perceived by learners (Payne, 1998a); (iii) an understanding of ‘the contradictory ways that children take up environmental discourses’ is important for the development of environmental education (Barron, 1995); and (iv) attitude surveys are insufficient as a means of working towards meaningful understandings of young people’s environmental perceptions and thinking.

Studies have focused mainly on primary school aged children, with the exception of Wals (1994a,b) study, which includes secondary as well as primary students. The evidence is qualitative in nature, reflecting these studies’ common aim of generating phenomenological (or poststructuralist, in the case of Barron, 1995) understandings of children’s ideas and perceptions. The claims tend to be descriptive and are often tentatively expressed, reflecting the phenomenological, and exploratory, nature of the work. This is particularly so for the findings reported about influences that may shape young people’s perceptions. Payne (1998a, p. 20), for example, makes it clear that his work ‘does not explain how children such as those in the study are socialised into, and socially construct, understandings of nature and of their environments’.

Turning to the second emerging node, evidence on students’ experiences of learning has come from recent research that has sought to investigate learning in environmental education from the perspective of the student. These include studies questioning students about the environmental education they received at school (Roper Starch Worldwide, 1994; Battersby, 1999; Connell et al., 1999), as well as more detailed exploration of young people’s experiences of participating in particular environmental learning situations while at school (Schindler, 1993; Jensen et al., 1995; Means, 1998; Bixler & Floyd, 1999; Lai, 1999; Rickinson, 1999).

This work has generated information about young people’s:

- perceptions of, and preferences for, environmental education at school; and
- experiences of environmental learning situations.

These kinds of foci, particularly the latter, are argued to be important because: (i) the voice of the learner is a severely neglected one in environmental education research and curriculum development (Payne, 1998a; Rickinson, 1999); and (ii) learning is an active process influenced by emotional factors, and needs to be researched as such through naturalistic consultation with students about their experience, and learning (Lai, 1999).

The evidence of this emerging node is predominantly qualitative in nature, with many studies being based on semi-structured interviews and participant observation of students. It is not exclusively qualitative, though, as some information about students’ preferences for environmental education is based on questionnaire survey data (Roper Starch Worldwide, 1994). Much of the evidence of all kinds pertains to secondary aged students, although there is some relating to primary children. It emerges from a variety of geographical contexts, including the UK, the US, Australia, various OECD countries, Hong Kong and Denmark.

Finally, the third emerging node relates to work undertaken on the capacity of school students to influence the environmental attitudes and behaviours of their parents through communication about environmental matters. One study undertaken on this was a European Union-funded project in the early 1990s (Uzzell et al., 1994). Through case studies in four European countries—Denmark, England, Portugal
and France—it sought to examine whether children, in conjunction with schools, could act as catalysts of environmental change in the home and the community. More recently, the impact of environmental education programmes on student–parent environmental communication and parental action has been investigated in Australia (Ballantyne et al., 1998a,b), the US (Leeming et al., 1997), and the UK (Evans et al., 1996).

The findings of these research studies provide insights into:

- the capacity for young people to act as catalysts of environmental change in relation to their parents; and
- the various factors that can affect intergenerational communication and influence.

These foci have been motivated by the idea that: ‘If children could be given environmental education at school and encouraged to disseminate it at home and in the community, this would be an extremely effective way of influencing and educating parents to sustainable environmental behaviours’ (Uzzell, 1999, p. 406).

The evidence relates to both primary and/or secondary school respondents, and comprises quantitative as well as qualitative findings. Studies either present numerical measures of the impact of educational initiatives on parents’ environmental characteristics (Evans et al., 1996; Leeming et al., 1997), or give a mixture of qualitative and quantitative evidence, such as orientation scale data combined with interview accounts (Uzzell et al., 1994; Ballantyne et al., 1998a). The analysis and discussion of this evidence tends to be exploratory and fairly descriptive. One exception was the European study, which was more comprehensive in scope and detailed in its findings.

3. Evidence on Learners’ Environmental Knowledge

There is, as explained in the previous section, a significant amount of evidence on students’ environmental knowledge. This evidence provides information about:

- young people’s factual knowledge of environmental phenomena—the extent of particular groups of students’ factual knowledge about wide ranges of different environmental phenomena;
- young people’s understanding (and misunderstanding) of environmental phenomena—the nature, and structure, of students’ ideas (including their misconceptions) about specific environmental issues, and how these compare to accepted scientific knowledge;
- the sources of young people’s environmental information.

The evidence relating to each of these foci will be considered in the following three sections. Each will describe the available evidence, and consider the key messages.

3.1. Students’ Factual Knowledge of Environmental Phenomena

3.1.1. The available evidence. There are several studies that have investigated young people’s environmental factual knowledge. These include:
surveys of the factual knowledge about a variety of environmental issues among secondary school students in the US (Roper Starch Worldwide, 1994; Gambro & Switzky, 1996, 1999), Australia (Clarke, 1996; Connell et al., 1999), Singapore (Ivy et al., 1998), The Netherlands (Kuhlemeier et al., 1999), and Hong Kong (Chan, 1998); and

- surveys of students’ factual knowledge of particular kinds of environmental problems, such as natural resource issues in Northwest USA (Cardeiro & Sayler, 1994), local urban waste management in a Spanish city (Membiela et al., 1993, 1994), and industrial pollution in the UK (Lyons & Breakwell, 1994).

The evidence generated by these studies is characterised by a number of distinctive features. Firstly, it constitutes survey-generated data of a quantitative nature, usually reported in the form of how many young people (in a particular sample group) know certain pieces of environmental knowledge: An example would be: ‘In 10th grade, 61% of the students were aware than the burning of fossil fuels is the primary source of energy in the United States today’ (Gambro & Switzky, 1996, p. 30). Secondly, it relates exclusively to students of secondary, as opposed to primary, school age. Thirdly, it concerns what young people know about a variety of environmental issues, and can therefore highlight variations in levels of factual knowledge for different environmental topics. This contrasts with the evidence in the next section about understanding/misunderstanding (Section 3.2), which tends to be more focused on what young people think about specific individual issues. Finally, it provides information about the proportion of students that correctly know certain pieces of factual information, but does not go into the nature of their knowledge. This represents another difference with the evidence in the next section, which considers the nature of students’ understandings and misunderstandings.

3.1.2. The key messages. The currently available evidence can be summarised in terms of three key messages.

(1) Levels of students’ factual environmental knowledge are generally low

In the majority of cases, levels of factual knowledge in relation to a wide variety of environmental issues are found to be low among groups of students. Researchers in the US, for example, speak of ‘disappointing levels of knowledge’ in light of the fact that among their sample of over 1800 high school students ‘only approximately one third (36.3%) [...] correctly answered five or more of the [seven] items’ (Gambro & Switzky, 1996, p. 32). More recently, in a study of over 9000 Dutch secondary school students, Kuhlemeier et al. (1999, p. 7) report that ‘the environmental knowledge of many students left much to be desired’, particularly in light of the high proportion of students that selected the response ‘I really do not know’, suggesting that ‘many [...] were uncertain whether or not the statements on environmental topics presented to them were correct’. Similar kinds of findings are reported for young people in Spain (Membiela et al., 1993), Australia (Clarke, 1996; Connell et al., 1998) and the UK (Lyons & Breakwell, 1994).

One study in Singapore, however, yielded contrasting findings. In their survey of 1256 secondary school/junior college students (aged 15 and 17 years), Ivy et al. (1998, p. 192) report ‘high environmental knowledge scores’, adding that ‘the mean knowledge score in the present study is higher than those reported in
several of the nation-wide environmental studies reviewed’ (ibid., p. 185). Another study in Hong Kong also claimed to have found encouraging levels of factual environmental knowledge amongst a sample of 1032 students. However, the basis for their claim that ‘students were very knowledgeable on many environmental issues’ does not seem well supported by their main finding that ‘Out of the 80 questions asked, 34 questions were correctly answered by at least 70% of the respondents’ (Chan, 1998, p. 11).

In seeking to draw comparisons of this nature between the findings of different studies of factual environmental knowledge, it is important to remember that they are all exploring factual knowledge of quite different environmental phenomena. For example, there is potentially a considerable difference between knowing about energy supply, acid rain and the greenhouse effect in the US (Gambro & Switzky, 1996, p. 32), refuse disposal in Orense, Spain (Membiela et al., 1993), and environmental facts about Hong Kong and the wider world (Chan, 1996). Notwithstanding this point, the general message stemming from recent evidence is that factual environmental knowledge among secondary age students is lower than might be hoped.

(2) Students’ factual knowledge can vary for different environmental topic areas

As well as indicating general levels of students’ factual environmental knowledge, several of the studies also suggest that students’ environmental factual knowledge can vary considerably depending upon the topic under consideration. Connell et al. (1998, p. 42), for example, found factual knowledge amongst 5688 Australian students to be lower for certain environmental concepts such as intergenerational equity and precautionary principle, as compared with others like renewable resources and ecology. Somewhat similarly, Kuhlemeier et al.’s (1999, p. 7) study in the Netherlands reported that ‘the knowledge of the students varied quite a bit between items’; an example (from many) being that practically all students knew about recycling, but just over a third realised that cut flowers from the florist’s are usually grown with poison.

Chan’s (1998) work in Hong Kong showed that, while there were no significant differences between Hong Kong students’ knowledge about global and local environmental issues, they were more aware of certain issues (such as wildlife issues and air pollution), and less aware of others (such as world population, rainforest destruction and Hong Kong’s pollution problems due to construction waste). Cardeiro and Sayler (1994) found that a sample of 542 students in Washington State (10–13 years) performed well on questions dealing with tropical rainforest destruction and the effects of clearcutting, but did badly with questions about animal populations and endangered wildlife species. In the US, Roper Starch Worldwide (1994) found that students’ self-reported knowledge levels were highest for air pollution and recycling, moderate for endangered animals, ozone depletion, trash disposal and rainforest destruction, and lowest for pollution of water courses and oceans and shortage of drinking water.

Finally, two studies (in Spain and Greece respectively) report that students’ factual knowledge is better developed in relation to larger animals, especially pets and mammals, than in relation to smaller non-domestic animals and plants (Membiela et al., 1994; Paraskevopoulos et al., 1998). Membiela et al. (1994, p. 136), for example, found that when asked about living creatures in their city,
students spoke about domestic animals or animals in captivity, while ‘small living creatures, both animals […] and plants’ were mentioned far more rarely. Discussion of such variations within the various research studies tends to focus on factors such as media coverage and school curricula, all of which are covered in Section 3.2.

(3) Students’ environmental factual knowledge appears to vary with several factors

From the studies discussed in this section, it would appear that environmental factual knowledge can be influenced by gender, schooling and socio-economic grouping. Evidence relating to age and geographical location is less conclusive.

Gender. There is conflicting evidence with respect to the influence of gender on young people’s environmental factual knowledge. In a recent US study of over 1800 high school students (17–18 years), Gambro and Switzky (1999) reported finding that male students were significantly more likely to have higher levels of environmental knowledge when compared with female students. Furthermore, this relationship remained significant when the number of science classes taken by students was controlled for. In contrast to this, Connell et al.’s (1998, p. 45) work in Australia found that ‘female students had stronger conceptual knowledge than male students, correctly defining more than five out of the ten concepts significantly more often’. In assessing the apparent divergence between these two findings, it is important to bear in mind the possible influence of these two research groups’ varying constructions of ‘environmental knowledge’. In other words, the above differences may reflect the fact that one study was concerned with ‘specific facts and concepts’ about ‘acid rain, the greenhouse effect and future sources of energy’ (Gambro & Switzky, 1999, p. 17), while the other explored ‘conceptual rather than factual knowledge’ about ‘a set of key environmental concepts’ (Connell et al., 1998, p. 40).

Indeed, a survey of over 2000 young people from disadvantaged and non-disadvantaged areas in the US (Roper Starch Worldwide, 1994) suggests that levels of factual knowledge can vary between the genders depending upon the environmental topic that is in question. It is important to bear in mind, however, that this study (unlike the ones referred to above) was based on self-report knowledge levels rather than tested levels. It found that female students reported greater knowledge than boys in relation to recycling, trash disposal and endangered species, while more boys than girls felt themselves to be knowledgeable about rainforest destruction. On the basis of this (which holds true across students from both disadvantaged and non-disadvantaged areas), they suggest that ‘girls tend to know more than boys about issues affecting the “here and now”’ (ibid., p. 77). A connection might be drawn between this and Myers et al.’s (1999, p. 117) study of over 700 English secondary students’ ideas about the environmental impacts of cars, in which the authors suggest that: ‘males tend to be more aware of issues which are longer term, of a wider dimension, but rather abstract. Females, in contrast, may be more concerned with immediate, local problems, perhaps impinging on human health’. However, it is important to stress that more generally this study found ‘relatively few items showing statistically significant differences between males and females’ (ibid., p. 117).

Two further investigations that explored this issue reported finding no significant relationship between gender and environmental knowledge levels
(Cardeiro & Sayler, 1994; Clarke, 1996). Indeed Clarke (1996, p. 25) states specifically that: ‘The gender difference in environmental knowledge reported in the literature is not supported by the data in this study’. The small scale of this research, which was conducted with one year group in one Australian school, is important to bear in mind, however.

Schooling. The findings of four studies suggest an influence of schooling upon young people’s environmental knowledge. Firstly, Connell et al.’s (1998, p. 44) study of two Australian cities found that: ‘Brisbane students [...] had a higher overall familiarity with environmental concepts and showed a greater ability to define environmental concepts correctly than Melbourne students’. In their discussion, the authors suggest ‘more effective environmental education in the Brisbane school system’ as an explanation for this trend, arguing that ‘students’ knowledge of the fundamental concepts dealt with by the questionnaire was obviously strongly related to the education students received’ (ibid., p. 45).

Further evidence comes from Kuhlemeier et al.’s (1999) recent study in The Netherlands, which reported marked and significant differences between the 206 schools in their sample in terms of the average environmental knowledge of their students. They also found that the difference between schools was greater for environmental knowledge than for other measures such as environmental attitude and environmentally responsible behaviour. Unlike Connell et al., however, these authors argue that the strong differences between schools’ environmental knowledge scores is more a reflection of ‘differences between types of training in the cognitive level of the student population, partially as a consequence of differential enrolment (selection)’, rather than a result of differences in instructional quality, since ‘environmental problems are seldom or rarely taught in Dutch secondary education’ (Kuhlemeier et al., 1999, p. 11).

Thirdly, in the realm of school-based science education in the US, Gambro and Switzky (1999, p. 20) found that there was a significant relationship between the number of science classes a student had taken and the level of their knowledge about environmental issues. This, they suggest, ‘provides some evidence that science education can be an influential factor in developing knowledge related to environmental issues’ (ibid., p. 20). It therefore also supports the idea that school-level factors can impact upon young people’s environmental knowledge.

Finally, Roper Starch Worldwide (1994, p. 65) reported, on the basis of students’ self-reports for both parameters, that: ‘there appears to be a strong correlation between overall environmental knowledge and [the extent of] environmental education in schools’. In other words: ‘students from disadvantaged [and non-disadvantaged] areas who say they are learning a “a lot” about the environment in school, are likely also to report they know “a lot” about the environment in general’ (ibid., p. 65).

Socio-economic grouping. There is limited evidence in relation to this issue, with the exception of two US studies. The first of these (Roper Starch Worldwide, 1994, p. 66), a survey of over 2000 American young people from disadvantaged and non-disadvantaged areas, found that ‘students from disadvantaged areas appear to have significantly less environmental knowledge than students from non-disadvantaged areas’. This study also noted a difference in the foci of their environmental knowledge such that students from disadvantaged areas cited ‘shortages of drinking water’ as the issue they know most about, while students
from non-disadvantaged areas felt most knowledgeable about ‘destruction of the rainforest’. In addition, while all of the female respondents in the sample reported greater knowledge about recycling and trash disposal (as noted above), girls from non-disadvantaged areas were the only ones to feel they also knew about endangered species.

The second, more recent, study (Gambro & Switzky, 1999), which investigated some 1800 high school students’ knowledge about energy and pollution issues, reported a significant positive relationship between parental educational attainment and students’ environmental knowledge. They also found, however, that the proportion of students achieving the satisfactory level of knowledge across all levels of parental education was low. In other words, ‘although the educational level of a student’s parent(s) may influence the amount of environmental knowledge a student possesses, it can only provide a foundation on which the child must build with her or his own experiences’ (Gambro & Switzky, 1999, p. 20).

Age. There is little evidence on the relationship between age and students’ factual environmental knowledge, and that which is available is based on cross-sectional, as opposed to longitudinal, studies. In other words, differences are between differently aged students within study samples, rather than changes in particular students though time. One study (Cardeiro & Sayler, 1994, p. 133) that found significantly higher environmental knowledge for 11-year-olds as opposed to 12-year-olds suggested it was due to ‘curricular differences’ as opposed to their ages per se. Furthermore, Roper Starch Worldwide (1994, p. 65) suggest that the effect of age is mediated in some way by socio-economic grouping. That is, while they find ‘no large differences for reported knowledge among the various grade groupings of students from disadvantaged areas’, the opposite was true for the students from non-disadvantaged areas where reported environmental knowledge increased with age after grades 4 and 5 (9- to 11-years-olds), only to decrease again after grades 9 and 10 (14- to 16-year-olds).

Geographical location. There is no consensus in the findings from studies that explored geographical location as a possible influencing factor on factual environmental knowledge. In their study of students in the US Pacific Northwest, Cardeiro and Sayler (1994, p. 135) found ‘little systematic variation in knowledge levels by geographical area’ between eastern and western Washington or by urban or rural setting. This was supported by Roper Starch Worldwide (1994, p. 65), who found that ‘knowledge about environmental issues and problems is consistent across the four regions of the country and similar in urban and rural areas for both disadvantaged and non-disadvantaged students’. By contrast, as mentioned above, the findings from Connell et al.’s (1998, p. 44) study of two Australian cities indicate marked variation in factual environmental knowledge between these two locations.

3.1.3. Summary. Surveys of secondary school students in several countries report generally low levels of factual knowledge relating to environmental issues. Perhaps unsurprisingly, it is also found that knowledge levels can vary considerably between different topics. There is also evidence to suggest that students’ factual environmental knowledge can vary with gender, schooling, and socio-economic grouping. Trends in relation to age and geographical location are
unclear given the currently limited evidence. Indeed, for all the influencing factors, the evidence is not particularly strong, and there is no statistical data available on the relative importance of these various factors.

3.2. Students’ Understanding of Environmental Phenomena

3.2.1. The available evidence. There are a large number of research studies that have investigated students’ understanding/conceptual knowledge relating to environmental issues. The available evidence encompasses:

- findings from surveys that have compared students’ conceptual knowledge and factual knowledge about environmental issues (Gomez-Granell & Cervera-March, 1993; Clarke, 1996; Gambro & Switzky, 1996; Foreid & Filho, 1997; Connell et al., 1998; Ivy et al., 1998);
- findings from studies (using questionnaire and/or interviews) of young people’s ideas about various global environmental phenomena such as the greenhouse effect/ozone depletion/air pollution (Boyes & Stanisstreet, 1993, 1994, 1996; Boyes et al., 1993; Revell et al., 1994; Qualter et al., 1995; Batterham et al., 1996; Potts et al., 1996; Myers et al., 1999), ecological habitats (Greaves et al., 1993; Strommen, 1995; Brody, 1996); waste management (Palmer, 1995; Kortland, 1997), and distant environments/ various local and global issues (Palmer et al., 1996; Glazar et al., 1998; Palmer, 1999); and
- information about the kinds of conceptual models held by students about the processes involved in various kinds of environmental degradation, such as ozone depletion (Christidou & Koulaidis, 1996; Christidou et al., 1997), the greenhouse effect (Koulaidis & Christidou, 1999), global environmental change causing skin cancer (Boyes & Stanisstreet, 1998), links between the greenhouse effect and ozone depletion (Boyes & Stanisstreet, 1997a), air pollution in cities (Wylie et al., 1998), and the timing of spring (Chipeniuk, 1998).

The evidence generated by these three groups of studies has the following characteristics. First, it relates predominantly to young people’s understanding of the science of environmental issues, particularly ones of a global nature. This reflects the strong science education influence in this part of the evidence base, in that most of the research has been undertaken within the context of school science. Secondly, it pertains to learners of both the secondary, and primary, age group. There is also a strong focus on students within the UK, reflecting the considerable outputs from two UK-based research groups (Palmer et al. at the University of Durham, and Boyes and Stanisstreet et al. at the University of Liverpool). Thirdly, the evidence comprises a mixture of the quantitative (fixed- or open-response questionnaires, sometimes followed up with factor analysis of response patterns) and the qualitative (semi-structured or unstructured interviews, sometimes involving stimulus materials such as photographs).

3.2.2. The key messages. There are four key messages that have emerged from the body of work on students’ understanding of environmental issues.
Students’ understanding of environmental issues is more limited than their factual knowledge

A common point made by several research reports is that while students may have factual knowledge about environmental phenomena, this is often not reflected by sound understanding of such phenomena. Gambro and Switzky’s (1996, p. 31) survey of 1870 US high school students, for example, reported a ‘36% discrepancy between students’ knowing that burning fossil fuel causes pollution and understanding the consequences of exploiting that energy source’. They conclude that ‘most high school seniors […] lack the necessary understanding to go beyond the common recognition of an issue and use their knowledge to grasp the consequences of environmental problems or offer solutions for those problems’ (ibid., p. 31).

A similar finding is reported in relation to a sample of over 2000 secondary school students in Hong Kong who were found to perform better on knowledge recall questions compared to ones ‘which required the application of concepts and evaluation of alternative explanations or solutions’, especially those involving visual rather than written information (Yeung, 1998, p. 257). Other studies that have reported similar kinds of findings include work carried out in Australia (Connell et al., 1998), Spain (Gomez-Granell & Cervera-March, 1993), the UK (Boyes & Stanisstreet, 1998), the USA (Strommen, 1995), and internationally (Foreid & Filho, 1997).

It is important to note, though, that there are two studies whose findings do not correspond with those mentioned above. Both Ivy et al.’s (1998) work in Singapore, and Clarke’s (1996) study in an Australian secondary school report higher student scores for conceptual understanding as compared with factual environmental knowledge. However, in the latter study the difference was only ‘slightly higher’ and in neither piece of work were the differences tested for statistical significance.

While all of the above studies have provided information about the extent of students’ environmental understanding, not all have also generated data on the nature of such understanding. The latter has tended to be explored by researchers in the science education field concerned with young people’s understandings and misunderstandings about the science of environmental issues. It is the findings from this work that give rise to the next key message.

Students display considerable confusion about the science of environmental issues, often characterised by persistent misconceptions

From a number of studies in this area, there is a recurring finding that young people’s ideas about many environmental issues are characterised by considerable confusion, and scientifically inaccurate conceptions. Before exploring this further, it is important to point out that the research evidence also highlights certain strengths in young people’s understanding of environmental issues. Palmer et al. (1996, p. 328) stress that ‘many children of a very young age, i.e. six, are capable of quite sophisticated thinking and reasoning’, and constitute ‘active thinkers in the realm of environmental issues’. Similarly, Strommen (1995, p. 695) describes primary aged children’s knowledge of forests as ‘rich in the sense that they have an impressive store of knowledge of different types of animals, plants, bugs, and other organisms’. In addition, Wylie et al.’s (1998,
study of 8- and 11-year-olds’ thinking about air pollution concludes that ‘children can engage in systematic thinking earlier than predicted by traditional developmental theories’.

These points, however, need to be seen alongside the considerable number of contrary arguments about young people’s environmental understanding being ‘incomplete’ and lacking in structure (Strommen, 1995, p. 695), and comprising erroneous ideas or ‘misconceptions’ (Strommen, 1995; Boyes & Stanisstreet, 1996; Palmer, 1999). The notion of misconceptions is widely reported in the context of studies on secondary school students’ ideas about global environmental issues (Boyes & Stanisstreet, 1993, 1994, 1996; Revell et al., 1994; Batterham et al., 1996) and ecological habitats (Greaves et al., 1993; Munson, 1994; Strommen, 1995; Brody, 1996), as well as primary school students thinking about distant environments, and various local and global issues (Palmer, 1995, 1999; Palmer et al., 1996; Glazar et al., 1998).

Looking across these studies, there appear to be two particular areas of confusion in young people’s thinking: confusion in distinguishing between phenomena, and confusion about processes.

Confusion in distinguishing between phenomena. A common finding from much of Boyes and Stanisstreet’s work is that young people frequently confuse and/or fuse ideas about different environmental issues. An often-cited case is poor understanding of the differences between the causes of global warming, on the one hand, and the causes of ozone layer depletion, on the other. Close to three-quarters of a sample of 861 secondary students in a UK study, for example, thought that ‘holes’ in the ozone layer caused global warming (Boyes & Stanisstreet, 1993), and 50% in another study (of 1700 students) agreed that the greenhouse effect was a cause of ozone depletion (Boyes & Stanisstreet, 1994). Other examples include poor understanding of the differences between: smoke from factories/cars as compared with other kinds of emissions in relation to ozone depletion (Boyes et al., 1999), and heat rays and UV rays in relation to skin cancer (Boyes & Stanisstreet, 1998). With respect to the latter, Boyes and Stanisstreet (1998, p. 34) stress that:

the problem is not simply one of knowledge (although this is lacking in some students) but also of conceptualisation. Although students know about the terms heat rays and UV rays, they may not be able to distinguish between the two—or even among these and heat or high temperatures. (original emphasis)

Such findings are echoed in several other studies (Revell et al., 1994; Foreid & Filho, 1997; Koulaïdis & Christidou, 1999).

As well as confusing the causes and consequences of different global issues, the evidence also indicates that students struggle with appreciating the distinctions between different kinds of habitats. In his study of 20 primary school children’s conceptions of forests and their inhabitants, for example, Strommen (1995, p. 695) noted that ‘children do not distinguish between marine and freshwater environments’ and so include animals like sharks, whales and dolphins as forest dwellers, and also readily include animals from the savannah such as ’high-familiarity zoo animals’ like lions, giraffes and elephants. He noted that ‘children’s notion of which animals live in forests are often inaccurate, even though their other knowledge about the animal may be correct’ (ibid., p. 695).
This concurs with findings reported by Palmer (1995, 1999) about children’s ideas about the inhabitants of rainforests, which commonly included temperate woodland creatures, and (less frequently) animals of the tropical savannah such as lions.

Another area of confusion with distinctions is noted in Kortland’s (1997) small-scale study of Dutch secondary school students’ perceptions of waste issues. This investigation reported that students had conceptual problems with the distinction between: renewable and non-renewable raw materials, recyclable and non-recyclable materials, and reusing and recycling (for which there is only one word in Dutch). Similarly Membiela et al. (1993, p. 31) reported that Spanish students ‘confused the term reuse and recycling’.

Confusion about processes. Another point that has been commonly noted is that students display poor understanding of mechanisms and processes. In her work with 62 6-year-olds in the UK, for example, Palmer (1995) reported that ‘young learners […] frequently possess blurred or inaccurate understanding of processes and events in the world around them’. One manifestation of this in relation to recycling was that ‘many children held the false idea that it is the very same can (bottle, crisp packet, etc.) that is used again for the same purpose for which it was originally intended’ (Palmer, 1995, p. 42). The author also commented upon how children confused ‘genuine recycling in the sense of a managed, factory-based process, and the use of waste for creative purposes [such as] recycling waste for the making of such items as robots, waste monsters, hats and boats’. Only a few, therefore, ‘articulated accounts of actual recycling which touched on reality’ (ibid., p. 43). A similar point is made in a later study by the same author concerning 6-year-olds’ ideas about the process of melting. Misunderstandings included the idea that snow would first change into ice before melting into water (15%), that snow would change into grass or ground (10%), or that snow just ‘went away’ (9%) (Palmer et al., 1996, p. 317).

The examples given above in connection with these two kinds of confusion are depicted in the literature as having persistence through time. Palmer (1999, p. 385), for example, in a recent discussion of her work on ‘emergent environmentalism’ among early years learners, states that:

One key outcome is, of course, the identification of ‘robust’ misconceptions that appear to be withstanding the passage of time. An example of such a misconception is that only temperate creatures can live in tropical forests. A significant correlation has been found between making this error at 6 and making it at 8.

Discussion about the causes or sources of such persistent misconceptions moves into the realm of the nature of children’s thinking, and/or the impact of various external influences on children such as school textbooks and the media. The following two key messages will explore each of these areas in turn.

(3) Students’ confusions appear to relate to the way they structure their knowledge

There are some studies that seek to understand students’ various understandings and misunderstandings by exploring in more detail the structure of their thinking. The evidence from such work suggests that students’ thinking about environmental phenomena:
• encompasses ‘robust [often inaccurate] models’ and metaphors (Boyes & Stanisstreet, 1997a, p. 23; Christidou et al., 1997);
• is ‘rich in content but poor in structure’ (Strommen, 1995, p. 695);
• comprises ‘funnelled’ ideas (Boyes & Stanisstreet, 1996, p. 193).

‘Robust models’ and metaphors. Boyes and Stanisstreet (1997a, p. 23) argue strongly that students’ knowledge about environmental issues does not simply comprise isolated ideas, but is grounded in ‘robust analogies and models of how these phenomenon occur’. With respect to the conflation of the greenhouse effect and ozone depletion mentioned above, two examples of student models underpinning this are that: (i) holes in the ozone layer somehow allow more solar radiation to arrive at the earth, thereby causing global warming; and (ii) the sun’s rays approach the earth through holes in the ozone layer, and then, being unable to find the holes to get back out again, thus contribute to global warming (Boyes & Stanisstreet, 1996, p. 190; 1997a). Further evidence on models and metaphors in student thinking is available in studies carried out in Greece (Christidou & Koulaidis, 1996; Christidou et al., 1997; Koulaidis & Christidou, 1999), all of which provide examples of the different ways in which primary children can conceptualise phenomena such as the ozone layer and its depletion, or the greenhouse effect.

‘Rich in content but poor in structure’. In his study of young children’s conceptions of forests and animals, Strommen (1995, p. 695) found their ideas to be ‘a collection of very concrete facts, detailed in their own right, but isolated from one another such that common features are not recognised or coordinated into systematic categories’ (ibid., p. 695). The basis for these arguments is that respondents, when asked about animal habitats and food sources in forests, were highly consistent and specific in their answers. For example, trees (lived in by birds and certain mammals) and meat (eaten by bears) were frequently mentioned. The author concludes that: ‘It appears that the children do not think of where an animal lives or what animals eat as categories or concepts. Instead, they only know about particular animal-place or animal-food relationships that require the naming of the specific animal or place to be accessed’ (ibid., p. 695).

Some support for this notion of students’ thinking being specific to particular cases or examples, is found in the work of Boyes and Stanisstreet (1997b) on ideas about the environmental impact of cars among 1600 14- to 15-year-olds. They found that over half of the respondents were aware that carbon dioxide in car exhausts contributed to global warming, but only 11% appreciated that nitrogen oxides could also have this effect. In response to this, the authors argue that: ‘A general difficulty here may be that some children’s thinking is unidimensional and that children intuitively associate one phenomenon with one cause; once they have accepted one cause of a phenomenon they may be reluctant to assent to other causes’ (ibid., p. 279).

This seems to correspond with a finding from Wylie et al.’s (1998) study of children’s systems thinking ability in relation to issues such as urban air pollution. Based on analysis of 35 primary school pupils’ interview comments about various photographs ‘depicting urban scenes in an Northern Ireland city’, they found that even though children were able to think in terms of cycles, ‘the
majority of their cycles were not linked in meaningful ways’ (ibid., p. 131). The authors conclude that ‘children do not integrate information spontaneously and [...] must be encouraged to do so’ (ibid., p. 133).

‘Funnelled’ ideas. Another argument put forward by Boyes and Stanisstreet’s work is that students’ thinking about the causes and consequences of various kinds of pollution can become funnelled. That is, the many different kinds of pollutants (or ‘inputs’) that they are aware of are seen as ‘giving pollution in general’, and the consequences (or ‘outputs’) are seen as ‘being caused by pollution in general’ (Boyes & Stanisstreet, 1996, p. 193; original emphases). This, the authors argue, helps to explain why young people often fuse and confuse the causes and consequences of different environmental problems, such as global warming and ozone depletion. As Batterham et al. (1996, p. 352) elaborate: ‘This funnels their thinking so that, although they are aware of the various sources of environmental contamination, children see them in a conflated way as causing all consequences, and so fail to distinguish the causal conceptual links’. They go on to add: ‘So, for example, children may correctly identify the link between vehicle emissions and global warming, but erroneously believe that vehicle emissions also contribute to ozone layer damage’ (ibid., p. 352). A similar argument about student thinking is made by Boyes et al. (1999) in response to finding that Greek students (to a greater degree than UK students) expressed agreement with the idea that ozone layer depletion would lead to more heart attacks. They suggested that students can: ‘sometimes [...] connect pieces of information, a proportion of which may be correct, in a scientifically coherent way and make inferences that are erroneous’ (ibid., p. 736).

(4) Students’ difficulties with understanding environmental issues appear to relate to various external influences, such as school, media and the issues themselves

As stated earlier, there are several studies that have set young people’s understanding/misunderstandings of environmental issues in a broader context encompassing external factors that may be influential upon their thinking. Three such factors have been dominant in these discussions: school, the media and the nature of the global environmental issues themselves.

School. Schools and teaching are discussed in several studies of students’ environmental knowledge and understanding. These have proposed the following connections between the nature of school-based environmental teaching and students’ environmental knowledge development.

- Use of ambiguous terminology in lessons and resources may foster confused and imprecise thinking on the part of students—Boyes and Stanisstreet see use of the term ‘pollution’ as particularly unhelpful in educating students about global environmental issues. Their view is that it contributes to a ‘funnelling’ of students’ thinking (noted earlier) by conveying too general an impression, whereby all pollutants are seen as ‘giving pollution in general’ which then causes a whole variety of environmental problems. The result of this is ‘a fusing and confusing [of] the various processes in the mind of the learner’. On this basis, they suggest that ‘rather than using the catch-all term pollution [...] children need to be made more aware of the specific pollutants
and the different problems that they cause’ (Boyes & Stanisstreet, 1996, p. 194). Evidence to support this argument is provided by a more recent study undertaken in the US, which investigated 143 middle school students’ use of certain environmental education textbooks for written classroom tasks about biodiversity dilemmas (Chenhansa & Schleppegrell, 1998). On analysing students’ work in relation to the texts they used, this study suggests that ‘Using one word, pollution, [...] seems to lead some students to a lack of clarity concerning what is the cause and what is the effect. [...] Students’ writing reflects this ambiguity, as they suggest both that the problem is pollution and pollution is causing the problem’ (ibid., p. 59).

This study, in fact, identifies further linguistic features of learning resources that can be unhelpful to students’ understanding of biodiversity issues. In particular, the authors argue against the use of abstract nouns (as opposed to concrete ones), and agentless processes (as opposed to ones with clear actors and actions). For example, in a passage about threats to Bengal tigers which states ‘Now they’re in trouble because of habitat loss and people killing them illegally for their bones, which are used to make traditional Asian medicines’, they criticise the phrase ‘habitat loss’ as it is expressed as an abstraction rather than as an ongoing process (like the people killing tigers) and so has less salience for students (ibid., p. 61). Their general argument is that ‘abstract nouns and lack of explicit agents impede students’ full comprehension of complex issues and obscure the causes and solutions to environmental problems’ (ibid., p. 53).

- Certain visual or metaphorical representations can be unhelpful to the development of learners’ understanding—another suggestion emerging from the work of Boyes and Stanisstreet is that children’s inaccurate ideas about links between the greenhouse effect and ozone depletion may be the consequence of illustrations in school textbooks. For example, the idea that holes in the ozone layer allow more solar radiation to arrive at the earth causing global warming, they suspect, ‘may have its origins [...] in schematic diagrams, [where] arrows are shown approaching the earth, re-radiating from the surface and then becoming trapped in the earth’s atmosphere’. Their view is that ‘children think that the “boundary” of the atmosphere is the ozone layer, and re-radiation as a mirror-like “reflection” of heat rays’ (Boyes & Stanisstreet, 1996, p. 190). There is evidence to support the idea that different kinds of representations can shape students’ understanding in Christidou et al.’s (1997) study of 40 primary students’ use of metaphors about the ozone layer and its depletion. They found that the way children represented the role and depletion of ozone is strongly correlated with the types of metaphors they used while constructing and/or articulating their models. On this basis, the authors propose that certain metaphors (such as the ozone layer, rather than the ozone hole) are more helpful to learners because they promote more appropriate models (such as a reduction in the concentration of ozone, rather than localised complete destruction of ozone).

- Teaching about environmentally responsible actions without considering why they are beneficial can increase young children’s misconceptions—in her work on young children’s concepts about waste management, Palmer (1995) reports evidence ‘that, in many instances, school-based learning added to children’s misconceptions and confusions, rather than developing accurate
scientific concepts’ (original emphasis). The basis for this claim was that many of the children that held ‘blurred knowledge’ had studied waste at school in a way that had focused exclusively on encouraging children not to throw waste away and to recycle, but had paid ‘scant attention to reasons why recycling is important, to details of the process, and to various methods of dealing with waste materials’ (Palmer, 1995, p. 44).

- Teaching of scientific explanations can hinder young people in their efforts to make sense of environmental phenomena in their daily lives—this idea emerges from a recent study of 90 Canadian high school students’ (16- to 18-year-olds) thinking about the timing of spring (Chipeniuk, 1998). Drawing on a social representations approach (from social psychology), this work sought to ‘explore the interplay between expert and common-sense ideas of nature in lay minds’ (ibid., p. 14). It involved content analysis of students’ written responses to the question ‘Please say when spring begins, in your opinion, and why it begins then’. The study found that: (i) three ‘theorettes’ or rudimentary causal explanations were mentioned most frequently, two more common-sense (i.e. Warmth/Snow-melt Spring which states that spring begins when the weather turns warm or the snow melts; or Biological Spring which states that spring begins when plants leaf, songbirds return, etc.), and one more scientific (i.e. Equinoctial Spring which states that spring begins on or about the vernal equinox, which approximates to 20 March); and (ii) respondents who used the scientific theorette of Equinoctial Spring tended to provide this explanation in isolation without elaboration, whereas the common-sense explanations were often connected or elaborated upon in some way. Chipeniuk sees these findings as indicating that ‘theories derived from expert science are displacing common-sense theories’, and such theories ‘can hinder rather than help [students] in their efforts to make sense out of phenomena’ (ibid., pp. 22–23). His view is that the explanation of spring occurring at the vernal equinox has little connection to tangible occurrences within students’ daily lives, and therefore ‘disables or disempowers the citizen mind in its efforts to understand spring’. This challenges the unproblematic acceptance of scientific knowledge as the content of environmental teaching and raises the question for environmental educators of what kinds of understanding of nature is most useful for ‘individuals in their daily lives’ (ibid., p. 24). This point is also made by Gough N. (1999, p. 39) who questions the way that the research on students’ environmental misconceptions makes ‘little or no acknowledgement of debates about the limits to scientific methods of conceptualising and/or resolving environmental issues’. His argument is that: ‘environmental educators do not have the science educator’s mandate (or excuse) for privileging “scientific” knowledge and methods’.

Media. There are also a number of studies that attempt to explain characteristics of young people’s environmental knowledge in terms of the effect of the media. Firstly, differences between the environmental knowledge of students in different geographical locations are often discussed in terms of differences in the media coverage in the various locations. In their study of over 1000 Greek and UK students’ ideas about the ozone layer, for example, Boyes et al. (1999) gave
the following explanation for ‘the fact that Greek students appear to relate ozone layer destruction incorrectly to radioactivity more readily than do UK students’:

[This] may be due to the greater use of nuclear power in the UK. Information about radioactivity in general is perhaps provided more often by the UK media than in Greece, where radioactivity is mentioned very little, the possible exception being during the Chernobyl accident. This sparse but negative media coverage may encourage children to see radioactivity as ‘bad’, so that they then feel that it is just another bad cause of ozone destruction. (ibid., p. 731)

A similar line of reasoning is used to explain regional variations in several other studies, including ‘the higher factual knowledge of eastern Washington students of forestry and salmon issues’ (Cardeiro & Sayler, 1994, p. 135), and New Jersey students’ greater knowledge of animal and plant names compared with those from Nebraska (Strommen, 1995).

Secondly, areas of misunderstanding evident in students’ thinking about environmental issues are commonly attributed to the nature of media-provided information. Membriela et al. (1993, p. 31), for example, argued that their respondents’ overestimation of the importance of atmospheric contamination and other ‘problems of little consequence at the local level’ reflected ‘the influence of the media on these students’ concepts’. Likewise, Gomez-Granell and Cervera-March (1993), in their investigation into 267 pre-university students’ conceptual knowledge about energy and the environment, held media coverage responsible for the sample’s superficial knowledge and limited factual knowledge of consequences beyond those of a general and/or immediate, short-term nature. They assert that ‘the media sensitise[s] public opinion, but do[es] not increase the degree of understanding of environmental issues’. They also point out, though, that this sensitising function of the media should not be underestimated as ‘It is a first step, an acquiring of factual knowledge of the many aspects of this complex matter, and a warning of the dangers to be faced in the future’ (ibid., p. 562).

Boyes et al. (1999) is another study that relates misconceptions to media-generated information. Their argument, though, focuses not only on the nature of the information coming from the media, but also the way in which this is used by young people. Their view is that:

Students seem to use this [media] information and construct their knowledge from it in ways similar to those in which they construct knowledge based on their experiences of the physical world (Gutierrez & Ogborn, 1992). Sometimes they connect pieces of information, a proportion of which may be correct, in a scientifically coherent way and make inferences that are erroneous (ibid., p. 736; original emphasis)

In this way, they attribute Greek (as opposed to UK) students’ greater factual knowledge of the eye problems associated with ozone depletion, and their more common misperception about it causing heart attacks, to the content of the media (first paragraph below) and the way in which this is processed by students (second paragraph):

Unlike the UK, Greece is a country where, on average, the sun shines for 2500–3000 hours per year. For this reason, the media provide a great
deal of information and advice about eye protection, skin cancer, and heat exhaustion leading to heart attacks, especially in summer [...] So chains of logic of the form: ozone layer destruction causes high temperatures, high temperatures cause heat exhaustion, and heat exhaustion causes heart attacks, might lead to wrong inferences that ozone layer depletion leads to heart attacks. One error in the chain and the conclusion is groundless. (ibid., p. 736)

The nature of global environmental issues. Boyes and Stanisstreet (1996, p. 43) cite a number of characteristics of global environmental issues that pose difficulties for students’ conceptualisation and understanding. Firstly, because many of global environmental problems are ‘invisible and rather abstract’, it is difficult for children’s learning to be directly experiential. Secondly, environmental issues and their consequences are often associated with uncertainty and probability and can, therefore, be challenging for young people. Thirdly, the slow, creeping nature of environmental change can make them difficult to appreciate and become concerned about their effects. Finally, the multidisciplinary nature of environmental issues requires a complex understanding of a range of traditional curriculum areas.

(5) Young people’s environmental understanding appears to be affected by several factors Several of the studies of young people’s understanding of environmental phenomena and problems have reported differences relating to factors such as age, gender and nationality.

Age. There is evidence to suggest that young people’s ideas and understanding of environmental issues change with age, both during primary school (Palmer, 1995; Palmer et al., 1996; Wylie et al. 1998), and secondary school (Boyes & Stanisstreet, 1993; Batterham et al., 1996). The findings suggest that:

• ideas become less uncertain and more realistic during primary school—Palmer’s (1995) study of the environmental knowledge about waste management of UK/US children aged 4 years (n = 124) and 6 years (n = 62) found differences between these two age groups. The younger children displayed a greater degree of uncertainty or lack of knowledge (i.e. incomplete answers) than the 6-year-olds whose responses were characterised more by ‘confusion and established misconceptions’ than a straight lack of knowledge. A connection might be drawn between this idea of certainty increasing and Wylie et al.’s (1998, p. 130) finding that ‘older children [11 years] might be described as more sceptical or realistic, as they were more likely to think of some reasons why an intervention might not be feasible’. This concerned primary children’s thinking about air pollution and the fact that, contrary to the researchers’ expectations, ‘the younger group [8 years] suggested more possible interventions to reduce pollution from factories or cars’. Wylie et al.’s argument is that this reflects the younger children being ‘more imaginative’ rather than ‘more knowledgeable’ about the pollution (ibid., p. 130).

• certain phenomena are better understood as students get older—in the early primary years context, Palmer et al. (1995) report an increase in accurate information articulated by 6-year-old students as compared with 4-year-olds about rain-
forests and deforestation, and polar areas and polar warming. In relation to polar warming, for example, the older children were better able to: correctly describe the process of snow melting and producing water that would enter the sea; and explain how warming could affect polar animals. Similarly, in Myers et al.’s (1999) work on secondary school students, differences were evidenced in students’ ideas about the composition of ‘clean’ air, types and sources of pollutants, and consequences of air pollution. Within their sample of 718 English secondary school students, considerably more Year 11 (15–16 years) than Year 7 (11–12 years) students volunteered that carbon dioxide and nitrogen were present in unpolluted air, and lorries (as opposed to power stations, burning fossil fuels or industry) were named more frequently by the younger students as a cause of air pollution. In a study of students’ ideas about the greenhouse effect, Boyes and Stanisstreet (1993, p. 540) noted that belief in erroneous notions such as litter being a direct cause of the greenhouse effect decreased with age.

- certain misconceptions persist or increase with age—as well as the finding that ideas can become more accurate through time, there is also considerable evidence that thinking can remain or become more erroneous as students become older. Between the ages of 4 and 6, for example, Palmer et al. (1996) report the persistence of misconceptions about the process of melting (as detailed earlier), and creatures of temperate woodlands being included as tropical rainforest inhabitants. These ideas persisted among a substantial minority (15–20%) of the sample. In studies of secondary school students ideas about global warming and ozone depletion, while knowledge of certain ‘acceptable’ notions improved with age such as the idea that global warming would produce an increase in flooding, other misperceptions remained—for example, that global warming was responsible for an increase in skin cancer, and ozone depletion would increase flooding in the world (Boyes & Stanisstreet, 1993, p. 549; 1996, p. 188).

- older students are better able to express ideas that are specific, longer-term and not directly related to human concerns, and to make links between phenomena—Batterham et al. (1996, p. 349), in their investigation of 713 UK secondary school students’ ideas about the environmental impact of motor vehicles, reported that the older students (aged 15 years) were more likely ‘to name particular gaseous pollutants such as carbon dioxide or nitrous oxides’ rather than using general terms such as ‘exhaust’ or ‘fumes’ which were more common among the younger respondents (11 years). This study also reported that the older respondents were more likely to mention the atmospheric problems associated with cars (e.g. air pollution, vehicle emissions, respiratory problems and global warming), while younger students focused more on their physical hazards (e.g. pedestrian injury, vehicle accidents and mortalities). In a similar vein, Palmer et al. (1996) found that 6-year-olds were more likely than their 4-year-old counterparts to refer to long-term effects of polar warming and deforestation, rather than only short-term effects. Finally, Wylie et al. (1998, p. 131) found that the older (11 years) pupils in their study were significantly better able than the younger ones (8 years) to think in terms of ‘a chain of events and […] understand how one event might impact on a second, and so on’.
Gender. There is not a great deal of evidence on the influence of gender on environmental understanding. In Boyes and Stanisstreet’s (1993, p. 549) study, boys were found to have better factual knowledge than girls of the well-known consequences of the greenhouse effect, and were clearer about the benefits to the greenhouse effect of using nuclear power instead of fossil fuel, and the irrelevance of nuclear weapons and nuclear waste in this debate. However, in a study of younger children’s ideas about forest and their inhabitants, gender differences were only found in relation to two parameters, and it was concluded that ‘if boys do possess more knowledge [than girls], their superiority is very limited’ (Strommen, 1995, p. 696).

Moving to the nature (rather than the degree of accuracy) of environmental understanding, there is some evidence to suggests that boys and girls display understanding of different aspects of environmental issues. With respect to the environmental impact of motor vehicles, girls more frequently raised the idea of damage to the ozone layer whereas boys were more likely to mention global warming (Batterham et al., 1996, p. 351). Furthermore, in the same study, girls were found to be more aware of ‘atmospheric’ pollution and the effect on humans of causing breathing difficulties, while boys raised ideas about the steps that could be taken by manufacturers such as fitting catalytic converters. This links with findings mentioned earlier (Section 3.1.2) in relation to gender differences in students’ factual knowledge, which suggested that girls were more aware of immediate, local problems relating to human health, while boys focused more on longer-term, more abstract issues (Roper Starch Worldwide, 1994; Myers et al., 1999). It also connects with Barron’s (1995, p. 113) study of Australian primary school pupils’ responses to a children’s story (see Section 6.1), which found that ‘the majority of boys differed from the girls’ in their suggested solutions to the problem of pollution. That is, while ‘the girls argued that the animals had the right to survive regardless of the perceived human need’, ‘most of the boys just kept stating that the Once-ler had to fix it up (referring to the factory)’ (ibid., pp. 111, 113).

Geographical location. There is some evidence to suggest that geographical location, in terms of students’ country of residence, can impact upon the nature of their environmental understandings and misunderstandings. A three-country study of 527 younger primary pupils’ ideas about waste management, for example, found that children in UK and Slovenia had a better understanding of the initial collection of waste and of the dumping and tipping of it than children in Greece. Yet children in Greece seem to be considerably more knowledgeable about the recycling process than children in Slovenia (Palmer, 1999, p. 383). In addition, two studies using the same instrument with students in Greece (Boyes et al., 1999) and the UK (Boyes & Stanisstreet, 1994) reported the following trends: (i) UK students were marginally better informed about the causes of ozone layer depletion such as CFCs and materials from refrigerators, but on the other hand were more likely to confuse ozone layer depletion with the greenhouse effect; and (ii) Greek students were better informed about eye problems being a consequence of ozone depletion, but were also more likely to think that it will be the cause of more heart attacks, and that ozone layer destruction is related to radioactivity.

3.3.2. Summary. There is a large amount of evidence relating to young people’s understanding/misunderstanding of the science of environmental issues. While
representing a mixture of qualitative and quantitative findings with primary and secondary aged learners, it is very focused on the science of global environmental issues. Survey data from several countries indicate that students’ low levels of factual knowledge relating to environmental issues is often coupled with poor understanding of such matters. More detailed investigations of students’ ideas about specific environmental phenomena (such as the greenhouse effect, waste management or ecological habitats) find there to be considerable misunderstanding of the science of such issues. There seem to be two particular areas of confusion in young people’s thinking: confusion between ideas about different phenomena such as the greenhouse effect and ozone depletion, and poor understanding of processes such as melting or recycling.

Certain of these confusions are found to persist, or even increase, through time, and relate not only to the nature of students’ thinking, but also various external influences, such as school textbooks, the media, as well as the complexity of environmental issues themselves. With respect to influencing factors, evidence suggests that environmental understanding/misunderstanding can vary with students’ age, gender and geographical location.

3.3. The Sources of Student’s Environmental Information

3.3.1. The available evidence. While there are very few studies that have exclusively investigated the sources of young people’s environmental information, there are several that have generated evidence on this topic. The available evidence encompasses:

- findings from studies that (in some way) questioned young people about the sources of their environmental information (e.g. Roper Starch Worldwide, 1994; Filho, 1996; Morris with Schagen, 1996; Bonnett & Williams, 1998; Connell et al., 1998, 1999); and
- outcomes from correlational studies of young people’s environmental knowledge and their media-related habits (e.g. Chan, 1998).

3.3.2. The key messages. There are two key messages arising from the evidence on students’ environmental information sources.

1) The main sources of young people’s environmental information are television and school

From the currently available evidence, there are indications that young people’s environmental information comes from a number of sources, the two most important of which are television and school. Other origins of information are the printed media, family and friends, previous environmental experiences, and environmental non-governmental organisations (NGOs).

Media. There is strong evidence across a number of studies that television is the major source of young people’s environmental information. In their survey of young people in the US, for example, Roper Starch Worldwide (1994, p. 105) reported that: ‘of a list of 14 possible sources of information about environmental problems and issues, one stands out: television. Over seven in ten students from
disadvantaged and non-disadvantaged areas say they learn about the environment from TV news and TV nature programs.' Compared with television (71%), far fewer respondents mentioned other kinds of media sources, such as newspapers (27%), movies with environmental themes (17%), and radio programmes (9%) (ibid., p. 106).

These findings are echoed by a number of more recent studies in different countries. Work carried out with 428 Year 11 (15–16 years) students in the UK found television to be ‘the single most important source of information about the environment’ (Morris with Schagen, 1996, p. 14), while subsequent studies in Europe (Filho, 1996), Hong Kong (Chan, 1996), Australia (Connell et al., 1998), the US/UK (Palmer, 1995), and the UK (Bonnell & Williams, 1998) have all identified the far greater importance of television relative to newspapers, magazines and radio.

This prominence of visual media sources is also reflected in Chan’s (1998) study of the relations between Hong Kong students’ use of the mass media and their environmental cognition. For a sample of 1032 13–18 year olds, Chan found that across TV, radio and newspaper, it was only ‘TV news watching’ that correlated strongly (and positively) with students’ global and local environmental knowledge. There was also a weak positive correlation between Chinese newspaper readership and global environmental knowledge. Interestingly, general TV viewing was not correlated with environmental knowledge, suggesting that ‘students are more likely to obtain environmental knowledge from news than from other programmes’ (ibid., p. 14). This aligns with Bonnett and Williams’ (1998) report of the kinds of UK television programmes that were mentioned by the primary school pupils they interviewed: ‘Newsround’ was specifically mentioned a number of times, as were ‘Blue Peter’, ‘Tomorrow’s World’ and nature programmes’ (ibid., p. 168).

While it seems clear, then, that television (and particularly news and current affairs programmes) is an important source of environmental information for young people, a recent Australian study suggests that this does not mean that it is seen as the most reliable source. Connell et al. (1998, p. 43) found that ‘school and NGOs were regarded as the most reliable, with the media being rated only of moderate reliability’.

School. There are a number of studies that report school as being the second most important source of young people’s environmental information. Chan (1996) found that 58% of respondents noted school, compared with 87% mentioning television. This corresponds with figures from an earlier US survey of young people from varying backgrounds (Roper Starch Worldwide, 1994), as well as work carried out across Europe (Filho, 1996), the UK (Morris with Schagen, 1996; Bonnett & Williams, 1998), the US/UK (Palmer, 1995) and Australia (Connell et al., 1998). One study (Morris with Schagen, 1996) that focused more closely on the contribution made by school found that geography and science lessons were seen by UK secondary students as a greater source of environmental information than lessons in personal and social education, technology or any other subjects. A similar picture of environmental education occurring mainly through science and geography was reported by high school students in Australia (Connell et al., 1999). In addition, among disadvantaged students in the US, science classes were also found to be the main context of environmental learning, along with field trips to museums/parks, and other classes such as English or social studies.
Learners and Learning (Roper Starch Worldwide, 1994). Relatively few of these US students reported having learnt about environmental issues through taking special classes focused on such issues, or joining a club during or after school. Finally, interviews with small groups of pupils in four UK primary schools reported how ‘children noted that they had done projects, including recycling, pollution, the rainforest, “doing habitats” and “materials”. The researchers also noted, however, that ‘few offered details about projects they had done and school trips were rarely mentioned’ (Bonnett & Williams, 1998, p. 168).

While it seems clear, then, that young people see school as secondary for information about the environment as compared with television, there is one study of over 2000 high school students in Hong Kong that reports the contrary. Yeung (1998, p. 258) noted how the fact that respondents did less well with questions concerned with environmental issues not formally taught in school is compatible with ‘replies from a majority of students who responded to the questionnaire survey (44.2%) that their main source of information about environmental issues were geography lessons and textbooks rather than television programmes, newspapers or magazines’.

Family. There is acknowledgement in a number of studies of the role of family members as a source of environmental information. After television and school, it is reported as being the next most important information source by young people in the US (Roper Starch Worldwide, 1994), the UK (Morris with Schagen, 1996) and across Europe (Filho, 1996). In two other studies, it features less prominently, being ranked as less important than newspapers and environmental NGOs (Connell et al., 1998) and newspapers, magazines and radio (Chan, 1996). It is also mentioned by students in the context of more open-ended interview-based explorations of their environmental ideas (Palmer, 1995; Bonnett & Williams, 1998). For example, in Bonnett and Williams’ (1998, p. 168) study ‘a few of the children described the recycling their parents do and one girl emphasised that children’s behaviour is shaped by the example of their parents—a point which concurs with Palmer’s (1995, p. 43) earlier UK–US study which reported that ‘children in both locations, but notably California, had a knowledge of recycling because of active, household participation’.

Previous experiences within the environment. Bonnett and Williams’ (1998) described how school trips and Guides and Cubs were mentioned ‘in relation to learning the Country Code and in terms of having been to places like those depicted in some of the photographs [i.e. a woodland, meadow, beach, and recycling centre]’. Strommen (1995, p. 696), however, in his study of children’s knowledge about forests, found ‘experience with forests to have only a modest effect on children’s performance’. He also noted though that ‘children’s self-reports of visiting forests do not provide any indication of the quality of their experiences’.

Environmental non-governmental organisations. Connell et al. (1998) reported that among 20% of their sample of Australian students, environmental NGOs were seen as the most important source of information. This meant it ranked after TV, school and newspapers. With respect to reliability, however, environmental NGOs were seen as providing the most dependable information.
Students’ environmental information sources appear to vary with certain demographic factors

There is evidence from a small number of studies (in particular, Roper Starch Worldwide, 1994) to suggest that students’ demographic characteristics can influence the kinds of environmental information sources that they see as important.

**Age.** Roper Starch Worldwide (1994, p. 107) reported that ‘grade is an important influence on sources of environmental information, with some items increasing in usage by grade while others decrease by grade’. More specifically, this study noted that television became more important with age among all respondents, while school either decreased (disadvantaged students) or remained unchanged (non-disadvantaged students) in importance. In addition, among the disadvantaged respondents, family and magazines (as well as school) became more important with age.

**Socio-economic grouping.** As well as the effects of social disadvantage on age-related changes, Roper Starch Worldwide (1994, p. 107) also found that school was a less important information source for the non-disadvantaged young people in their sample. This concurred with another of its findings in this study that ‘students from non-disadvantaged areas [...] report learning less about the environment in school than students from disadvantaged areas’.

**Gender.** It is noted by Connell et al. (1998, p. 45) that male and female students in their study ‘differed in the sources from which they obtained most of their environmental information’. They found that males gained more information from the television, while females attached greater importance to newspapers, school and environmental NGOs. Both groups also rated their respective favoured sources as more reliable, although (as mentioned earlier) across the whole sample it was found that school and NGOs were seen as most reliable by students.

**Geographical location.** Among disadvantaged students in the US, there were marked differences between the information sources of those from urban areas and those from rural areas. Young people in urban locales were more likely to cite school and museums, while rural dwellers were more likely to use newspapers as a source of information about the environment (Roper Starch Worldwide, 1994). Young people’s geographical location was also found to be significantly related to their information sources in Connell et al.’s (1998) Australian study. More students in Melbourne than in Brisbane reported gaining most of their information from schools and the print media, and Melbourne students also identified the media and schools as more reliable than Brisbane students.

3.3.3. **Summary.** From the relatively limited amount of evidence currently available about the sources of environmental information, it is clear that young people see television and school as the two most important sources of their environmental information. Less prominent are the family, personal experiences and environmental NGOs. Little appears to be known about how these various sources are viewed by young people, and for what purposes they are used or not used. One exception to this is Connell et al.’s (1998) finding that Australian
students distinguished between the reliability of different sources, with school and NGOs being seen as more reliable than the media. There is a limited amount of evidence about certain influencing factors (age, socio-economic grouping, gender and geographical location) affecting students’ views of environmental information sources.

4. Evidence on Learners’ Environmental Attitudes and Behaviours

The research evidence relating to this second established node provides information about:

- **students’ environmental concerns**—the kinds of environmental issues that students’ are concerned about, and (less commonly) how these concerns compare with other concerns that they may have;
- **students’ environmental attitudes**—the extent to which young people are concerned or indifferent in relation to the environment and/or environmental issues, and the extent to which students are willing to make sacrifices for the environment, such as willingness to conserve resources; and
- **students’ environmental behaviours**—the extent of young people’s actual (usually self-reported) involvement in environmentally responsible practices, e.g. regularity of involvement in reusing or recycling instead of throwing away, and the factors that support or constrain young people in taking such actions.

Each of these foci will be discussed in a separate section.

4.1. Students’ Environmental Concerns

4.1.1. The available evidence. There are a number of studies that have investigated the kinds of environmental phenomena that concern young people. These include:

- survey studies of students in Australia (Connell et al., 1998), Singapore (Ivy et al., 1998), the UK (Morris with Schagen, 1996; Uzzell et al., 1995), the US (Riechard & McGarrity, 1994; Roper Starch Worldwide, 1994; Riechard & Peterson, 1998) and across Europe (Filho, 1996);
- interview-based investigations with young people in Australia (Kwan & Miles, 1998; Connell et al., 1999), and the UK/Germany (Cullingford, 1994; Prelle & Solomon, 1996); and
- studies of young people’s views of the future (Hicks & Holden, 1995; Oscarsson, 1996; Hutchinson, 1997; Barraza, 1999).

It should be emphasised, however, that in several of these studies, students’ environmental concerns have represented just one small part of a much larger research focus under investigation. For this reason, there is in fact not a particularly strong base of evidence in this area, with the consequence that the messages emerging are not particularly robust or coherent.

4.1.2. The key messages. The current evidence can be summarised in terms of three main points.

1. **Young people rate certain environmental issues as more serious than others**

On the basis of current evidence, it is difficult to make strong and conclusive statements about the relative seriousness that young people assign to different
environmental issues. What can be said is fairly descriptive and is not based on strongly coherent themes emerging between several individual studies.

In terms of young people’s perceptions at the global level, there seems to be concern among Australian (Connell et al., 1998), Singaporean (Ivy et al., 1998), and UK (Morris with Schagen, 1996) students with ozone depletion, over and above other issues such as global warming/greenhouse effect, deforestation, and air and water pollution. However, this contrasts with the findings of studies in Europe (Foreid & Filho, 1997) and the US (Riehard & Peterson, 1998), which respectively suggest that ‘pollution’ and ‘acid rain’, and ‘water pollution’ and ‘air pollution’ are seen as more serious than ‘ozone depletion’ and (especially in the US study) ‘global warming’.

With respect to perceptions of problems at the national level, as well as ozone depletion, air and water pollution, and acid rain, there seems also to be importance attached to issues such as ‘rubbish disposal’, ‘land use’ and ‘forest cutting’. This is most clearly illustrated in Ivy et al.’s (1998) study in Singapore, which, on the basis of students’ rankings of the same list of issues for ‘most serious in the world’ and then ‘most serious in Singapore’, found that there were differences between the problems students perceived as the most serious globally and locally. As the authors explained:

At the global level, the kinds of problems selected [...] are more related to changes and deterioration of the physical environment. Locally, however, rubbish disposal (17.7%) was perceived to be the most serious problem in Singapore, followed closely by land use (17.4%). Unlike the previous case, these are more societal-generated problems and are also more directly related to the lives of the students. (Ivy et al., 1998, p. 190)

As well as this study suggesting that the kinds of environmental concerns young people express differ between the global and the local, there are two pieces of research which suggest that the degree of environmental concern young people have can also differ between these two scales. Both suggest that global environmental issues are seen as more serious/concerning than local ones. Morris and Schagen’s (1996) survey of 428 UK secondary school students (aged 15–16 years) found that young people were more concerned about global environmental issues such as ozone depletion and rainforest destruction, than about local issues such as air and water pollution and loss of habitats. Similarly, Uzzell et al. (1995), in their study of 32 female UK students of a similar age (14–15 years), reported that ‘environmental problems are seen as more serious the further they are away from the perceiver, such that environmental problems affecting the national [and global] level are seen as more serious than those affecting the local level’ (Uzzell, 1999, p. 405).

A feature common to almost all of the above studies is that they did not seek specifically to investigate why their respondents perceived certain issues as more serious than others. Other than Kwan and Miles’ (1998) work discussed in relation to the key message (Section 4) below, the only study that included such a focus is Prille and Solomon’s (1996) investigation of 14-year-old school students in Germany and England. Respondents were not only asked to identify their three most important issues from a list of nine environmental problems, but also to explain (in the form of a written response) why they thought these were important. On the basis of coding, these responses were analysed according to whether the reasons given were emotional or factual, and whether the
factual arguments provided were correct or erroneous. Among the three most commonly selected items (ozone depletion, rainforest destruction and threats to wildlife), they found that the most emotionally charged responses were associated with ‘threats to wildlife’, while issues such as ‘hole in the ozone layer’ and ‘cutting down the rainforest’ tended to be characterised by factual-type information, often of an incorrect nature. The general conclusion is that their findings show ‘how very different in emotional tone, cognition and invitation to act, these nine issues appeared to be to the students’ and that ‘no simple overall model, cognitive, social or moral, seemed likely to encompass all this diversity’ (Prelle & Solomon, 1996, p. 99). This suggests that not only do students see certain issues as more serious, but also that they feel differently about different issues. That is, the basis of their concern for the ozone depletion can be qualitatively different from their concern about wildlife extinction. Such ideas, though, are certainly in need of further investigation.

(2) Young people’s views of the future reveal varying concerns and, in some cases, considerable pessimism

Insights into young people’s views of the future have emerged from studies in Australia (Hutchinson, 1997; Connell et al., 1999), Sweden (Oscarsson, 1996) the UK (Hicks & Holden, 1995), and Mexico/the UK (Barraza, 1999). These utilise a variety of methods including questionnaire survey (Hicks & Holden, 1995; Oscarsson, 1996; Hutchinson, 1997), qualitative interviewing (Hutchinson, 1997; Connell et al., 1999), and analysis of children’s drawings (Barraza, 1999).

From all of these studies it is clear that young people hold, and are able to express, a variety of concerns and ideas relating to the future. Findings about the nature and depth of such concerns, however, differ between studies. Hutchinson’s (1997) investigation of Australian upper secondary school students reported, on the basis of questionnaire responses \((n = 650)\) and small group dialogues \((n = 160)\), definite pessimism and cynicism about the future. It found that ‘only a little over 20% believed that much progress will be made in lessening the problems of ecological violence, such as habitat destruction and polluted environments, by the year 2002’, and in the discussions several were described as speaking ‘both eloquently and disturbingly about an environmentally insecure and unsustainable future’. A similar depiction of views was reported by Barraza’s (1999) analysis of the drawings of 247 primary school children in England and Mexico. When asked to draw planet Earth as it would be 50 years into the future, 54% depicted that it would be in worse shape, while far fewer (22%) illustrated that things would have improved. Others either expressed uncertainty as to whether there would be positive or negative changes in the future (18%), or felt there would be no change. For the majority, then, that were pessimistic about the future, ‘their drawings revealed a deep concern for problems such as pollution, war, global warming, loss of species, acid rain, rubbish, deforestation and lack of water’ (ibid., p. 58).

The findings of these studies, however, contrast with those from two investigations undertaken in Sweden and Australia. In a study of 900 Swedish 16-year-olds, for example, Oscarsson (1996, p. 265) states clearly that ‘Our data does not indicate that pupils possess an overwhelmingly pessimistic view of the future’. It is found that ‘most pupils seem to feel the future will be pretty good,
especially their own, but also Sweden’s’. It is noted, however, that ‘things are a little more negative concerning the global future’, although apparently still more optimistic than findings from similar studies undertaken in Sweden in the 1970s and 1980s. Comparable findings to this Swedish study are reported by Connell et al.’s (1999) recent interview-based investigation of similarly aged Australian students. On the basis of comments relating to the question ‘What are your main hopes and fears about the future?’, this concluded that ‘the majority of young people did not appear to be overly concerned or cynical about the future of the world or their ability to do anything about it’ (ibid., p. 99). As with the Swedish study, the authors note how this conclusion contrasted with those of several earlier studies.

On the basis of the current evidence, it is difficult to draw conclusions or suggest reasons for these contrasting findings from different studies in different geographical locations.

(3) The level of young people’s concern about environmental issues relative to other types of issues is unclear

The findings from the research on students’ views of the future highlight the variety of kinds of issues that can concern young people, a point which is also well illustrated by Cullingford’s (1994) account of 8-year-old children’s thinking about themselves in relation to their own environment and to other countries. These studies raise the question of how young people’s environmental concerns compare with other types of concerns that they may have. Empirical evidence on this issue is limited, as many studies in this area ask students’ exclusively about environmental topics. Exceptions to this include some of the studies on views of the future (Hicks & Holden, 1995; Oscarsson, 1996), as well investigation with young people in Brisbane and Melbourne (Connell et al., 1998, 1999) and the US (Roper Starch Worldwide, 1994). The findings emerging from these studies are not clear-cut, but do begin to suggest some insights about the relationship between young peoples’ environmental concerns and other priorities.

Firstly, Connell et al.’s (1998) questionnaire survey found that ‘protecting the environment’ was the most frequently selected item from a list of several societal goals for Australia. Chosen by 23% of the 5688 respondents, it was placed ahead of ‘preventing war and nuclear threats’ (22%), creating a fairer and more humane society’ (14%), reducing unemployment’ (11%), and ‘strengthening the economy’ (5%) (ibid., p. 42). While this particular finding is not discussed in great detail, the implication is that environmental protection is seen by the young people within this study as important not only in its own right, but also relative to other kinds of societal agendas.

In contrast to this, however, the corresponding qualitative investigation carried out with young people in the same two Australian cities, found that, when asked about their general hopes and fears, ‘the young people were concerned primarily with personal levels of meaning—personal relationships, careers, academic success and enjoyment—and a desire to make sense of their lives and their place in the world’. (Connell et al. (1999, p. 98)). As mentioned earlier, this leads the authors to conclude that the majority were not ‘overly concerned or cynical about the future of their world or their ability to do anything.’ (ibid., p. 99). This suggest that environmental issues may feature less prominently in the personal hopes and fears of young people.
Support for this is provided by Oscarsson’s (1996) study of Swedish 16-year-olds. Through questions about students’ own future, Sweden’s future, and the global future, Oscarsson’s work was able to show that foci of concern varied considerably between these three levels. At the personal level the onus was predominantly on employment issues with little mention of environmental problems, while at the national level political and economic considerations dominated, and at the global level environmental issues and warfare were far more prominent. It would appear, therefore, that the foci of young people’s views and concerns can vary for different scales. This is as indicated by Hicks and Holden’s (1995) questionnaire study of 300 young people in the UK between 10 and 18 years of age, which reported differing hopes and fears for the future of the local area (crime, pollution, amenities, and prosperity) and for the global future (war, pollution, poverty and starvation).

In addition to variation with scale, Roper Starch Worldwide (1994) find that the kinds of issues that concern young people vary considerably between those from disadvantaged and non-disadvantaged areas. Among the latter, concern about harm to the environment is second only to AIDS, while among students from disadvantaged areas, the environment is ranked sixth after AIDS, kidnapping, the number of people with guns, crime and violence locally, and the economy. The suggestion that socio-economic grouping can affect young peoples’ concerns is discussed under the next key message below.

Overall, it would seem fair to say that the relations between young peoples’ environmental concerns and their other priorities are at present poorly understood, but they appear to vary between different scales (i.e. the personal versus the global) and with socio-economic background.

(4) Young people’s environmental concerns appear to be affected by certain factors

While few studies have sought to investigate the reasoning behind young people’s differing environmental concerns, some attention has been given to the kinds of factors that may be influential in this area. As with much of the work reported in this section, the evidence that is available is at an early stage of sophistication, and tends to indicate points in need of further investigation, rather than points of strong coherence and generalisability. Nevertheless, there is some early evidence relating to gender, age, geographical location and socio-economic grouping.

Gender. Several research studies report differences in environmental concerns in relation to gender. Prell and Solomon (1996), firstly, found that while the males frequently mentioned nuclear power, the females tended to report threats to wildlife as a major concern. (The level of statistical significance for these correlations was not reported in this paper.) Differences were also reported by a recent qualitative study in Australia (Connell et al., 1999), which found that, when asked to name the most important environmental issues in Australia, more female students identified endangered animals, while more males mentioned soil erosion and land degradation.

Rieichard and Peterson (1998) reported significantly higher perceptions of risk among females as opposed to males for eight environmental hazards including, for example, pesticides, earthquakes, oil spills, and decrease in topsoil. A similar difference between males and females was reported for US students by Roper
Starch Worldwide (1994), but this was only significant among young people from non-disadvantaged areas. Among students from disadvantaged areas, boys were as concerned about the environment as girls.

In addition, a number of the studies on young people’s views of the future report differences between boys and girls, noting that female students tend to be more interested in such issues, and also more pessimistic about them than their male counterparts (Hicks & Holden, 1995; Oscarsson, 1996). It is also reported by Hutchinson (1997, p. 196) that in envisioning the future ‘many girls were both less optimistic about conventional science and technology and more open to alternative imagery of peaceable or ecologically sustainable science and technology than their male peers’. This echoes Barron’s (1995) earlier mentioned finding about boys and girls in a primary school class positioning themselves differently in relation to the effects of pollution within a story about logging (see Section 3.2.2).

Age. One of the few studies to explore age in relation to young people’s environmental concerns is Kwan and Miles’ (1998) work with 69 upper primary, junior and senior secondary students in Brisbane. Once again this is a study of cross-sectional, as opposed to longitudinal, trends. Using data from open-ended question items and focus group discussions, they reported a distinct difference between the younger and older students in their sample:

Primary students expressed a greater attachment to their own personal environment than did other students. They particularly valued their personal belongings and possessions such as toys and books. [...] Secondary students, on the other hand, expressed greater attachment to the natural environment [...] such as sunshine, the beach, the coast, waterways and the air. (Kwan & Miles, 1998, p. 14)

The authors suggest that with age there is ‘a gradual strengthening and deepening of students’ concern towards the environment from self-centred to the broader society and, eventually, the world’. Furthermore, they argue that the nature of young people’s reasoning about the environment develops with age from ‘more egocentric reasons’ related to most primary and some junior secondary age students’ attachments to personal environments, through to ‘more philosophical and scientific reasons’ used by senior secondary students to ‘substantiate their likes and dislikes about social environments’ (ibid., p. 17). By contrast, in their study of 231 young people in the US, Riechard and Peterson (1998) found no significant relationship between perception-of-risk scores for 20 environmental hazards and student age (in terms of being either 10 years or 17 years of age). These findings are clearly not in direct opposition though to those of Kwan and Miles as they are from different kinds of studies with different kinds of foci (survey hypothesis testing of perception of risk, compared with open-ended qualitative exploration of environmental concerns and opinions).

Geographical location. Several studies make mention of variations between the environmental concerns of young people in different countries, or parts of countries. Prelle and Solomon (1996) found German 14-year-olds to be more concerned about packaging and nuclear power than their English counterparts, who saw acid rain and river pollution as more serious. They also reported some urban–rural differences, with English rural students tending to be more concerned about acid rain than urban dwellers, for example. Similarly, Connell et al.’s (1999, p. 100) interview-based study with young people in Brisbane and
Melbourne found marked differences between the Brisbane students, whose concerns focused exclusively on ‘local urban development’ and its encroachment on natural areas, and those in Melbourne whose comments were all about ‘local air and water pollution’ issues. Such findings lead researchers to suggest that the nature of the local socio-physical environment can be an influence upon young people’s concerns. Ivy et al. (1998), for example, suggest that rubbish disposal and land use are perceived by Singaporean students as the most serious environmental issues facing their country because of ‘the nation’s small and limited land area’ (ibid., p. 190). In a similar way, Connell et al. (1999, p. 100) argue that ‘the different foci of concern between students in the two cities tend to reflect the industrial nature of Melbourne in contrast to Brisbane’s sprawling suburbs’.

In contrast to the above studies, however, Barraza’s (1999, p. 61) investigation of Mexican and English children’s drawings of the environment and the future reported ‘more similarities than differences’. The author suggests that this lack of differences could be the result of three factors: (i) their similar socio-economic level, (ii) the fact that they were all from urban places, and (iii) their access to similar information (e.g. television, computers).

Socio-economic grouping. As mentioned earlier, Roper Starch Worldwide’s (1994) survey of young people in the US found that concern about the environment relative to other social issues was significantly greater among students from non-disadvantaged areas. This suggests that socio-economic grouping and living situations can exert an influence upon the degree of young people’s environmental concern. Such a link, however, is not suggested by Riechard and Peterson’s (1998) study of US students’ perceptions of environmental hazards. This found no significant relationship between risk perceptions and ‘community socio-economic setting’ (based on the percentage of students receiving free and reduced-cost lunches).

4.1.3. Summary. Studies in several countries report varying levels of concern for different environmental issues, with the highest levels relating to ozone depletion for studies in the UK, Australia and Singapore, and water/air pollution and acid rain for studies across Europe and the US. Two UK studies suggest that levels of concern can vary not only between issues, but also with different scales, both finding that global environmental issues are seen as more serious/concerning than local ones. This concurs with findings relating to young peoples’ views of the future which suggest that environmental concerns may feature less prominently in the personal (as opposed to the global) hopes and fears of young people. As most studies, however, have focused exclusively on environmental issues, there is currently little evidence or clear findings about how students’ environmental concerns might compare and/or conflict with other kinds of issues that may interest them. There is some evidence, though, to suggest that gender, age, geographical location and socio-economic grouping can influence the nature of young people’s environmental concerns.

4.2. Students’ Environmental Attitudes

4.2.1. The available evidence. There is a considerable amount of evidence on young people’s environmental attitudes. This has emerged from:
national surveys of young people in the UK (Lyons & Breakwell, 1994; Morris with Schagen, 1996), The Netherlands (Kuhlemeier et al., 1999), Hong Kong (Chan, 1996), Singapore (Ivy et al., 1998), Australia (Hampel et al., 1996), and the US (Roper Starch Worldwide, 1994); and

an inter-city comparison (Connell et al., 1998), and an individual school-level investigation (Clarke, 1996) in Australia.

The evidence generated by these studies tends to be produced by questionnaire surveys that assess the extent to which samples of young people express agreement or disagreement with statements concerning either: (i) a certain aspect of the environment and/or people’s relation with the environment, for example, ‘Owing to pollution of the environment, the world threatens to become unfit to live in for future generations’ (Kuhlemeier et al., 1999, p. 6); and/or (ii) their willingness to take behaviours and make sacrifices for the environment, such as ‘I am prepared to pay a little more for an environmentally friendly product’ (ibid., p. 6). Generally, findings are in the form of basic response frequencies and descriptive statistical analyses, with few examples of more complex statistical analyses such as regression or multi-level modelling (e.g. Lyons & Breakwell, 1994; Chan, 1996; Morris with Schagen, 1996). They are also concerned with the older secondary school age group rather than primary or lower secondary years students.

4.2.2. The key messages. There are three key messages emerging from the evidence within this section.

(1) Young people appear to hold generally positive environmental attitudes

All the studies of relevance to this section are united in finding that, on the whole, students are more likely to agree with statements of a pro-environmental nature than to be indifferent or agree with anti-environmental sentiments. As illustrated by the points below, this represents a finding common to upper secondary students in a considerable variety of contexts, and with respect to a considerable diversity of kind of environmental attitude statement.

• Within a sample of 5688 students from two major Australian cities, 82% were found to hold beliefs that aligned with either an ‘environmental’ (62%) or a ‘strongly environmental’ orientation, as opposed to one that was ‘technological’, ‘strongly technological’ or ‘neutral’ (Connell et al., 1998).

• With respect to 992 secondary school students in Hong Kong, ‘results indicated that the respondents showed overwhelmingly positive environmental attitudes. The mean scores ranged from 2.69 to 4.13 on a five-point scale [where 5 represents the most positive environmental attitude]’ (Chan, 1996, p. 302).

• A study of 1256 Singaporeans aged 14 and 16 years found that ‘generally the students had a moderately positive attitude towards the environment’ (Ivy et al., 1998, p. 186).

• Lyons and Breakwell (1994, p. 230) found that the ‘level of environmental concern among a sample of 1089 13- to 16-year-olds in 12 secondary school across England and Scotland was “relatively high: 56% of the respondents were strongly in favour of controlling pollution from industry, and 47% were strongly in favour of banning the use of CFC aerosol sprays’’. This is backed up by another study in the UK context (Morris with Schagen, 1996), which
reported high levels of agreement within their sample of 428 Year 11 students with arguments such as ‘young people should do something to protect the environment’.

- In Kuhlemeier et al.’s (1999, p. 10) study of over 9000 Dutch secondary school students, ‘57% of the students had, according to our definition, a positive to very positive environmental attitude’.

(2) Young people’s attitudes are less pro-environmental in relation to certain issues, such as those concerning their own lives

As well as reporting generally positive attitudes among their samples, several of the studies also found that students would express less environmentally conscious attitudes in relation to certain questions. Ivy et al. (1998), for example, observed that in contrast to strongly positive attitudes for certain environmental issues such as waste disposal in the oceans, the conservation of forests and ozone depletion:

responses were least favourable when the environmental concerns were more specifically related to their lives. [...] This was most evident for two of the items in the study which were related to the use of cars. [...] Owning a car is every Singaporean’s dream. (emphasis added)

A somewhat similar pattern seems evident within Chan’s (1996) study in Hong Kong, which, as well as finding strong support for animal and natural resource conservation, government pollution controls, and making personal contributions to environmental protection efforts, also reported a lack of disagreement with the statements ‘the benefits of modern consumer products are more important than the pollution that results from their production and use’ and ‘industry is trying its best to develop anti-pollution technology’. This leads the author to conclude that:

the student’s over-optimism towards technological development and the perceived importance of the benefits of modern consumer goods were the major factors that contradicted concern for the environment. (Chan, 1996, p. 303)

Both of the above points connect with Connell et al.’s (1999, p. 42) statement that their findings show ‘strong support for an environmental paradigm, but a sense of indecision about the importance of technology and economic growth at the expense of environmental protection’ (emphasis added). They found, for example, that ‘the most popular response to several items was a neutral position suggesting that the students were undecided about statements such as: “complex technologies will always be able to find solutions to our problems”; “complex technologies will always be risky because of the chance of human error”; “modern technology has reduced our freedom and independence”, and “economic growth should be given priority over environmental protection”.

On the basis of these three studies, it seems fair to argue that there is evidence for a complexity in young people’s environmental attitudes that goes beyond the frequently reported picture of fairly positive views towards the environment. There would appear to be contradictions, particularly in relation to environmen-
tal considerations strongly linked with their own lives such as the use of cars (Singapore), modern consumer products (Hong Kong) and modern technology (Australia). Further support for this comes from Barron’s (1995) work with a class of Australian primary school children (see Section 6.1), which found that while most of the girls in the study (unlike the boys) took up ‘light green discourses’ in relation to logging, in relation to technology ‘most of the boys and the girls [took] up scientific fix all discourses’ (ibid., p. 115) [emphasis added]. Barron argues that ‘rather than being confused or unable to make up their minds’, this ‘could be read as the children taking up multiple subjectivities in relation to contradictory discourses’ (ibid., p. 116). Such variability in attitudes and viewpoints seems a crucial topic for further research exploration, not just in terms of more empirical investigation, but also (perhaps more crucially) through a wider conceptual consideration of the nature of the ‘environment’, as well as the ‘attitude’, part of environmental attitudes.

(3) Young people’s environmental attitudes appear to be influenced by several factors

As well as investigating the nature of young people’s environmental attitudes, certain of the studies in this section sought also to examine the extent to which such attitudes were influenced by particular factors. The findings emerging from these studies suggest that environmental attitudes can be affected by gender, socio-economic grouping and (less conclusively) age, and academic ability/orientation.

**Gender.** There are four studies that suggest a significant relationship between gender and environmental attitudes. All of these indicate that females are more likely than males to be environmentally concerned and/or willing to undertake behaviours for the environment. Connell *et al.* (1999), for example, reported consistent differences between males and females across several parameters, including views more consistently aligned with an environmental paradigm, and belief in the possibility of having both a prosperous economy and a healthy environment. Similar kinds of findings are reported by two other Australian studies (Clarke, 1996; Hampel *et al.*, 1996). Furthermore, among 992 Hong Kong secondary school students, Chan (1996) found that not only was gender significantly related to environmental concern levels, but also that it was the only factor that remained significant when entered with other variables such as education and housing type into a regression model. In contrast to the above findings, there is one study that found no significant relationship between gender and environmental concern. Lyons and Breakwell (1994, p. 231) found ‘no gender differences in the level of environmental concern as indexed by respondents’ attitudes towards either controlling industrial pollution or towards banning CFS aerosol sprays’. It is, however, important to recognise that this study’s index of environmental concern was based on three single-item measures and, as such (in the words of the authors), ‘should be interpreted with some caution’ (ibid., p. 234). It is unclear, for instance, whether such patterns would be maintained across concern about a wider range of types of environmental issues and ideas.

Given the specificity of Lyon and Breakwell’s scale, and the fact that there are no studies reporting a case of males having more favourable environmental
attitudes, there does seem to be considerable evidence to suggest that females of the secondary school age express greater levels of environmental concern than their male counterparts.

**Socio-economic grouping.** There appears to be support for the notion that environmental attitudes are affected by socio-economic grouping. Hampel et al.’s (1996, p. 295) study of over 600 Australian adolescents found that students from schools with low socio-economic catchment areas responded in a ‘significantly more “materialist” and environmentally less responsible way’. Such students were significantly more likely to assert the right to use cars as they wished and were less likely to believe that recycling of cans was worthwhile. They were also more likely to demonstrate a *laissez-faire* opposition to environmental controls such as banning of CFCs, rather than the generally liberal, more ecocentric view articulated by those from schools with higher socio-economic catchments. In considering the findings from Hampel et al.’s study, it is important to note that these are based on school-level (rather than pupil-level) variation. In another study, a significant relationship is found between housing type and levels of environmental concern, such that students living in private (as opposed to public) housing exhibited a stronger concern about the environment and were more willing to undertake behaviours of a pro-environmental nature (Chan, 1996). Furthermore, when considered alongside age and gender, housing type (along with age, but not gender) remained significant. This suggestion that socio-economic grouping is more important as an influence on environmental concern than other background factors such as age and gender is echoed by Lyons and Breakwell (1994). On the basis of a discriminant function analysis encompassing several variables, they argue that second to variables associated with respondents’ environmental knowledge, ‘socio-economic grouping was the second most powerful discriminatory variable, whereas age played only a small role in the function and gender was not selected’ (*ibid.*, p. 233). As explained earlier, though, this study investigated attitudes in relation to a very specific environmental topic (industrial pollution of CFCs) using only three questionnaire items.

**Age.** There is a small amount of evidence relating to the effect of age from two cross-sectional studies. One study found that older school students (Year 6) ‘exhibited stronger concern about the environment’ as compared with their counterparts in younger years (Years 3 and 4) (Chan, 1996, p. 304). Lyons and Breakwell (1994), however, report that while age was related to environmental concern among their sample, this relationship ceased to remain significant once a number of other additional variables were also considered. In particular, knowledge about industrial pollution, scientific knowledge, socio-economic grouping, and TV science watching were all found to be more powerful discriminatory variables than age.

**Academic ability and orientation.** Few studies have examined the possible interaction between educational ability and orientations, and environmental attitudes. One exception is Morris and Schagen’s (1996) work, which found no statistically significant relationship between students’ ability and their level of environmental concern. What they did find, however, was a significant positive relationship
between students’ self-reported enjoyment of school subjects and their environmental concern. One other study which looked at students’ academic orientation (in terms of whether they felt their ‘best subjects’ were in ‘Design and Technology’, ‘Communication and Culture’, ‘Personal Development’, or ‘Social and Business Education’) in relation to environmental attitudes found ‘no statistical relationship’ (Clarke, 1996). However, this study was confined to the Year 11 cohort of one school.

4.2.3. Summary. Researchers have paid considerable attention to surveying the environmental attitudes of secondary school students in a variety of national locations. These report generally positive environmental attitudes, i.e. greater agreement with pro- rather than anti-environmental sentiments. However, several studies find students to be less environmentally conscious in relation to certain issues—in particular, those linked to their own lives and material aspirations. Examples include the use of cars in Singapore, modern consumer products in Hong Kong, and modern technology in Australia. A number of studies suggest a relationship between environmental attitudes and gender and socio-economic grouping, such that female students and those from more socio-economically advantaged backgrounds tend to be more pro-environmental in their attitudes than boys and those from less advantaged backgrounds. Trends with respect to age and academic ability/orientation are less clear.

4.3. Students’ Environmental Behaviours

4.3.1. The available evidence. There are a number of studies that have explored the extent and nature of young people’s involvement in pro-environmental behaviours. These include research undertaken in the US (Roper Starch Worldwide, 1994; Kahn & Friedman, 1995), Singapore (Ivy et al., 1998), Australia (Clarke, 1996; Connell et al., 1998), The Netherlands (Kuhlemeier et al., 1999), the UK (Morris with Schagen, 1996), the UK and Germany (Prelle & Solomon, 1996), and across Europe (Filho, 1996). As will be clear from the references, none of these have focused exclusively on behaviour, but rather have investigated environmental behaviours along with environmental concerns and/or environmental attitudes. There are, therefore, strong similarities between the evidence in this section, and that already covered in the preceding two sections on concerns, and attitudes. In other words, it is mostly questionnaire survey-based (except Prelle and Solomon’s use of open written responses from students), concerned with older secondary age students, based on descriptive statistical analysis, and related to a variety of geographical locations.

It is important to emphasise that all of the evidence relates only to self-reported behaviour. That is, there are no studies that investigate actual observed behaviour, or indirectly corroborated practices such as membership lists of environmental organisations. Aside from this commonality, it is clear that, as with studies of attitudes and concerns, there are differing constructions of ‘environmental behaviour’ within almost all of the studies. They vary in terms of:

- the number of behaviours—some adopt a very narrow focus on two particular behaviours such as ‘recycling newspapers’ and ‘recycling cans and bottles’ (Kahn & Friedman, 1995, p. 1409; Filho, 1996), while others explore a far
greater number of possible behaviours (Connell et al., 1998; Ivy et al., 1998; Kuhlemeier et al., 1999);
• the specificity of the behaviours—most of the studies ask respondents about quite specific and concrete acts like ‘How often do you use more tap water than is strictly necessary, e.g. take a long shower or let the water run continually when brushing your teeth or doing the dishes?’ (Kuhlemeier et al., 1999, p. 13), but some ask much more generally such as ‘performing tasks such as recycling’ (Filho, 1996);
• the nature of the behaviours—the focus in most studies is on the student as either consumer (e.g. buying green products), and/or energy user and garbage producer (e.g. use of water, recycling/refuse activities); less commonly included are behaviours of a social nature such as gathering environmental information, and involvement in political activities and community projects (Connell et al., 1998);
• the friendly or unfriendly nature of the behaviours—most studies ask only about involvement in environmentally friendly acts, but some also assess the extent of environmentally unfriendly behaviour such as ‘How often do you leave litter behind when you are outside, e.g. throw candy wrappers, cans or chewing gum in the street?’ (Kuhlemeier et al., 1999, p. 14) and ‘How often do you buy aerosols without checking whether they contain CFCs?’ (Ivy et al., 1998).

On the whole, then, there is evidence on the extent of young people’s involvement in pro-environmental behaviours in the realm of energy use, recycling and consumer activity. Less plentiful is the evidence on young people’s involvement in pro-environmental behaviours of political or community nature, and in environmentally unfriendly behaviours of most kinds.

4.3.2. The key messages. There are three key messages emerging from the evidence base in this area.

(1) Young people report some involvement in environmentally responsible behaviour

It is clear from a number of studies that young people do report involvement in behaviours of an environmentally related nature. Among the 5688 young Australians in Connell et al.’s (1998, p. 43) study, for example, 55% stated that they had taken deliberate actions to improve the environment, while 40% said they had not. A slightly more recent study in The Netherlands found that the behaviour of about a quarter of their 9000 respondents could be described as ‘(extremely) environmentally friendly’, and another 50% were in the category where ‘environmentally friendly behaviour was exhibited more often than environmentally unfriendly behaviour’ (Kuhlemeier et al., 1999, p. 8). Similar reports of practices of positive environmental behaviour emanate from studies in Singapore (Ivy et al., 1998), and Europe (Filho, 1996).

The above findings, though, are not without their qualifiers. While there is evidence of involvement, there is also evidence of considerable environmentally irresponsible behaviour. Ivy et al. (1998), for example, express concern that only 30.7% had never dropped litter, and Kuhlemeier et al. (1999, p. 8) assert that ‘a lot of things still need improving in the environmentally responsible behaviour of large groups of students’. Similarly, Connell et al. (1998, p. 47) argue that their
findings highlight how ‘much more needs to be done to increase present levels of student environmental responsibility and behaviours’.

(2) Certain pro-environmental behaviours appear to be more prevalent than others

Looking beyond the general extent of young people’s environmental behaviours, there are also indications of the kinds of behaviours in which students are involved. From this there is evidence of differential patterns of activity, whereby:

- environmental conservation practices such as turning off lights and reusing printed paper were more common among Singaporean students than environmentally friendly consumption activities such as selecting products with ‘green’ labels and avoiding ones with lots of packaging (Ivy et al., 1998);
- environmental conservation and consumption practices were reported more frequently by Australian students than behaviours involving information gathering, political and community activities, and financial donations (Clarke, 1996; Connell et al., 1998);
- in the area of conserving energy, UK students were reportedly more likely to turn off lights and electrical appliances, than they were to either wear extra clothing instead of turning up the heating, or to apply energy considerations to purchases made in the marketplace (Morris with Schagen, 1996, p. 11);
- students from disadvantaged areas in the US were more likely to report that they and their families made efforts to save energy and water than to cut down on the amount of trash and garbage or reduce use of pesticides and fertilisers (Roper Starch Worldwide, 1994).

In noting these, however, it is important to recognise that these represent specific findings in specific studies. In other words, their generalisability is yet to be established. Furthermore, the reasoning (conscious and/or unconscious) behind such patterns was largely left unexplored by the studies concerned. Hence no claims can be made about what such trends represent.

(3) Young people’s environmental behaviours seem to be influenced by several factors

Owing to the shortage of detailed empirical investigation into environmental behaviours, there are few strong points that can be made about influential factors. What can be said tends to emanate from the findings of just one or two studies, and must necessarily be seen as indicative rather than conclusive. With this in mind, the evidence that is available suggests that environmental behaviours can be influenced by socio-economic grouping, schooling, gender and other people.

Socio-economic grouping. Roper Starch Worldwide (1994) found significant differences between the environmental actions of US students from disadvantaged and non-disadvantaged communities. While both groups were equally likely to be involved in saving energy and saving water, students from disadvantaged areas were significantly less likely to be engaged in several of the other listed activities, in particular those relating to litter and recycling. In this the authors see a link with these students’ ‘higher concern about energy and water […], as well as [their] lower concern about recycling’ (ibid., p. 96). As well as this study’s findings, there is also a suggestion from a study of 72 children in an inner city
Black community in the US that ‘their economically impoverished socio-economic grouping and inner city geographical context affected their environmental views, values and behaviours’ (Kahn & Friedman, 1995, p. 1414). They cite the fact that: ‘while it is true that 74% of the children said that they or their families recycle cans and bottles, children often told us that local recycling centres provided monetary compensation for recycling these items, but seldom for newspapers, if the centres accepted newspapers at all. Only 25% of the children said that they or their families recycled newspapers.’ Some connection might be seen between Kahn and Friedman’s argument and the fact that one of the more frequently mentioned reasons for reluctance in undertaking environmental behaviour by Australian students was the costs involved (Connell et al., 1998, p. 43).

**Schooling.** That school can impact upon students’ environmental behaviour is suggested by Kuhlemeier et al.’s (1999) work, which found that schools whose students knew relatively more about environmental problems engaged in more environmentally friendly behaviours than those where students were less knowledgeable. This corresponds with Roper Starch Worldwide’s (1994) finding that disadvantaged students who report either knowing a lot about the environment and/or learning a lot about the environment in school seem more likely to undertake environmental behaviours such as buying more recycled products and cutting down on trash or garbage. Furthermore, Morris and Schagen (1996) reported that environmental behaviours were significantly higher for students from schools in which there was a designated environmental education coordinator and/or staff thought to be expert in, and strongly motivated towards, teaching environmental education. The same effect, though, was not evident for schools simply having an environmental education policy or senior staff in support of environmental education. This leads them to argue that: ‘it is the beliefs and practices of environmentally motivated teachers which are the most significant elements [in school] in prompting young people to undertake environmental action’ (ibid., p. 20).

**Gender.** In the context of Connell et al.’s (1998) study, it is clear that female students were more regularly and more extensively involved in behaviours to improve environmental quality. The same is found by Morris and Schagen (1996), where girls within their sample have significantly higher scores than boys for individual environmental behaviours. Similarly, the survey undertaken by Roper Starch Worldwide (1994, p. 98) found that ‘gender is a key factor in five out of the top six environmentally-friendly behaviours’. Across both disadvantaged and non-disadvantaged groups, more girls than boys reported that they and their families saved energy and water, reduced littering, and bought recycled products.

**Other people.** When Australian students were asked about the degree of support, indifference or hindrance their environmental behaviours were given by various kinds of people, it emerged that: ‘the highest degree of full support was from others involved (59%) and their immediate families (46%) [while] the highest level of antagonism or indifference was from close friends (40%) and teachers (32%)’ (Connell et al., 1998, p. 43).
4.3.3. **Summary.** The limited research that has been undertaken on students’ pro-environmental behaviours provides evidence that young people have some (self-reported) involvement in practices relating to energy conservation, recycling and (less commonly) ‘green consumerism’. Most studies, however, emphasise the need for these behaviours to increase, and to encompass consumption practices and social political actions, as well as conservation practices. In a similar way to young people’s concerns and attitudes, there is some evidence to suggest that the nature and degree of young people’s environmental behaviours can be influenced by factors such as socio-economic grouping, schooling, gender and other people.

5. **Evidence on Learners’ Environmental Learning Outcomes**

5.1. **The Available Evidence**

There is a considerable body of evidence on environmental learning outcomes, although (as described in Section 2) the overall amount is less than that pertaining to the previous two sections. This evidence provides information about the outcomes of environmental education interventions in terms of the extent to which they bring about changes in students’ environmental knowledge, attitudes and/or behaviours. The research studies that have generated this information include:

- evaluations of school-based environmental education initiatives focused on particular teaching strategies (Gayford, 1995; Leeming *et al.*, 1997; Bailey & Watson, 1998; Mason & Santi, 1998; Park & Chang, 1998; Bogner, 1999), content areas (Hanson, 1993; Kortland, 1997; Bradley *et al.*, 1999), or skills (Corral-Verdugo, 1993; Ramsey, 1993; Corral-Verdugo *et al.*, 1996);
- investigations into the effects of out-of-school programmes such as residential field courses undertaken by school groups at outdoor centres (Uzzell *et al.*, 1995; Emmons, 1997; Bogner, 1998; Dettmann-Easler & Pease, 1999), as well as work undertaken at local parks, zoos and museums (Gutierrez de White & Jacobson, 1994; Farmer & Wott, 1995; Milton *et al.*, 1995).

The evidence emerging from these various studies is very similar in nature, and in focus. As outlined in Section 2, almost all of these studies (except Emmons, 1997 and Mason & Santi, 1998) constitute quasi-experimental investigations into the effects of certain educational treatments (independent variable) on students’ environmental knowledge, attitudes or behaviour (dependent variable). It also pertains predominantly to innovative educational programmes rather than regular practices, and to short-term rather than long-term effects. In light of these strong similarities in the focus of the evidence, this section (unlike the preceding two) is not divided into subsections. All the evidence is discussed in terms of one set of key messages.

Many of the programmes investigated are environmental science-based and so there is a strong science education influence within the research evidence on learning outcomes. There is a mixture, though, of studies of primary, and of secondary, aged children. In terms of geographical location, much of the evidence pertains to initiatives within the US or Western Europe (Germany, The Netherlands, Switzerland and the UK), with a small number of studies relating to programmes in Belize, Mexico and South Korea.
5.2. The Key Messages

The evidence on environmental learning outcomes can be understood in terms of three key messages.

(1) Educational interventions can change learners' environmental knowledge, attitudes and actions, at least in the short term

The studies reviewed in this section provide evidence of a positive effect of certain environmental education initiatives on students' environmental knowledge, attitudes and/or actions. The kinds of educational interventions that have been investigated include residential field courses undertaken by school groups at outdoor education centres, as well as school-based initiatives focusing on particular content areas, learning strategies, or skills.

Residential Field Courses

There are several studies that report treatment effects relating to environmental education initiatives in the form of outdoor field courses. The most conclusive evidence is provided by Bogner’s (1998) study, which investigated the effects of a 5-day residential outdoor ecology programme in a German national park. Aimed at secondary school students, this programme involved students working in small groups undertaking a mixture of ‘cognitively biased activities’ such as locating and identifying animal tracks, and emotionally orientated ones such as ‘Touch a Tree’ and simulation games. The aim was to provide an ‘original encounter with biological and ecological themes [through] structured and participatory learning activities on trails within a woodland area’. There was also an onus on avoiding ‘the kinds of partitions and divisions that are found in normal biology syllabi’ (ibid., p. 20).

Through comparison with two control groups that either participated in an outdoor programme without an ecological focus, or did not attend any programme, Bogner reported the following effects 1 month after the programme among his sample of 351 secondary school students (12–13 years):

• significant gains in students’ environmental knowledge;
• significant changes in students’ attitudes towards human utilisation of nature; and
• significant shifts in students’ willingness to plan and take action for the environment.

This study provides some clear evidence that participation in this well-established outdoor ecology programme did effect positive changes in students’ environmental knowledge, attitudes and behaviour.

These findings concur with certain other pieces of work. First, there is support from a more recent study of six residential environmental education programmes in midwest America (Dettmann-Easler & Pease, 1999). These programmes, lasting from 2 to 5 days, all involved students as a class, either with their regular teacher or permanent centre staff at an outdoor residential centre, undertaking wildlife education activities such as pond and stream study as well as outdoor pursuit activities. Investigating a sample of 697 students (10–12 years), Dettmann-Easler and Pease found significant differences in participants’
attitudes to wildlife 1 week after the programme, as compared with 3 weeks before. Furthermore, these differences, which were significantly greater than those of a control group that received classroom (rather than outdoor) wildlife education, were also still largely evident some 2 to 3 months later.

A second source of similar evidence is Uzzell et al.’s (1995) investigation into the effects of a 4-day experiential environmental education course at a UK field study centre. Their evaluation focused on students’ perceptions of the severity of environmental problems at various scales (global, national, local and personal) both before, after and 6 weeks following the course. Albeit with a fairly limited sample of 63 female secondary school students, they found that immediately after the course, participants were significantly more concerned about environmental problems at the personal, local and national level, as compared with their perceptions prior to the programme. This, they argue, ‘indicates that the children were more concerned about the specified problems as a consequence of the environmental education course’. This same study, however, also raises the critical question of the longevity of such changes, as the data collected 6 weeks after the course showed students’ perceptions to have ‘declined to below the pre-course level’, i.e. reversion to pre-course levels of low concern after returning to school (ibid., p. 177). This point over the durability of learning outcomes such as changes in young people’s attitudes and knowledge is explored further below.

Finally, further evidence of attitudinal change is provided by Emmons’ (1997) qualitative case study of ten Belizean high school students during a 5-day environmental education course at a wildlife sanctuary. This study reports outcomes of increased sensitivity for the environment and more caring attitudes towards specific animals, as well as ‘fewer expressions of “fear” by the students’ of the forest habitat (Emmons, 1997, p. 331). This study’s small sample size and lack of a control/comparison group, however, mean that its findings are not conclusive for (in the author’s words): ‘it is difficult to determine how much growth [in students’ environmental sensitivity] can be attributed to the programme itself’ (ibid., p. 342). However, by studying students’ reactions and interactions with the forest environment during their participation (rather than simply before and afterwards), this study was able to generate insights into ‘the formative processes’ of perceptual and attitudinal change (ibid., p. 327). This aspect of the study is explored further in relation to the next key message.

**School-based Initiatives**

The research evidence indicates that targeted classroom-based programmes can also be effective in altering students’ environmental attitudes, knowledge and actions. Research is available in relation to a variety of such initiatives, including those focused on particular teaching–learning approaches, particular content area, and/or particular skills.

**Initiatives utilising particular teaching–learning approaches.** Several initiatives seeking to bring about environmental education through certain (often non-traditional) teaching–learning strategies have been investigated and reported in the literature. The most recent example (Bogner, 1999) concerns a conservation education programme in Swiss secondary schools which ‘sought to bring pupils into close contact with the natural history of a local endangered bird’ through a
combination of classroom and outdoor work, and cognitive and affective approaches. The programme, initiated by two Swiss conservation agencies but delivered by regular school teachers, lasted one school year and encompassed four units: (1) the bird’s natural history; (2) construction of a nesting box; (3) writing letters to Senegal where the bird winters; and (4) observation of local bird behaviour. Using a questionnaire administered to an experimental ($n=226$) and a control ($n=75$) group both 1 week before and 4 weeks after the course, the programme is shown to have a significant positive effect on the students’ specific knowledge and certain aspects of their environmental perception. In particular, students who followed the programme expressed a stronger intention to act in an environmentally conscious manner, and reported greater enjoyment of nature.

A similarly positive evaluation is reported by Leeming et al. (1997) in their study of an educational programme (The Caretaker Classroom Program) initiated by a major US city newspaper to encourage elementary school classes to engage in pro-environmental activities. This supported teachers to devise and undertake a series of at least eight activities with their students during a school year in order to ‘develop factual knowledge, build knowledge and/or take action for the environment’. Examples of activities pursued included recycling cans and paper, planting trees and flowers (grades 1–3) and participating in environmental organisations, engaging in recycling projects (grades 4–6). Evaluated in terms of pre-test (early in the school year)/post-test (late in the school year) comparisons with non-participating classes in the same year group and school, it was found that children who had taken part in the Caretaker programme ($n=514$) showed a significantly greater change in environmental attitude from pre-test to post-test than did those children who did not participate ($n=339$). Such changes in environmental attitudes, however, were not reflected in the area of environmental knowledge, which appeared to be unaffected by the programme. With respect to attitudinal change, though, this study took the analysis a step further by investigating the extent to which children within the class were differentially affected by the programme and (as discussed further in key message (3) below) established that ‘there was no evidence that the positive effect of participation in Caretaker activities was limited to a small subset of children’ (ibid., p. 37).

Another study reporting attitudinal changes through a particular teaching–learning initiative is Park and Chang (1998). This evaluated a South Korean high school teaching strategy to foster ‘environmental sensitivity’ which emphasised ‘body relaxation and the examining of here-and-now situations’ (ibid., p. 176). The authors report that students in the experimental group ($n=158$) were more likely to: be able to identify and write about their feelings (as opposed to their thoughts, values or knowledge) about environmental issues; express strong, as opposed to weak, feelings; and express certain kinds of active feelings, such as ‘rage’, ‘love’ and ‘disdain’. It is important to recognise that these differences, however, were not statistically tested, and were based on a sample of female students only.

Two further pieces of work have evaluated teaching–learning initiatives in terms of their impact upon students’ environmental knowledge/understanding. One of these is Milton et al.’s (1995) study of the Park/School Program, which involved 46 inner city students from an elementary school in a US city undertaking participatory field studies in urban forest ecology with graduate students in
a local park. The programme placed an emphasis upon changing attitudes through ‘direct contact with a natural environment’ and involved three successive curriculum units of the fall park ecology, the winter regional watershed and the spring wildlife, each involving eight 75-minute lessons. Lessons encompassed a combination of outdoor exploration/observation and laboratory work, and at the end of each unit there was an outdoor presentation by the students to their families and local people. The quantitative evaluation through pre-test/post-test comparison between the participating class and one from a similar local school that did not take part indicated that the former demonstrated clear gains in their knowledge of ecology which were greater than those of the control group. In the area of environmental attitudes, though, no real differences were found between the experimental and control groups. Both of these findings, however, were not tested for statistical significance and so cannot be seen as conclusive.

A second study (also not particularly conclusive) comes from Bailey and Watson (1998), who undertook a pilot evaluation of a strategy based on drama/role play aimed at establishing basic ecological understanding with primary students (in particular, an understanding of the relationships between organisms). Significant post-test differences in ecological understanding scores were found between students who had been taught through the ‘Ecogame’, and those who had not. Noteworthy methodological weaknesses (such as the fact that the treatment was administered by the researcher, while the alternative teaching was by a regular class teacher), however, mean that these differences, although statistically significant, cannot be described as conclusive.

Initiatives focused upon particular content areas. As well as evaluating programmes with particular pedagogical approaches, research studies have also explored environmental education initiatives with particular substantive themes. One example is a large-scale energy education programme in the US which, through a national non-profit organisation (the Energy Source Education Council), provided free teaching resources to schools nationally. The resources were structured into eight units, each with a different designated theme (such as ‘How energy is used’) and a specific target age range from kindergarten to grades 5–6. The package included a teacher’s guide, student book, home activity booklet, tests, posters and a video. The evaluation of this programme (Hanson, 1993) took place some years after the programme had been delivered in schools and generated evidence of ‘long-term independent impact on students even after as long as six years have passed’ (ibid., p. 380). On the basis of statistical differences between 1349 Grade 6 students who had encountered varying numbers of the programme’s curriculum units during elementary school, the programme was shown to have positively impacted upon students’ energy knowledge, conservation behaviour, and interest in learning about energy.

Two further sources of evidence come from evaluations of high school environmental science courses. The first concerns an environmental science course developed by a university and education agency in Texas with the aim of providing ‘an introductory unit on the environment and environmental issues’ through instruction and hands-on activities (Bradley et al., 1999). The course included student and teacher guides on four themes of air, water, land and living organisms and was designed to be taught over 10 weeks (one
Based on pre- and post-testing of 475 students from grades 9–12 taking the course across 18 schools, it was found that students’ environmental knowledge scores and environmental attitudes were significantly increased after the course. It is important to recognise, though, that these findings were not based on comparison with a control group. The second was a study of an elective course in environmental science taken by 31 students within one Canadian high school of 220 students (Simmons, 1998). Through a survey of the environmental attitudes of the entire school population at the beginning and end of an academic year, it was reported that ‘there was no evidence to indicate that completion of the course was related to attitude change’ (ibid., p. 1).

Finally, the development and trial of a teaching unit on waste within the Dutch junior secondary school context (Kortland, 1997) provides another example of empirical evaluation of an initiative with a particular theme. This unit used a specially designed worksheet and discussion-based activity to try and tackle and modify the kinds of conceptual problems the students had been found to have in understanding waste issues. For example, it sought to challenge their apparent inability to distinguish between reusing and recycling. On the basis of a pre- and post-test questionnaire ($n=27$) assessing students’ knowledge and understanding of waste-related issues and ideas, it was concluded that there was ‘a mix of slightly positive, negative, or no, learning effects as far as the students’ specific conceptual problems are concerned’. In other words, ‘the effectiveness of the additional teaching/learning activity directed at students’ conceptual development leaves much to be desired’ (ibid., p. 73).

**Initiatives aimed at fostering particular skills.** Finally, there is also evaluatory evidence relating to environmental education initiatives focused on particular kinds of skills. One source of such evidence is Ramsey’s (1993) work on the instructional effects of issue investigation and action training (IIAT), an environmental education methodology aimed at the development of responsible environmental behaviour in middle school students. The programme, which lasts one semester, consists of six multidisciplinary science modules that introduce students to environmental issues, the skills needed to analyse and investigate issues, and the skills needed to take responsible action. Notwithstanding the threats of confounding variables affecting the recorded experimental ($n=96$)/control ($n=86$) differences, the author reports that overt environmental behaviour, group locus of control, knowledge (and perceived knowledge) of environmental action skills, and perceived skill in the use of environmental action skills were all significantly improved among those students (14–15 years) who participated in the 18-week programme. On this basis, Ramsey claims that the programme ‘tends to foster independent overt environmental behaviour on the part of eighth grade students’ (ibid., p. 34).

The second example is work-investigating ways to aid student’s in their ability to distinguish environmental facts from opinions, termed by Corral-Verdugo (1993) as ‘environmental critical thinking skills’. Two studies on this topic in Mexico (Corral-Verdugo, 1993; Corral-Verdugo et al., 1996) suggest that certain teaching strategies (namely, providing examples, giving individual feedback and offering reinforcement) can make significant improvements to students’ ability to distinguish facts from opinion, as compared with being taught through
exposition with no additional examples or support. These findings were based on 60 randomly selected elementary school students who were subsequently randomly assigned to one of four groups that received a lesson through either exposition, examples, feedback, or reinforcement (Corral-Verdugo et al., 1996). The results of this study replicated those of an earlier one that noted a positive influence of giving examples on the experimental students’ ability to differentiate facts from opinions, relative to the control group, who received no specific examples prior to the task (Corral-Verdugo, 1993). An important shortcoming of this earlier study, though, was its small sample size (24 third-grade students), although students were randomly assigned to either the control or the experimental group.

Taken together, the findings discussed above make it clear that certain environmental education initiatives both within and outside of schools can be shown to effect changes in learners’ environmental attitudes and knowledge. Notwithstanding this, it is worth raising the issue of the durability of any such changes in young people’s attitudes and knowledge. Many of the studies referred to only provide evidence of changes over a very short time span after an intervention. Their evidence cannot be taken, therefore, as any indication of lasting impacts. This is a concern in the light of Uzzell et al.’s (1995) finding (admittedly for a relatively small sample of female students) that, despite an initial significant post-course increase, students’ environmental concern 6 weeks after a residential field course was lower than their pre-course level. These authors argue that their findings suggest ‘that environmental attitudes are fairly well entrenched [and] environmental education as it is currently taught at one school and its associated field centre does not lead to a lasting change in children’s environmental attitudes or values’ (ibid., p. 177–178).

Contrary to this study, however, are three that provide evidence of changes in more than the very short term. First there is Bogner’s (1998) finding that students’ greater willingness to plan and take action for the environment after participating in a 5-day outdoor ecology programme was evident not only 1 month, but also 6 months, after the programme. Secondly, Dettmann-Easler and Pease (1999, p. 38) found that changes in students’ attitudes to wildlife after participation in residential programmes were ‘generally retained for at least two to three months’. Thirdly, the US Energy Source Education Program was found to have impacts on students even after as long as 6 years after the end of their participation (Hanson, 1993).

(2) Certain aspects of environmental education programmes appear to facilitate positive outcomes

It is clear from the above discussion that there is some evidence to suggest that environmental education initiatives can effect changes in learners’ environmental knowledge or attitudes. What is less clear, however, is how and why such initiatives bring about such effects. This is because many of the research studies that have generated evidence on learning outcomes have not attempted to identify any basis for the measured programme outcomes. There are, however, some exceptions, including two studies that have explored the processes, as well as the outcomes, of educational initiatives (Emmons, 1997; Mason & Santi, 1998), and investigations that have compared the outcomes of programmes with
differing characteristics (Gutierrez de White & Jacobson, 1994; Farmer & Wott, 1995; Bogner, 1998; Dettmann-Easler & Pease, 1999; Zelezny, 1999).

Taking the process-orientated studies first, Emmons (1997) suggest that certain influences during a 5-day field course were important in participants becoming more positive about the forest and less fearful/more caring towards specific animals. These included factors of three kinds:

1. instruction through role modelling (e.g. teachers demonstrating and sharing their interests and ‘likes’ about the forest); the opinions of others (e.g. student sharing what others like or dislike, and why); and direct experience (e.g. students becoming aware of the surroundings and noticing what they like about them);
2. conceptual grasp relationships—students learning that the wildlife sanctuary provides a safe place for plants and animals; and
3. recreational relationships—students enjoying the natural surroundings and finding them physically challenging (ibid., p. 334).

In reporting these it is important to stress that this work was an exploratory part of a larger study and, while these influences are well evidenced in terms of examples of changes in students’ comments about the environment during the course, they are not explicitly supported with reflective accounts from participants about what influences they felt were significant in bringing about changes in their perspectives. At present, then, these insights might be seen as ideas for further empirical investigation.

Another piece of work that has generated findings about process is Mason and Santi’s (1998) investigation of changes in Italian students’ conceptions of the greenhouse effect through ‘socio-cognitive peer interaction’ in classroom-based group discussion. This pedagogical approach, which is grounded in constructivist theories of learning, involves a combination of: (i) small group discussions—four or five children reasoning and arguing about relevant topics such as how the Earth gets warm, or what could be done to prevent the increase in global warming; and (ii) whole class discussion—where the teacher puts forward what had been expressed in the small groups asking the children to compare the different points of view (ibid., p. 70). The study involved 22 elementary school pupils (10–11 years) being taught by two teachers who ‘were already trained in creating a social constructivist learning environment’ (ibid., p. 70). On the basis of qualitative analysis of transcripts of lesson discussions, and students’ initial and final representations of the greenhouse effect (generated through individual interviews), this study proposes three ways in which the ‘classroom discussion led the children […] to build new knowledge based on revision of their personal conceptions and beliefs’. These include:

1. ‘collaborative learning’ which ‘fostered meaning negotiation and sharing to advance the children’s conceptual understanding’;
2. ‘discourse reasoning’ which promoted the ‘anchorage of new data […] to children’s new knowledge’; and
3. ‘argumentative dynamics’ by which the children made ‘explicit the presuppositions underlying their conceptions’ and thereby enhanced their metaconceptual awareness and triggered conceptual change (ibid., p. 81).
These processes, like those suggested by Emmons (1997), would seem important ones for future empirical attention, for, as asserted by the authors, ‘the definition of more and more adequate tools and procedures to evaluate individual learning products and processes [...] remains a field open to further research’ (ibid., p. 81).

Turning to the research that has compared the outcomes of programmes with differing characteristics, there is evidence to suggest that the following programme characteristics are important determinants of effectiveness in terms of students’ learning outcomes.

- **Duration**—Bogner’s (1998) evaluation of an outdoor ecology programme specifically included two versions of the same programme (a 1-day and a 5-day) and so was able to show that outcomes ‘tended to depend on the duration of the intervention: only the residential five-day programme had any effect on behavioural levels, although both [versions] addressed the same goals’. This, Bogner argues, ‘should encourage educators to promote week-long programmes that can shift attitudes and behaviour’ (ibid., p. 26). This notion of longer programmes being more effective than shorter ones is supported by the findings of a recent meta-analysis of research on educational interventions and their impact on students’ environmental behaviours (Zelezny, 1999). This identified a trend of intervention effectiveness being greater with participants who were 18 years or younger, which the author suggested may be due to the fact that interventions with this age group tended to be more prolonged than those with older participants (which tended to be considerably shorter).

- **Location**—Dettmann-Easler and Pease’s (1999) study of six residential wildlife education programmes drew comparisons between such programmes and classroom-based wildlife teaching on similar themes. On the basis of greater pre-test/post-test differences in attitudes to wildlife, this article argued that ‘residential programmes are still more effective in fostering positive attitude changes than a single, in-class programme’ (ibid., p. 38). In contrast to this study, Zelezny’s (1999) meta-analysis of the findings from 18 studies of educational interventions in classroom and outdoor settings proposed that classroom interventions improved environmental behaviour more effectively ($r = 0.65$) than interventions in non-traditional settings ($r = 0.27$). It is not clear, however, the extent to which this finding is a reflection of the setting of the interventions per se, as opposed to, for example, the nature of the programmes offered or the age and characteristics of the learners taking part or the criterion of evaluation, e.g. attitude or behaviour change.

- **Preparatory and follow-up work**—Gutierrez de White and Jacobson’s (1994) study of zoo-based conservation education for school students in Colombia showed that changes in students’ knowledge and attitudes occurred only for those students ($n=184$) whose teachers had participated in a specially designed training workshop lasting 3 months prior to the zoo visit. Neither the alternative treatment groups ($n=161$ and 163, who were exposed to various combinations of the different aspects of the treatment except the teacher workshop) nor the control group ($n=263$) recorded any significant changes in knowledge or attitudes. While this study was not able to identify which aspects of the teacher pre-course workshop were contributing to the recorded outcomes, the authors argue that: ‘systematic classroom preparation and
reinforcement provided by informed teachers seem to be essential for improving cognitive achievement and attitude from a field trip to the zoo' (ibid., p. 21). With respect to follow-up work, there is some evidence from a Seattle-based study (Farmer & Wott, 1995) to suggest its importance in supporting fieldwork undertaken out of school, such as in museums and public gardens. However, the differences between the experimental (n=51) and the placebo (n=60) group, although significant, were small and modifications to the research design would have been necessary for conclusions to have been more concrete.

As well as these empirically investigated characteristics of interventions, reference on a more speculative basis is also made within the literature to several further aspects of programmes that improve effectiveness in terms of learning outcomes. These include:

- **Duration**—Emmons’ (1997) study argued that: ‘the length of time that students spent at Cockscomb (5 days for most) appeared to be important in the reduction of negative perceptions of the environment, including fears. [...] A shorter environmental education programme may not have had the same effect’ (ibid., p. 342).
- **Location**—Milton et al. (1995), in their discussion of the effective outcomes of a Park/School programme, highlighted the ‘outdoor classroom’ as ‘the most significant of the many aspects of the programme that motivated the children’ (ibid., p. 36). Taking another dimension of location, Emmons (1997) saw significance in the fact that the programme that she evaluated ‘did not completely remove students from all that was familiar to them, as might a nature experience for inner city children in the USA, for example’ (ibid., p. 342). Instead, in her view, it was an environment that ‘although certainly novel’ was also one that the students could link with, due to ‘their own experiences in rural Belize’ and this contributed to its ability to challenge participants’ environmental perceptions (ibid., p. 342).
- **Community involvement**—another feature emphasised by Milton et al. (1995) in their discussion of the success of a Park/School programme was the amount of community involvement, whereby student participants were able to share their knowledge and experiences with their families and friends and so gain self-esteem through this process.

Finally, in addition to these factors of success, Uzzell et al.’s (1995) study of a residential field course highlights a possible source of ineffectiveness in meeting desired environmental learning outcomes. Finding that levels of environmental concern were lower 6 weeks after a 1-week residential programme than they were both before and immediately after the programme, these authors suggest that such courses are ineffective for two reasons. Firstly, they accentuate the distinction and separation between ‘the world of the school’ (scientific understanding of the environment) and ‘the world of our physical surroundings’ (familiar understanding of the environment). As a consequence, ‘children’s concern decreases following an environmental education course, especially at the local level, because they cannot relate the scientific content of their lessons to the social worlds they inhabit’ (ibid., p. 179). Secondly, the hands-on experience they provide is often with the symptoms of the problems (such as
measuring air pollution) but not with the environmental problem itself, which ‘is in society, not in the environment’ (ibid., p. 179). It thus only provides a ‘partial and deficient’ experiential encounter that is not able to challenge and change the values and attitudes of young people.

Overall, while there is evidence to suggest that certain processes and certain programme characteristics can facilitate positive learning outcomes, it would seem that empirical understanding in this area is in need of further development. Issues such as which kinds of programmes and learning processes work better for which kinds of aims, topics and students are still largely to be established.

(3) Educational interventions can affect young people’s environmental knowledge, attitudes and behaviour in different ways

As well as indicating that educational interventions can have desired effects and how this can be facilitated by certain programme characteristics, the evidence on learning outcomes also provides some indication of the differential impacts that interventions can have on (i) participants’ environmental attitudes, knowledge and behaviour; and (ii) students of different ages, abilities and environmental perspectives.

**Differential impacts on attitudes, knowledge and behaviour.** It is clear from certain studies that learners’ environmental attitudes, knowledge and behaviour are not necessarily affected to the same degree by educational interventions. With respect to change in the realm of attitudes and knowledge, there are two programmes that were found to have opposite effects. The Caretaker Classroom Program, which provided support for elementary school teachers within a US city to undertake pro-environmental activities over a school year with their pupils, was found to have a significant positive influence on environmental attitudes, but no significant impact on environmental knowledge (Leeming *et al.*, 1997). In contrast to this, another programme (The Park/School Program) that brought elementary students to a local park to undertake participatory field studies in ecology with graduate students in environmental studies was reported to yield gains in terms of environmental knowledge, but not to bring about any particular change in attitudes (Milton *et al.*, 1995). Unfortunately, the outcomes of the Park/School Program evaluation were not statistically validated, and the differential effects on knowledge and attitudes were not a focus of discussion in the research report. However, in the study of the Caretaker Classroom Program, the authors describe the absence of an effect on knowledge as ‘not particularly surprising’, saying that they had ‘no reason to believe that the Caretaker teachers presented any special curriculum materials associated with the various activities’ (ibid., p. 41). They also add, however, that use of a less general research instrument for measuring environmental knowledge may well have shown larger effects.

Moving into the realm of environmental behaviour in addition to attitudes and knowledge, two studies have provided further examples of differential impacts. One of these is Ramsey’s (1993) work on the instructional effects of issue investigation and action training (IIAT), an environmental education methodology aimed at the development of responsible environmental behaviour
in middle school students. What this evaluation finds is that all the dependent variables (i.e. overt environmental behaviour, group locus of control, environmental action knowledge, and perceived knowledge about, and skill in the use, of environmental action skills) were significantly enhanced by the programme, with one exception—environmental sensitivity. This criterion, defined as ‘the belief that humans must live in harmony with the environment’, was not significantly altered as a result of IIAT instruction. Arguing that the development of environmental sensitivity seems to be longitudinal, cumulative and directly related to outdoor experiences, Ramsey suggests that ‘because IIAT is a formal classroom instruction methodology used over one semester, the cognitive components may not directly relate to the affective characteristics of environmental sensitivity’ (ibid., p. 36). This links with the points made earlier about intervention effects being affected by the location and duration of individual programmes, and suggests that fostering development of environmental sensitivity requires something more than focused classroom work directed at investigation and action skills.

The second study that reported differential impacts in terms of environmental behaviour as well as attitudes and knowledge was Bogner’s (1998) evaluation of two versions of an outdoor ecology programme in a German national park. As outlined previously, this investigation found a critical difference between the 1-day and the 5-day programmes, in that, while they both yielded improvements in knowledge and attitudes, only the longer one provoked favourable changes in individual behaviour, either intended or actual. This finding is not explored in much detail in the study’s discussion, but it might be interpreted as suggesting that change in the realm of students’ environmental behaviour is more challenging (in terms of length of intervention) than that in the realm of knowledge and attitudes.

Varied impacts on different kinds of students. As well as indications of varying effects on environmental knowledge, attitudes and behaviour, there is also some evidence to suggest that programmes can affect different students in different ways. The evidence base here is extremely limited as most studies have focused solely on differences between their treatment and control groups, and not on variation within their treatment groups. An exception is Leeming et al.’s (1997) evaluation of The Caretaker Classroom Program, which explored differences in individual student outcomes according to their age, and their level of interest in environmental activities (as identified by their teacher). Their aim was to ‘better understand the breadth of effect within each classroom’ (ibid., p. 34). In relation to age, they found that there was a difference in the nature of the positive effect of the programme on the younger (aged 6–9 years) and older (aged 10–14 years) children. That is, while the younger children showed a marked increase in attitude score as a result of participation in the programme, those in the older year groups ‘generally showed a decline in attitude score from pre-test to post-test, with participation in Caretaker activities limiting the amount of decline’ (ibid., p. 40). In concluding about this ‘unexpected’ finding, the authors highlight the urgent need for further research (especially longitudinal studies) on ‘the influence of programmes such as Caretaker over successive years, and the age range at which such programmes have their greatest influence’ (ibid., p. 41).

This same study also yielded interesting findings about the variability of impact within the participating classes by undertaking additional analyses on
three contrasted subgroups: (i) children identified by the teacher as being most interested and active in the environmental activities; (ii) those least interested and active; and (iii) those in between these two extremes. This showed that attitudes towards the environment of almost all children benefited from participation, with the exception of those rated as least interested by their teachers. The authors therefore argue that ‘there is no evidence that the positive effect of participation was limited to a small subset of children in the experimental classrooms’. That said, it was also reported that outcome levels were different depending upon students’ interest, such that ‘children rated highest by their teacher showed the largest increase in pro-environmental attitudes and those rated lowest the smallest increase’ (ibid., p. 37). This raises important questions about the spread of environmental education impacts within groups of learners, and in particular the possibility that certain students may neither enjoy, nor gain from, such learning experiences.

The only other study that has attempted to explore differential impacts has been Gayford’s (1995) investigation of discussion-based learning with secondary school science students (16 years) in the UK. On the basis of pre-test/post-test differences in environmental knowledge between the experimental ($n=100$) and control ($n=100$) groups for three subgroups of varying ability, he reports that statistically significant differences were only evident within the middle and lower ability students, and not the higher ability. This is explained in terms of the discussion-based lessons being characterised by greater incidence of ‘the more able and more knowledgeable students explaining to others’ (ibid., p. 142).

5.3. Summary

There is evidence that learning outcomes in terms of changes in students’ environmental knowledge and/or attitudes, and, in a few cases, behaviour can be generated by certain programmes. These encompass a variety of residential field courses, as well as school-based initiatives focused on particular teaching approaches, content areas or skills. Impacts, however, are often only measured for relatively brief periods of time after programmes take place, so their long-term durability is often unassessed. Furthermore, even in the short term, there are several cases where intended outcomes are only partially realised, or (less commonly) fail to occur at all. The difficulty is that little is currently known about how and why programmes are able to bring about certain kinds of learning outcomes. This is because most of the evidence simply reports whether or not a significant effect is measured. Having said that, a small number of studies have attempted to generate data on programme characteristics and impacts. These suggest that:

• learning outcomes can be facilitated by certain processes (such as role modelling and direct experience on outdoor courses, and collaborative group discussion in classroom lessons), and certain programme characteristics (such as duration and preparation/follow-up work);
• different kinds of programmes can affect learners’ environmental knowledge, attitudes, and behaviour in different ways; and
• different kinds of students (e.g. those with more or less environmental interest) can be affected differently by environmental learning experiences.
6. Emerging Evidence on Learners’ Perceptions of Nature, Experiences of Learning, and Influences on Adults

Having considered the evidence relating to the three established nodes in the preceding three sections, attention can now turn to the three emerging nodes. As described in Section 2, there are three emerging nodes within the current evidence base, and these focus on young people’s:

- perceptions of nature;
- experiences of learning; and
- influences on adults.

As emerging nodes, these have less currently available evidence than the more established nodes, and represent research foci that have begun to attract greater empirical attention during the time period of this review. They also seek (in their different ways) to investigate new aspects of learners and learning through different kinds of conceptualisations and/or approaches. There is a strong emphasis, for example, on the voice of the student, and seeking to understand how learners themselves perceive nature or make sense of environmental education. There is also a concern to explore processes such as students’ learning strategies or interactions with their parents, in a way that conceives of learners as active agents, rather than passive subjects, in their environments, educational settings and family homes. In these ways, then, they are challenging established conceptualisations and approaches for investigating learners and learning in environmental education, and emphasising perceptions (as opposed to factual knowledge), experiences (as opposed to outcomes) and influence on parents (as opposed to changes in their own attitudes and behaviour).

The following sections will examine the available evidence, and the key messages for each of these emerging areas.

6.1. Students’ Perceptions of Nature

Evidence on students’ perceptions of nature comes from a small number of studies, most of which have been exploratory. The earliest, and most comprehensive, of these was a 3-year study of young adolescents’ perceptions and experiences of nature in four middle schools in the Detroit metropolitan area of the US (Wals, 1994a,b). This study has been complemented more recently by investigations with primary school pupils in Australia (Barron, 1995; Keliher, 1997; Payne, 1998a,b), and the UK (Bonnett & Williams, 1998).

These studies provide information about:

- the way students perceive ‘nature’ and (to a lesser extent) ‘environment’; and
- some of the influences that may shape such perceptions.

This work has focused mainly on primary school aged children, with the exception of Wals (1994a,b) study, which includes secondary as well as primary students. The evidence is qualitative in nature, reflecting these studies’ common aim of generating phenomenological (or poststructuralist, in the case of Barron, 1995) understandings of children’s ideas and perceptions. The claims tend to be descriptive and are often tentatively expressed, reflecting the phenomenological, and exploratory, nature of the work. This is particularly so for the findings
reported about influences that may shape young people’s perceptions. Payne (1998a, p. 20), for example, makes it clear that his work ‘does not explain how children such as those in the study are socialised into, and socially construct, understandings of nature and of their environments’.

6.1.1. The key messages. There are two key messages emerging from the studies in this area.

(1) Students tend to perceive ‘nature’ as a natural/non-human entity, associated with recreation, danger and being under threat

At a very basic level, an important finding emerging from the work in this area is that young people do have perceptions of ‘nature’ and ‘environment’. As Keliher (1997, p. 241) states in the context of her study of 6- to 7-year-olds: ‘The results indicate that the children who participated in this research have well developed perceptions of nature.’ Moreover, in terms of the content of these perceptions, there appears to be a considerable degree of commonality between the ideas reported by different studies. This is more clearly documented in relation to perceptions of ‘nature’.

Firstly, there seems to be a tendency for young people to perceive ‘nature’ as natural, living things, with minimal (or no) human interference, and as a relatively static entity. The Australian primary school pupils in Payne’s (1998b, p. 217) study were reported to conceive nature as ‘living and non-living things existing naturally in the environment’ with ‘minimal human influence, interference or effect’. Of the 14 children interviewed, only one included humans in his concept of nature, and most seemed to view nature ‘as a relatively static entity—temporally and spatially’. In a similar way, Barron’s (1995, p. 118) study with a class of five-year-old children in an Australian primary school noted that ‘all of the children, in varying degrees, maintained a separation of themselves, as human, above and apart from the non-human world’. These notions of nature as naturalness were also found among UK children of a similar age. Bonnett and Williams (1998, p. 163) describe how ‘nature [was] characterised as “living things”’ and that ‘there was some disagreement about whether or not people should be regarded as being part of nature’. The perceived dimensions of nature reported in Wals’ (1994a, p. 185) research with US adolescents also reflect this idea of nature as natural, living things with little or no human influence. Three dimensions in the perceptions voiced by the students were of nature as: ‘flowers, animals, trees and alive’, ‘pure, peaceful, pristine and not human-made’, and ‘self-supporting, wild and spontaneous’. The first two of these were also reported in Keliher’s (1997) Australian study.

Secondly, three recurring themes seem to be expressed by children in association to nature.

• Nature as a place for leisure activities and solitude—several studies highlight the centrality of leisure activities and solitude in young people’s perceptions of nature. Those interviewed by Bonnett and Williams (1998, p. 164), for example, ‘tended to associate being in “natural places” with relaxation [and] an escape from everyday life and troubles’, and also ‘tended to compare the woodland and the meadow in terms of their suitability for playing games’. Similarly, Australian respondents when asked to write a story describing a
‘good’ local environment, ‘agreed unknowingly that “One Tree Hill” was
good primarily because of the abundance of “natural” features like bush, trees
and animals that afforded recreation and solitude’ (Payne, 1998b, p. 219). In
addition, US adolescents not only perceived nature to be ‘freedom’ and
‘solitude’, but also reported experiences of nature as ‘entertainment’ (e.g.
fishing), ‘a challenging place’ (e.g. wild-water canoeing), as ‘a background to
activities’ (e.g. biking) (Wals, 1994b, p. 186).

- **Nature as threatening**—that children can associate nature with danger was an-
other commonly reported finding. Wals (1994a, p. 189) described how students
from inner-city Detroit felt that ‘nature itself can be scary because of the
dangerous animals that wander around, but the real danger comes from the
people who are there and the fact that there is no familiar place to escape to’.

Similar kinds of fears were expressed by children in the UK who were con-
cerned about ‘dangers such as being mugged’ in a woodland or meadow
(Bonnett & Williams, 1998, p. 165), and in Australia who ‘believed natural areas
[such as forest] may harbour dangerous wild animals’ (Keliher, 1997, p. 241).

- **Nature as under threat**—Wals’ (1994a, p. 190) research in Detroit highlighted
how young people can often talk about nature as ‘a threatened place’. While
this was more prevalent among the suburban, as opposed to the inner city,
students (discussed further below), all participants ‘expressed serious con-
cerns about the quality of the environment and many have experienced
pollution in one form or other’. Factual knowledge of, and concern about,
issues such as pollution, litter, and other environmental problems were also
reported by Keliher (1997) and Bonnett and Williams (1998). These findings
clearly link with points made in earlier chapters about young people’s
environmental factual knowledge, concerns and attitudes.

In terms of ‘environment’, there is less available evidence, as fewer studies have
explored the meanings that young people attribute to this term. Payne (1998b,
p. 219), who compared children’s conceptions of both ‘nature’ and ‘environment’,
found that children were more likely to include human-made objects
within their concept of ‘environment’ than in their concept of ‘nature’. This was
despite all except one of the children stating beforehand that ‘nature’ and
‘environment’ were the same. Payne sees this ‘ambivalence’ between the two
concepts (particularly in terms of the importance of naturalness) as an important
topic for further investigation. A similar kind of variability was noted by Bonnett
and Williams (1998, p. 165) in the sense that some of their respondents included
the built environment within their meaning of ‘environment’, while others
‘suggested that the word was more readily associated with the natural world
rather than the man-made’. Two further findings reported by each of these
studies were that ‘children appeared to relate environment to a place, as an area
known or experienced, in a spatial or geographic manner’ (Payne, 1998b, p. 223),
and ‘sometimes the environment was spoken about more as a set of concerns or
problems or as something to be managed’ (Bonnett & Williams, 1998, p. 165).

(2) Students’ perceptions of ‘nature’ appear to be shaped by several influences

The studies in this section have generated some preliminary findings about the
kind of influences that may shape young people’s perception of nature. On the
whole, these findings are speculative rather than conclusive, being inferred from
students’ depictions of nature, rather than investigated as a specific part of the study. Only two of the studies (Wals, 1994b; Barron, 1995) focused specifically on exploring differences between the perceptions of different kinds of students. The other pieces of work make some tentative suggestions as to possible shaping influences that may warrant further investigation. From this relatively limited evidence, the following influences would appear important.

Socio-economic setting. Wals (1994a,b) study of adolescents in Detroit suggests that the differing physical and social circumstances of suburban and inner city students can be seen to influence their respective perceptions of nature. The inner city students were the only ones to speak about nature ‘as a threatening place’ (e.g. with ‘people hiding behind trees’ and ‘where people get murdered’). The suburban students, by contrast, were alone in speaking about nature ‘as a challenging place’ in terms of ‘mystery, drama, the unknown, and the adventure’. Wals (1994a, p. 190) argues that this ‘makes painfully clear that growing up in a poor Detroit neighbourhood, infested with crime, violence and death, colours [inner city students’] outlook of the world around [them]’. This was supported by the fact that these students’ perceptions of danger were articulated not only about the areas in their neighbourhoods, but also about pictures of forest areas well away from the city. In reporting these differences, though, it is crucial to add that there were also many similarities between these two groups of students. Indeed, Wals (1994a, p. 73) stresses that: ‘The students from Detroit, as different as their lives may be, have a lot more in common with each other’s thinking about the environmental issues than I had anticipated.’

Gender. Barron’s (1995) feminist poststructuralist analysis of 25 young primary school pupils’ responses to a children’s story (The Lorax) suggests that different discourses can be taken up by boys and girls in relation to environmental issues. This work sought to ‘examine the ways, and to what extent, boys and girls entering school have positioned themselves in relation to discourses about the environment’ (ibid., p. 108). On the basis of interviews with the pupils about the characters and events of the story, Barron reports that gender differences were evident in relation to themes such as exploitation of the environment. For example: ‘the question for girls was, which humans have the right to stop the trees being cut down rather than whether humans have the right to cut down trees;’ while ‘for most of the boys the human right to cut down trees was assumed’ (ibid.: p. 111-2). Her argument, therefore, is that ‘we need to see [that] the subjective positions of children in relation to environmental discourses are also influenced by gender discourses’ (ibid., p. 118).

Experiences of nature. Wals’ work also suggests that experiences of nature can be influential upon students’ perceptions of nature. For example, inner city students who had been on trips to nature areas outside the city were unlikely to describe such places as threatening, whereas those that had not had such experiences perceived both local and distant nature areas as potentially dangerous and threatening. This leads Wals (1994a) to argue that ‘the few experiences [such students] do have in nature areas are very special to them and have great impact on their perceptions of nature’. A similar finding was reported by Keliher (1997, p. 241) in the Australian context in that: ‘Those children with a wide range of formative experiences of nature parks [and the like] were less likely than others
to consider natural areas as challenging or threatening.’ Furthermore, Payne (1998a, p. 25) notes the irony in the fact that the children’s valuations of nature as natural were ‘derived [...] from recreational and therapeutic involvements—both instrumental, or anthropocentric, reasons’.

**Age/cognitive development.** On finding most of the children in his study ‘conceptualised place as a static “nature” and an unchanging environment’, Payne (1998a, p. 25) suggested that this relates to their relatively young age. His view is that: ‘Given the 11–12 year age of these children this is not surprising, even if some did discern detrimental changes to their local environments/places in the more recent past.’ Furthermore, in response to the same children showing ‘some ambivalence’ in their concepts of nature and environment, Payne (1998a, p. 22) suggests that: ‘The most plausible explanation for this apparent contradiction is that concepts of nature and environment were not fully developed despite cognitive leanings to, or constructed preferences for, the naturalness of nature.’ He goes on to say that ‘further research into the changing nature of conceptions and constructions of nature and environment is required’.

**Media.** In considering why young children ‘continue to perceive of nature as pure or natural’ despite ‘direct experiences of a local environment as nature modified or transformed’, Payne (1998a, p. 25) suggests that ‘one possibility is the influential role of nature documentaries on television where nature is typically “imaged” by technologies as pristine, sublime and relatively untouched by human and cultural interventions’. Keliher (1997, p. 242) proposes that ‘probably due to the high profile given to environmental issues by television programmes, the 6–7 year old children in this study also had a well developed sense of nature as a threatened place’.

It is clear that many of the above shaping influences are poorly evidenced in terms of the type, and extent, of their effect on young people and their perceptions of nature. This is well recognised by Payne (1998a, p. 26), who stresses the need for ‘further research into the nature of conceptions of a wide range of populations (children, teenagers, adults, aged, multicultural, gender) and settings (city, rural, remote)’, and ‘comparative studies of how children “socially construct nature” from the ground up but over and through time and space, in addition to inquiries into the roles played by teachers and curricula’.

**6.1.2. Summary.** Studies in Australia, the UK and the US suggest that young people perceive ‘nature’ as natural living things with minimal or no human interference, and as a relatively static entity. Three recurring themes expressed by young people are of nature as a place for leisure and solitude, as potentially dangerous and frightening, and as being under threat. While at a preliminary stage, there are findings which suggest that students’ perceptions and constructions of nature may be shaped by influences such as their socio-economic setting, gender, experiences of nature and exposure to images and ideas within the media.

**6.2. Students’ Experiences of Learning**

Evidence on students’ experiences of learning has emerged from recent research that has sought to investigate learning in environmental education from the
perspective of the student. These include studies questioning students about the environmental education they received at school (Roper Starch Worldwide, 1994; Battersby, 1999; Connell et al., 1999), as well as more detailed exploration of young peoples’ experiences of participating in particular environmental learning situations while at school (Schindler, 1993; Jensen et al., 1995; Means, 1998; Bixler & Floyd, 1999; Lai, 1999; Rickinson, 1999). This work has generated information about young people’s:

- perceptions of, and preferences for, environmental education at school; and
- experiences of environmental learning situations.

The evidence of this emerging node is predominantly qualitative in nature, with many studies being based on semi-structured interviews and participant observation of students. It is not exclusively qualitative, though, as some of the information about students’ preferences for environmental education is based on questionnaire survey data (e.g. Roper Starch Worldwide, 1994). Much of the evidence of all kinds pertains to secondary aged students, although there is some relating to primary children. It emerges from a variety of geographical contexts, including the UK, the US, Australia, various OECD countries, Hong Kong and Denmark.

6.2.1. The key messages. There are two key messages arising from the evidence in this area.

(1) Students appear to have mixed views of environmental education in terms of its amount, context and content

The evidence from the small number of studies that have consulted students about their school-based environmental education suggests that their views comprise a mixture of certain criticisms, as well as some more positive views. These can be considered in relation to three aspects of environmental education provision.

(a) Amount of environmental education. Connell et al.’s (1998, p. 44) survey of young people in two Australian cities reports ‘quite strong support for increased attention to environmental issues in the classroom’. Almost half of the sample in this study indicated a desire to discuss environmental issues at school at least once a month (36%) or once a week (18%) (ibid., p. 44). Similar conclusions might well be drawn from the qualitative aspect of the same study (Connell et al., 1999), which found students to be critical of ‘missed opportunities’ for environmental education within high school. Some interviewees, for example, felt that secondary school had not provided them ‘with any environmental education’ (ibid., p. 102). (As described below, this was often due to students experiencing a lack of access to environmental teaching because of its concentration within particular subjects of the school curriculum.)  

A survey of US students suggests a similar picture of students highlighting a shortage of school-based environmental education provision. Roper Starch Worldwide (1994) report that considerable proportions of their sample did not feel school was contributing more than a little to their education about environmental issues. For example, ‘large numbers of students from both disadvantaged (47%) and non-disadvantaged (58%) areas report learning “only
a little/practically nothing” about environmental issues in class’ (Roper Starch Worldwide, 1994, p. 69).

(b) Context of environmental education. Connell et al.’s (1999) study raised the question of the curricular context of environmental education, in that there was some dissatisfaction among final year high school students who felt unable to learn about the environment due to not taking subjects such as geography and biology. One student was quoted as feeling it was ‘not possible to learn anything about the environment unless you took particular subjects’ (ibid., p. 102). This suggests that a wider curricular context for environmental education is important to students, especially in the later years of schooling when specialisation in certain subjects is more likely.

This concentration of environmental education in certain subjects of the curriculum is reflected in the findings of work carried out in the UK and the US. Battersby’s (1999, p. 452) pilot investigation with four classes of senior secondary school students reported that ‘pupils were aware of being taught about the environment […] principally through geography and biology’. Similarly, Roper Starch Worldwide (1994) found that science classes were the main context of environmental learning for the vast majority of the respondents. However, unlike in the Australian study, this issue was not reported by students in these two investigations as a source of dissatisfaction. Indeed, the US study found that socially disadvantaged students saw science classes (43%) as the most effective way to learn about the environment at school, followed by field trips to museums or parks (10%) and lessons in subject such as English or social studies (9%). They were less positive about participating in school recycling or clean-ups (4%), or clubs during or after school (2%). The reasons for these viewpoints, however, were not explored within the study and consequently it is difficult to go far beyond the basic findings.

Information about the physical, as opposed to the curricular, context of environmental education is provided by a small group of studies that have explored young people’s preferences relating to outdoor learning activities. These draw upon the idea that young people can associate nature settings with certain fears and concerns, and suggest that such feelings can influence students’ preferences for outdoor educational activities. Simmons (1994a,b), for example, found children from the Chicago metropolitan area expressed concerns of three kinds about a variety of nature scenes: possible natural hazards, threats from other people, and inconveniences for their physical comfort. In a similar way, Bixler et al. (1994) reported a classification of young people’s fears and discomforts while on field trips to wildland areas. Although based on reports from outdoor educators, rather than from young people themselves [2] it suggested that urban students express a variety of fears during learning activities at urban nature centres. It noted, particularly, how fear of getting lost, fear of disgusting/dirty things, and fear of strangers were important in the reactions of children, along with the perhaps already well-known fear of certain animals. Such studies conclude that: (i) such fears are ‘very real to children’ (Simmons 1994b, p. 202), but can often be ‘anxiety reactions (“Who checks the woods for killers?”) rather than a response to seeing, smelling or hearing something perceived as dangerous’ (Bixler et al., 1994, p. 31); and (ii) they ‘pose barriers to enjoying and learning about wildlands’ (Bixler et al., 1994, p. 31), and must be ‘address[ed]
directly, if one is to organise a successful environmental education experience in [such] settings’ (Simmons 1994b, p. 202).

The common point running through all of the above studies is that students are found to express preferences in relation to the curricular and the physical context of their environmental education.

(c) Content of environmental education. There is also evidence of mixed views in relation to the content of environmental education at school. In Connell et al.’s (1999, p. 103) research, for example, positive views were expressed by some students (especially those from Melbourne in the first year of the study) who were pleased with the environmental teaching received at school. There was praise for subjects such as geography and the sciences, and for situations ‘where they had been taught by particular teachers who possessed a strong environmental interest and ethic’ (ibid., p. 102). There was also a general belief among most respondents that school served a role in providing ‘the basics’ about environmental issues which could be trusted and used to investigate such issues further or compared with information from other sources such as the media and personal experience.

On the other hand, though, criticism was voiced by some interviewees about the kind of environmental work that was undertaken, which was seen by one student to be ‘not very memorable because the lessons were so boring’ and focused solely on certain topics such as ‘ozone and greenhouse’. Some respondents also reportedly expressed a ‘desire for practicality and relevance in their studies’. One quote provided makes the case for ‘more practical experiences in schools. What you learn in school needs to be put in perspective in the real world’ (ibid., p. 103).

There are echoes here of views expressed by Danish students after their experience of the Jaegerspris Project (Jensen et al., 1995). This project involved school teachers and students working in collaboration with their communities to solve locally based environmental problems. Three particular dimensions of the project were identified as being important to the students: the authenticity (‘as close to real life as possible’), the actions (‘genuine environmental actions in the local community’), and the participation (‘pupils take part in the idea formation and in the decisions’) (ibid., p. 92). When asked what they thought environmental education should be like, students stressed the need for experience as well as knowledge, and the importance of enabling learners to be ‘confident in what they say’ and to ‘let them run things themselves’ (ibid., pp. 90–91).

Another initiative is the US Global Learning and Observation to Benefit the Environment (GLOBE) programme, which promotes the use of student-collected data by members of the scientific research community. Using surveys and focus groups of student participants, the programme evaluation reports that students were motivated by working in partnership with scientists and by the ICT aspects of the project (Means, 1998). High proportions believed the measurements they made would be important for scientists, and would help people better understand the Earth. Furthermore, ‘reporting data through the Internet and accessing the GLOBE web site to find data you submitted last week’ were also suggested as important parts of what made the programme ‘real’ for students (ibid., p. 103). Indeed, the highest student approval rating was for the use of technology as part of the programme.
These studies suggest that the content of environmental education, and the ways in which this is presented and investigated, are matters of concern to school students.

(2) Students experience environmental learning situations in active and individual ways, and their views can conflict with those of their teacher

Research exploring students’ experiences of particular environmental learning situations draws attention not only to the active way in which learners make sense of their encounters with environmental education, but also the individual way in which this occurs. In a study of secondary school environmental geography lessons, Rickinson (1999, p. 134) found marked differences between the way individual students understood, and responded to, the topics and tasks of lessons. In a lesson on rainforests, for example, which involved watching a video, and then writing a poem, about the Kayapo Indians, two students were found to: understand and enact their poetry task in quite different ways (as a creative writing exercise, on the one hand, and an empathetic writing activity on the other); express quite different perspectives upon similar aspects of the lessons (the video was strange and amusing, as opposed to being unsurprising and lacking in information); and attribute significance to different aspects of the lesson (watching a video ‘was a nice change from weather and graphs’, or learning about the Kayapo ‘is not really learning about the rainforest’).

A similar sense of critical awareness in individual students’ accounts of learning situations is suggested by Lai’s (1999) study of secondary school students’ experiences of a geography field trip in Hong Kong. This too reports diversity in respondents’ views both prior to, and after, their excursion. After the field trip, for example, it was clear that the two parts of the day—a teacher-guided trip of local physical features in the morning, and a student-led field investigation in the afternoon—were experienced differently by different students. Of the ten interviewed, two were happy to have both aspects, another three preferred the guided trip mode (having seen no purpose in the afternoon’s survey and disliked working ‘without a teacher [and not knowing] where to begin’), and the remaining five preferred the afternoon mode when they could ‘work on their own and hence have more freedom’ (ibid., p. 248).

Further evidence on variations between individual students in relation to fieldwork is provided by a recent study of 450 US middle school students’ preferences for environmental education activities involving the manipulation of organic substances (Bixler & Floyd, 1999). Using the notion of ‘disgust sensitivity’ (i.e. ‘reactions to organic objects with certain perceptual characteristics’), they find significant differences between students with high and low disgust-sensitivity in terms of preferences for different (i) environmental education activities; and (ii) aquatic fieldwork sites. Students with high disgust-sensitivity were significantly more likely to prefer activities involving no handling of organic materials, and fieldwork sites with clear water, no algae and easy lakeshore access.

These findings suggest that students can have strong views about the content and learning tasks in environmental education, and furthermore that these can diverge considerably from those of their teachers. In connection with this,
another aspect of students’ learning experiences mentioned by several studies is that of teacher–student conflict in relation to the topic or the learning tasks. In addition to the studies described above, several of the national reports generated by the OECD Environment School Initiative (ENSI) Project [3] highlight situations where teachers and students were operating with differing perspectives on the environmental issues under consideration. One case was where Danish teachers experienced problems with a lack of interest and motivation among the students while undertaking work on ‘domestic animals’. This was due (it later transpired) to students expecting work on pet animals but teachers setting up tasks related to production animals (Elliott, 1995, p.18). A similar kind of teacher–student conflict is reported by Schindler (1993) in relation to independent project work on improving the environment, undertaken also as part of the aforementioned ENSI Project.

The common picture emerging from this small group of studies is that of students as active processors, and critical consumers, of learning situations such as environmental lessons, fieldtrips and project work. The key point is that the students in these studies were not unaware or uncritical of the nature of their learning situations, but instead evaluated and responded to them in active, critical and individual ways.

6.2.2. Summary. A small number of studies suggest that students have mixed views of their environmental education at school. While environmental education undertaken with certain teachers or as part of particular action-orientated programmes are praised, there is criticism voiced in relation to environmental teaching being concentrated in particular subjects or lacking practicality and relevance.

More detailed investigations of students in particular environmental learning situations suggest that learners can be highly individual in their responses to such experiences. The picture emerging is of students as critical consumers, rather than passive recipients, of environmental curricula.

6.3. Students’ Influences on Adults

Evidence on students’ environmental influence on adults such as parents and community members is provided by a small number of studies. The most comprehensive of these was a European Union-funded project undertaken in the early 1990s (Uzzell et al., 1994). Through case studies in four European countries—Denmark, England, Portugal and France—it sought to examine whether children, in conjunction with schools, could act as catalysts of environmental change in the home and the community. As explained in a later publication, ‘the idea behind this work was simple: if children could be given environmental education at school and encouraged to disseminate it at home and in the community, this would be an extremely effective way of influencing and educating parents to sustainable environmental behaviours’ (Uzzell, 1999, p. 406). It worked from the premise that ‘environmental education is more than just about raising levels of awareness and changing attitudes and behaviours’, but instead needs to be about the acquisition of ‘action competence’ [4].

More recently, the question of student–parent communication about environmental matters has been the subject of an exploratory study in Brisbane,
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Australia. Ballantyne et al. (1998a) investigated the extent to which two school-based environmental education programmes were able to facilitate intergenerational communication and environmental learning between primary school pupils and their parents. Two further studies have evaluated environmental education initiatives in terms of their impact upon the parents of their school-age participants. These were undertaken in the US (Leeming et al., 1997) and the UK (Evans et al., 1996). In comparison to the European and Australian projects described above, these two studies provided information solely about the extent, and not about the process and dynamics, of intergenerational influence.

Taken together, the findings of these research studies provide insights into:

- the capacity for young people to act as catalysts of environmental change in relation to their parents;
- the various factors (both educational and social) that can affect intergenerational communication and influence; and
- the complex and subtle nature of environmental influence between children and parents.

The evidence relates to both primary and/or secondary school respondents, and comprises quantitative as well as qualitative findings. Studies either present numerical measures of the impact of educational initiatives on parents’ environmental characteristics (Evans et al., 1996; Leeming et al., 1997), or give a mixture of qualitative and quantitative evidence, such as orientation scale data combined with interview accounts (Uzzell et al., 1994; Ballantyne et al., 1998a). The analysis and discussion of this evidence tends to be exploratory and fairly descriptive, with the exception of the European study, which was more comprehensive in scope and detailed in its findings.

6.3.1. The key messages. There are three key messages emerging from the evidence described above.

(1) Young people can influence the environmental behaviours of their parents, but this does not happen automatically

There is evidence from all four of the studies in this area to suggest that young people can act as an influence upon their parents’ environmental attitudes and behaviours. In the UK case study reported by Uzzell et al. (1994), statistically significant differences were found between the action competence of the parents of four classes of 20 children, who experienced different kinds of environmental education. The basic trend was that the more the educational intervention promoted intergenerational discussion and socio-cognitive interaction, the greater was the impact on the parents’ reported action competence. This, the authors ‘take to be an indication that children can act as catalysts of environmental change’ (Uzzell et al., 1994, p. 203).

This conclusion corresponds with the findings of subsequent investigations. Leeming et al.’s (1997) evaluation of the Caretaker Classroom Program (see Section 5.1) found ‘strong evidence that children who participated in the Caretaker programme influenced their parents to adopt more pro-environmental behaviours’ (ibid., p. 40). Parents of the participants (n=348) displayed significantly greater awareness of environmental issues and involvement in
pro-environmental behaviours after their children’s activities than did parents of the control group (n=138). These parents also reported greater parent–child discussion about the environment than control parents, an effect that did not vary as a function of either the age of the child or the Caretaker teachers’ rating of the child’s involvement with the activities. The authors conclude from these findings that ‘participation in the Caretaker program increased parent–child discussion of the environment, and this effect occurred across different ages and levels of involvement’ (ibid., p. 40).

A similar kind of outcome is reported by Ballantyne et al. (1998a) for one of the environmental education programmes in their study. On the basis of parental interviews (n=14), they argue that ‘the [energy education] program appeared to have had some success in influencing parent behaviour’, citing examples of reported changes in household energy use practices (ibid., p. 6). In another study of 35 parents, Evans et al. (1996) found that there was a significant increase in parental recycling after their children had received an environmental education programme as part of their science studies. As noted earlier, however, this study (unlike Leeming et al., 1997 and Uzzell et al., 1994) did not establish difference based on comparison with a control group.

While positive relationships between children’s educational experiences and parental environmental attitudes/behaviours have been reported, several of the aforementioned studies also make clear that such effects are far from an automatic consequence of environmental education interventions with young people. The authors of the EU study found that, contrary to their original assumption that ‘children would act as spontaneous catalysts of environmental change’, ‘educational programmes alone are insufficient to bring about change’ (Uzzell et al., 1994, p. 213). The next key finding explores this point further, with respect to the conditions that appear to facilitate student–parent communication and influence.

(2) Student capacity to influence parents/adults seems to be facilitated by a variety of conditions, both educational and social

Some of the studies on intergenerational communication and influence have highlighted certain conditions that appear to be important in shaping the nature and extent of students’ capacity to influence their parents or other adults. As proposed by Ballantyne et al. (1998a, p. 6), these can be divided into (i) factors relating to the educational intervention that is experienced by the students (and, in some cases, the parents), and (ii) factors relating to the students, parents, and communities involved. It is important to state that some of these factors are based on preliminary findings of a tentative nature (those from Ballantyne et al., 1998a), while others (from Uzzell et al., 1994) have a stronger empirical basis.

(a) Educational factors. The following characteristics of environmental education programmes have been found (or are suggested) to be helpful in promoting intergenerational environmental communication and influence.

• Inclusion of adults, as well as children—one of the key conclusions from the European study is that ‘it is necessary to work simultaneously with the child and the adult to support both the children and adults in the catalytic process’ (Uzzell et al., 1994, p. 213). The UK case study, for example, identifies ‘encour-
aging the educational process to continue in the home environment’ as a key condition for children to be able to act as catalysts in respect of their parents (ibid., p. 203). In a similar way, Ballantyne et al. (1998a) found that the one environmental education programme that appeared to have some success in influencing parent behaviour was the one that included a homework task. This task involved students conducting an electricity audit of their home, and the researchers found that ‘four out of the five parents who had said they talked about the program at home, indicated it was initiated by the homework activities’ (ibid., p. 6). This leads the authors to suggest that ‘programs need to incorporate student actions which have the potential to involve parents as partners in student-centred activity in the home’ (ibid., p. 9).

- **Authentic environmental issues and actions**—a key dimension of the European study was the importance of ‘authenticity’ in environmental education, in terms of dealing with actual, local environmental problems, as opposed to envisaged or construed problems of an ‘as if’ nature (Uzzell et al., 1994, p. 59). A focus of this kind was found to be crucial in enabling Danish schools to act as catalysts for environmental changes in the local community (ibid., pp. 91–136). Furthermore, in the UK case study, educational programmes using ‘as if’ situations (such as school grounds initiatives) were criticised for their limited capacity to effect attitudinal and behaviour changes among children and parents (ibid., p. 211). In addition, one of the preliminary conclusions from the more recent Australian work is that ‘one way to encourage student and parental environmental communication and action in the home is by designing programs that focus on tangible targets for action’ (Ballantyne et al., 1998a, p. 9).

- **Enjoyment for learners**—Ballantyne et al. (1998a) suggest that students are more likely to discuss a programme with their parents if they have enjoyed the educational experience. They found that the programme that was described by students more favourably was also the one that was significantly more likely to have been discussed at home. Furthermore, those students who enjoyed this programme talked significantly more frequently about the programme at home than their peers who did not find it enjoyable. A challenge highlighted by the EU project, however, is that parents and children in their case studies tended to speak about the context (where they went, what they saw) and global appreciation (interest, pleasure) of environmental education activities, rather than the content (what they learnt) (Uzzell et al., 1994, p. 215). This suggests that making programmes enjoyable for students is only one step towards fostering discussion with their parents about its messages.

(b) **Social factors.** Intergenerational communication and influence seems also to be related to a number of social characteristics of the students, parents, families and communities involved.

- **Parents’ and students’ environmental knowledge and concern**—Uzzell et al. (1994, p. 214) report that catalytic effects were more likely among children from backgrounds where ‘the level of [parental] consciousness, knowledge and concern for the environment […] is greater’. This point, however, is not supported by Ballantyne et al. (1998a, p. 7), who found that student–parent discussion about two environmental education programmes was ‘not associated with parents’ general environmental attitudes, knowledge or behaviour’. 
Their view is that this was not surprising ‘given that it was the students who initiated discussions based on their program experiences and assigned tasks’. Both studies are in agreement, though, that students’ environmental views are important. For example, in Ballantyne et al.’s study, students who were willing to undertake pro-environmental actions were significantly more likely to discuss their environmental education programme with their parents at home.

- **Parent–child communication and collaboration**—in addition to parents’ and students’ environmental knowledge and concern, the extent and nature of their family communication practices would also seem important. In the European project, intergenerational influence was more likely in families where ‘children and parents readily communicate with each other about the environment’ and where ‘parents are in the habit of helping their children with school work and extra-curricular activities’ (Uzzell et al., 1994, p. 214). Similar findings emerged from the Brisbane study, which found that child–parent discussion about environmental education activities was more frequent in homes where communication in general, and discussion about environmental issues in particular, took place more frequently. Both these studies suggest that it is not only the amount, but also the quality, of the communication between children and parents that is important. Uzzell et al. (1994) establish that intergenerational influence necessitates communication based on dialogue between the child and the parent where the young person can have as much chance as the adult to take on the role of ‘expert’. Ballantyne et al. (1998a, p. 8), found that students who talked about the programme at home were ones who described past discussions with their parents in more positive terms, such as being listened to and being able to express their true feelings.

- **Supportive wider community**—the national case studies in the European project highlighted the importance of the wider social, cultural and political context as an influence upon intergenerational communication and environmental action. This was often experienced as a constraining influence. In the Portuguese case study, for example, intergenerational action for the environment was made unlikely by the parents’ overriding concern with ‘survival and security needs’ (Uzzell et al., 1994, p. 216).

(3) Student–parent environmental influence is complex and subtle

Through ‘fine grained’ (as opposed to aggregated) analysis of the effect of particular children on their parents, Uzzell et al. (1994) were able to shed some light on the complexity of intergenerational influence. In particular, this suggested that:

- **young people can influence their parents unknowingly**—while almost half of the parents in the UK case study perceived their children to have had an influence upon their environmental understanding, the majority of children were not conscious of their catalytic effect. Uzzell et al. (1994, p. 210) state therefore that ‘children can act in a catalytic way unknowingly and uninformedly; parents’ attitudes and behaviours could change through child action although the child has not provided the specific knowledge base for this to occur’. They also note, though, that ‘what seems crucial is that the parents perceived their children as
being concerned about the environment and this perception alone might have been enough to change the level of their concern’.
• children can influence parents in different realms—one of the examples explored by Uzzell shows how a child can bring about change in his/her parents’ environmental knowledge, but not in their environmental concern or actions. This, it is claimed, reflected these parents’ high level of existing knowledge about environmental problems, and their view that the provided educational materials were limited in their originality and relevance (Uzzell et al., 1994, p. 206).

6.3.2. Summary. Studies of intergenerational influence suggest that students, after participating in environmental education activities, are capable of influencing the environmental attitudes and/or behaviours of their parents. In other words, environmental education programmes can have an impact not only on students, but also indirectly on parents. Such influence, however, is not an automatic process, and appears to be facilitated by programmes being enjoyable for students, including tasks that can involve parents and dealing with actual local problems, in addition to students and parents having an interest in the environment and good communication patterns. It also seems that intergenerational influence is a complex process, and that young people can influence their parents without being conscious of their effect.

7. Conclusions and Implications
Having explored evidence from a large number of studies relating to several different aspects of learners and learning, this final section seeks to draw together and elaborate upon the preceding discussion. It begins with a critical examination of the strengths and weaknesses of the evidence base (Section 7.1), followed by a discussion of key messages about learners and learning (Section 7.2). It ends with a consideration of the several issues and challenges that arise from this work for research users, researchers and future reviews of the field (Section 7.3).

It is important to emphasise that this final section of the review seeks to open up, rather than close down, debate about research evidence on learners and learning in environmental education. Its purpose, then, is to raise issues and questions that will stimulate further discussion about the meaning, and implications, of the empirical findings discussed in this article.

7.1. Strengths and Weaknesses in the Evidence Base
Before taking stock of what the findings from the four preceding sections tell us about learners and learning, it is worthwhile considering the strengths and weaknesses of the evidence relating to each of the individual nodes, as well as of the evidence base as whole.

Evidence on environmental knowledge
Strengths. The first strength of this node is the large amount of empirical evidence that is available, particularly in relation to learners’ scientific under-
standing/misunderstanding of environmental issues. The accumulation of evidence in this area is a strength in that it enables key messages to be well evidenced with corresponding findings from different studies, or questioned in light of conflicting findings from similar pieces of work.

Secondly, this node also has a variety of evidence. That is, while there is a definite predominance of quantitative, survey-generated evidence (e.g. Gambro & Switzky, 1996; Ivy et al., 1998; Kuhlemeier et al., 1999), there are also findings from qualitative interview-based inquiries (e.g. Palmer, 1995; Strommen, 1995; Christidou & Koulaidis, 1996). This mixture is seen particularly in the work on learners’ environmental understanding/misunderstanding, and on the sources of their environmental information. This is advantageous in that it diversifies the kinds of key messages that can be drawn. For example, it is possible to make statements about the nature, as well as the extent, of students’ misunderstandings, or about students’ views of, as well as how frequently they use, different sources of environmental information.

A further strength is that in the work on students’ scientific understanding/misunderstanding, there seem to be connections between studies, in that ideas are developed and refined through related studies undertaken in similar ways over time. There are cases, for example, of initial exploratory studies informing the design of instruments of a more closed type used in subsequent investigations (e.g. Batterham et al., 1996; and Boyes & Stanisstreet, 1997b). Similarly, there are comparative studies that have used similar instruments with students in different geographical locations (e.g. Boyes & Stanisstreet, 1994; Boyes et al., 1999). The strength of such interconnected studies is that they provide a body of similarly focused findings, which can be brought together and compared and contrasted.

Weaknesses. One weakness of this node, however, is the limited amount of evidence available on the sources of students’ environmental information. This reflects the fact that the level of analysis in most of the studies that have been undertaken on this topic is not particularly detailed. There is little beyond simple rankings of different kinds of sources, most of which are reported in a descriptive manner without reference to statistical analyses. It is important to state, though, that this situation is largely a product of there being few studies that have focused exclusively on the sources of students’ environmental information. This topic tends rather to be one small part of wider studies investigating many other aspects of students’ environmental knowledge, attitudes and behaviours. As explained earlier in Section 3.3, this put limitations upon the strength and detail of the key findings that could be drawn, especially in relation to influencing factors. Indeed, the findings on influencing factors related to all aspects of students’ environmental knowledge were problematic due to shortages of evidence and/or methodological difficulties. Evidence on the effect of age, for example, is limited by a predominance of cross-sectional, as opposed to longitudinal, studies, so that trends are based on variations between age groups within samples rather than actual changes in students over time. In a similar way, there are few studies that focus specifically on the influence of factors such as gender, socio-economic grouping and geographical location, and there are none that examine the relative importance of such factors.

A second weakness within this node stems from the variety of ways in which different research studies have approached and operationalised the concept of
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environmental knowledge’. As argued in Section 3, a distinction can be drawn between findings about students’ factual knowledge, students’ understanding/misunderstanding, and the sources of their environmental information. These reflect researchers’ focusing upon different aspects of ‘knowledge’, all of which could be investigated in different ways. An important difference was between studies that had investigated students’ self-reported levels of knowledge, and those studies that had tested their knowledge levels in some way. There is also variation, however, in relation to the aspect of the environment that the students are meant to know about (however ‘knowing’ is defined). This manifests itself in the data collection instruments of studies, such as the questionnaire items or the interview questions. Research into factual knowledge, for example, has used a whole range of questionnaires focused on quite different environmental issues and facts. These include an emphasis on natural resource and environmental issues in a study in the Pacific Northwest of the United States, concentration on a wide range of local as well as global environmental issues in a study in Hong Kong, and a focus on energy supply, greenhouse effect and acid rain in a national US context. Research studies on sources of environmental information have also used different terminology in questionnaire items (such as ‘media’, as opposed to distinguishing between ‘television’, ‘radio’ and ‘print media’), or provided respondents with different lists of sources from which to select (with a few studies including ‘non-governmental organisations’ and ‘personal experience’). Furthermore, interview-based studies on this topic did not use lists of options at all, but asked students open-ended questions about sources of environmental information. These examples highlight the difficulty of trying to draw conclusions that are more than relatively superficial statements from the findings of a number of studies.

Thirdly, there were differences in sample size and sample selection among the surveys of students’ factual knowledge. While most made efforts to ensure large, representative samples (e.g. Cardeiro & Sayler, 1994; Gambro & Switzky, 1996; Chan, 1998), some drew upon much smaller samples and provided little information about how these were selected (e.g. Membiela et al., 1993). This is not to necessarily discount the internal validity of the latter study’s findings, but merely to draw attention to the potential problems with drawing inferences from the findings to a wider population.

Evidence on environmental attitudes and behaviours

Strengths. One strength of this area is the fact that there is a considerable accumulation of evidence about learners’ environmental attitudes. Several large-scale surveys of environmental attitudes have provided evidence relating to young people in a variety of locations. This means that strong key messages can be drawn, in the sense that they can be supported by findings from several studies. For example, the notion that young people are less pro-environmental in relation to issues concerning their own lives emerged as a key message common to three large-scale surveys in different countries (Chan, 1996; Connell et al., 1998; Ivy et al., 1998).

A second strength is that the evidence relating to young people’s environmental concerns (although quite limited in amount) encompasses a variety of evidence types. In other words, there is a mixture of findings from exploratory
interview-based studies (e.g. Prelle & Solomon, 1996; Kwan & Miles, 1998; Connell et al., 1999), as well as from questionnaire surveys (e.g. Roper Starch Worldwide, 1994; Ivy et al., 1998; Connell et al., 1999). An advantage of this is that as well as making the point that there is variation among students in levels of concern for different issues, some commentary can also be added about why students might be more concerned about certain issues than others.

Weaknesses. Firstly, this node is characterised by a relative shortage of evidence relating to certain foci, namely students’ environmental concerns and environmental behaviours. This reflects both the small number of studies that have been undertaken on these two topics (compared with work on attitudes), and the tendency for the research that has been carried out to have been part of larger studies (as with environmental awareness and sources in the previous node). Comparison between the findings of studies on these two foci was therefore more difficult, meaning that key messages were necessarily less conclusive and detailed. This was particularly seen with the evidence on influencing factors, where there were similar difficulties to those highlighted for the previous node.

Secondly, in just the same way as the previous evidence node, the research in this node has operationalised ‘environmental attitudes and behaviours’ in different ways. A distinction was drawn in Section 4, for example, between evidence on the kinds of issues that students are concerned about (concerns), and evidence on the extent to which they are concerned or indifferent in relation to aspects of the environment (attitudes). Even more variability was found in relation to the aspect of the ‘environment’ that was investigated. In the studies of students’ concerns, for example, those that asked respondents to rank a set of environmental issues according to their seriousness all used different original lists. Some investigations also used different lists for different scales, meaning that comparison between, say, global and national-level concerns was difficult. Furthermore, among the studies of young people’s views of the future, some ask general questions about the future (Hutchinson, 1997; Connell et al., 1999), while others distinguished between different scales such as the personal futures and/or global futures (Hicks & Holden, 1995; Oscarsson, 1996). Similarly in the attitude studies, the nature and foci of the questions asked of students differ considerably, both within and across the studies. Some items, for example, focus more on the nature of the environment (e.g. ‘The balance of nature is very delicate and easily upset’; Clarke, 1996, p. 22), while others ask more about human relations with the environment (e.g. ‘People should adapt to the environment wherever possible’; Connell et al., 1999, p. 42). Some items were specific and concrete, while others were much more abstract and metaphorical. Furthermore, in the instruments used in behaviour studies, there is marked variation in the number (many or few), specificity (specific or general), and nature (consumer, domestic, social) of the pro-environmental behaviours that are investigated. The recurring point in all of these examples is that research studies have operationalised environmental concerns, attitudes and behaviours in different ways, and this makes comparison and contrast difficult within this node of the evidence base.

A third weakness was in relation to the sampling within this node of evidence. Within several of the studies of environmental attitudes, the criteria for selecting samples of schools and students is not made clear. For example, Lyons and
Breakwell (1994) and Chan (1996) do not explain in any detail the nature of the national or regional representativeness of their selected school, or why such a basis is an appropriate one. Meanwhile, Ivy et al. (1998) talk about including ‘above average’, ‘average’ and below average’ schools but do not define the basis for these distinctions. In such situations, the parameters of the wider population represented by the sample, and hence the possible generalisability of the findings, is unclear.

Finally, there is a weakness in the fact that much of the evidence on concerns, attitudes, and behaviours tends to be based solely on descriptive analysis of variations in students’ responses to different questionnaire items. Aside from studies investigating the factors that are influential upon young people’s environmental attitudes which in some cases used factor analysis and multi-level modelling, the data analysis undertaken is more likely to have involved frequency comparison rather than complex analytical statistics. Findings tend therefore to be fairly descriptive, and, other than speculative suggestions, do not move into considerations of why students might perceive certain issues to be more serious or important than others, or hold certain attitudes more strongly than others. This means that key messages in this section are less specific than, say, those relating to students’ environmental understanding, despite (as in the area of environmental attitudes) a considerable amount of evidence.

**Evidence on environmental learning outcomes**

**Strengths.** One strength of this node is the fact that evaluation evidence is available for a considerable number and variety of environmental education initiatives, including residential field courses, as well as a variety of school-based programmes. This enables key messages to be illustrated with several examples of programmes with different emphases and outcomes. Furthermore, the accumulation of evidence about a number of types of programmes means that the evidence base can be used to raise issues about programme characteristics that may be either more or less effective in changing learners’ environmental attitudes, knowledge and/or behaviours.

A second strength lies in the methodological improvements that clearly feature in several of the studies within this node. An earlier review in the area of learning outcomes highlighted several serious methodological weaknesses in the research that had been undertaken at that time (Leeming et al., 1993). While several of these remain prominent in some of the work in this review (see below), it is clear that a number of studies have made concerted efforts to respond to Leeming et al.’s criticisms. Bogner (1998), for example, took steps to evaluate the typicality of the sample in relation to the ‘average pupil population’, to avoid the evaluation instruments being administered by those responsible for delivering the educational instruction, and to use particular statistical analyses in order to examine trends at the individual rather than the group level. Other studies pursuing measures of a similar kind include Ramsey (1993), Leeming et al. (1997), and Bogner (1999).

A further aspect worthy of note in this node of evidence is the fact that there are two studies that have investigated educational programmes in terms of their processes, as well as their outcomes (Emmons, 1997; Mason & Santi, 1998). This represents not only a methodological diversification in terms of examples of
naturalistic qualitative programme evaluations, but also a widening of the evidence base to encompass questions about the processes associated with certain learning outcomes.

**Weaknesses.** Firstly, while all studies in this node share a common broad pre-test/post-test framework, there is considerable variation in the specifics of individual study’s designs. There were certain studies, for example, that did not have either a control group, or a pre-test, or were lacking both of these. As argued by Leeming et al. (1993), this can be seen to curtail the credibility of the findings by increasing the possibility of Type 1 errors (acceptance of a true null hypothesis). Furthermore, Bogner (1998, p. 24) asserts that the inclusion of a pre-test of both the experimental and the control groups is crucial because ‘without [such] evaluations all surveys could be open to misinterpretation if they report any “improved” scores on the basis of pre-evaluations only’.

A second weakness evident within certain studies concerned the use of small sample sizes, with young people often selected on the basis of convenience rather than representativeness. The difficulty here is that this makes uncertain the generalisability of the findings. As Emmons (1997, p. 343) acknowledges in relation to her investigation of ten high school students from the same school in a small town: ‘students from other towns might have […] interacted differently with the teacher, each other and the environment’. A similar point is made by Ramsey (1993, p. 36), whose evaluation of a science-based innovation examined differences between treatment and control classes in different schools and therefore suffered from the following potential ‘validity threat’: ‘differing teacher characteristics, school setting characteristics, and learner characteristics could have accounted for observed changes on the post-test’. An additional problem arose in that certain researchers failed to provide information about the nature, and selection criteria, of the sample being investigated. Park and Chang (1998), for example, omitted to explain the number, and kind, of schools from which their student sample was drawn.

A third weakness in the evidence on learning outcomes is the distinct lack of studies considering follow-up data some time after the educational intervention. Only a small number investigated the question of the extent to which treatment effects persist through time (Hanson, 1993; Uzzell et al., 1995; Bogner, 1998; Dettmann-Easler & Pease, 1999). This, as pointed out by Leeming et al. (1993, p. 19), represents a real problem in the validity and usefulness of findings since: demonstration that an effect persists over time provides additional evidence of the true impact of the intervention technique. However, even a true impact is of little value if it is lost almost immediately, and practitioners will certainly be most interested in those techniques that have been shown to have a lasting influence.

Fourthly, there were weaknesses in relation to data collection and data analysis. One shortcoming common to several studies was the use of research instruments that were not tested for validity and reliability. Many researchers also used questionnaire instruments that were not based on previously used attitude scales. This meant that making comparisons between the findings of studies was extremely difficult, and the quality of certain instruments was never established. Another recurring difficulty was a lack of measures to guard against the impacts of the researcher within the study. Only two of the studies reviewed
for this node (Ramsey, 1993; Bogner, 1998) explicitly acknowledged this issue and took measures to avoid problems of, for example, the evaluation instruments being administered by those responsible for delivering the educational instruction. In the realm of data analysis, a number of studies (as noted in Section 5) did not include a statistical component within their analyses of pre-test/post-test differences, with the consequence that it was difficult to assess the validity of their reported effects.

Emerging evidence on learners’ perceptions of nature, experiences of learning, and influences on adults

**Strengths.** An important strength of these nodes of emerging evidence is their broadening of the evidence base to new research foci, and ways of understanding learners and learning. As outlined earlier, these three nodes are underpinned by a common concern to investigate aspects of environmental education such as nature, action and learning from the perspective of the learner. They are therefore questioning established conceptualisations and ways of investigating young people’s knowledge, behaviour and learning, with a greater emphasis on perceptions (as opposed to factual knowledge), influence on parents (as opposed to changes in their own characteristics), and experiences (as opposed to outcomes). In several cases, the research in these emerging area is foregrounded, and based upon, considerable conceptual discussion drawing upon ideas beyond, as well as within, environmental education research. Examples include Uzzell *et al.* (1994), Wals (1994a,b) and Ballantyne *et al.* (1998a,b).

**Weaknesses.** Firstly, an inevitable consequence of the emergent nature of these nodes is that the studies tends to be exploratory, and the findings preliminary. There is more raising of issues than generation of conclusive findings. There is also a stronger focus on description, as opposed to analysis or explanation. This naturally influences the kind of key messages that can be drawn at this stage, particularly given the relatively small number of studies that have been undertaken in the emerging nodes thus far.

Secondly, there are also certain areas of methodological weakness that are important to highlight. In the work on students’ perceptions of nature, for example, few details are provided about exactly how the various data generation tasks were introduced to the children. This makes it difficult to compare findings for different activities both within, and between, studies. Another difficulty in this work, as with some for other areas, is a lack of information about how the analysis of the (usually qualitative) data was undertaken. In the work on child–parent influence, comparisons with a control/comparison group were not always undertaken, and most of these studies focused on short-term changes in parents’ behaviours rather than longer-term impacts.

Finally in the area of learning experiences, the evidence comprises findings from a mixture of studies with quite different foci. There are small pieces of evidence from surveys of students’ environmental characteristics, in-depth case studies of certain learning situations, as well as investigations of educational preferences. Unlike the other two emerging nodes of perceptions of nature and influences on adults, then, the evidence on experiences of learning does not seem to have a shared, common focus. While this is not necessarily a weakness *per se,*
it does mean that, at present, it is difficult to identify detailed key messages about students’ environmental learning experiences.

**Evidence base as a whole.**

Considering the evidence base as a whole, it would seem that there are a number of interrelated strengths and weaknesses, the balance between which is developing and changing.

**Strengths.** An important strength, firstly, is the size of this evidence base and the fact that there now is a considerable amount of empirical evidence and research activity in the area of learners and learning. This is particularly evident for topics such as students’ ideas about the science of global environmental issues, young people’s environmental attitudes, and learners’ environmental learning outcomes. It would seem, therefore, that research on learners and learning is a growing, rather than a neglected, part of the environmental education research field.

A second strength is that this evidence base is not stagnant, but is developing and changing. This can be seen in the lessening of certain of its imbalances and uniformities (described below) as new research foci emerge, bringing with them different methodological approaches and conceptual frameworks. New nodes of evidence are emerging on students’ learning experiences (as opposed to learning outcomes), and students’ perceptions (as opposed to scientific knowledge) of nature. Such research foci often involve a view of students as active evaluators of experiences, or constructors of knowledge rather than passive recipients of environmental education or information. This is seen as a positive development, in that it is diversifying the conceptual make-up of the evidence base. There are also signs of a greater variety of evidence being available for topics such as students’ environmental concerns and their ideas about environmental phenomena.

**Weaknesses.** Related to these strengths, however, are certain weakness. While the evidence base has grown in size, it remains uneven in foci, in the sense that there are marked accumulations of evidence for certain topics, but marked shortages and/or absences of evidence for other topics. Areas with a relative shortage include the sources of young people’s environmental information sources, students’ environmental behaviours, and students’ environmental learning processes. These, of course, reflect a number of key imbalances within the current evidence base, in particular the fact that there is more information about learners than about learning, more information about students’ environmental characteristics than about their educational characteristics, and more information about learning outcomes than about learning processes.

Another weakness is the uniformity which, despite some change, still characterises much of the evidence that is currently available. There is a general lack of methodological and conceptual diversity, as compared with the wider field of environmental education research. The vast bulk of the evidence (particularly within the established nodes) is quantitative in nature, and the qualitative evidence that is available is largely grounded in one particular epistemological framework (i.e. interpretivist/constructivist). Furthermore, from a conceptual perspective, much of the research included within this review is informed by a
passive view of students, especially the work on students’ environmental learning outcomes, and environmental knowledge, attitudes and behaviour. As was argued in Section 2.1, these features suggest that research on learners and learning has been somehow insulated from many of the recent methodological and theoretical developments that have characterised the broader environmental education research field.

Finally, the evidence base can be seen to suffer from a lack of interconnectedness between its various nodes of evidence. That is, cross-references are rare between individual studies (especially of differing methodological approaches), there are few review-style articles seeking to present and synthesise findings from different studies, and there is little conceptual discussion between different kinds of approaches. It would seem, therefore, that methodological developments in the field have led to a diversification of foci, which in turn has brought with it a fragmentation (rather than a synthesising) of the evidence base as new evidence has been generated and presented in isolation from that already in existence.

Overall, then, there are positive signs in the current evidence base, not least its growing size and its changing nature. That said, important weaknesses remain in the form of a continued imbalance of focus, an over-dependence on certain methodological approaches, and a need for greater interconnectedness.

7.2. Key Messages from the Evidence Base

With these strengths and weaknesses in mind, it is now possible to revisit the key messages relating to the each of the major foci within the evidence base.

Students’ environmental knowledge.

Surveys of young people in several countries report generally low levels of factual knowledge relating to environmental issues, often coupled with poor understanding of such matters (e.g. Gambro & Switzky, 1996; Connell et al., 1998; Yeung, 1998; Kuhlemeier et al., 1999). More detailed investigations of students’ ideas about specific environmental phenomena (such as the greenhouse effect, waste management or ecological habitats) find there to be considerable misunderstanding of the science of such issues (Boyes et al., 1993; Boyes & Stanisstreet, 1993, 1994, 1996; Greaves et al., 1993; Revell et al., 1994; Palmer, 1995, 1999; Strommen, 1995; Batterham et al., 1996; Brody, 1996; Palmer et al., 1996; Potts et al., 1996; Kortland, 1997; Glazar et al., 1998; Myers et al., 1999). Across these studies there seem to be two particular areas of confusion in young people’s thinking: confusion between ideas about different phenomena such as the greenhouse effect and ozone depletion (e.g. Boyes & Stanisstreet, 1993), and poor understanding of processes such as melting or recycling (e.g. Palmer, 1995).

Certain of these confusions are found to persist, or even increase, through time—examples include misconceptions remaining during the early years of primary school about the process of melting and the inhabitants of tropical rainforest (Palmer et al., 1996), and incorrect connections being made during secondary school between global warming and skin cancer, and ozone depletion and flooding (Boyes & Stanisstreet, 1993, 1996). Discussion about the origins of such erroneous ideas suggests two sets of influences. Firstly, they seem related
to the nature of students’ thinking, which is described as being ‘rich in content but poor in structure’ (Strommen, 1995), and comprising ‘robust [often inaccurate] models’ (Boyes & Stanisstreet, 1997a; Christidou et al., 1997), and ‘funneled’ ideas (Boyes & Stanisstreet, 1996). Secondly, they also seem related to various external influences, such as school textbooks (Boyes & Stanisstreet, 1996; Christidou et al., 1997; Chenhansa & Schleppegrell, 1998), the media (Gomez-Granell & Cervera-March, 1993; Cardeiro & Sayler, 1994; Strommen, 1995; Boyes et al., 1999), as well as the complexity of environmental issues themselves (Boyes & Stanisstreet, 1996).

Across several studies, the main sources of young people’s environmental information are found to be television and school (Roper Starch Worldwide, 1994; Morris with Schagen, 1996; Bonnett & Williams, 1998; Chan, 1998; Connell et al., 1998, 1999). Other sources include the print media, family and friends, environmental experiences, and environmental NGOs. Little is currently known about how these various sources are viewed by young people, with the exception of one Australian study which found that students saw school and NGOs as more reliable than the media (Connell et al., 1998).

Finally, there is some evidence to suggest that students’ factual knowledge and scientific understanding of global environmental issues, and their sources of environmental information, can be affected by gender, age, socio-economic grouping, geographical location and schooling. On the topic of gender, three studies suggest that girls tend to know more about immediate local issues affecting the here and now, while boys tend to be more aware of longer-term abstract issues of a wider dimension (Roper Starch Worldwide, 1994; Batterham et al., 1996; Myers et al., 1999). In relation to age differences, the evidence (albeit from cross-sectional studies) indicates that older students (during the primary and the secondary years) are better able than their younger peers to: name specific pollutants (Batterham et al., 1996), express ideas with greater certainty (Palmer, 1995), describe long-term effects (Palmer et al., 1996), and think in terms of chains of interconnected events (Wylie et al., 1998) about various environmental issues. As noted above, however, there are findings which indicate that certain erroneous ideas persist or increase with age (Boyes & Stanisstreet, 1993, 1996; Palmer et al., 1996). On the question of socio-economic groupings, Roper Starch Worldwide’s (1994) survey of students from differing social backgrounds in the US found differences between these two groups in terms of their environmental knowledge levels, and sources of environmental information. On the whole, however, clear-cut trends are difficult to identify for many of these factors. This reflects problems highlighted in Section 7.1.

Students’ environmental attitudes and behaviours.

Surveys of young people in various countries report generally positive environmental attitudes, i.e. greater agreement with pro- rather than anti-environmental sentiments (Lyons & Breakwell, 1994; Roper Starch Worldwide, 1994; Chan, 1996; Morris with Schagen, 1996; Connell et al., 1998; Ivy et al., 1998; Kuhlemeier et al., 1999). However, several studies find students to be less environmentally conscious in relation to certain issues—in particular, those linked to their own lives and material aspirations. Examples include the use of cars in Singapore (Ivy et al., 1998), modern consumer products in Hong Kong (Chan, 1996), and modern technology in Australia (Connell et al., 1998).
In terms of the kinds of environmental issues that young people are concerned about, studies in several countries report varying levels of concern for different environmental issues. The highest levels relate to ozone depletion for studies in the UK, Australia and Singapore (Morris with Schagen, 1996; Connell et al., 1998; Ivy et al., 1998), and water/air pollution and acid rain for studies across Europe, and the US (Foreid & Filho, 1997; Riechard & Peterson, 1998). Two UK studies suggest that levels of concern can vary not only between issues, but also with different scales, both finding that global environmental issues are seen as more serious/concerning than local ones (Uzzell et al., 1995; Morris with Schagen, 1996). This concurs with findings relating to young peoples’ views of the future which suggest that environmental concerns may feature less prominently in the personal (as opposed to the global) hopes and fears of young people (Oscarsson, 1996; Connell et al., 1999). As most other studies have focused exclusively on environmental issues, there is currently little clear-cut evidence about how students’ environmental concerns might compare and/or conflict with other kinds of issues that may interest them.

In terms of pro-environmental behaviours, there is evidence that young people have some involvement in practices relating to energy conservation, recycling and (less commonly) ‘green consumerism’ (Roper Starch Worldwide, 1994; Morris with Schagen, 1996; Connell et al., 1998; Ivy et al., 1998; Kuhlemeier et al., 1999). Most of these studies, however, emphasise the need for these behaviours to increase, and to encompass consumption practices and social political actions, as well as conservation practices.

Evidence on influencing factors in relation to attitudes and behaviour includes gender, age, socio-economic grouping, geographical location and schooling. Perhaps the largest amount of evidence is in relation to the impact of gender, where findings from several studies show girls to be more pro-environmental than boys in their attitudes and behaviours (Roper Starch Worldwide, 1994; Chan, 1996; Clarke, 1996; Hampel et al., 1996; Morris with Schagen, 1996; Connell et al., 1998, 1999). Two other investigations find that girls are more likely than boys to express concern about threats to wildlife and endangered animals, while boys are more likely to mention nuclear power and soil erosion/land degradation (Prelle & Solomon, 1996; Connell et al., 1999). On the topic of age, Kwan and Miles’ (1998) work with upper primary, junior and senior secondary students in Brisbane suggests that the nature and focus of students’ environmental concerns altered from a personal focus on toys and books in primary years to a greater attachment with the natural environment such as sunshine or the beach in later secondary years. There are several studies that suggest a relationship between socio-economic grouping and environmental attitudes (Lyons & Breakwell, 1994; Chan, 1996; Hampel et al., 1996), and environmental concerns and behaviours (Roper Starch Worldwide, 1994). As with the influencing factors relating to environmental knowledge, however, the evidence for many of the above factors is insufficient or inconclusive.

Students’ environmental learning outcomes.

There is evidence that learning outcomes in terms of changes in students’ environmental knowledge and/or attitudes, and, in a few cases, behaviour can be generated by certain programmes (Corral-Verdugo, 1993; Hanson, 1993;
These encompass a variety of programme types, including:

- residential field courses, such as a 5-day outdoor ecology programme in a German national park, which was shown to have effected significant changes 1 month afterwards in students’ knowledge, attitudes and willingness to plan and take actions for the environment (Bogner, 1998);
- school-based initiatives utilising particular teaching approaches, such as the Caretaker Classroom Program in the US, which encouraged elementary school classes to engage in pro-environmental activities, and was found to bring about significant change in participants’ environmental attitudes (but not their environmental knowledge) (Leeming et al., 1997);
- school-based initiatives focused on particular content areas, such as the large-scale US energy education programme which provided free teaching resources to elementary schools nationally and was found to have positive long-term impacts upon students’ energy knowledge, conservation behaviour and interest in learning about energy (Hanson, 1993);
- school-based initiatives aimed at fostering particular skills, such as the programme entitled issue investigation and action training (IIAT), which was reported to ‘foster independent overt environmental behaviour on the part of 8th grade students’ in US middle schools (Ramsey, 1993, p. 34).

Such impacts, however, are often only measured for relatively brief periods of time after programmes take place, so their long-term durability is often unassessed (exceptions include Hanson, 1993; Uzzell et al., 1995; Bogner, 1998; Dettmann-Easler & Pease, 1999). Furthermore, even in the short term, there are several cases where intended outcomes are only partially realised, in that programmes yield changes in certain areas, such as environmental attitudes, but not in others, such as environmental knowledge (Ramsey, 1993; Milton et al., 1995; Leeming et al., 1997; Ballantyne et al., 1998a; Bogner, 1998). Alternatively, desired programme outcomes can fail to occur at all, such as in the case of a Dutch secondary school teaching unit on waste (Kortland, 1997).

The difficulty is that little is currently known about how and why programmes are able to bring about certain kinds of learning outcomes. This is because most of the evidence simply reports whether or not a significant effect is measured. Having said that, a small number of studies have attempted to generate data on programme characteristics and impacts. These suggest that:

- learning outcomes can be facilitated by certain processes such as role modelling and direct experience on outdoor courses (Emmons, 1997) and collaborative group discussion in classroom lessons (Mason & Santi, 1998);
- programme duration (Emmons, 1997; Bogner, 1998; Zelezny, 1999), location (Dettmann-Easler & Pease, 1999; Zelezny, 1999) and preparation/follow-up work (Gutierrez de White & Jacobson, 1994; Farmer & Wott, 1995) can affect outcomes;
- different kinds of programmes can affect learners’ environmental knowledge, attitudes, and behaviour in different ways (Ramsey, 1993; Milton et al., 1995; Leeming et al., 1997; and
different kinds of students (e.g. those with more or less environmental interest) can be affected differently by environmental learning experiences (Leeming et al., 1997).

Students’ perceptions of nature, experiences of learning and influences on adults.

Studies in Australia, the UK and the US suggest that young people perceive ‘nature’ as natural living things with minimal or no human interference, and as a relatively static entity. Three recurring themes expressed by young people are of nature as a place for leisure and solitude, as potentially dangerous and frightening, and as being under threat (Wals, 1994a, b; Keliher, 1997; Bonnett & Williams, 1998; Payne, 1998a). While at a preliminary stage, there are findings which suggest that students’ perceptions and constructions of nature may be shaped by influences such as their socio-economic setting, gender experiences of nature and exposure to images and ideas within the media.

A small number of studies suggest that students have mixed views of their environmental education at school (Roper Starch Worldwide, 1994; Jensen et al., 1995; Means, 1998; Battersby, 1999; Connell et al., 1999). While environmental education undertaken with certain teachers or as part of particular action-orientated programmes are praised, there is criticism voiced in relation to environmental teaching being concentrated in particular subjects or lacking practicality and relevance. More detailed investigations of students in particular environmental learning situations suggest that learners can be highly individual in their responses to such experiences (Schindler, 1993; Elliott, 1995; Bixler & Floyd, 1999; Lai, 1999; Rickinson, 1999). The picture emerging is of students as critical consumers, rather than passive recipients, of environmental curricula.

Studies of intergenerational influence suggest that students, after participating in environmental education activities, are capable of influencing the environmental attitudes and/or behaviours of their parents (Uzzell et al., 1994; Evans et al., 1996; Leeming et al., 1997; Ballantyne et al., 1998a). In other words, environmental education programmes can have an impact not only on students, but also indirectly on parents. Such influence, however, is not an automatic process, and appears to be facilitated by programmes being enjoyable for students, including tasks that can involve parents and dealing with actual local problems, in addition to students and parents having an interest in the environment and good communication patterns (Uzzell et al., 1994; Ballantyne et al., 1998a).

General themes about learners and learning.

Given these various key messages, the important issue now is what these tell us about learning and learners in environmental education.

Learning in environmental education. The current evidence base provides information about two aspects of learning: learning outcomes (usually of groups of students), and learning experiences (usually of individual students).

The evidence on learning outcomes shows that environmental education programmes can effect change in students’ environmental attitudes, knowledge and (in a few cases) behaviours. The evidence relates to a variety of both school-based and outdoor educational initiatives. Effects, however, tend to be measured in the short term, and in most cases their durability over time is
unclear. Furthermore, positive effects can be partial in that change in attitudes—though not behaviour—might occur, or can be absent altogether. It is not well understood how or why particular outcomes do or do not occur, although there is some evidence to suggest that certain aspects of programmes are helpful in yielding positive impacts. These aspects include: programme duration in terms of week-long, as opposed to shorter, outdoor field courses (Emmons, 1997; Bogner, 1998); preparatory and follow-up work in connection with programmes at local zoos/museums (Gutierrez de White & Jacobson, 1994; Farmer & Wott, 1995); parental and community involvement with programmes (Uzzell et al., 1994; Milton et al., 1995; Ballantyne et al., 1998a); and authenticity of content in terms of dealing with actual, local environmental issues (Uzzell et al., 1994). There is also some evidence to suggest that learning outcomes can be facilitated by certain processes such as role modelling and direct experience aiding attitude change on outdoor courses (Emmons, 1997) and collaborative group discussion helping conceptual development in classroom lessons (Mason & Santi, 1998).

In addition to the influence of various programme characteristics, evidence suggests that learning outcomes can also be affected by the nature of the participating students. A small number of studies have found variations in outcomes in relation to: students’ age and level of interest in the environment (Leeming et al., 1997), students’ ability levels (Gayford, 1995), and the extent to which students enjoy a programme (Ballantyne et al., 1998a). This concurs with emerging evidence about students’ learning experiences, which indicates that individual students can make sense of similar learning tasks in quite different ways. What is clear from this is that students are active experiencers, rather than passive recipients, of environmental curricula, and respond to learning situations in individual ways.

Taken together, then, it would seem that the evidence from studies of learning outcomes and from studies of learning experiences are both highlighting a common point—the importance of the learner in the process of learning.

Learners in environmental education. The current evidence provides information about two aspects of learners in relation to environmental education: their environmental characteristics (such as attitudes, knowledge, concerns, perceptions, etc.), and their educational perspectives (such as experiences, preferences, etc.). A recurring theme throughout all of this evidence is that students are not neutral or ‘blank slates’ in relation to either the environmental or the educational aspects of environmental education. Studies of students’ environmental attitudes, concerns, perceptions, and understandings, for example, generate pictures of young people having ‘robust models’ of global environmental phenomena (Boyes & Stanisstreet, 1997a), deeply held feelings (including fears) about natural areas (Simmons, 1994b; Wals, 1994a), and particular views about the future and perceptions of nature (Hutchinson, 1997; Bonnett & Williams, 1998; Payne, 1998a). Meanwhile, research on learning experiences and preferences report varying perspectives on learning through fieldwork (Lai, 1999), classroom learning tasks (Schindler, 1993; Rickinson, 1999), environmental information sources (Connell et al., 1998), the nature of school-based environmental education (Connell et al., 1999), and outdoor activities (Bixler & Floyd, 1999).
Several studies also highlight the intricate and often contradictory nature of students’ perspectives. It is clear that the views of students are complex and varied, rather than straightforward and simple. Bonnett and Williams (1998) and Payne (1998a), for example, both describe groups of children expressing contradictory or ambivalent perceptions of nature, as something both separate from, but then also including of, people and human-made objects. In a similar way, Barron (1995, p. 116) writes of ‘children taking up multiple subjectivities in relation to contradictory discourses’. Studies of attitudes, meanwhile, note conflicts between a pro-environmental stance on many issues, but a less environmentally conscious attitude about issues linked with their own lives and material aspirations (Chan, 1996; Connell et al., 1998; Ivy et al., 1998). Similarly, in studies of classroom learning (Rickinson, 1999) and fieldwork activities (Lai, 1999), a marked variety is found in individual students’ perspectives on, and responses to, particular aspects of their learning situations.

The origins and development of students’ environmental and educational perspectives are not well understood. What is known is that environmental characteristics can (i) vary with demographic factors such as gender, age and socio-economic grouping; (ii) change at least in the short term as a result of educational interventions; and (iii) be affected by influences such as the media and schooling. The way in which these influences play out over time, though, is currently unclear, due to the fact that our current understanding of learners is a largely static one. In other words, we do not know a great deal about how students’ perspectives develop and/or change over time.

7.3. Issues and Implications

For research users.

An important outcome of this review is its demonstration of the considerable amount of research activity that is currently occurring in the area of learners and learning in environmental education. This would seem a positive and encouraging sign for those interested in the field of environmental education research from the perspective of developing and improving practice and/or policy. The review highlights a number of topics relating to school students for which research evidence is currently available, including: students’ knowledge and ideas about global environmental issues; their environmental concerns and attitudes; their environmental learning outcomes; their capacity to influence their parents; and their perceptions/experiences of nature and environmental learning situations. These may well be of real interest and relevance to research users such as teachers, curriculum developers, policy makers, and outdoor educators whose practical concerns have a connection to such topics. It is difficult, though, to foresee precisely the kinds of ways in which people might use the evidence discussed in this review, especially given the wide variety of potential research users in environmental education. Furthermore, in considering possible implications, it should be recognised that research evidence will rarely translate easily into simple ingredients for developing environmental education practice or policy.

Having said that, I would argue that the empirical findings contained within this review could be useful to research users in three main ways. Firstly, they
may help to suggest certain aspects of environmental education that are either helpful or unhelpful from the perspective of learners and/or learning outcomes.

The research on students’ ideas about global environmental issues, for example, identifies a number of aspects of environmental teaching that may be a hindrance to students’ understanding of such issues. These include: (i) use of general terms such as ‘pollution’ which, it is argued, can hinder students distinguishing between different pollutants and environmental problems (Boyes & Stanisstreet, 1996); (ii) abstract nouns such as ‘habitat loss’ in textbooks, which, due to their abstract and agentless nature, are found to have less salience for students and so can be easily overlooked (Chenhansa & Schlepppegregl, 1998); (iii) schematic diagrams illustrating the greenhouse effect using arrows approaching the earth, which, according to Boyes and Stanisstreet (1996), can be misread by students as showing the greenhouse effect being caused by holes in the ozone layer allowing more solar radiation into the earth’s atmosphere; (iv) studying environmentally responsible behaviours such as recycling without considering exactly how and why such practices are environmentally beneficial as this can result in ‘blurred knowledge’ among primary school children (Palmer, 1995); and (v) learning about scientific explanations for environmental phenomena such as spring which reportedly can lead students to give up more common-sense explanations that may, in fact, be more helpful to them in their daily lives (Chipeniuk, 1998). In highlighting these arguments, however, I would add that they each make assumptions about the nature of environmental teaching which may or may not be shared by individual research users coming to consider their possible implications. This point is clearly articulated by Gough, N. (1999, p. 35) in an article about research on students’ misconceptions (see Section 3.2), in which he argues that: ‘assumptions about why and how people may be disposed to act (or not) on what they learn in environmental education are usually implicit in research literature. [And] unless these assumptions are made explicit, and can be shown to be defensible, unwarranted conclusions may be drawn about the putative effects of environmental education programmes and pedagogies’.

The research on learning outcomes, meanwhile, proposes that certain aspects of environmental education programmes can be helpful in terms of effecting positive changes in students’ environmental knowledge, attitudes or behaviours. These include: outdoor residential field courses lasting for a week rather than 1 or 2 days (Emmons, 1997; Böchner, 1998), out-of-school visits to local zoos and public gardens encompassing preparatory and follow-up work (Gutierrez de White & Jacobson, 1994; Farmer & Wott, 1995), school-based programmes including elements of community and parental involvement (Uzzell et al., 1994; Milton et al., 1995; Ballantyne et al., 1998a), and environmental curricula focusing on actual local environmental issues as opposed to envisaged or construed ones (Uzzell et al., 1994).

There is also some evidence to suggest that learning outcomes can be facilitated by certain processes such as role modelling and direct experience aiding attitude change on outdoor courses (Emmons, 1997) and collaborative group discussion helping conceptual development in classroom lessons (Mason & Santi, 1998). All of these characteristics, however, need to be considered in relation to the nature, aims and context of the particular programmes that were evaluated. That is, they are not necessarily generalisable ingredients for success.
for any programme of environmental education, but characteristics that yielded differences for particular programmes.

A second way in which the research evidence may be useful for research users is by providing information about characteristics of learners that could have implications for practice and policy in environmental education. A general point that emerges from this review is that students come to environmental education with a whole host of existing environmental and educational perspectives. The ways in which these play out in relation to particular environmental learning situations would seem an important issue for practitioners and curriculum developers in environmental education. In terms of specifics, consideration might be given to that fact that:

- young people, including those of a primary school age, are capable of sophisticated thinking in relation to environmental issues (Strommen, 1995; Palmer et al., 1996; Bonnett & Williams, 1998; Wylie et al., 1998);
- individual students (such as boys and girls, or older and younger students) may differ considerably in their attitudes towards, concerns about, and perceptions of the environment and nature (Roper Starch Worldwide, 1994; Batterham et al., 1996; Chan, 1996; Morris with Schagen, 1996; Connell et al., 1998, 1999; Kwan & Miles, 1998; Myers et al., 1999);
- students can differ in their curricular and pedagogical preferences, and thus may respond to different kinds of environmental education activities in varying and individual ways (Bixler & Floyd, 1999; Lai, 1999; Rickinson, 1999); and
- certain aspects of global environmental issues, such as their processes, distinctions and interconnections, appear difficult for students to understand, and can become the source of considerable confusion and misperceptions (e.g. Boyes & Stanisstreet, 1993; Palmer, 1995).

The issue emerging from all of the above statements is how these characteristics of learners might be taken into account in teaching and learning practices within environmental education. This is particularly important when one considers that all of the above characteristics may differ in significant ways between students and their teachers. As Payne (1998a, p. 19) asserts:

Environmental educators would do well to consider learners’ views about ‘nature’ and the ‘environment’. […] Without an adequate understanding [of such views] teachers may find themselves promoting a view, or experience of nature that has a lot, little or nothing to do with children’s daily living circumstances.

Finally, one further outcome of this review for research users relates to the information it provides about recent research in the particular area of learners and learning. It is hoped, for example, that details about the make-up of the current evidence base and the kinds of studies that have been undertaken on particular topics in particular geographical locations might better enable research users to access and engage with research specifically related to their interests. In addition, the discussion of strengths and weaknesses, both at the level of the evidence base and of individual studies, will hopefully draw attention to the problematic nature of research evidence and the intricate connections between methodology, methods and findings. The overview of the field and what it provides in terms of evidence may also play a part in enabling
research users to have a stronger and more informed voice in debates about future directions and priorities for environmental education research as a field. This, though, will depend on greater dialogue between researchers and research users, possibly in relation to the development of user reviews, a concept which is explored further below as part of the implications for future reviews of the area.

For researchers.

For researchers in environmental education, this review highlights a number of issues and challenges for future work on learners and learning. Implications can be identified in relation to three main weaknesses in the current evidence base: (i) its methodological uniformity; (ii) its substantive imbalances; and (iii) its fragmentation. This focus on weaknesses, however, is not to overlook the strengths of recent work in the area, which, as argued below, provide an important basis for future development.

The first weakness relates to the area’s methodological and conceptual make-up, and the fact that research on learners and learning is considerably less diverse in these respects than the wider field of environmental education research. Critical reflection and discussion about the ways in which this has come about, what it might mean, and how it could be addressed, would seem important for the future evolution of the area. Given the fact that the vast bulk of the evidence base is quantitative in nature, and the qualitative evidence that is available is predominantly interpretivist/constructivist, this review suggests that consideration could usefully be given to: broadening the range of theoretical and epistemological frameworks within the area, enhancing the extent of qualitative evaluation and inquiry, and continuing the development of conceptions of learners as active agents, rather than passive subjects, in relation to the environment and environmental education (see, for example, Gough, N., 1999 on ‘rethinking the subject in/of environmental education research’ in the light of poststructuralist understanding of subjectivity and agency). There are signs of such developments already present within the evidence base, including the emergence of qualitative evidence in areas such as young people’s perceptions of nature (Simmons, 1994a; Wals, 1994a,b; Barron, 1995; Keliher, 1997; Bonnett & Williams, 1998; Payne, 1998a,b), learning processes (Emmons, 1997; Mason & Santi, 1998), experiences of environmental learning situations (Lai, 1999; Rickinson, 1999), thinking about the environment and environmental issues (Cullingford, 1994; Kwan & Miles, 1998; Wylie et al., 1998; Connell et al., 1999), and influences upon their parents (Uzzell et al., 1994; Ballantyne et al., 1998a), as well as empirical work proposing conceptualisation of learners as ‘thinker[s] and problem solver[s]’ (Wylie et al., 1998, p. 117), and as individuals with ‘rich working knowledge of the social and environmental circumstances [...] in which they find themselves’ (Payne, 1998a, p. 20). Notwithstanding these examples, the argument remains that environmental education is a field characterised by a wide spectrum of methodological approaches and theoretical perspectives, several of which are poorly represented in the part of the field dealing with what is perhaps the most crucial aspect of environmental education—its learners and their learning.

A second weakness in need of attention is the unbalanced nature of the current evidence base. A number of key imbalances of research evidence have become apparent throughout this review: in particular, the relative shortage of work on learning processes as opposed to learning outcomes, educational
characteristics as opposed to environmental characteristics, and learning as opposed to learners. These inequalities of focus manifest themselves as gaps in the current understanding of learning and learners, all of which deserve careful consideration in relation to future research. With respect to the current shortcomings, I would suggest three strategies as potentially helpful. First, that a broader empirical focus be adopted in relation to several areas, such as:

- young people’s knowledge and understanding of the socio-political, as well as the scientific, aspects of environmental issues, including ones that are local as well as global;
- students’ experiences of environmental education as it occurs within all areas of the mainstream school curriculum, as well as through innovative science-based programmes, and of environmental education using ICT and virtual learning environments, as well as using more traditional learning contexts and resources;
- students’ attitudes and perspectives towards social and educational phenomena more generally, as well as towards the environment and environmental education in particular; and
- learners’ interactions and influences among their peers, as well as with their teachers/educators, and parents/family.

Secondly, that certain areas be accorded a deeper level of empirical investigation, including:

- differential environmental learning outcomes vis-à-vis different kinds of programmes, and different kinds of students;
- the nature of students’ thinking about environmental phenomena (as distinct from the amount, or the accuracy of such thinking);
- the processes, experiences and contexts of young people’s environmental learning, including what kinds of conditions are helpful for which kinds of students undertaking which types of learning;
- the influence of, and interrelationships between, factors such as ethnicity, culture, social class, and gender on young people’s environmental characteristics and educational responses; and
- all aspects of young people’s environmental behaviours and actions.

Thirdly, that longitudinal (as opposed to cross-sectional) studies be prioritised for all work relating to learners and learning, and especially in relation to:

- the dynamics and development of young people’s environmental perceptions and perspectives at different age levels;
- patterns and changes in young people’s preferences and responses to environmental education at different stages in their schooling; and
- the long-term durability of learning outcomes (both positive and negative) of environmental education programmes.

It is important to emphasise that all of the above suggestions could be informed by ideas not only from other research in environmental education, but also from social science inquiry more generally. In the field of educational research, for example, useful insights could well stem from recent work on students and their perspectives in relation to classroom teaching and learning (Cooper & McIntyre, 1996; McCallum et al., 2000), secondary school science (Reiss, 2000), the primary
school curriculum (Pollard & Filer, 1996; Pollard et al., 1997; Thiessen, 1997), and school improvement (Rudduck et al., 1996). Furthermore, notions of pupil career and identity (Pollard & Filer, 1996), and learners’ craft knowledge (Cooper & McIntyre, 1996), as well as methodological debate about researching with students (e.g. Soohoo, 1993; Clark & Moss, 1996), could also prove useful dimensions for future research on environmental learning. These are but a few examples from recent educational research; other fields will no doubt provide many further possibilities.

Finally, the third weakness of fragmentation within the evidence base suggests an additional challenge for researchers: the need to increase the interconnectedness of the evidence base. That is, future research needs to focus not only on enhancing methodological diversity and addressing substantive gaps, but also on forging stronger connections with and between many of the current concentrations of evidence in the area. This stems from the view that there is scope for improved understanding of learners and learning in environmental education through better links being made between existing findings in this area. One example where connecting currently separate bits of the evidence base could be helpful is in relation to the issue of differential learning outcomes stemming from environmental education programmes. In my view, understanding of this issue could be facilitated by viewing it in connection with emerging evidence on students’ learning experiences and established evidence on students’ environmental attitudes and ideas. That is, in light of the notion of learners possessing individual and sophisticated perspectives on environmental issues and educational procedures, it is less surprising that learning outcomes may differ between students on the same programme. In a similar way, emerging findings about young people’s perceptions of nature, including their fears, may well be informative for future investigations of students’ responses to, and outcomes from, environmental learning situations, especially those in outdoor settings.

These examples underpin the crucial point that the current evidence base on learners and learning contains much that is of value for future research. A key challenge, though, will be to build upon the current evidence in a way that moves beyond a concern with simply evaluating environmental education programmes or establishing information about students’ environmental characteristics, towards genuinely seeking to understand learning and the role learners play within this process. In advocating this, I come back to Erickson and Shultz’s (1992, p. 478) description of the educational research field in the early 1990s, which would appear highly applicable to the environmental education research field of the early 2000s:

Presently we do not understand at all clearly how intellect, will, culture and politics meet at the intersection of curricular materials, classroom arrangements, pedagogical approaches, and students, within whose subjective experience learning presumably takes place.

For future reviews of the field.

As well as generating ideas for research users and for researchers, this review also raises a number of issues for future reviews of the field. At a general level, I would hope that this review serves to highlight the importance and value of work that attempts to make sense of and critically analyse research in environ-
ment of learning. As the field grows and becomes more complex, the importance of research funding and researcher time for reviews, and the development of different kinds of review processes, will arguably increase.

In light of the experience of undertaking this particular review, I feel there is a definite need for more reviews in environmental education which approach the field as an evidence base, and focus on the nature and quality of the empirical evidence. However, this is not a simple or straightforward undertaking, and this review has only begun to touch upon many of the challenges and complexities that are involved (see also Rickinson, 2001). A particular difficulty, which goes right to the heart of evidence-focused reviews, is that of making judgements about the validity, credibility or trustworthiness of different kinds of research evidence. Issues of quality with respect to research are inevitably highly contentious and complex, particularly in a field such as environmental education where methodological differences are deep-seated and hotly debated. While this review has tried to develop a process of examining strengths and weaknesses in the evidence base, this has a long way to go especially in relation to the critical appraisal of qualitative evidence, which, relative to quantitative work, has to deal with more diverse genres of inquiry, fewer examples from previous reviews, and little agreement over criteria of quality (see, for example, the discussion in Environmental Education Research, 6(1), Special Issue: Qualitative Methods of Inquiry). There is a need, therefore, for future reviews to better problematise these kinds of issues, and to draw more extensively upon methodological discourse both within, and beyond (e.g. Davies, 2000; Hammersley, 2000), the field of environmental education.

Finally, relating back to an earlier point made about greater dialogue between researchers and research users, I would argue that there is a need not only for more varied academic reviews in environmental education, but also for the development of user reviews. This draws upon Bassey’s (2000, p. 25) distinction between an academic review, ‘a critical and analytical account of the state of public knowledge of the topic’ aimed primarily at other researchers, and what he terms a user review: ‘a form of professional paper which is devised and written by researchers and users working together’ with the aim of critically informing the thinking of a particular policy maker or practitioner audience. The latter, Bassey explains, would arise from an academic review but would be much briefer and more readable in style and, most importantly, would focus on specific issues of relevance to particular groups of users. I would argue that reviews of this kind are currently rare in environmental education, but could, in fact, represent an important and promising opportunity for the field, its practitioners and its researchers.

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Notes on Contributor

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NOTES

[1] Following a recent curriculum review, the prominence of environmental topics in the UK National Curriculum has been enhanced. Under the term ‘education for sustainable development’, one of the stated aims of this new curriculum document is to: ‘develop [pupils’] awareness and understanding of, and respect for, the environments in which they live, and secure their commitment to sustainable development at a personal, local, national and global level’ (QCA, 1999, p. 11).

[2] Strictly speaking, this study should have been excluded from this review as its respondents are not students. Some of its findings, however, have been included in this section because: (i) its findings were drawn upon in a later study that did focus on young people themselves (Bixler & Floyd, 1999); (ii) it required respondents to provide illustrations of any fears or discomforts they reported as being expressed by children; and (iii) it provided a justification for questioning the staff rather than the students: ‘[they] would be more likely to remember the spontaneous expressions that children may not remember or have the writing skills to report’ (Bixler et al., 1994, p. 27).

[3] The ENSI project involved schools in several countries initiating environmental education programmes aimed at the development of ‘dynamic rather than passive qualities’ in students and the use of interdisciplinary inquiry to foster environmental awareness (OECD, 1995). In particular, this project sought to enable school students to experience the environment ‘as a sphere of personal influence’ and ‘as a challenge for initiative, independence and responsible action’ (Elliott, 1995, p. 13).

[4] Developed from a number of health and environmental education projects in Denmark (e.g. Jensen, et al., 1995), action-competent environmental education is concerned with ‘action on the social and natural environment rather than simply the acquisition of learning or opinion formation’. It therefore requires education to have a goal ‘related to citizenship’ (Uzzell, 1999, p. 402). Having action competence is ‘more than just being aware of or having an attitude towards environmental problems, or even having a set of skills’. It requires ‘a consciously solution-orientated approach to societal problems [...] a positive approach to co-operative decision-making, a respect for democracy and an understanding of participatory processes’ (Uzzell et al., 1994, pp. 12–13).
REFERENCES


Appendix 1: Further details of literature search procedures

1. Bibliographic Databases

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<th>Data bases</th>
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<td></td>
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<td></td>
<td>‘field studies’</td>
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2. Journal Searches (manual)

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## Appendix 2: The review framework

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<th>country(ies) where the work was undertaken</th>
<th>Age of learners:</th>
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