AN INTERPRETIVE INVESTIGATION OF "EARTHKEEPERS", AN EARTH EDUCATION PROGRAM, AT A SCOTTISH OUTDOOR EDUCATION CENTRE

Duncan Jonathan Martin

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ABSTRACT

Earth Education is a unique phenomenon in that it comprises activities aimed at developing concepts, positive feelings about the environment and environmentally benign behaviour. "Earthkeepers" is a two and half day program designed according to the principles of Earth Education, for young people between the ages of 10-12 years old. This thesis is a longitudinal evaluation of the Earthkeepers program at Ardroy Outdoor Centre in Argyll, Scotland. It was conducted in the style of naturalistic inquiry using Grounded Theory.

This research conducted unstructured and semi structured interviewing of 59 pupils taken from the final year of three primary schools in Fife, Scotland. They were interviewed before and after the program. A selection of these pupils was then interviewed one year and two years after the program. Other stakeholders were also interviewed, including primary and secondary teachers, primary school senior managers, instructors, program leaders, Institute for Earth Education staff and program authors. Interviews were unstructured and semi-structured in format. Other qualitative methods were used, comprising participant observation and documentary analysis.

The thesis addresses the extent to which the program *can* meet its aims by identifying and examining the learning theory it adopts. It was found to be internally consistent in general terms, adopting an eclectic but coherent approach, although some claims made by the program authors are difficult to support in their entirety.

This work focuses on an interpretation of the meanings and understandings that participants develop in relation to the natural environment. The program was found to be successful at developing four basic ecological concepts which were retained and developed by the vast majority of the participants for the duration of the evaluation. The specific ecological concepts comprised Energy Flow, Cycling, Interrelationships and Change. The program also produced highly significant and

memorable positive experiences that were sometimes regarded as life-changing experiences.

GLOSSARY OF TERMS AND ABBREVIATIONS

ACC	'Acclimatization' programs. Nature education programs designed by Van Matre for young learners attending Summer camps in the US.
Accredited Status	Accredited status is awarded to those programs that meet stringent criteria laid down by The IEE and is an attempt by The IEE to maintain program quality.
Conceptual Encounters	An Earth Education Vehicle targeted at the learning of individual ecological concepts. They attempt to use metaphors and conceptual models of abstract concepts to make them 'concrete' for learners. They are used in the majority of published Earth Education programs including Earthkeepers.
DfEE	Department for Education and Employment
Earth Caretakers	A model Earth Education program for pupils aged 10-12 involving one day away from school and intended to initiate year-long learning and exploring. Originally written as an example of program design for demonstration purposes, it became one of the most common Earth Education experiences in the U.K., much to the chagrin of The IEE.
Earth Rangers	A model Earth Education program for pupils aged 10-12 intended to stimulate motivation in the early stages of a curriculum involving environmental education. It involves one full day of activities and a year of post-program work and, ostensibly, is the least intense Earth Education program.
Earthkeepers	A published Earth model Education program for pupils aged 10-12 that involves two and a half days of Earth Education activities and post-program school work. The program focuses upon encouraging pupils to address their use of energy and materials.
Earthwalk	A Vehicle, comprising four to six activities, structured in such a way as to provide a nature walk that focuses on stimulating perception and emotional responses to nature.
I.E.E.	Institute for Earth Education.
Immersion Experiences	A collection of activities intended to provide an experience that immerses the participants in the natural world. *Immersion* requires the overcoming of perceptual barriers, including physical and psychological barriers, and the use of different senses in order to create positive feelings and new perspectives about the familiar.
Institute for Earth Education	A non-profit volunteer organisation, founded in 1974, now comprises an international network of individuals and institutions, whose aim is to design and develop educational programs that change perceptions of and behaviour towards the natural environment. Amongst their achievements they list 20 publications in the field of nature education, 175 experiences and activities, five complete programs and the training of 50,000 leaders in seven languages on five continents (I.E.E., 2000).
Lost Treasures	An unpublished model Earth Education program for pupils aged 8-9 years

	old involving classroom activities and field excursions focusing on natural communities (Van Matre, 1990, p.283).
LTS	Learning and Teaching Scotland.
Magic Spot	An activity that provides the opportunity to be alone in the natural world.
Model Earth Education Program	A program that fulfils all the criteria of The IEE. For example, model programs should include the four major concepts of energy flow, cycling, interrelationships and change; should have mechanisms which encourage pupils' participation through stimulation of interest; should specify explicit objectives; and should focus on building good feelings for the earth.
NCC	National Curriculum Council.
Pledge Sheets	Written pledges that pupils make at the end of the residential part of Earthkeepers, to use less energy and materials.
QCA	Qualifications and Curriculum Authority.
SCAA	School Curriculum and Assessment Authority.
SNH	Scottish Natural Heritage. The sponsoring organisation for the Earthkeepers program at Ardroy Outdoor Centre, including the evaluation.
Sunship III	A published Earth Education program for pupils aged 13-14 that involves two and a half days of Earth Education activities and post-program school work. The program focuses upon pupils' choices about their impact upon the earth.
Sunship Earth	A published model Earth Education program for pupils aged 10-12 that involves five days of Earth Education activities and post-program work. The program focuses upon developing seven ecological principles.
Vehicle	A group of Earth Education activities designed to meet similar objectives.
Y and S Tasks	Tasks that puils undertake to attain the second two keys in order to become Earthkeepers.

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I beg pardon, once and for all, of those good readers who take up novels merely for amusement, for plaguing them so long with old-fashioned politics, and Whig and Tory, and Hannoverians and Jacobites. The truth is, I cannot promise then that this story shall be intelligible, not to say probable, without it. My plan requires that I should explain the motives on which its action proceeded; and these motives necessarily arose from the feelings, prejudices, and parties of the times. I do not invite my readers (...) into a flying chariot drawn by hippogriffs, or moved by enchantment. Mine is an humble English post-chaise, drawn upon four wheels, and keeping his majesty's highway. Such as dislike the vehicle may leave it at the next halt, and wait for the conveyance of Prince Hussein's tapestry, or Malek the Weaver's flying sentry-box. Those who are contented to remain with me will be occasionally exposed to the dulness inseparable from heavy roads, steep hills, sloughs, and other terrestrial retardations; but, with tolerable horses and a civil driver, I engage to get as soon as possible into a more picturesque and romantic country, if my passengers incline to have some patience with me during my first stages.

"Waverley" by Sir Walter Scott, 1814.

1 INTRODUCTION

Sir Walter Scott's novel "Waverley" was based upon the story of a young man, educated and brought up in England but with Scottish ancestry, who travelled to Scotland to take a commission in the army. The story was set at the time of the Jacobite rebellion in 1745 and involved a blend of realism and romanticism, and the old world and the new. This evaluation was located in Fife and Argyll, at the time of the referendum for Scottish Devolution. It occurred one year after Mel Gibson's film, Braveheart, became part of a growing desire for self-determination. The researcher, an Englishman with Scottish ancestry, travelled to the research sites from England, during a period which saw the dominant paradigm in environmental education challenged by a multiplicity of perspectives.

National identities coloured many of the interactions that occurred between the participants, stakeholders and the researcher. Indeed, Earthkeepers was a program written in the U.S., implemented predominantly by the English, in a Scottish centre. The centre was on the shores of a loch used as a nuclear submarine facility and one of the schools was overflown by RAF and USAF jet aeroplanes on a daily basis. This was Earth Education with a Scottish flavour but with many other subtle, and not so subtle, overtones. Consequently, the accounts and observations have been influenced by the context. However, this is not to suggest that this work has no relevance for any other context. One of the criteria for judging an evaluation such as this, is whether it is transparent. To this end, major decisions have been explained and justified with reference to literature, theory or data. Examples have been used to illustrate how the analysis has been performed and the conclusions drawn. By considering the issues, choices, justifications, and explanations it is believed that the study will be made relevant to a wider context.

The evaluation begins with an introduction to Earth Education as a phenomenon and includes a brief discussion about the aims and objectives, and how its authors perceive it to be different from environmental education. This introduction sets it in the context of national curricula, although these issues are explored in much more depth in the appendices.

Chapter 2 comprises a review of the research literature on Earth Education and identifies priorities for research and evaluation.

Chapter 3 discusses the implications of the survey of literature and explains the reasons why the Earthkeepers program was chosen, and why the Scottish centre was the best site in which to conduct the research.

Chapters 4 and 5 are a discussion of the approach to learning adopted by Earth Education in general and Earthkeepers in particular. They discuss learning in the area of ecological concepts and ecological 'feeling' respectively. One of the aspects of Earth Education is that it has a distinct methodology which is implicitly critical of western schooling. Therefore, it was necessary to identify where this methodology came from, how it was developed and how it was justified. The conceptual chapter is much lengthier than the 'feeling' chapter because conceptual learning has had much more attention than feelings and emotions, and because the conceptual approach of Earth Education has evolved considerably in comparison with the approach to 'feeling'. This chapter is the first part of the examination of internal consistency *i.e. Can* it do what it claims?

Chapter 6 is a detailed discussion of the methodology and methods. It synthesises the priorities for research identified in the research literature review with the theoretical analysis of the Earthkeepers program in Chapters 4 and 5. It begins with a deconstruction of some of the assumptions used in the earlier chapters, specifically those concerned with Bloom's taxonomy. It then discusses theoretical debates in research and makes the case for an interpretive study. It concludes by discussing the methods.

Chapter 7 addresses the data and analysis. This is by no means a complete record of the data. The interviews alone would run into millions of words. Therefore, it focuses on providing examples to show how the data was analysed to develop an understanding of pupils' learning for one aspect of the program. It then includes summary results for other aspects. It also illustrates how the methods emerged from the context rather than being pre-ordained. The Review and Reflection sections represent these as stages although in reality the evolution was a smoother process.

Chapter 8 is a discussion of the major findings in the context of the most recent work on Earth Education programs. It also analyses Earthkeepers for internal consistency, but this time the question is, *does* it do what it claims?

Chapter 9 is a discussion of the conclusions and it makes recommendations for the outdoor centre and The Institute for Earth Education (The IEE).

The final three chapters are appendices.

Appendix 1 and 2 are detailed analyses of the coherence between Earthkeepers and the national curricula of England and Wales, and Scotland. These documents were produced as part of this evaluation and are referred to in the text. The coherence between the program and the English curriculum was co written with Kate Ainsworth, a volunteer staff member of The IEE.

Appendix 3 is an estimation of the impact of pupils' carrying out the tasks as pledged during the program.

A glossary is provided to assist the reader with some of the terminology in the discussion.

1.1 THE INSTITUTE FOR EARTH EDUCATION

Earth Education is a product of summer camps that took place in the U.S.A. in the 1960s and 1970s. It developed from Acclimatization programs, which were introductory nature education programs, so called because they were aimed at acclimatizing people to the earth and its natural systems. Acclimatizing finally developed into a series of multi-activity learning programs designed to meet specific objectives (Van Matre, 1972, 1974). The programs involved experiences aimed at both affective and cognitive objectives but as Van Matre notes (1990, p.63), they were seen as being focused upon perceptions and feelings to the extent that during the 1970s Acclimatization had become a generic term for sensory awareness activities (*ibid.*, p.83), and sometimes even *any* activities conducted in the outdoors (*ibid.*, pp.85-86) with non-cognitive objectives. Van Matre's immersion experiences were certainly alluring and he notes that people "...latched onto [these] to the exclusion of everything else" (*ibid.*, p.84). Furthermore, by the mid 1980s Van Matre had discovered that the term 'acclimatization' had been used before by a society with aims in direct opposition to his. Thus the founding of the Institute for Earth Education in 1984 was intended to create distance from these misconceptions surrounding Acclimatization.

1.2 EARTH EDUCATION OVERVIEW

Earth Education programs are described by The IEE as focusing "...primarily upon understanding basic ecological systems (...), what these systems mean for people in their own lives, and what people must do to begin living more in harmony with these systems which support all life on earth" (Van Matre and Johnson, 1987, p.*vii.*). These three basic principles inform the programs' rationale, the subject content or curriculum and the methods. Hence, The IEE believes that its programs are qualitatively different from other forms of environmental education in several important ways; they focus largely on developing ecological feeling through a combination of mental and physical engagements with the natural world; they are meticulously planned and are often incredibly intense, thought provoking experiences; and they have tended to use a dogmatic definition of what environmental education should be and rejected the pressure to become "...everything to everyone" (Van Matre, 1990, p.252).

Acclimatization had four components comprising feelings, concepts, the mechanics of learning and solitude, which were all bound together with the elusive and difficult to define ingredient, magic (Van Matre, 1979, p.6; 1990, pp.63-72) (Figure 1).

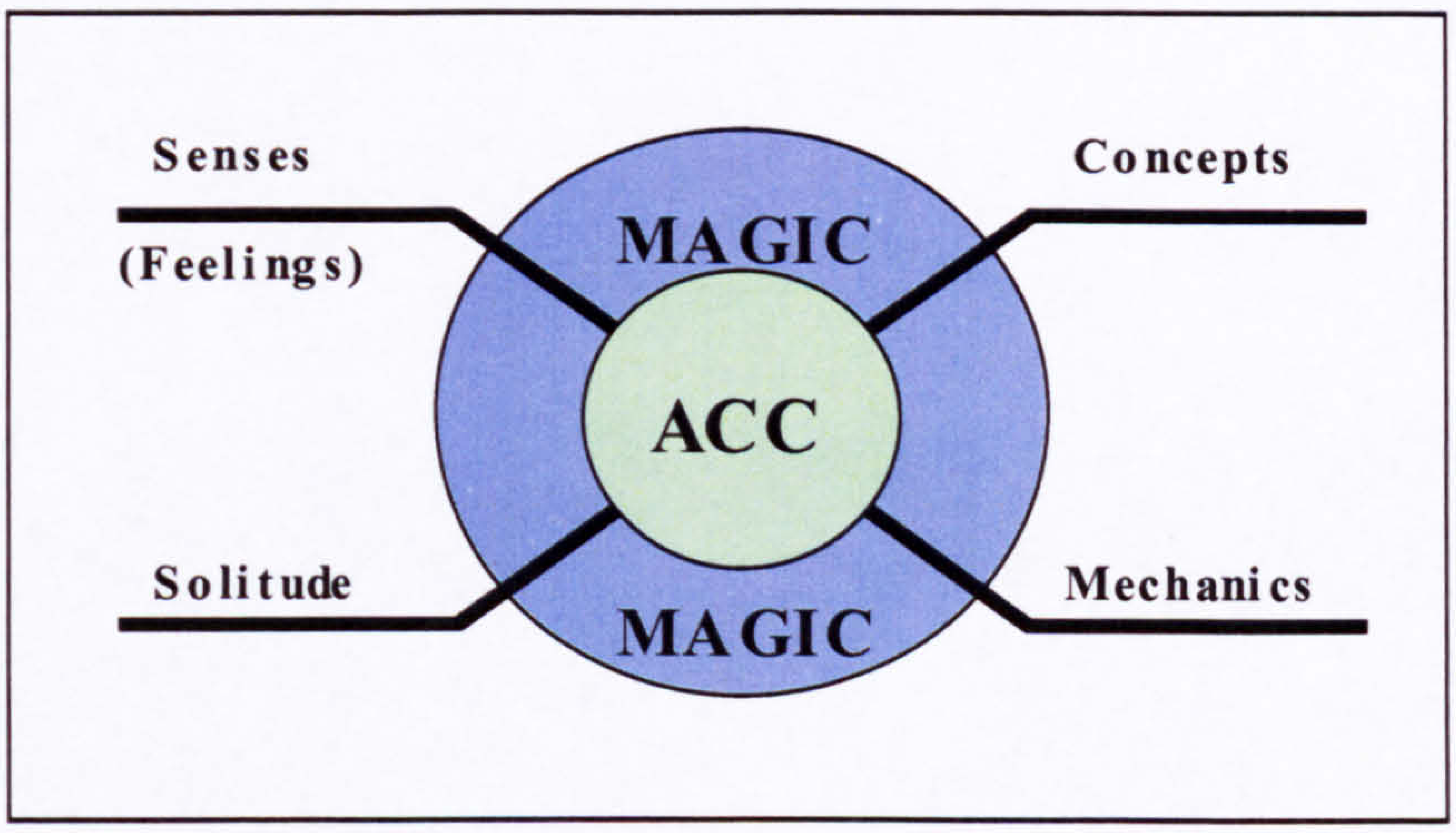

Figure 1: The Major Components of Acclimatization (Van Matre, 1979, p.6)

The aims of Acclimatization, which have been distilled from the program descriptions and included below in Table 1, were intended to break down barriers, provide interesting and enjoyable experiences and inform participants about the natural world.

Table 1: The Aims of Acclimatization (Van Matre, 1972, pp.11-12)

...To break down the barriers that man has built to cut himself off from nature, to the point "...where one human being can feel himself totally involved with it... Once he has felt this unity ... he is more hesitant to destroy her".
...To stimulate awareness, increase appreciations and motivate further involvement.
...and to address ecological concepts concerned with cycles, energy flow, change and adaptation, community and habitat, and interrelationships.

These aims were much more clearly stated and expanded upon in 1984 when Acclimatization became Earth Education. From this time the principles of Earth Education were stated under the three headings, the "Whys" (rationale and ideology), the "Whats" (aims, objectives and content) and the "Ways" (pedagogy and methods) (see Table 18, p.78). Although the ideological and philosophical position had been alluded to in previous publications (Van Matre, 1972; Van Matre, 1974, pp.9-15; Van Matre, 1979) it was not described in detail until publication of the Principles of Earth Education (Van Matre, 1990). This helped to clarify the assumptions that underpinned Van Matre's approach. As such this declaration is almost unique amongst forms of environmental education as rarely do publications of programs or packages state any ideological position.

Another major development from Acclimatization was the reorganisation of the conceptual elements to include a more comprehensive list of seven key ecological concepts and to introduce more specific behaviour elements to the programs whereby learners would be required to examine and change their lifestyles in order to *"...live more lightly on the earth."* (Van Matre, 1990).

The general clarification of aims was partly due to the process of growth and evolution within The IEE , and partly to provide a template from which others could produce programs consistent with the ideological or pedagogical stance of The IEE. This has been successful to some extent with the production of various Earth Education experiences[1] in the U.K., including Teddy Bears' Picnic, a program based on Earth Education for six to seven year old children which has been delivered throughout the U.K. (Rhymer, 1997). However currently there are ten full Earth Education programs which are at various stages of development, for all ages. Four of these programs have actually been published namely, Earth Rangers (10-12yrs old), Earthkeepers (10-12yrs old), Sunship Earth (10-12 yrs old) and Sunship III (13-14yrs old). Other programs continue to be developed and await final approval by The IEE (Van Matre, 2003).

[1]These are not "Programs" as there are a stringent set of criteria that an experience must fulfil if it is to be given this title. See Van Matre (1990, pp.269-270).

1.3 THE CONTEXT OF EARTH EDUCATION

Van Matre (1972, 1974, 1979, 1990) has been highly critical of environmental education, perhaps even dismissive, and has offered a summary of the differences between the aims of Earth Education and the tendencies of environmental education (1990, p.252). Here he makes a complex distinction between Earth Education and environmental education (Table 2).

Table 2: Environmental Education Vs Earth Education (Van Matre, 1990, p.252)

Environmental Education (Tendencies...)	Earth Education (Aims...)
Supplemental and Random	Integral and programmatic
Classroom based	Natural world based
Issues oriented	Lifestyles oriented
Focuses mainly on developing secondary concepts and conducting environmental studies projects	Focuses largely on developing "ecological feeling" based on a combination of mental and physical engagements with the natural world.
Activity based	Outcome based
Claims to teach how to think not what to think	Claims to instil values and change habits
Relies heavily upon conducting group discussions to achieve its instructional objectives	Relies primarily on participatory educational adventures to achieve its instructional objectives.
Integrates the inputs (messages) and consolidates the applications (projects)	Consolidates the inputs (messages) and integrates the applications (projects)
Infused with "Cornucopian" management messages and views.	Infused with the principles of deep ecology.
Accepts a wide range of definitions.	Rejects becoming everything else.

As well as criticising the environmental education curriculum, Table 2 illustrates that many of Van Matre's arguments also address structural influences, such as those from the wider society in which the activity takes place.

Furthermore, Van Matre (1990, p.34-36) criticises environmental education for its role in advertising and promoting companies' interests as he believes that the technocentric messages (O'Riordan, 1981; Pepper, 1984) presented are incompatible with what the aims of environmental education should be. Van Matre is one of the few authors of nature education programs that has been explicitly critical of other programs, methods and organisations, or implicitly critical of western social, political and economic systems.

Van Matre's analysis has itself been criticised both in the literature (Randle, 1992, p.26) and informally (Ansell, 2000; Tate, 2001; Johnson, 2003). For example, Johnson (2003) described two occasions where Earth Education programs have been subject to charges of extremism, comprising religious and environmental extremism: Some Michigan community members considered Earth Education to be religiously unsound, due to concerns that Earthkeepers contained elements of witchcraft, but were unsuccessful in their attempts to prevent schools from undertaking the program. However, authorities in Oregon successfully proscribed Earthkeepers, finding that some of its elements too closely resembled the behaviour of "Tree Hugging" logging protestors. As a result Van Matre has become cast as pariah or prophet, a dichotomy which is typified by the 'debate' in Randle (1992, pp.25-32).

Criticism has also clouded much of the debate surrounding Earth Education and it is difficult to find high quality critiques of the programs themselves. Indeed, few articles have been published that discuss Earth Education in peer-reviewed journals or books (e.g. Gough, 1987; Keen, 1991b; Robottom and Hart, 1993; Job, 1996; Black and Reeve, 2000), which is perhaps astounding considering that such programs have been published around the world for nearly thirty five years. Even among peer-reviewed publications it is not infrequent to find the work of The IEE misrepresented and this is discussed at greater length in chapter 2.

Although Earth Education claims to be different from mainstream environmental education in terms of its content, learning methods and underpinning philosophy, its objectives have many similarities with more widely known educational programs, initiatives and policy documents. Anecdotal evidence indicates that it has much potential for enhancing science education (Rhymer, 1992), environmental education (Dyer, 1988a), teacher education, curriculum design and administration, and evaluation in education (Gough, 1987, p.59). Limited evaluation has been attempted with short term undergraduate studies (e.g.

Rowbotham, 1983; Farnbank, 1993) and post-graduate theses (Keen, 1991a) but prior to the implementation of this research few projects had convincingly addressed programs' influence upon ecological understanding, ecological "feeling" or long term behavioural change.

1.3.1 EARTH EDUCATION AND NATIONAL CURRICULA

Earth Education programs include objectives concerned with understandings, values and feelings, and behaviour. The programs are not focused upon issues, but rather are concerned with the development of basic conceptual understandings. Environmental issues are considered, but only as far as is required to provide illustrative examples, normally local examples, to show the relevance of concepts to learners' lifestyles. The basic concepts that comprise Earth Education's curriculum would normally be part of a science and geography curriculum, although there are also clear links between other aspects of the Earth Education curriculum and other aspects of the school curriculum, such as English, mathematics and art. However, Earth Education programs involve much more than just conceptual learning and the following discussion addresses the potential of Earth Education programs in a wider sense.

Environmental educational policy documents have been concerned with the three areas of knowledge, skills and attitudes. Concerning behaviour, or skills, according to the European Community, one of the goals of environmental education is to... "...lay the foundations for a fully informed and active participation of the individual in the protection of the environment..." (Council of Ministers, 1988, cited in NCC, 1990).

In 1990 the National Curriculum Council (NCC) considered that environmental education aims to "...Provide opportunities to acquire ... skills to protect and improve the environment... and [it] encourages active participation in resolving environmental problems." (NCC, 1990). This was echoed in 1996 by The School Curriculum and Assessment Authority (née NCC) who stated that environmental education aims to "Provide all pupils with opportunities to acquire the ... skills required to engage effectively with environmental issues... and encourage active participation in resolving environmental problems" (SCAA, 1996, p.2). Reflecting concerns about the apparent diminishing importance of environmental education, the document's title was changed to "...Environmental Matters..." from "Environmental Education" suggesting a shift of focus from the cross curricular theme of Environmental Education to something lacking coherence and identity.

Most recently the national curriculum for Citizenship (DfEE/QCA, 1999b; 1999d), statutory guidelines for pupils aged between 11 and 15, requires "...pupils to be taught about ... the world as a global community and the ... environmental and social implications of this...". Furthermore, older pupils should also "...be taught about the wider issues and challenges of global interdependence and responsibility, including sustainable development and Local Agenda 21."(DfEE/QCA, 1999b; 1999d).

Non-statutory guidelines (DfEE/QCA, 1999e) mention pupils being given various opportunities to take responsibility for themselves and the environment, to learn about the needs of other living things, and the factors that affect the local natural environment, for example. Simple environmental issues are also mentioned as an example of how pupils might consider moral and social dilemmas. An initial reading of the curriculum might indicate that it appears to be failing to deal with the idea of value promotion, except from the perspective of provision of pupil choice. However the Statement of Values (DfEE/QCA, 1999c) provides a concise and useful clarification of this issue. It states that commonly agreed values in society, which should be taught in schools, include environmental values. These are given in Table 3.

Table 3: Extract From Statement of Values in the National Curriculum (DfEE/QCA, 1999c)

We value the environment, both natural and shaped by humanity, as the basis of life and a source of wonder and inspiration. On the basis of these values, we should:

- *accept our responsibility to maintain a sustainable environment for future generations*
- *understand the place of human beings in nature*
- *understand our responsibilities for other species*
- *ensure that development can be justified*
- *preserve balance and diversity in nature wherever possible*
- *preserve areas of beauty and interest for future generations*
- *repair, wherever possible, habitats damaged by human development*

Despite this apparent commitment to environmental education the DFEE/QCA have not yet provided the means by which these values may be addressed in schools. Furthermore whilst the DfEE/QCA claim that authority for these values is gained by consensus it side-steps the rather obvious conclusion that these values are too ill-defined and ambiguously stated to be of any practical use. For example, there is no discussion of what might be meant by "...the place of human beings in nature" (QCA, 1999c).

The Scottish 5-14 curriculum seems to share common ground with the aims of Earth Education. For example the general structure of the 5-14 curriculum suggests that the curriculum should help pupils to acquire and develop "...the capacity to treat others and the world around them with respect" (LTS, 2000, p.4) where one of the fundamental bases for a personally rewarding life is the engendering of "...a commitment to the environment" (LTS, 2000, p.5). These general aims are also evident in the five cross curricular themes, specifically in Education for Citizenship, where the potential for exploring environmental themes through environmental projects and sustainability issues is highlighted (LTS, 2000, p.28). However, this document is necessarily very general but when the individual documents are analysed the potential coherence between Earth Education and the 5-14 curriculum can be fully explored (see Appendix).

To date, policy documents in England and Wales consistently have failed to provide teachers with effective statutory legislation for environmental education provision, consistent with other curriculum areas such as Mathematics, English and Science. Comments from a recent review (Rickinson, Dillon, Teamey, Morris, Young Choi, Sanders and Benefield, 2004, p.54) suggested that policy makers needed to recognise that opportunities for outdoor learning in school grounds and beyond were "*...in decline or under threat*" due to curriculum and resources constraints. Whilst Rickinson *et al.*'s findings were not specific to environmental education, Earth Education programmes involve a significant outdoor component and it is likely that the decline in outdoor learning is also applicable to Earth Education and other forms of experiential environmental education. Cooper (2000, p.26) has also stated that "Outdoor education has suffered from an overloaded, content-based National Curriculum", but he states that recent changes provide a number of opportunities for further development. However, despite this cautious optimism, the absence of statutory provision or entitlement remains.

Scotland has fared slightly better as the 5-14 curriculum suggests the engendering of an emotional relationship with the environment. However, it does not clarify how this should, or could, be achieved. Therefore Earth Education programs and activities could have a role in addressing values in the various curricula, particularly in the absence of clarification by legislative bodies. Earth Education also has much in common with the specified content of various subjects in the curricula of Scotland, and England and Wales. The links between one Earth Education programme, Earthkeepers, and these policy documents have been detailed in the Appendix.

1.4 SUMMARY

This chapter has described the main ideas behind Earth Education, its aims and how it sets out to achieve these through the delivery of education programs to children of all ages. It has discussed how the founder, Van Matre, has been critical of environmental education for many different reasons and has, perhaps in turn, received his own share of criticism and attention from stakeholders in environmental education and sometimes, even the community. Conversely, some have been highly complimentary of Earth Education activities and programs as the activities and programs were seen as highly original and innovative for many reasons, not least their willingness to address learning in the affective domain. Practitioners of Earth Education have also provided much anecdotal evidence to indicate the potential that it might have for delivering powerful and meaningful experiences for young people. Such debate has been swinging from one extreme to the other since commentaries first appeared on Earth Education and there has been little progress in the discussion since the early 1980s.

This work aims to analyse the phenomenon of Earth Education by examining some of these contradictions and their underlying assumptions. Naturally, this requires an examination of the main practice of Earth Education which, in the U.K. at least, necessitates the evaluation of children's learning programs. In order to effect this inquiry, the following chapter examines the existing literature on Earth Education and suggests potential areas for research.

2 RESEARCH IN EARTH EDUCATION

This chapter comprises a synthesis of work on Earth Education and Acclimatization carried out prior to the inception of this research project (1996). The discussion highlights those aspects of the Earth Education phenomenon that had, up to this time, been addressed or neglected by the existing body of knowledge, and contributes to the chosen methodology (Chapter 6) insofar as it identifies, from the research, the principal areas of concern for Earth Education. It begins by examining theoretical work on Earth Education, including work that has cited Earth Education as exemplary practice, work that has attempted to analyse Earth Education critically, and practitioners' autobiographical or anecdotal accounts of experiences with Earth Education. The section concerning empirical work (Section 2.3) includes a discussion of research into the efficacy of Earth Education programs and activities in terms of their effect upon knowledge, feelings and behaviour. The discussion concludes with an account of studies that have examined the potential for Earth Education to deliver national curricula.

Chapter 1 has outlined Van Matre's (1972, 1990) critique of environmental education, including a summary of the differences between the aims of Earth Education and the tendencies of environmental education. These differences occur at various levels and include discussions of curriculum content and structure, educational psychology and underpinning philosophy. Van Matre's insistence upon the distinctiveness of Earth Education has probably led to it receiving a significant amount of attention from various authors. This work has tended to be of one of five types, listed in Table 4.

Table 4: Classification of Types of Work, Published and Unpublished, on Earth Education.

i)	**Theoretical Analyses: Exemplary Practice**	General research that uses Earth Education as an exemplar of one type of approach or another.
	Theoretical Analyses: Critical	Critical, and frequently negative, discussion of aspects of Earth Education.
ii)	**Practitioners' Perspectives**	Auto-biographical or Anecdotal accounts of leaders' experiences of programs and activities.
iii)	**Empirical**	Reports of empirical research on programs or activities
iv)	**Curriculum**	Examination of the coherence between Earth Education and national curricula.

This discussion will now explore each of these five types in turn, using examples drawn from the available literature.

2.1 THEORETICAL ANALYSES

A small amount of work that has discussed Earth Education has been published by the process of peer-review (Gough, 1987; Greenall-Gough, 1990; Keen, 1991a; Keen, 1991b; Robottom and Hart, 1993; Job, 1996; Beder, 1997). Much of this is not concerned with empirical research but makes reference to Earth Education as exemplary practice in some aspect of education. For example, Gough (1987, pp.49-67) suggests that Earth Education exemplifies an "ecological paradigm for education", one that places greater importance upon the individual's senses and perceptions and less emphasis upon the learning of detailed theoretical knowledge. Gough provides support for Earth Education's use of "Big Picture" concepts, the avoidance of naming and labelling, and the focus on sharing and doing rather than showing and telling. However, he also comments that most educators, parents and employers are *unlikely* to accept that the existing system of mass education is deeply flawed because of entrenched social interests and élites (*ibid.*,p.56). Beder (1997) explores the hegemonic relationship between education and business further, referring to Earth Education as an exemplification of an approach that has survived without pandering to corporate interests.

Gough (1987, p.59) also suggests that the Earth Education approach can be applied to areas outside nature education, that is curriculum design and administration, and evaluation in education. Robottom and Hart (1993, pp.22-27) also cite Earth Education as a model of interpretivist[2] approaches to both practice and research in environmental education but there is perhaps a sense that they are concentrating on the affective aspects of Earth Education activities. Certainly their main source of information seems to be Acclimatization (Van Matre, 1972; 1974), publications which lack the detail on learning theory given by later examples (e.g. Van Matre, 1979; 1990).

Some of this work unfortunately presents the work of The IEE in misleading ways. For example, Job (1996) uses "Earth Education" to include *all* forms of nature education, including the work of Cornell (1979, 1989), that attempt to address affective objectives. Job's diagram (Figure 2) also suggests that "Control over Learning" in Earth Education lies mid-way between teacher -centred approaches and pupil-centred approaches, yet there are Earth Education activities that could be placed anywhere on this continuum[3].

[2] This is discussed in chapter 6.

[3] This framework for analysis provided by Job, begs a multitude of deeper questions that betray certain philosophical assumptions. Not least amongst these is the use of the category "Emphasis on Quantification" as counterpoint to "Emphasis on Affective Learning". Job offers no satisfactory rationale for his deviation from the more traditional approach (Bloom *et al.*, 1956) of placing *cognitive* learning in opposition with affective learning.

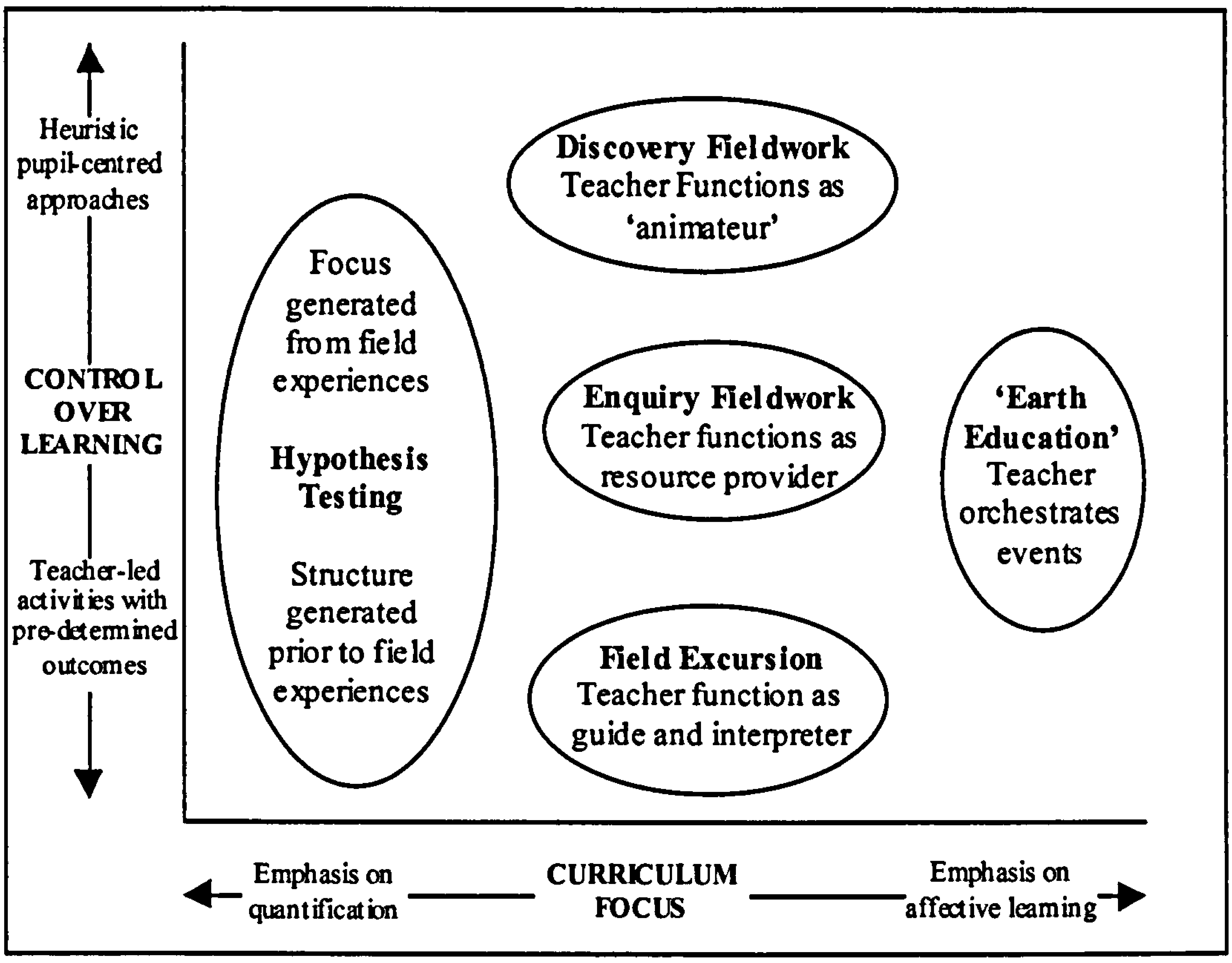

Figure 2: Analysis Of Nature Education Using Two Continuums: Control Over Learning (Vertical Axis) And Curriculum Focus (Horizontal Axis) (Job, 1996)

Such misunderstandings about the work of The IEE are unfortunately commonplace; perhaps the most frequently held belief is that Earth Education consists of activities aimed at learning in the affective domain exclusively. For example, MacLellan (1988) focuses on the awareness aspects of Earth Education, whereas much of Randle's (1992) short article is concerned with the approach to values education.

Some authors have been critical of aspects of Earth Education, particularly the operation of The IEE and of those elements that distinguish it from Environmental Education. For example, Randle (1992) attempts to discuss critically the organisational structure of The IEE. In particular he comments upon the "...exclusivist attitudes..." (*ibid.*, p.26) of the Institute towards outsiders and towards others' use of Earth Education material. These attitudes, according to Randle (*ibid.*), are derived from a *modus operandi* that includes secrecy, elitism, and pedagogical dogmatism. Furthermore he refers to The IEE as a religious "...sect... [wherein The Truth can]...only be handed down in certain ways, by certain anointed people, at certain appointed places" (*ibid.*, p.26). Moreover, he suggests that IEE members practise idolatry and self-deception. He also mentions others' accusations that Earth Education is "...propaganda", yet simultaneously refuting it, but his rebuttal is weak and tends to be overwhelmed by the tone of his other swingeing criticisms. His caricature of The IEE caused a certain amount of damage to the work of The IEE (Rhymer, 1999) and because these comments were inadequately explained and developed, they were probably unhelpful to the wider field of Environmental Education.

Robbins (1985) also took issue with Acclimatization, but her main objection was the structure of the curriculum of Earth Education and other aspects of its pedagogy. She concentrated (*ibid.*, p.10) upon the rigidity and lack of flexibility of the approach, making the point that pupils' questions "...will be superior, however much the pill is sweetened, to an imposed idea pressed upon children unevenly capable of absorbing it" (*ibid.*, p.11). Her comments are more useful than Randle's (1992) as they are expanded upon and present an alternative case without recourse to pejorative language. However, her presentation of "traditional" nature education is probably an idealised picture of what pupils learn from field excursions.

What is of great concern, is that there is some degree of coherence between Randle's (1992) and Robbins's (1985) articles: Both refer to problems of pedagogy and particularly, flexibility. Caddy (1993, p.53-54) provides some support for this, reporting one outdoor centre manager's claim that Earth Education discriminated against the less able by its recommendation of inappropriate activity props and the use of large blocks of written text in some activities. Furthermore, Randle claims that he has "...almost never met [a person who had attended an Earth Education workshop], who was not at least a little troubled by some aspects of what he/she had encountered", and...

> Everywhere I went I was constantly amazed to find that the same sorts of conversations occurred. Grossly to oversimplify, outside the initiate group there was ... dismay at the Institute's attitudes.
> (Randle, 1992, p.25).

So it would appear that many people, particularly educators who lack experience and knowledge of Earth Education (Duckworth, 1986, p.22), perceive there to be problems with Earth Education, yet it is likely that these very people would be responsible for deciding whether pupils participate in Earth Education. Ironically, of the various critical articles, none seem to have countered the main thrust of Van Matre's critique of the field of Environmental Education, specifically that it has largely failed to achieve what it set out to. Perhaps, then, these critical comments can be set in their proper context, that is of a schooling system that relies heavily on didactic methods wherein certain types of knowledge have more status than others. Consequently, attempts to maintain the *status quo* by practising professionals, through the defence of traditional pedagogy, may actually more closely resemble the responses of reactionary conservatives, for as Gough (1987, p.57) comments...

> ...it is difficult to imagine those of us who have been inducted into the 'priesthood of scholars and scientists' willingly turning our backs on the storehouses of theoretic knowledge with which we are so familiar.

This suggests that reliable research into practitioners' perspectives is an urgent necessity for The IEE and environmental education, as Earth Education seems to promise so much. This is discussed in the next section.

2.2 PRACTITIONERS' PERSPECTIVES

Autobiographical accounts, supported by a great deal of anecdotal evidence, indicate that Earth Education has much potential for enhancing nature education (Duckworth, 1985;1986;1988; Cree and King, 1988; Dyer, 1988a; Rhymer, 1992). These are now summarised below.

The impact of Earth Education on leaders' emotional, perceptual and intellectual relationship with the environment has been described by Duckworth (1985, p.3), Bragg, (1988, p.17), Cree and King (1988, p.14), Gray (1988, p.17) and McNally (1997), whilst its effect on pupils' development has been widely affirmed by Duckworth (1986, p.22), Bragg (1988, p.17) and Dyer (1988a, p.13). The term "Pupils' development" has variously included the learning of transferable ecological concepts (Duckworth, 1986, p.23), enhanced motivation towards schooling (Duckworth, 1986, p.23; Rhymer, 1992, p.30) and improved self-esteem and confidence. Programs are also described as having an impact upon children's affective development, contributing to the development of environmental attitudes (Dyer, 1988b, p.19) and contributing to a healthier relationship with the natural world (Duckworth, 1986, p.22; Cree and King, 1988, p.15). Indeed, a significant advantage of Earth Education over environmental education is its ability to encourage many different forms of interaction with the natural world (Duckworth, 1985, p.7), involving perception, observation and evaluation (Duckworth, 1986, p.25). Most authors report that pupils enjoy the activities and programs (Duckworth, 1985, p.4; Bragg, 1988, p.17; Cree and King, 1988, p.14; Dyer, 1988a, p.13) and that Earth Education helps to create a unique and productive learning atmosphere (Duckworth, 1986, p.23).

The quality of programs has been supported by claims of their extensive trialling and testing (Duckworth, 1985, p.4, 7, 8; Duckworth, 1986, p.24; Rhymer, 1992, p.29), and that they do, indeed, achieve what they set out to (Rhymer, 1992, p.31). Duckworth (1985, p.6) also claimed that Earth Education programs were favourably comparable with the highest quality program he had encountered in his professional life as a teacher in an outdoor centre. Dyer makes the point that one significant advantage is that activities appeal to wide ranges of ages and abilities (Dyer, 1988a, p.14).

Regarding the structural operation of The IEE Rhymer (1992, p.31) argues that Earth Education takes a unique stance in the field of environmental education in its disavowal of corporate sponsorship and, hence, the influence of consumerism and cornucopianism (Irvine, 1995). Furthermore, he argues that Earth Education's concentration on core ecological concepts is further removed from indoctrination or propaganda than what often passes as environmental education, that is, litter-picks and tree-planting (*ibid.*, p.30), for example.

In summary, the autobiographical and anecdotal accounts, summarised above, apparently embody a wide ranging justification for the use of Earth Education, but their reliability and accuracy remains unchallenged given that they were not subject to peer review. Furthermore, many of the accounts referred to above were written by individuals with vested interests in Earth Education. Consequently, convincing and robust evidence of activities' success in enhancing children's learning coherent with contemporary views of cognitive development, or the ability of programs to help learners live more lightly on the Earth through developing ecological feeling, remains elusive.

2.3 EMPIRICAL WORK

Social research may be considered to be the investigation of relationships, for example, between individuals, between individuals and their institutions, or between an individual's conceptions and behaviour. It is possible to represent these relationships and interactions occurring at different levels using the analytical device presented by Strauss and Corbin (1990, p.163; 1998, pp.181-199). This diagram has been presented in Figure 3 to show how these levels are evident in the phenomenon of Earth Education. This enables actions and interactions pertaining to a given phenomenon to be considered at the different levels at which they occur.

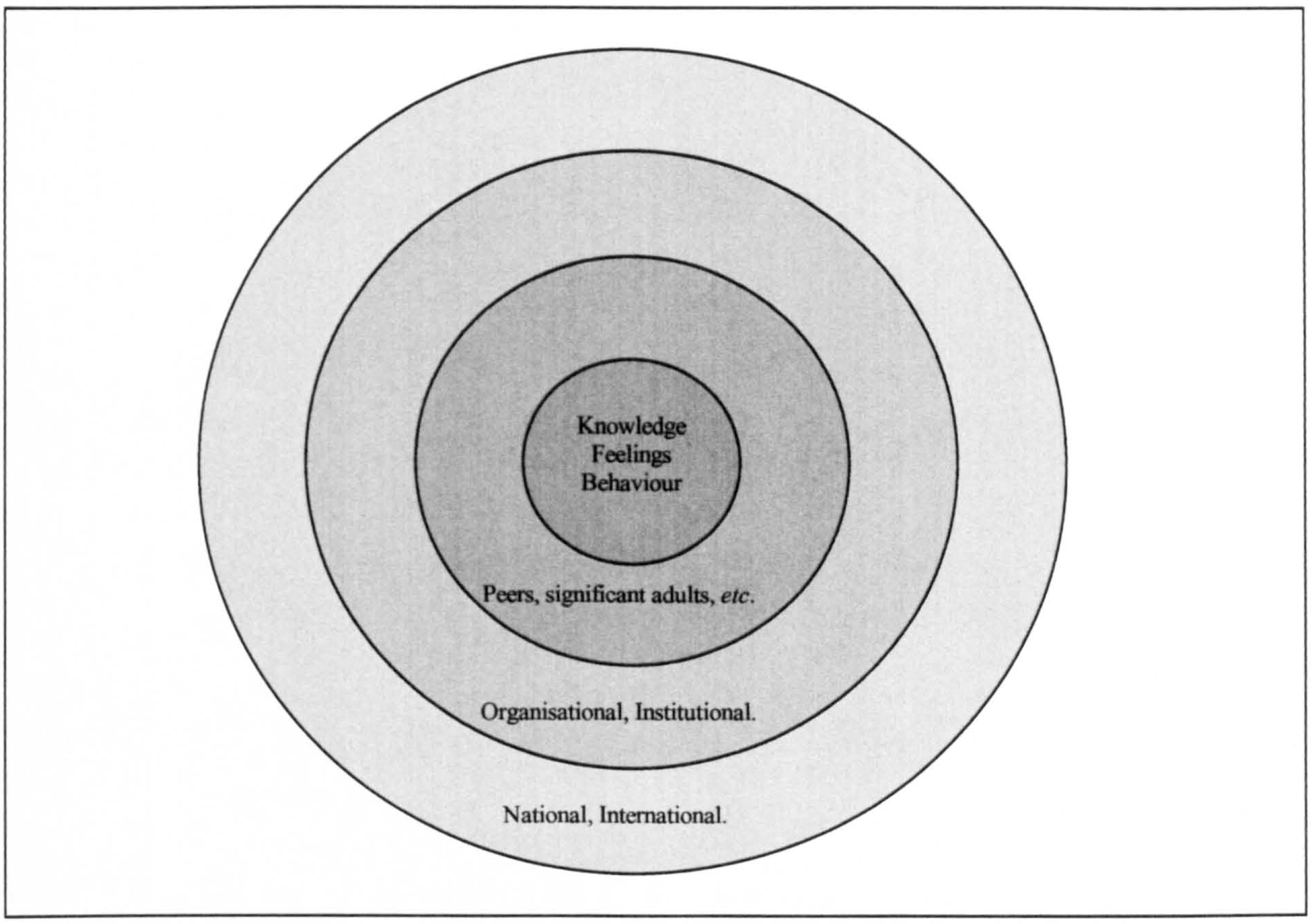

Figure 3: The Conditional Matrix Applied to Research in Earth Education (Strauss and Corbin, 1990, p.163; 1998, pp.181-199)

Existing research has almost exclusively examined the relationship between the individual and the Earth Education Curriculum by asking the question "Does Earth Education work?". The body of empirical work, carried out in Australia, Canada, the United Kingdom and the United States, will now be examined in the light of the Matrix. It begins with a discussion of research that has been conducted at the level of the individual and includes a review of the effect of programs on knowledge, feelings and behaviour. It then moves to a consideration of participants' perspectives of the programs, followed by those of teachers and parents. Finally it reviews work that has examined the Earth Education curriculum along with curriculum policy documents.

2.3.1 THE KNOWLEDGE COMPONENT

The approaches to the assessment of learning have probably been as numerous as the individuals conducting the research owing to differences that include methods, intended audience, pedagogy and epistemology. For example, there is little coherence in the approach to the notion of what constitutes "ecological learning". Indeed, most of the work appears to be unconscious of this question. Nevertheless this has not meant that such work should be merely dismissed, but rather that careful scrutiny is required in order to tease out such important assumptions. Some more recent approaches (van Wissen, 1992; Farnbank, 1993) have attempted to examine the *quality* of learning. This has been achieved through the idea of individual "concept" development but neither have taken an explicitly constructivist approach. Both of these qualitative studies have worked with various methods that have included; open-ended pre- and post-program questionnaires; interviews with pupils, parents and teachers; video recordings and field observations. They have both used small samples and rarely use statistics except for description. Quantitative studies (Payne, 1981; Bires *et al.*, 1982; Cancilla, 1983; Jack, 1991; Keen, 1991a; Keen, 1991b) have regarded ecological learning as a process of "knowledge" acquisition or the receiving of transmitted facts. Typical methods for these studies include pre- and post-program questionnaires, multiple choice tests, the use of control groups, large samples and descriptive and inferential statistics. Essentially, the main distinction to draw here is that the former group considered that knowledge is actively generated by each learner, whilst the latter considered that knowledge is passively received from an authoritative source.

Qualitative research has demonstrated that ecological learning is effected by Earthkeepers (Van Wissen, 1992), Earth Caretakers (Farnbank, 1993) and Sunship Earth (van Wissen, 1992; Farnbank, 1993; McNally, 1997). However, this work has yet to provide a convincing or detailed account of the long term conceptual development as a result of a full Earth Education program. In general these studies have claimed that conceptual change has occurred, but have made rather naïve assumptions about participants' prior knowledge; for example, none have had the luxury of time in order to investigate concepts prior to participants' program attendance. Furthermore some have been insufficiently aware of their methodological biases and have used qualitative methods to attempt to make "objective" statements normally confined to quantitative work, for example regarding whether participants have reached some pre-determined level of understanding.

Notwithstanding methodological problems there have been some indications of conceptual development. Farnbank (1993) suggested that most children showed some form of immediate conceptual development as a result of the Conceptual Encounters "The Great Burger Race", "Food Factory" and "Mr Sun's Restaurant".

Quantitative work has demonstrated that statistically significant increases in knowledge occurred as a result of Earthkeepers (Park, 1997) and Sunship Earth (Bires *et al.*, 1982; Cancilla, 1983; Keen, 1991a; Keen, 1991b). Park's (1997) short-term study was limited by its lack of a control group but it did use a suitably large sample of 280 pupils. Bires *et al.* (1982), Cancilla (1983) and Keen (1991a; 1991b) share similar approaches in that they all used some kind of control group and attempted to prove that Sunship Earth could contribute to ecological learning. It is perhaps hardly surprising that the results showed an increase in knowledge for program participants. For example, Keen's (1991a; 1991b) work assesses ecological learning simplistically using nine multiple-choice questions phrased with terminology that is particular to the Sunship Earth program. So one might draw the conclusion that although these projects have reliable results, they lack validity because of the bias inherent in the questionnaire design. Furthermore, in all three cases the questionnaires for assessing knowledge were aimed at factual recall rather than higher order thinking skills such as evaluation and synthesis (Bloom *et al.*, 1956), and so the findings of some of these studies are perhaps rather trivial.

Statistically insignificant but nevertheless beneficial effects on knowledge have occurred as a result of Sunship Earth (Payne, 1981), although this study also used low-level questions aimed at testing factual recall. This study also introduced further variables by comparing Sunship Earth with another program, although it is unclear whether this is a fair comparison. Jack's (1991) work on Earth Caretakers discovered an overall increase in knowledge for a small sample and this increase was greater than for the control group. However Jack's work (*ibid.*) was methodologically inadequate due to sampling issues and problems with validity and reliability.

2.3.2 THE FEELING COMPONENT

Research on the feeling component of Earth Education constitutes the majority of the available literature but approaches to this aspect are probably as varied as the approaches to the evaluation of ecological learning. Work has been influenced by researchers' perspectives of what is meant by the "feeling component". Quantitative work has generally been restricted to an examination of only those aspects of "feeling" that are measurable, in strict scientific terms. These studies have tended to examine "feeling" through attitude measurement exclusively, defining "attitudes" as organisations of motives, emotions, perceptions and cognitive processes that have a bearing upon some aspect of the world of the individual (Allport, 1935). Such studies (Payne, 1981; Bires *et al.*, 1982; Mulligan, 1989; Park, 1997) have typically used Likert Scales (Likert, 1932) or Semantic Differentials (Osgood *et al.*, 1957) to measure immediate attitude change as a result of program participation although some have measured attitude change over a longer time interval. However, this is only one perspective and other views, typically using qualitative data, have taken a broader definition of "feeling". This has included attitudes, emotions, values, intentions, beliefs, perceptions, senses *etc.* These studies have used all manner of data gathering techniques, including document analysis (e.g. Rowbotham, 1983), video images (e.g. Farnbank, 1993), participant observation (e.g. Heath, *ca.*1988), interviews (e.g. Van Wissen, 1992) and participant diaries (McNally, 1997).

Quantitative research was used by Keen (1991a;b) to investigate how attitudes changed over a period of one year, although no quantitative work has attempted to measure changes over longer periods than this. Statistically significant increases in environmental attitudes for participants of Sunship Earth were demonstrated by Bires *et al.* (1982) and for Earthkeepers by Park (1997). Statistically insignificant increases were found for Sunship Earth by Mulligan (1989). However, Keen (1991a; 1991b) and Payne (1981) found no changes in attitude as a result of the Sunship Earth program. Many of these approaches can be criticised for using a too narrow definition of the feelings components, and for using simplistic questionnaires that were incapable of producing valid results. If quantitative evidence of increases in attitude is required, particularly in the longer term, then a priority for research is to produce an instrument that is both reliable and valid.

Qualitative studies have used the term "attitude" in a different manner. Heath (*ca.*1988) referred to "attitudes" but did not attempt to measure these, as Keen (1991a; b) or Bires *et al.* (1982) had. Heath (*ca.*1988) observed participants during Earthwalks and produced a rather descriptive discussion, lacking in-depth analysis, which suggested that Earthwalks improved sensory awareness and environmental attitudes. Whilst participant observation can be an effective way of gathering data it is difficult for the novice researcher to overcome personal bias and be sufficiently theoretically sensitive to what they see. Nevertheless qualitative studies, like the work of Heath (*ca.*1988), demonstrate that they are probably superior approaches for generating theory compared with *a priori* hypothetico-deductive studies exemplified by Keen (1991a;b). Further evidence of Earth Education's effects upon emotions, feelings, attitudes and senses is given by the following series of qualitative studies.

Rowbotham's work (1983) on Sunship Earth, using participant observation, questionnaires and teacher interviews, found an increased willingness to commit to environmentally benign behaviours amongst program participants, increased participant motivation and performance of pupils regardless of their level of ability, and development of children's senses.

Greenall-Gough (1990) and Van Wissen (1992) independently discovered that participants of Earthkeepers and Sunship Earth developed an "environmental ethic" which persisted for at least one month after the program. Follow through work, especially with teachers, was helpful in maintaining these attitudes.

Newman's discussion (1987) takes a unique approach since it attempts to examine "spiritual" experiences, although he acknowledges the difficulties that such a label engenders. The empirical work is of little value because of methodological and sampling limitations but the work is useful for its review of literature on ecstatic experiences (Laski, 1961) and the building of personal relationships (Maslow, 1964). It also contains some compelling interview transcripts of the highly emotional experiences of participants of Earthwalk activities, of which little reliable evidence is currently available.

All of these studies have approached the "feeling" aspect of Earth Education programs in a different way and they have rarely managed to distinguish adequately between various aspects of human experience that come under the aegis of the affective domain. Perhaps another pressing role for research is to explore the affective domain and identify how some of these elements might affect each other, their similarities and differences, and how they might be addressed through educational activities.

2.3.3 BEHAVIOUR

The extent to which behaviour has been changed by a nature education program is a difficult area to assess. It is probably even more difficult to assess the impact of behaviour and lifestyle upon resource use. Because of these difficulties it is perhaps not surprising that research has so far relied upon qualitative data and has not attempted to analyse behaviour change using quantitative means. Studies have not merely examined the environmentally benign behaviour of participants, despite this being the main motive of Earth Education programs, but have also examined whether pupils have continued to take part in self-directed Earth Education activities, such as Magic Spots, after the program. Research has also commented upon the effect of programs upon participants' disruptive or anti-social behaviour. Methods have generally relied on the self-reporting of behaviour through interview (Farnbank, 1993) or participant observation (Rowbotham, 1983), although this information has usefully been augmented by verification with parents and teachers (Rowbotham, 1983; Van Wissen, 1992; Farnbank, 1993) on occasion.

Van Wissen (1992) found that the behaviour of participants in Earthkeepers and Sunship Earth had changed and this persisted for up to six months after the programs' completion. Follow through was found to be helpful in this process. Behaviour change involved participants' using less energy and materials in accordance with the simple tasks suggested by the program literature.

Rowbotham (1983) commented upon the motivational effects of Sunship Earth and reported that teachers had commented that pupils were far less disruptive during Sunship Earth compared with other educational activities. There have been no attempts to measure this as such but much anecdotal evidence (Duckworth, 1985; 1986; Bragg, 1988; Cree and King, 1988; Dyer, 1988a; Gray, 1988; Randle, 1992; Rhymer, 1992) supports Rowbotham's findings.

2.3.4 PARTICIPANTS' PERSPECTIVES

This section discusses the participants' perspectives of Earth Education programs and as such it is an analysis at a different level from that discussed in section 2.3. It addresses this through work that has used participants' and significant adults' comments.

Several studies have sought to evaluate Earth Education by simply asking participants closed questions. Results have suggested that participants experience enjoyment (Jack, 1991; Caddy, 1993; Farnbank, 1993; Drysdale, 1997), enhanced motivation (Rowbotham, 1983; Caddy, 1993) and a stimulated interest (Caddy, 1993) as a result of Earth Caretakers, Earthkeepers, Sunship Earth and Earthwalks. Studies that have given negative results (Rowbotham, 1983; Greenall-Gough, 1990) have exclusively been concerned with non-standard programs or novice program deliverers.

Common sense might suggest that gathering opinions is a reasonable approach to take when evaluating Earth Education but it is fraught with difficulties that affect the value and status of such opinions. For example, how would decisions about the child's schooling be affected if a participant were to speak favourably about an Earth Education program? As Young (1971) has argued, knowledge has become stratified in Western Society and this has served to support the interests of the ruling elite. Therefore it is unlikely that a child's unfavourable comments about high status (*ibid.*) curriculum areas such as mathematics or science would carry much weight with decision-makers. Conversely, positive comments about low-status subjects such as environmental education would be equally irrelevant for educational reform. Western Society has not only decided what is best for the child to learn but it has also, to a greater or lesser degree decided how, where, when and by whom this will be done. So it would appear that the decision to evaluate a program by concentrating upon participants' positive or negative comments ignores the wider political context in which schooling occurs.

Another problem with relying solely on such opinions is that the influence of various factors can be crucial to the quality of the data and consequent analysis. Silverman (1985, p.165) and May (2001, pp.142-143) argue that interviews are social constructions between the participants and cannot be considered to represent a reality that is external to the interview. Therefore the context of the interview and the meanings the participants attribute to their responses are crucial aspects of the research process. For example, Patton (1990, pp.335-347) discusses the advantages and disadvantages of using program staff for conducting program evaluation interviews. In this case, the relationship between researcher and participant would have an influence. These may comprise explicit relations where the researcher has mandated control over the participant's conduct, for example a teacher or parent, or they can be tacit, for example a respected peer or adult who may be some form of role model. In both cases the participant has an interest in giving a response that they think the researcher wants to hear or read. Furthermore some of the studies used parents' and teachers' reports of participants' attitude towards the program, an approach which is not only unreliable for the reasons mentioned above, but also because it assumes that adults untrained in data collection will be sufficiently aware of their biases to provide useful data.

Finally, children's opinions are notoriously changeable (Opie and Opie, 1959); they can be influenced by many different things. Neither is it clear what their statements and opinions refer to; the question asked by the researcher, the question heard by the pupil and the participant's response may be three entirely different things. For example, in Piaget's (1929) seminal work he asked young children "Can the sun feel?". The word "feel" can be a noun, a verb or an adjective and has numerous meanings depending upon the context. Consequently, Piaget has been criticised for his neglect of this methodological issue (Flavell, 1963).

Clearly then, studies that use participants' retrospective evaluations of the programs as a major source of data without paying attention to the context of the interview or exploring meanings of statements should be treated with a degree of circumspection and the results interpreted very carefully. It would certainly be unwise to base any formal conclusions on the evaluative comments of program participants alone.

2.4 CURRICULUM ANALYSES

On a level of the conditional matrix (Figure 3, p. 23) further removed from the individual than the learning of knowledge or participants' perspectives, lies work which has investigated general curriculum issues. Document analysis has suggested that Earth Education programs are appropriate contexts for delivering aspects of the curriculum in Germany (Heggemann, 1996) and England and Wales (Rowbotham, 1983; Heath, *ca.*1988; Mollard, 1991). Furthermore, Earth Education has the ability to address feelings and emotional elements of human experience, phenomena that have been largely ignored by the curriculum in England and Wales (Theaker, 1988; Mollard, 1991). However, Heath (*ca.*1988) commented upon the difficulty of *assessing* the results from programs for curriculum purposes, reflecting the growing obsession with evidence-based practice (Sougnez, 2002) which has been partly responsible for the decline in the numbers of those willing to be teachers in the U.K. over the last decade.

Conversely some have indicated conflicts between the school's curriculum and the Earth Education curriculum particularly regarding follow-through work (Caddy, 1993) or resource issues (Rowbotham, 1983; Theaker, 1988). These reports have indicated that this makes Earth Education unrealistic as part of a school's curriculum, particularly where the school is also operating within a compulsory National Curriculum, as in the U.K.. Consequently there have been suggestions that the best context for program implementation is through the informal sector (Brown, 1990; Theaker, 1988) but this clearly conflicts with counter-recommendations that Earth Education should be available to a wider audience (Theaker, 1988).

Some workers have examined the way Earth Education activities have been structured. Mollard (1991) highlighted the value of taking a programmatic approach to learning, whilst Hawkins (1984) took a wider perspective, suggesting that the main strength of Earth Education was its eclectic pedagogical approach as it allowed for a wide diversity of learning styles, outcomes and experiences. He also commended the Earth Education methodology for its operation in different learning domains (Bloom *et al.*, 1956; Krathwohl *et al.*, 1964). Conversely, Caddy (1993, pp.53-54) contradicted this by reporting that some teachers believed that the inflexible approach of Earth Education was incompatible with diverse children's backgrounds, experiences and learning outcomes, and particularly with children with special needs. However, this is perhaps indicative of an assumption here, that Earth Education *aims* to produce an idealised and uniform response and does not allow for, or perhaps even discourages, diverse learning outcomes. However, an examination of the IEE's publications and descriptions of programs does not entirely confirm this, although the issue is explored in much greater detail in later chapters.

Lastly, perceptions of Earth Education that regard it as being unrealistic are not infrequent (Caddy, 1993) but probably betray limited and narrow conceptions of the opportunities presented by follow-through work and national or state curricula. In England and Wales, it may also be indicative of the de-skilling and de-professionalisation that has resulted from a whole raft of educational innovations over a twenty year period that has created teachers who feel more secure when they can work with closely prescribed curriculum and assessment models (Sougnez, 2006). One pragmatic solution to this issue might be to identify opportunities for follow-through work coherent with the various curriculum documents in order to promote effective and widespread use of Earth Education programs.

Perhaps of more concern, is the failure of any researchers to even attempt to counter Van Matre's charge that cross curricular environmental education "bordered on the idiotic... [and has] ...failed" (1972, p.1). One might expect those that claim Earth Education programs to be "unrealistic" or "idealist", to ground their comments in a critical comparison of Earth Education with the *status quo*. This has not been found to be the case. It might not be unreasonable to suggest that this inadequate dismissal of Earth Education reflects somewhat conservative attitudes towards schooling, particularly in light of previous discussion of knowledge stratification (Young, 1971) and the bias in curriculum towards a technocratic rationality (Giroux, 1981).

Hawkins concluded by suggesting that it was...

> ...time for some hard thinking and hard talking in schools about the way children learn, the way they develop their environmental perception and as to whether or not they and society are well served by a fragmented curriculum of invariably astonishing irrelevance.
>
> (1984, p.72)

For Hawkins, the curriculum is clearly failing both the long term interests of society, and its members, and one solution might be to reform the curriculum to include approaches exemplified by Van Matre and others.

2.5 SUMMARY

The preceding discussion began by examining published work that has referred to Earth Education as exemplary practice of one form or another. This work has highlighted, briefly, the value of its curriculum structure, pedagogy, and the use of competing methodological paradigms for early evaluation purposes. Other comments have drawn attention to the attitudes of The IEE towards gaining funding for program development. In one way or another Van Matre has consistently refused to conform and his work has comprised implicit and explicit criticisms of the *status quo*, in many different ways. Responses to these criticisms have not always been favourable. For example, objections to Earth Education have alluded to its misappropriation of political and psychological theory. Some communities, driven by fundamentalist religious belief or corporate interests (Johnson, 2003), have even gone as far as to make official objections to Earth Education, alleging connections with witchcraft or extreme environmentalism. Consequently, research could examine profitably any of these issues and it is likely that a thorough analysis of Earth Education should be grounded by a discussion of its underpinning social, psychological, philosophical or political theory, depending upon its focus.

Some theoretical work has misrepresented Earth Education's use of objectives from the affective domain as being the entirety of the work of The IEE. Therefore, it would not be unreasonable to suggest that research activity should, at least partially, aim to produce a proper account of the cognitive, as well as the affective aspect of activities and programs.

In direct contrast to Earth Education's antagonists, are the comments from practitioners. They believe that programs have positive emotional, conceptual and behavioural effects upon both adults and participants. These effects are described as being far more significant than the mere development of scientific concepts, and include outcomes in personal and social education, citizenship and interpersonal relations. The ability of programs to develop ecological awareness is asserted although this is rarely reported in a convincing manner. Empirical work has also attempted to provide evidence of the development of various aspects of what might constitute awareness, although this research has tended, pragmatically, to reduce the notion of awareness to a consideration of attitude change or the retention and recall of factual knowledge. Some studies have also tried to measure behavioural change although empirical work has been restricted, almost universally, to the consideration of short-term impacts rather than long-term development. Therefore, priorities for research include explorations of ecological awareness, cognitive development and affective development, involving an exploration of what these might entail and the influence of Earth Education upon this development. Furthermore, if the overarching claim of Earth Education is that it influences behaviour, as part of a necessary response to the ecological crisis, then research that explores the relationship between Earth Education and participants' behaviour is probably crucial for environmental education.

However, the question of whether Earth Education can provide an appropriate response to the ecological crisis, has almost universally been reduced to efforts to verify, in a technical sense, the quality of programs. That is, the success of programs at initiating behavioural change. Yet MacLeod (1997, pp.51-66), in his examination of the work of The IEE, used a critical perspective (Fien, 1993) to uncover some of Van Matre's assumptions. These comprised the assumptions underpinning Earth Education's presentation of the ecological crisis, Van Matre's (1990) critique of environmental education, the notion of curriculum design and implementation in Earth Education, and the concept of nature presented by activities and programs. There is much potential for the further application of critical perspectives to the development of these ideas thereby enabling exploration of the outer rings of the Conditional Matrix.

Earth Education programs and activities have not received an equal amount of attention. Most studies have been directed at examinations of the Sunship Earth program or at Earth Education in general. Other published programs such as Sunship III, Earth Caretakers, Earthkeepers and the ACC programs have been largely ignored. Likewise, individual activities, such as Conceptual Encounters, Magic Spots or Earthwalks, have also been considered only partially by studies that have attempted to examine their contribution to the Earth Education approach in general. Therefore priorities for future work include thorough examinations of Earthkeepers, Sunship III and ACC programs where possible, or more focused examinations of Earth Education Vehicles such as Magic Spots, Conceptual Encounters or Earthwalks.

Much of the work discussed above has not been subject to peer review and hence the quality is variable. Often the work has been performed by undergraduate students, rarely conscious of important theoretical issues. One of these issues concerns different research methods that are dependent upon various paradigmatic assumptions, which will be discussed at length in chapter 6. One of the major requirements for future research is that it should address methodological issues by taking account of philosophies of knowledge (epistemology) and reality (ontology). Through reflection on major methodological questions such as "What counts as knowledge?" or "To what extent are methods drawn from the physical sciences suitable for analysing problems that occur in the social world?", we can begin to expose some of our assumptions about the process of research. Only by answering such questions can we construct methods coherent with these ideological assumptions, and undertake research that is robust, trustworthy and contributes to the debate in a useful manner.

This chapter has re-examined the existing work on Earth Education which has, in general, been concerned with a limited analysis of interactions or phenomena at the centre of the matrix in Figure 3. Whilst the effect of the program on learners is an important task, it has yet to be completed in a useful and compelling manner and deeper analyses at the centre of the matrix are required. Furthermore, analyses at other levels of the matrix are needed, using methodologies drawn from appropriate paradigms of inquiry. This chapter has also suggested various focuses for future research. Perhaps, given the various and frequently conflicting, public and professional perceptions of some aspects of Earth Education around the world, such work is an urgent necessity for The IEE and stakeholders in environmental education.

3 PRELIMINARY RESEARCH

Chapter 2 has discussed previous work on Earth Education and whilst it is clear that there is a growing body of research, which includes several original and noteworthy studies, this work has, until recently, been performed in isolated pockets. Consequently, many authors have tended merely to repeat others' efforts, insofar as they examined programs that had been evaluated before, or used the same focus or similar methods. Furthermore, many researchers repeated the errors of earlier studies, often making similar methodological assumptions. It was, therefore, of central importance to conduct a study that broadened and deepened knowledge of the effects of Earth Education by considering some broad aims. These are summarised in Table 5.

Table 5: Broad Aims of Research in Earth Education

This research project aims...
• to avoid replication,
• to concentrate on a narrower range of Earth Education practice,
• to examine mid- and long-term outcomes,
• to develop the use of appropriate methods,
• to enhance coherence, consistency and validity by addressing methodological issues.

The first two of these aims will be discussed in the remains of this chapter while the remaining three will be discussed in Chapter 6.

3.1 IDENTIFYING A FOCUS

This project was conceived in late 1993 with much of the background work being conducted between 1993 and 1996. Of the 19 research projects on Earth Education produced prior to this period, most were concerned with producing an evaluation of the Sunship Earth program (Payne, 1981; Bires *et al*, 1982;

Cancilla, 1983; Rowbotham, 1983; Anthony and Goff, 1984; Mulligan, 1989; Keen, 1991a;b; Van Wissen, 1992) or Earth Education in general (Anthony and Goff, 1984; Hawkins, 1984; Heath, *ca.*1988; Theaker, 1988; Brown, 1990; Mollard, 1991; Caddy, 1993). Three studies had examined Earth Caretakers (Jack, 1991; Henny, 1992; Farnbank, 1993) but only one had engaged with Acclimatization (Newman, 1987) and one with Earthkeepers (van Wissen, 1992). It can be seen that evaluative projects had been heavily biased towards the approach of Earth Education in general, or towards the better established program, Sunship Earth.

Much of the research concerning the Earth Education approach in general is flawed due to two linked assumptions. Firstly, that it is possible to evaluate the whole of Earth Education by a generalisation of the results from an examination of one activity, such as Magic Spots. Sometimes this is apparently justified because the activity chosen for analysis is one that seems most distinct from other types of fieldwork genres (for example, see Job, 1996) or appears to characterise the Earth Education 'methodology'. However, previous discussion (Section 2.1) has indicated that Earth Education activities potentially involve a range of objectives in different learning domains, with different curriculum focuses, and with different roles for the teacher. Therefore researchers' choices of activities 'representative' of Earth Education are perhaps more revealing of their personal bias than forming appropriate accounts of the Earth Education phenomenon as a whole.

Secondly, it is flawed because of the assumption that it is possible to evaluate the whole of Earth Education by extrapolating, either literally or metaphorically, results from an analysis of one program. This is further clarified by reference to different types of curriculum, operating at different levels. Eisner (1979, pp.87-107) referred to these as the explicit, the implicit and the null curriculum. The explicit curriculum comprises the stated content; the implicit curriculum includes the modes of delivery and the messages conveyed by the organisation of the curriculum, and the null curriculum comprises what is *not* included. Bowles and Gintis's political analysis (1976) suggests that the hidden curriculum, which consists of Eisner's (1979) implicit and null curriculum, is a more powerful force, and has more impact on pupils, than the formal curriculum, whilst functioning to reproduce power relations in society. Clearly The IEE has a great deal of influence on the explicit curriculum and the null curriculum, or the formal curriculum, but apparently has much less influence upon the implicit curriculum, or the hidden curriculum; the latter will be an aspect of the context in which the program is delivered. The formal curriculum of Earth Education, comprising program publications, differs from program to program in many ways, including the age ranges catered for, the concepts addressed, and the duration of the learning activities. The hidden curriculum, or null curriculum, varies with location, and is determined by many different factors such as the nature of pre- and post-program work and the centre's organisation. Whilst Van Matre has attempted to reveal and guide aspects of the hidden curriculum by formalising some of these influences upon participants' values and perceptions, it is highly unlikely that this has been exhaustive or complete. Influences exist, then, on different levels and affect the way programs are delivered, and consequently, their outcomes. Therefore any single program, or even all Earth Education programs, can not be considered to be representative of everything that is Earth Education. A comprehensive evaluation of the phenomenon of Earth Education is probably not possible with an examination of any of these programs alone.

Notwithstanding the apparent failings of general evaluative projects, they should not be dismissed out of hand, as they may well contain useful analyses of some aspects of Earth Education. For example, Newman's (1987) examination of Earthwalks using Laski's (1961) typology of ecstatic experiences, is useful because of its attempt to link intense, and perhaps sometimes even ecstatic, experiences reported by some participants, to their participation in Earth Education. As such it represents one of the few studies where empirical work has been grounded in appropriate theoretical frameworks.

The survey of literature had demonstrated a paucity of explanatory theory, or even useful results, concerning program outcomes. Clearly, many researchers had attempted to provide summative evaluations (Patton, 1990, pp.150-159) yet had been unable to provide convincing evidence of the programs', or Earth Education's, effects. Results that were available were heavily reliant upon unsystematically recorded anecdotes, assumptions and data of questionable value. Exceptions to this included work on Sunship Earth including a Ph.D. thesis (Keen, 1991a) and several Master's theses (Cancilla, 1983; Mulligan, 1989; Payne, 1981; Van Wissen, 1992). Jack's (1991) and Henny's (1992) Master's theses on Earth Caretakers, and Van Wissen's (1992) partial treatment of Earthkeepers, were also worthy of note. However, these studies had generally used quantitative methods, indicating the potential contribution that other approaches could make to the literature. It was decided that qualitative data or a report in the qualitative style would be most useful for achieving the general aims set out in Table 5 and should be incorporated into this evaluation wherever possible.

Furthermore there was also an absence of comprehensive studies on Earthkeepers, few on Earth Caretakers and none had yet considered Sunship III, which was in the final stages of piloting and publishing at this time[4]. So whilst an overall summative evaluation of Earth Education was regarded as the collective goal, it was probably rather ambitious to expect to be able to complete this in a robust manner with one study. Indeed, Strauss and Corbin (1990, p.37) concur by stating that "...it is impossible for any investigator to cover all aspects of a problem", and Patton (1990, p.162-168) comments, there are no "...perfect research designs" and there are always trade-offs to be made in framing the research question. What is therefore required is some means of reducing the problem to that which is manageable. Indeed, this is one of the issues that much of the previous work (discussed in chapter 2) did not take into account and consequently this work tends to be overambitious. Patton (1990, p.163) continues by suggesting that the researcher begins with an extensive list of potential questions and moves to a position with a much shorter list of focused questions which are both realistically possible and significantly important. Since this chapter has proposed some broad aims (Table 5) regarding the Earth Education phenomenon, it would seem logical to now turn to pragmatics and explain the rationale behind the choice of focus.

3.1.1 SITE AND PROGRAM SELECTION ISSUES

Pragmatically, the first step was to discover which programs were available as objects of study. In order to facilitate access to program participants only those programs operating in the U.K. were considered. This was particularly pertinent because previous research had demonstrated that coherent qualitative methods had been rather neglected and therefore would probably have a significant role to play in gathering data. The use of U.K.-based Earth Education was especially relevant for logistics. Furthermore, various forms of qualitative enquiry (e.g. Moustakas, 1975) call for a position of 'indwelling', where a sense of connectedness develops between researcher and research participants in their mutual efforts to elucidate the nature, meaning, and essence of a significant human experience (Patton, 1990). This connectedness would probably be more intense with personal contact between researcher and researched.

The first decisions regarding the choice of focus were derived from the researcher's involvement with The IEE , firstly as an active member by taking part in training workshops, attending speeches and being involved in Earth Education activities and programs with child and adult learners. Secondly, as an associate staff member of The IEE and this facilitated the gathering of data from various informal interviews and participant observations of associate staff meetings.

[4] Finally published in 1997.

Preliminary inquiries to The IEE in 1993 revealed that Earth Education programs were running at numerous sites throughout the U.K. These were Earth Caretakers, Earthkeepers, Sunship Earth and Sunship III. However, The IEE suggested that some of these sites would have been inappropriate for an evaluative research project because they lacked accredited status, or program quality had deteriorated since achieving accredited status. The notion of 'accredited' status, and how it contributed to the choice of a program site, is discussed below.

3.1.1.1 "Accredited Status" and Program Integrity

From the outset, discussions with The IEE were centred upon program choice and they were particularly concerned that research should evaluate 'accredited', model programs. The IEE considered that such research had the advantage of having the best chance at revealing the potential benefits of the Earth Education methodology, and hence would be more likely to be supportive of their work. Perhaps, more significantly, it would probably be used as a justification for The IEE's attitude towards maintaining program and activity integrity, perceived by some (e.g. Randle, 1992) as bellicose. For The IEE then, along with many authors of previous studies, gaining affirmation of the *quality* of the Earth Education experience was one of the primary aims of research activity. However, the notion of program integrity raised another series of interwoven and extremely important issues concerned with the context of program delivery.

Earth Education has received little, if any, support from government, corporations or commercial sponsors[5]; programs have always been created by a network of volunteers distributed around the world. Without governmental support, either regionally or nationally, there are fewer mechanisms by which The

[5] Van Matre (1990, pp.34-40) explained this position in some length elsewhere and Beder (1997) provides further support. The IEE subsists almost entirely on income derived from selling materials such as books and program resources, membership contributions, and training sessions (IEE, 2002).

IEE can control the way in which programs are used and few sanctions can be realistically imposed upon those 'misusing' programs. This is in spite of attempts at 'quality control' by The IEE , who have copyrighted materials, provided extensive program notes and guidance, and provided training workshops. Whilst the scenario of every program being accredited was considered desirable by The IEE, this was probably an unrealistic expectation as programs are not delivered in an ideological vacuum, but rather in a context which reflects a multitude of different, and sometimes contradictory, ideologies. Thus, the aims of The IEE are mediated and reinterpreted by program deliverers. Therefore the evaluation of a program, in which activities were revised, adapted, or entirely omitted, could be just as useful to The IEE and the wider sphere of environmental education, as one that examined an accredited or 'ideal' program, although the focus of such evaluations and the concepts produced would probably be very different.

Nevertheless, in the interests of maximum relevance and utility for The IEE and the sphere of environmental education, the evaluation of an accredited program was considered to be most appropriate.

3.1.1.2 Program Choice

Further investigation showed that there were only two available sites in the U.K. where accredited programs were running and these sites were visited in 1994 and in 1995. The accredited programs comprised Sunship Earth in the Wyre Forest and Earthkeepers near Reading. Sunship III was also running at the Wyre Forest site, but it was intermittent, was a relatively new program, and had few participants. Sunship Earth, a week-long program for 10 to 12 year old children, ran once a year for an extra curricular "nature group" in a centre based in the Wyre Forest. In this case the "nature group" comprised children between the ages of 10 and 13 drawn from various primary and secondary schools near Birmingham. The other program being delivered frequently and consistently was Earthkeepers, a three day program for 10-12 year old children, which ran throughout the school year in a centre near Reading for junior school groups from the London borough of Brent.

The Wyre Forest Sunship Earth program presented problems as access to the children on a long term basis would have been difficult as they would have been attending various schools making the logistics of gathering some forms of qualitative data difficult. Other factors, such as school ethos, curriculum and ease of access may also have been variable and it would have been problematic to gather sufficient high-quality information for all of these schools. Furthermore, the group of children attending the program was thought by IEE stakeholders to be atypical in that they were not a representative sample. The typical group that attended Earth Education programs usually consisted of one age group from a junior school and any findings from the Wyre Forest program could have been regarded as being too specific to represent an evaluation of Earth Education programs as a whole. Furthermore, a relatively small group of pupils participated annually (30 or fewer) indicating that quantitative results would have to be gathered over a number of years for statistically reliable findings, The main underlying issue here was, therefore, the extent of generalisability of results.

However, some of the problems of using the Wyre Forest program could have been resolved partially by shifting the goal of research to the development of understanding and explanatory theory, as opposed to prediction and control. Chapter 2 has indicated that a major weakness in previous work has been that the research designs were almost exclusively founded upon the hypothetico-deductive method with little attention given to exploring the question of what appropriate hypotheses might be. Compared with a 'typical' visiting school group, the Wyre Forest sample would probably have been more variable with respect to age, social circumstances, racial background or educational ability and choosing a widely varying sample is one way in which inductive approaches can be significantly enhanced (Patton, 1990, p.182; Strauss and Corbin, 1990, pp.75-95). The opportunities presented by this context, for developing an inductive approach, were mediated by the problem of access and ultimately it was decided that without significant researcher-subject contact, the gathering of data in enough depth would have been impracticable.

Lastly, Sunship Earth had already been subject to a lengthy analysis (Keen, 1991a/b). Since one major research aim was to broaden the scope of evaluative information on Earth Education programs, another research project on Sunship Earth was not considered to be a priority, given the paucity of work on other programs such as Earthkeepers or Sunship III.

The Reading program, although initially thought to be exemplary because of its accredited status, was apparently not running according to program guidelines because it contained some omissions and alterations, and did not have enough access to wilderness or uncultivated areas. Consequently The IEE had expressed grave reservations regarding the use of this particular centre for evaluative research (Van Matre, 1995). The locations of the children were also less accessible than the Birmingham group, both in distance and distribution as they were from London and were due to disperse to different secondary schools. There was also some concern that these groups would represent a skewed sample of the population because of their cultural and social characteristics. For example the visiting groups of children were racially and culturally diverse, approximately 60% of all children were non-white, and there were 132 first languages in the borough. Furthermore, apart from the large proportion of children who had English as a second language, many spoke no English. Some children were refugees from global war zones, and were described as bearing the emotional scars of turbulent biographies. For example, two children were described as 'elective mutes' and one child's behaviour was thought to have been the result of his experience as a 'boy soldier' (Gray, 2004). Whilst it would be easy to dismiss some of these claims as mere speculation or assumption, they were made by teachers with nearly thirty years of experience. At the very least, they reflect the challenging and varied contexts within which formal schooling occurs. Therefore, the use of such a sample would have been of immense interest and relevance to issues such as inclusion and differentiation, which continue to be close to the centre of much educational reform. Nevertheless, the issue of program quality was regarded as of most importance and this site was rejected as a potential object of this evaluation.

It appeared that neither of the two accredited programs would be suitable objects for this research as they were regarded by important stakeholders as too idiosyncratic, or they were inaccessible given the resources available. The problem of finding an appropriate site and program did not appear to have a solution until late 1995 when Scottish Natural Heritage approved a funding application by Ardroy Outdoor Centre, based in Lochgoilhead on the west coast of Scotland, for setting up and evaluating Earth Education. The program chosen for this project was Earthkeepers. In 1996, £14,000 was made available for a research project, of which approximately £7,000 was available for staffing costs. This had the advantage that time would be available for the researcher to become immersed in the natural setting, and for collecting and analyzing data. All pupils attended schools in Fife, a relatively compact area of Scotland bounded by the Tay and Forth estuaries, and therefore access to pupils on a short and long term basis would probably be more straightforward. The program was being set up in its entirety with the aim of achieving accredited status. Therefore there was some degree of quality control which ensured greater commitment to the outcomes by The IEE. The venue for the program was the west coast of Scotland which was perhaps more conducive to the program aims since the activities had the potential of being conducted in wilderness or semi-wilderness areas. Yet the area's wilderness properties were compromised to an extent by military, agricultural and recreational interests (See Figure 4).

Figure 4: A Nuclear Submarine Surfaces in Loch Goil

In a location such as the U.K. it is probably unrealistic to expect exclusivity of access to wilderness areas for conducting such activities.

3.1.2 EARTHKEEPERS; FOUR KEYS FOR HELPING YOUNG PEOPLE LIVE IN HARMONY WITH THE EARTH.

Earthkeepers, an Earth Education program for children aged 10-12 years, is aimed at turning out youngsters...

> ...who possess some basic ecological understandings and good feelings about the earth and its life, and will undertake not only to live more lightly themselves, but to share their insights and behaviours with others.
>
> (Van Matre and Johnson, 1987, p.11)

An "Earthkeeper" is described as someone who has various characteristics or attributes. These have been detailed in Table 6. The attributes describe the outcomes that might be expected from learners although they are idealised statements and are undifferentiated for different levels of response. As such they comprise a statement of program aims, although they are not necessarily regarded as solely behavioural objectives.

Table 6: Characteristics of Earthkeepers (Van Matre and Johnson, 1987, p.11)

An "Earthkeeper"...	
...understands how energy and materials tie all life together	K activities[a]
...experiences good feelings when they're in touch with nature	E activities[a]
...undertakes personal lifestyle changes in order to begin living more in harmony with the natural world	Y activities[a]
...helps others increase their understanding of, feeling for, and harmony with the earth and its life	S activities[a]
[a] The significance of K, E, Y and S activities are explained below	

The program provides experiences that address each of these elements in this order. It involves three days in a residential outdoor centre, although some Earthkeepers programs are run on a non-resident basis, followed by work at school. There should also be some preliminary work in the classroom before the program (*ibid.*, 1987).

Upon arrival the students take part in a highly structured experience over three days which involves 17 activities directly related to the program and there is the possibility that these activities could be added to by a maximum of a further nine. In theory the program could involve between 18 and 26 hours of activities. A program schedule example is shown in Table 5.

Table 5: Sample Earthkeepers Schedule (Van Matre and Johnson, 1987, p.20)

Day 1	Activity	Day 2	Activity	Day 3	Activity
11.30	Arrive	8.00-9.00	Breakfast	7.30-8.30	Breakfast
noon-1.00	• Lunch	9.00-10.30	• Conceptual Encounter: Connection Inspection	8.30-9.45	• Seasons
1.00-1.30	• Opening Ceremony-E.M.'s Lab	10.30-noon	• Conceptual Encounter: Time Capsules	9.45-11.15	• "Y" and "S" Tasks • Magic Spots • Pledging
1.30-2.45	• Conceptual Encounter: Munchline Monitors	noon-1.00	• Lunch	11.15-11.30	• Closing Ceremony- • E.M.s Lab
2.45-4.00	• Conceptual Encounter: Great Spec-tackle	1.00-2.15	• E.M.'s Diary	noon-1.00	• Lunch
4.00-4.45	• Magic Spots	2.15-3.30	• Earthwalk	2.00	• Depart
4.45-6.00	• Free Time	3.30-4.00	• Magic Spots		
6.00-7.00	• Supper	4.00-6.00	• Free Time		
7.00-8.00	• "K" box/Mural	6.00-7.00	• Supper		
8.00-9.00	• Evening Activities	7.00-8.00	• "E" box/Mural		
		8.00-9.00	• Earthkeepers game show		

The Earthkeepers program is described by Van Matre (1990) as a "*two and a half day experience for preparing to use less energy and materials*". It attempts to achieve this by using three types of activities for addressing three forms of learning; concepts, feelings and emotions, and behaviour. These activities have been placed into each category in Table 7.

Table 7: Earthkeepers's Activities Arranged by Category

Concept-building K- Knowledge	Feeling Component Feelings and Emotions E-Experience	Processing Component Behaviour Y- Yourself S- Sharing
"Munchline Monitors" (Food Chains) "Great Spec-tackle" (Soil, Air and Water Cycles) "Connection Inspection" (Interrelationships) "Time Capsules" (Change) "Earthkeepers Game Show"	"Magic Spots" (Solitude and Reflection) "E.M.'s Diary" (Discovery and Adventure) "Earthwalk" (Observation) "Seasons" (Immersion)	"Closing Ceremony" "Pledging" (Recording of promises to alter environmental "bad" habits) "Y and S Tasks" (Continuation of individual and independent natural world based-discovery and learning, and the sharing of this with another person)

Learners are awarded a small brass key when the tasks for each objective have been completed. Each key has a letter embossed on its surface to indicate the component it relates to (K, E, Y or S). The key is used during ceremonies to open a padlocked box to discover one of four 'secrets' at the end of each group of activities.

3.1.3 EARTHKEEPERS AT ARDROY

Earthkeepers was a relatively new program to Ardroy Outdoor Education Centre although the head of centre had maintained an interest in the work of The IEE for some years. Earthkeepers had been run at the centre early in 1995, and despite being partially set up and conducted by a member of the Ranger Service experienced in the implementation of Earth Education programs, it was by no means an accredited program.

The program was then run again in February 1996, where the program was observed with a visiting group of pupils from Fife. The researcher, along with advice from the U.K. branch of The IEE, assisted the centre in producing a program as close to the requirements of The IEE as possible. Activities had been developed from the descriptions contained in the program and activity literature, and these were steadily piloted and improved in order to get them to correspond as closely as possible with the publications. Revisions were made to the centre's delivery of the program, an associate staff member visited the centre to observe the Earthkeepers program, and accredited status was granted as a result.

To summarise, the Earthkeepers program at Ardroy outdoor centre was regarded as being the most suitable of all programs being implemented at the time. Firstly, the program had been accredited by The IEE. The lack of resident staff experienced in delivering Earthkeepers was addressed by The IEE, the outdoor centre and the Ranger Service, by conducting staff training. This was carried out by consultants from The IEE who provided model demonstrations of the activities. Further consultation was provided by the researcher who had a close professional relationship with the program director and the program was continually reviewed up to and during the schools' visits, with written and verbal feedback.

Secondly, access to the pupils for data gathering was facilitated by external funding that enabled the researcher to spend protracted periods of time in the research setting, being Fife and Argyll. Furthermore, the research program was supported by senior managers from the centre and the education authority.

Third, because of the concerns of The IEE that the sample group should be 'fairly typical', the Ardroy program was suitable because it operated in a semi-formal schooling context. That is, it involved school groups visiting their local authority centre during the normal course of the curriculum. Furthermore, the program was relatively short compared with other Earth Education activities. Therefore the opportunity existed for pupils not only to engage with an Earth Education program, but also to engage with a program of adventurous outdoor pursuits intended to have an impact upon their personal and social development. The IEE regarded this as being a typical context for the delivery of Earth Education and therefore the value and applicability of the results to similar contexts could be more easily appreciated.

Lastly, the environs of Ardroy outdoor centre, situated on the shore of Loch Goil, provided a range of contrasting semi-wilderness environments that were readily accessible from the centre. The use of wilderness was an important concern of The IEE and this location contributed to the program's accreditation.

3.2 SUMMARY

This chapter has discussed the issues that determined the selection of an appropriate site. This choice was also influenced by the nature of the centre's program and, in practice, the choice of site and program were made simultaneously.

One key issue for this evaluation identified by the discussion was that qualitative data had not played a significant part in previous work. Qualitative data is time consuming and expensive to collect and so the choice of program and site was influenced by the quality of researcher access. Quantitative research is an efficient means of gathering large quantities of data but it generally requires large numbers of participants in order to make useful generalisations from a small sample to a large population. Because of the relatively small number of program participants in the U.K., and the lack of sites running good quality programs, the potential for gathering reliable results was not strong. Furthermore, some previous work had assumed that all Earth Education experiences were essentially the same, and many researchers had attempted an overall analysis of Earth Education based upon one program or vehicle, or had not examined the contribution of the centre's context to the effects of the program. Furthermore, findings were often of limited use as they did not communicate the depth of experiences that programs were, according to practitioners' anecdotes, able to provide. Therefore a qualitative evaluation was considered most likely to be able to make a significant contribution to the literature.

Earthkeepers had received little empirical evaluation at this time, was a relatively new program, and involved less commitment from schools as it was shorter than Sunship Earth. The outdoor centre in Scotland, though physically remote from the researcher, was a good candidate for a research project as it had received a substantial grant for setting up and evaluating Earthkeepers and therefore significant resources were available for program development and evaluation. One key issue for The IEE was that research should be focused initially on providing supporting evidence for the value of good quality or 'accredited' Earth Education activities in typical delivery contexts. The resources provided for the Scottish Earthkeepers program were more likely to support program quality, and hence more likely to enhance the value of findings to The IEE and other stakeholders. In addition to this, the Scottish program was used by visiting primary schools as part of their overall provision, and this was considered to be the typical context of program delivery. Consequently, an evaluation of the Scottish Earthkeepers program was tentatively confirmed as the focus of this research.

Earthkeepers had already been delivered by the outdoor centre on a few occasions although the resources allowed the development of this program so that it met the requirements of The IEE. The centre achieved accredited status by undertaking staff training and commissioning or making equipment that had been specified by the program literature. This was augmented by a number of consultations with the IEE's representatives, the local Ranger Service and the researcher. The well-established relationship between the researcher and some of centre staff was another factor that was considered likely to facilitate data gathering.

At this stage, the existing research had been explored, a site and program had been chosen, and the style of the research appropriate to this context was tentatively identified as being qualitative. However, before any final decisions could be made about the most appropriate methodology and method, an analysis of the program's curriculum was required. This is reported in the next two chapters.

4 THE CONCEPTUAL APPROACH OF EARTH EDUCATION

This chapter, in nine main sections, examines the approach to cognitive learning in Earth Education. Cognitive learning has been addressed, generally, through the development of concepts and the chapter examines how this approach has evolved from the first Acclimatization programs (ACC), to the more recent publications such as Earthkeepers.

Section 4.1 and 4.2 provide an overall account that illustrate how learning theory became more clearly articulated, from ACC to Earth Education, with more explicit references to educational and developmental psychology. They also note how the number of concepts was reduced from around 70 to seven, and finally four 'key' concepts. Thus, the later curriculum was much more prescriptive and specific than the early ACC programs.

The change from ACC to Earth Education, section 4.3, marked a number of major developments in Van Matre's work, not least of which was the categorisation of activities into different groups (vehicles), intended for different outcomes. This section also examines how learning theory was addressed in the first Earth Education program, Sunship Earth. This remains, arguably, the longest and most complex Earth Education program, comprising a five-day centre experience, with a number of different vehicles. The ways in which these activities could achieve their stated outcomes, is analysed in great detail and thus the activities' descriptions are compared against their objectives.

Section 4.4 continues this detailed deconstruction, but it is applied to the Earthkeepers program. Thus the conceptual activities are compared against their 'design criteria' and the level of consistency is examined.

The analysis in section 4.5 considers the 'methodology' of Earth Education and how this is evident in the activities. However, the question arises regarding whether this 'methodology' comprises a coherent philosophy. Theoretical aspects of this, including the curriculum structure and its justification, are discussed here. Van Matre's rationale for his work is underpinned by a critique of pedagogy and schooling. A central idea that emerges from this analysis is the emphasis placed upon the value and importance of learning through experience, through the presentation of structured 'concrete' experiences.

The chapter continues, in section 4.6, with a detailed discussion of cognitive development in Earthkeepers. The analysis identifies links between this methodology and major psychological theorists, noting major contributions from Skinner, Bruner and Piaget. Section 4.7 highlights some tensions between different aspects of Earth Education revealed by the theoretical analysis although the implications of these for program outcomes are discussed with reference to empirical data in chapter 8. Section 4.8 examines Earth Education in the light of Constructivism, a more contemporary description of learning.

4.1 INTRODUCTION

The difference, in ideological and pedagogical terms, between Earth Education and other forms of environmental education has been argued for many times by Van Matre (1979; 1990), by Van Matre and Johnson (1987; 1997) and by Van Matre *et al.* (1987). Not only has the ideological position been clearly stated on several occasions, but the underpinning learning theory has also received a significant treatment.

The approach to learning taken by modern Earth Education programs, such as Earthkeepers and Sunship III, has been evolving since the first Acclimatization (ACC) program was published in 1972, the first of Van Matre's programs. By the mid 1980s these had evolved into Earth Education programs such as

Earthkeepers and Sunship Earth. Although not published until 1972, work had been progressing on the pedagogical approach of the program since the early 1960s (Van Matre, 1990, p.52).

Acclimatization was intended to be a sensory and conceptual approach to nature education which would convey "...a sense of the inter-relatedness of life, a respect for the wholeness of the environment..." (Van Matre, 1972, p.3). Although the rationale for this first program lacks the structure and clarity of later publications (Van Matre, 1979; 1987; 1990; and Van Matre and Johnson, 1997), its general aim was to produce a camper who...

> "...should come to 'feel' his environment. To draw it close to him. To love it. To understand it -- not for its labels and fables and fears -- but as an intrinsic part of himself (...) If we take care of our natural heritage now, then we'll have an American heritage later"
>
> (Van Matre, 1972, p.5).

The rationale focuses on affective and cognitive learning, combined with references to behavioural outcomes. This was much more clearly stated towards the end of the same publication by the statement...

> We believe that a person must "feel" something about his environment before he will truly undertake to live in harmony with it. From our viewpoint, seeing a forest as a community is important only if it leads to an environmental commitment. That is, if it produces an 'alternative consciousness'. Everything is a choice. Lifestyles will change only as conceptual structure is 'mated' to feelings. ... Thus, in order to re-adjust one's focus or 'frames' and enhance the potential for 'feeling', we immerse; to convey understanding, we conceptualize. Together, the process of Acclimatization emerges.
>
> (Van Matre, 1972, p.121)

Thus knowledge and understanding were important only insofar as they lead to a change in consciousness and ultimately, behaviour[6]. The early programs concentrated on conceptual learning and developing feelings but they also attempted to examine the role of human beings in the creation of the ecological crisis by exposing children to "pollutant, or destruction-impact experiences" (Van Matre, 1972, p.15) such as deforestation. One of these experiences was included in each day of the program but they are not comprehensively described in the literature. Only later (see Van Matre, 1979) did specific activities emerge that would deal exclusively with children's lifestyles.

Along with this shift in emphasis were several other changes in the way programs were designed. The program descriptions became much more specific about their aims, objectives, underlying philosophy and educational psychology (pedagogy). They also specified more clearly the preparatory work and follow-up work which could be done by visiting groups of children. This specification was a response to Van Matre's realisation that Acclimatization's meaning had become somewhat confused. To some it had become a generic term for sensory awareness activities (Van Matre, 1990, p.83), while others borrowed the term to describe their own activities which bore little or no resemblance to the work of Van Matre (Van Matre, 1990, pp.85-86). Van Matre (1990, p.83) suggests that these problems were exacerbated by the historical use of the term Acclimatization in some parts of the world.

However, not only was the specification an attempt at quality control but also, Van Matre saw a need to provide guidelines by which others could write their own programs which would share the philosophy of The IEE. These guidelines needed to be highly specific in order to ensure that both "quality" programs were produced and that practitioners could easily and accurately duplicate existing programs. Indeed, Van Matre notes (2000) that the problems with

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[6] Several assumptions are made here. Firstly, it is assumed that a change of consciousness produces a change in behaviour. Secondly, that learners have the ability or capacity to change their lifestyles, or if they do not then such a consciousness will remain until some such time in the future when they are able to make choices about their lifestyles.

Acclimatization were not due to the inherent nature of the work but rather to the way it was misinterpreted by practitioners, who often only duplicated parts of what they had seen done. Perhaps this is not too surprising since those activities which deal with feelings in programs are likely to be the most powerful. Furthermore, these "feelings" activities are unusual as most forms of nature education do not address emotions or feelings directly, through their activities. Hence participants in introductory sessions or short programs might be much more likely to remember, and wish to practise, those activities which dealt with feelings.

In order to reduce the possibility of similar problems occurring with Earth Education a template was made available for others to follow in order for them to write Earth Education programs. This template (Van Matre, 1990, pp.249-306) specifies in detail how a program should be constructed and delivered. It includes details of the ways in which potential program designers should approach the task of teaching environmental concepts and a discussion of how people learn concepts. These are different in several respects from the descriptions in the first publications (Van Matre, 1972; 1974), and therefore it is necessary to examine their development to better understand the approach to conceptual learning taken in Earthkeepers (Van Matre, 1987).

4.2 ACCLIMATIZATION AND ACCLIMATIZING

4.2.1 LEARNING THEORY AND ACCLIMATIZATION

In Acclimatization, the first of Van Matre's programs, concepts were defined as "...a cognitive abstraction used to categorize or classify human experiences and perceptions" (Van Matre, 1972, p.121). However, it is not always clear whether Van Matre makes an adequate distinction between concepts and perception. Concepts are further explained as 'frames' which structure and direct experience, and which must be refocused by organised, "dynamic and relatively shocking... techniques" (*ibid.*). The aim of the program is described as being that of *substituting* a new conceptual structure for previously held frames so that the *imposed* conceptions of Acclimatization direct the child to see a forest as an ecological community, for example. Note that learning, or concept development, is described in terms of "imposition" and "substitution". However, it would, perhaps, be naïve to assume that the use of these words alone is indicative of one particular approach to learning. Concepts and perceptions tend to have been discussed using the metaphor of "frames" or "eyeglasses". Therefore Van Matre's tendency to talk about substitution, imposition and refocusing might have been a result of the limitations of this metaphor. It would seem that Van Matre views concepts as being open to replacement or substitution by the learning process and furthermore, that this is indeed a necessary criterion for a worthwhile program.

Van Matre stresses the role of "good, ordered instruction" (*ibid*, p.121) in this process and to this end describes techniques used by the program such as experiential loops, concept and sensory chains, concept gimmicks and sensory techniques, (*ibid*, p.122). However, this description struggles to convey a sense of the overall structure of the program as conceptual learning appears to take place throughout activities that are also designed to generate positive feelings for the environment. One of these 'concept gimmicks' is described as an "...action-oriented device prepared to convey an understanding of a particular concept or concept-statement (...with...) chief emphasis upon the unusual, fun, and magic. *It must involve movement on either the camper's or object's part*" (*ibid*, p.122). Van Matre's use of italics indicates the importance of "action" as a component of any Acclimatization activity and indeed this emphasis has survived the changes in Van Matre's programs so that "action" remains an integral part of every contemporary Earth Education experience. In Acclimatization the justification for the use of "action" in learning is hardly articulated except in terms of immersion and experience being inherently more memorable than didactic intervention.

Whilst a careful reading of the material demonstrates that cognitive and affective learning have been interwoven to make a program which addresses learning in what might be called a holistic manner, the program lacks the clear organisation demonstrated by later publications.

4.2.2 ECOLOGICAL CONCEPTS IN ACCLIMATIZATION

The guidelines for program design refer to approximately seventy-five ecological concepts which could be included in an Acclimatization program, and although Van Matre suggests that it would be impossible to cover all of these in one program, he does not prescribe any particular number (*ibid.*, p.123). The description states that twenty were used for the core of the program (*ibid.*) and reference is made to American sources of ecological concepts from which seven concepts described in the program's introduction are distilled into the following epigraph (Table 8).

Table 8: Key Ecological concepts in Acclimatization (Van Matre, 1972, p.12)

The Web of Life
Light, air water and soil are the elements of life.
Life is divided into producers, consumers and decomposers.
Everything is becoming something else.
Everything has a home.
Homes in a defined area form a community.
Inhabitants of these communities live together in competition, co-operation, or neutrality.
Man is the chief predator.

These seven concepts are very general statements and would require further elaboration if they were to be used in any educational activity. The program described by Van Matre (1972) elaborates upon concepts only in the descriptions of the activities themselves but it is not a straightforward task to identify these concepts from the descriptions (e.g. *ibid.*, pp.25-30).

4.2.3 LEARNING THEORY AND ACCLIMATIZING

The sequel to Acclimatization was Acclimatizing. "Where ACCLIMATIZATION is designed to introduce all newcomers to their natural environment, *Acclimatizing* personalizes the experience. *Acclimatization was like six hours of preparation before playing the game. Acclimatizing IS the game* (Van Matre's emphasis)" (Van Matre, 1974, p.13). These two programs were still complementary but Acclimatizing was seen as an extension and progression from Acclimatization, and had the intention of addressing a "...life-long approach to a personal way of relating with the natural world" (*ibid.*, p.13).

Acclimatizing, as a critique, was also more focused on the shortcomings of mass schooling, lamenting the lack of importance placed upon 'significant' learning in ecology. He comments that most of educational theory is ignored when it comes to teaching children and that a great number of teachers opt for either didactic instruction and transmission-style teaching, or they advocate the "...'do your own thing' curriculum, but all too many ... end up denying their own thing" (*ibid.*, p.11). Schooling is also linked tentatively with notions of social control[7] when Van Matre refers to the effects of these approaches as "...enervat(ing) the brain cells of even the most energetic youngsters (while keeping those little posteriors glued to fixed seats)" (*ibid.*, p.11).

In Acclimatizing, Van Matre considers the conceptual approach of mass schooling and suggests an alternative. This alternative is drawn from the psychological approach described by Acclimatization, and from an assertion concerning the role of a teacher where "...GOOD TEACHERS DO NOT TEACH; THEY CREATE EXCITING LEARNING SITUATIONS..." (*ibid.*, p.14) and advises that "You must first decide what it is that you want to help

[7] Developed in much more detail by a great many authors. See for example Durkheim (1972), Young (1990, pp.45-67), Giroux (1981, pp.37-62).

someone to learn... Next you must create a learning situation ... involving as many senses as possible" (*ibid.*, p.15). In this way various psychological approaches[8] have been combined to produce the theory underpinning the program's design. Learning is described as a "whole person" experience (*ibid.*, p.12) engaging both the mind and the body, maximising time for natural observation and personal expression. Central to this approach is the notion of "...learning by good doing..." (*ibid.*).

Acclimatizing represents a small step, in evolutionary terms, towards what are known today as Earth Education programs. Whilst the overall approach to program development and learning theory remains similar on a superficial level of examination, concepts are now referred to as 'chains' where the 'links' are formed by items of knowledge or micro-concepts, in the same way that a fully developed concept of 'A Chair' might consist of other concepts such as 'Leg', 'Seat' or 'Arm-rests' *etc.* However, Van Matre does acknowledge that any learning activity is unlikely to be enough on its own for building a concept and will be, at best, a concept 'builder' (*ibid.*, p.15). The implication of this view of conceptual development is that concepts develop gradually, and that any change happens slowly as more information is received and processed. Thus concepts appear to evolve as a result of experience. This idea of conceptual evolution is somewhat at odds with the view of conceptual "substitution" (Van Matre, 1972, p.121) or "imposition" (*ibid.*) alluded to in Acclimatization (Van Matre, 1972) which implies that incorrect ideas are a result of incorrect concepts rather than insufficiently developed concepts.

4.2.4 ECOLOGICAL CONCEPTS IN ACCLIMATIZING

Seven concepts are chosen as being more important than others are. These concepts are described in Table 9.

[8] Here Van Matre alludes to Rogerian psychology (Rogers, 1983) where the role and perspective

Table 9: "Core" Ecological Concepts in Acclimatizing (Van Matre, 1974, p.76)

Energy Flow	*All energy flows from the sun*
Land Formation	*Glaciers molded and shaped this land*
Soil Formation	*Soil is made from rocks and plants*
Homes	*Everything has a home*
Adaptation	*Everything grows to fit where and how it lives*
Communities	*Plants and animals that need one another live Together*
Web of life	*All living things are connected*

Whilst many of the activities in Acclimatizing contain some form of concept building activity, those which most obviously address each of these concepts are formed into an Environmental Study Trail with twenty stations. The program booklet describes each of the twenty stations at great length. These stations address concepts in an order so that the more complex ones at the end of the trail rely on some kind of an understanding of the ones at the beginning. Many of the stations on the trail involve a great deal of reading and the use of cloze tests. They use a programmed learning approach (Van Matre, 1974, p.102) and require children to undertake a variety of tasks, including performing simple experiments and hypothesis making (*ibid.*, p.106), taking measurements of rainfall and tree ages (*ibid.*, p.107) and taking soil, water and air temperatures in order to compare microclimates (*ibid.*, p.111). Although Van Matre discusses the value of creating learning situations which involve all of the senses (*ibid.*, p.15) the stations on the environmental study trail seem to rely on learners being able to ingest a large amount of information through reading programmed learning material.

If the approach used in the Environmental Study Trails is compared with Van Matre's critique of the methods of mass schooling described above, there might seem to be a tension between rhetoric and practice. Van Matre justifies this

of the individual and student-centred learning were of prime importance.

approach by describing how the Study Trail stations refer to specific features surrounding the learner and therefore they "...remove such key words as 'cycles', 'adaptation' and 'conditions' from the realm of the abstract and place them securely in the immediate surroundings" (*ibid.*, p.126). In addition Van Matre claims that it is an "...experience in total learning. Concepts are introduced, assimilated and applied." (*ibid.*, p.126). Whilst much of the children's activity is not connected directly with the concept, it *is* used to provide a number of examples with which the learner is likely to have had a great deal of contact due to the other activities[9] described in the same program. Van Matre (*ibid.*, p.102) further comments that the Trail would be followed by those "campers who (were) interested in pursuing a little further some of the concepts they learned in Acclimatization"; it was not considered to be a core part of the program and hence did not represent the only approach to the teaching of concepts in the Acclimatizing program. Indeed, if the complete range of activities described by Acclimatizing are considered to be significant for concept formation, albeit to various degrees, then it can be seen that Van Matre's claims, described above, are justified to an extent. However it is not always clearly stated which knowledge objectives are addressed by each of the program's activities.

In summary, the Acclimatization and Acclimatizing programs dealt with a wide range of concepts that numbered as many as 21 for the program core. Precise conceptual content was not prescribed at first but the later Acclimatizing program dealt with a specific list addressed mostly through traditional didactic methods, albeit managed through the use of a "study trail". The apparent tension between this use of what could be considered to be a traditional pedagogy and Van Matre's critique of mass education was partially resolved by taking into account the variety of teaching and learning styles employed by the programs. One important aspect of Acclimatizing was that it referred in passing to the introduction, assimilation and application of concepts as the main tenet of the

[9] These other activities encourage the learner to experience the natural world in a new way via all of the senses and will also involve some kind of conceptual learning. They also include journeying activities such as "Seton Journeys" (Van Matre, 1974, p.182), "Walden Solos" (*ibid.*, p208), and others.

learning theory but this wasn't developed in any great detail. It was, however, developed into the "*informing*, assimilating and applying" (I.A.A.) learning model in the "Sunship Earth" program (Van Matre, 1979) and has since become the central idea behind learning in Earth Education activities and programs. The transformation of Acclimatization to Earth Education will now be discussed, in terms of the use of learning theory with particular attention, once again, to the development of ecological concepts.

4.3 ACC BECOMES EARTH EDUCATION

Van Matre comments (1990, p.83) that it became increasingly apparent over a number of years that Acclimatization's purpose had become confused with a number of other nature education initiatives and in 1984 Acclimatization became Earth Education. For example, prior to this change Sunship Earth (Van Matre, 1979) was subtitled "An Acclimatization Program for Outdoor Learning" but the last publication of Sunship Earth (*ibid.*) was subtitled "An Earth Education Program Getting to Know Your Place in Space" (Van Matre, 1999).

4.3.1 LEARNING THEORY AND SUNSHIP EARTH

Sunship Earth (Van Matre, 1979) was not only a full description of a program including general guidelines for leaders, but also, and more significantly, it marked an important development in Van Matre's philosophical and psychological approach. Sunship Earth (*ibid.*) demonstrates how programs became more carefully described, more structured and more explicitly referenced to the (then) current theoretical approaches in education and psychology. Van Matre made reference to the work of Skinner and Bruner in this program (Van Matre, 1979, pp.25-28), but neither approach was used exclusively. This use of a variety of approaches was justified by Van Matre's claim (1990, pp.280-281) that it was not necessary, or even possible, to rely on only one psychological approach when creating a program which used a wide range of learning styles. Van Matre chose those strategies "...most suited to the outcomes (he) had in mind for the setting and situation..." within which he was operating. Van Matre also referred to the "Informing, Assimilating and Applying Model" which was developed extensively from the work of Bruner (Van Matre, 1999) and was specifically for use with Earth Education programs. This model is summarised in Table 10.

Table 10: The I.A.A. Model (Van Matre, 1979, pp.25-28).

Informing
Learners receive specific information about an ecological concept at a location. This information is written inside a specially designed work book and on some of the equipment at the location.
Assimilating
"To assimilate means to absorb and incorporate, to digest" (Van Matre, 1979, p.26). Learners are helped to assimilate understandings by being given tasks which require them to physically "act out" the concept (ibid).
Applying
Learners locate and record examples of the concept in their immediate natural setting.

Other psychologists' work is also used to justify parts of the program. For example, the I.A.A. model is supplemented with the use of repeated reinforcement of material, that is an important part of Skinner's theory. Furthermore the work of Piaget (1929) is particularly obvious when Van Matre attempts to define concepts (1979, pp.23-24, 26). For the first time in the literature concepts are defined as tools for thinking, which take the form of general notions about "things". It is acknowledged that they are dynamic frames that undergo constant change, particularly when subject to new information. Concepts are described as mental "...folders in the brain's filing system" (*ibid.*, p.23). This definition, and its use in the I.A.A. model, draws heavily on the work of Piaget (1929) where it refers to schema, assimilation and accommodation, and conceptual development. Van Matre also refers to Piaget's theory that the child's thinking evolves through individual stages of intellectual development whereby different forms of logical structure are used by the child to understand the world (*ibid.*, p.26). These stages are detailed in Table 11.

Table 11: Piaget's Stages of Development (Flavell, 1963)

Sensory-Motor Intelligence (0-2 yrs)   *Neo-natal reflexes evolve into rich, complex network of schemas or concepts for organizing concrete experience.*   ***Preparation for and Organisation of Concrete Operations (2-11yrs)***   *This period begins with the first representational activity of the toddler and ends when concrete operations become habitual. This period has a subperiod of <u>Preoperations</u> during which representational thought (or abstract thought) begins with attendant distortions and instabilities which are an inevitable consequence of the previous period- concreteness, phenominism, irreversibility, egocentrism, animism, preconcepts and transducive reasoning etc.*   ***Period of Formal Operations (11-15yrs)***   *Similar to the second period which involves stabilization of concrete operations, or those mental operations which involve reality itself. The main difference is that previously, concrete reality was the content of operations where it becomes classified, ordered, denumerated etc. Second degree operations involve the content of the first degree operations; the content is no longer concrete reality but the aforementioned first degree operations themselves. In this way thought becomes conceptual, representational, subject to free manipulation, and directed towards possibility as well as reality.*

Piaget's separate stages have some significance for Van Matre's work because they suggest that, for example, a ten year old child will struggle to work with abstract concepts and would require "concrete" examples of new concepts to make learning significant. Thus Van Matre justifies his use of activities which rely heavily on props and direct experience to provide the "concrete" example of a whole picture of a concept.

The importance of language in concept development is also explored to a certain degree. Van Matre (*ibid.*, pp.7-8) suggests that the relationship between language and perception is anything but simple. He implies a dynamic and complex relationship between them, suggesting that language shapes perception, which in turn is also affected by language. He asserts that children have essentially negative concepts of the natural world where they are "...cut off from contact with much of life by a set of admonitions", (*ibid.*, pp.6-7) and where "...concepts about life (...) have been formed for kids by commercial advertisements which insist on using words in misleading ways..." (*ibid.*, p.7). The blame for the mis-formation of concepts is also attributed to adults, both parents, leaders and indeed "...the whole cultural milieu in which (children) live." (*ibid.*, p.7). Thus, it is the formidable task of Earth Education to overcome these misconceptions and it attempts this by reversing the emphasis on concepts and senses as shown in Table 12.

Table 12: The Approach to Concepts and Senses in Earth Education (Van Matre, 1979, p.8)

	Concepts	**Senses**
Traditional Education Model	differentiated (focus on smaller and smaller bits of material)	undifferentiated (emphasize thinking more than perceiving)
Acclimatization Model	undifferentiated (emphasize the big picture)	differentiated (focus on sharpening individual senses)

This 'undifferentiated' treatment of concepts is intended to enable an exposition of the 'big picture' rather than the minutiae of any particular concept. This is done, in the program, in order to provide answers to the questions, "How does life on this planet function, who lives here, how do living things work together (...) and where are we?" (*ibid.,* p.12). This is important for Van Matre (*ibid.*, p.23) for two reasons. Firstly, that it is necessary to create a conceptual frame which is small enough and simple enough to allow the pupil the opportunity to gain a complete understanding in one attempt. By emphasizing the 'big picture' it is claimed that the concept is made concrete rather than abstract. Secondly, it is implied that it is important for the creation of a durable conceptual frame which will be the basis of future learning.

It can be seen that Sunship Earth (Van Matre, 1979) represents a significant development in the way concepts are addressed as summarised by Table 13.

Table 13: The Description of Concepts in Sunship Earth (Van Matre, 1979)

Concepts are... • *...simple(discrete) or complex (large).* • *...changing frames influenced by new information (or lack of it).* • *...more affected by data from primary sources or experience than by secondary data.* • *...folders in the brain's filing system.* • *...governors of perception*[10]. • *...organizers of new learning, in preparation for the future.*

[10] Although this point is argued to some extent, the link is not quite clear. Van Matre (1979, p.23) does state that concepts govern perception, behaviour follows perception, and therefore by changing perception, behaviour can be influenced.

4.3.1.1 Earth Education Vehicles

The seven concepts are addressed by "Concept Paths", "Interpretive Encounters" and by "Discovery Parties" (Van Matre, 1979, p.69). These three types of activity, described as Earth Education "vehicles" (Van Matre, 1990, pp.262-264) demonstrate the eclectic approach of Sunship Earth towards conceptual learning. The differences between these vehicles were examined by observing the program in action and by a detailed analysis of the literature and are summarised in Table 14.

Table 14: Characteristics of Vehicles in Sunship Earth (Van Matre, 1979)

	Concept Paths	Interpretive Encounters	Discovery Parties
Design Criteria	•assimilating and applying ecological concepts to the natural world. •emphasize short, simple and concrete tasks. •include established concept-building activity stations. •use special tools for presenting, reinforcing and transferring information. •encourage observation and examination between 'stations'. •leader guides group through a series of experiences.	•develop a deeper understanding of one concept. •use activities which flow in small steps from concrete to abstract. •use peer-to-peer interactions. •use problem solving storyline. •involve longer, ongoing roles for participants. •leader sets up and directs activity.	•focus on building a sense of wonder and place. •encourage personal exploration and discovery. •emphasize making firsthand contact with nature. •require participants to make choices about what to investigate and where to go, within the activity's constraints. •involve opportunities for sharing. •leader sets stage, but thereafter responds rather than initiates.
Treatment of concepts	Parts of concepts.	Addresses whole or multiple concepts.	Examples of applications of concepts.
Structure	Scripted. Carefully planned.	Partly Scripted. Carefully planned. Much opportunity for participant-led investigation	Loosely scripted. Carefully planned.
Leader's role	Orchestrator/Performer/Teller.	Orchestrator/Performer/Teller.	Story Teller/Enthusiastic knowledge sharer.
Pupil's role	Listener/Actor/Example Provider.	Listener/Actor/Example Provider.	Explorer.
Role of action in concept learning	Major part of activity.	Major part of Activity	Very little or none.
Objective/learning outcome	Clearly stated.	Usually clear but can lack clarity and precision.	Non-specific.
Focus of Attention	Activity props. Instructions. Leader.	Activity props. Instructions. Leader.	Natural world (Pre-placed objects.) Instructions. Leader.
Duration	7.5 hours	2.5 hours	2 hours
Group size	6-7.	15-20(+).	5-15(+).
Length	30 mins.	90 mins.	45-75 mins.

Although Sunship Earth uses a range of vehicles for teaching concepts, most of the time is spent on Concept Paths and Interpretive Encounters, with Discovery Parties having the least amount of time. This is not to say that Discovery Parties are less important or significant for children's learning as they may, for example, provide an epiphanic experience (Patton, p.386) which might have a greater overall effect on the quality of learning than any other activity.

4.3.2 ECOLOGICAL CONCEPTS IN SUNSHIP EARTH

The conceptual approach of Sunship Earth addresses seven ecological concepts, similar in many ways to those described in Acclimatizing (Table 9). These are compared in Table 15.

Table 15: Concepts in Acclimatizing and Sunship Earth (Van Matre, 1979, pp.16-20)

Core Ecological Concepts in Acclimatizing (Van Matre, 1974, p.76)	**Major Ecological Concepts in Sunship Earth (Van Matre, 1979, pp.16-20)**
Energy Flow *All energy flows from the sun*	***Energy Flow*** *Sunlight energy is transferred from the sun to living things which can capture it, then on to those which can not.*
Soil Formation *Soil is made from rocks and plants*	***Cycles*** *As these organisms grow and die they use life's essential chemicals and return them to their reservoirs.*
-	***Diversity*** *These chemicals vary greatly in different places and times and produce a diversity of plants and animals*
Communities *Plants and animals that need one another live together* ***Homes*** *Everything has a home*	***Community*** *Groups of such diverse organisms are found living together where conditions best meet their needs.*
Web of life *All living things are connected*	***Interrelationships*** *In meeting these needs organisms are constantly interacting with each other and their surroundings.*
-	***Change*** *Because organisms are constantly interacting with each other and their environment, everything constantly changes.*
Adaptation *Everything grows to fit where and how it lives*	***Adaptation*** *Some organisms are able to meet their needs in new ways, brought about by the constant change of environment.*
Land Formation *Glaciers molded and shaped this land*	-

Table 15 illustrates that the concepts of Energy Flow, Adaptation, Homes/Community and Web of life (Interrelationships) appear to be similar if not identical. However, some of these comparisons are not so straightforward as these programs each refer to Community and Communities yet the text seems to describe slightly different things; Acclimatizing's "Communities" emphasizes the interactions between organisms, yet Sunship Earth's "Community" refers to the ecological niche exploited by different organisms. Other concepts in Sunship Earth such as Cycles could be said to include concepts from Acclimatizing such as Land Formation and Soil Formation.

Sunship Earth seems to represent a change in the subject matter that concepts describe, although Van Matre comments that "No-one has a secret formula for determining a set of ecological concepts with which everyone will agree. The study of how life works is too broad for such exactness"...and "...exact definitions of these concepts are hard to find"(1979, p.12). He goes on to say that "No attempt at placing these concepts in a particular order can be completely successful (...) because natural systems do not operate in a fashion which lend themselves to Man's models" (*ibid.*, p.13). These difficulties are indicated by the considerable overlap and lack of clarity in the descriptions of some of the concepts in the tables above. But Van Matre claims that his list was produced by a consideration of trying to keep the concepts simple and manageable, dealing with the "big picture", focusing on the basic functions of the planet and providing some kind of cohesiveness (1979, p.12). In this way concepts were chosen which seem to follow logically from a consideration of the main aims of the program.

Concepts are mainly presented by a total of fifteen "concept path" activities arranged in groups of five. Each concept path activity contributes to a part of one of the concepts mentioned in Table 15. For example, the concept of Adaptation, described in full by the extract in Table 16, has two concept path activities devoted to it.

Table 16: The Concept Statement for Adaptation from Sunship Earth (Van Matre, 1979, p.20)

Adaptation *"Some plants and animals arrive at new ways of meeting changes in the flow of energy and the cycling of life's building materials. They are better prepared to respond to new demands because they happen to have special ways (structures or behaviours) which allow them to continue to be successful in a particular role. Since they are the ones that survive to reproduce others like them, over time their new structures or behaviours become commonplace. The diversity of a community's interrelationships provides a type of "biological reservoir" for the demands brought about by changes in the conditions of life.* *In a sense this process decides the future of life on earth, for how all specific kinds and animals fit their niche and how well they can meet the changes which take place in their habitats will determine their success. Each organism interacting with others in its community is a unique organism. And there is no way of knowing which ones may carry with them the key for adjusting to the problems which lie ahead. In the long run, because of their vastly different characteristics, some kinds of plants and animals will end up with different solutions for similar problems, while others end up with similar solutions but for different problems."*

This concept has two activities which address its two components of 'Problems' and 'Solutions'. 'Problems' refers to the fact that the shape and behaviour of each kind of plant or animal is suited to the kinds of problems it must solve. 'Solutions' refers to the fact that many kinds of plants and animals face the same problems but often have different ways of solving them (Van Matre, 1979, p68). Thus, whilst the concept statement itself is a detailed expression of an idea, the activities aimed at the concept component considerably simplify the concept by concentrating on a small part of it. Some concepts are addressed by three activities and some by only one. This might reflect the overall importance of the concept, its complexity and depth, or it might reflect the ease with which activities can be designed to teach the concept in the 'Earth Education' way.

These activities represent a significant development from Acclimatizing because the associated activities are aimed at the children actually acting out the concept (*ibid.*, p.26). In the above example, 'acting out' means that participants experience trying to pick up food without the use of their thumbs and try to drink the 'nectar' from a model of a flower with a range of different types of beaks. Whilst the activity is likely to give participants a very clear idea of how structural and behavioural features of organisms enable them to obtain food, the activity is unlikely to be as successful at making concrete that part of adaptation which deals with the process of natural selection. Indeed, it would not be unfair to say that less than half of the concept path activity actually addresses the concept described in Table 16. However, as Van Matre has pointed out, any simplification will necessarily include omission and such simplification is essential for understanding (*ibid.*, p.13).

A full treatment of the learning objectives, which are related to the seven ecological concepts, would be inappropriate in this discussion. However, the components of each of the concepts that Sunship Earth shares with Earthkeepers (Van Matre and Johnson, 1987) have been summarised in Table 17.

Table 17: Learning Objectives for Four of the Concepts in Sunship Earth (*ibid.*, pp.64-68)

Concept	*Component*	*Learning Objectives* (The student understands that...)
•Energy Flow	*capture(photosynthesis)*	*... green plants are the only things which can change the sun's light into energy-rich sugars*
	paths(food chains)	*...the sun's energy follows certain paths once it is captured by green plants.*
	loss	*...as energy moves from the sun to plants and on to animals, much of it is lost.*
•Cycling	*air*	*...the earth's air is used over and over as plants and animals trade oxygen and carbon dioxide*
	water	*...water is moved by the heat of the sun through great cycles, to be (re)used by living things.*
	soil	*...the soil provides plants with nutrients, and that bacteria return these nutrients to the soil.*
•Interrelationships	*competition*	*...some plants and animals compete for the same sunlight, water and food.*
	co-operation	*...some plants and animals are related because they work together to meet their needs.*
	dependence	*...all plants and animals depend on the others for things they can not do for themselves.*
•Change	*origins and time*	*...everything on the earth is changing over time, sometimes so slowly we can not see them.*
	stages	*...everything is changing over time. Several stages of change can often be seen once.*

Each component is addressed by a different activity and so it is apparent that the majority of the program's conceptual learning, in fact eleven out of fifteen activities, is concerned with the four concepts of energy flow, cycling, interrelationships and change. Learners are expected to engage in five activities each morning of the program, with each activity taking thirty minutes. Thus the total learning time for these four concepts is one and a half hours for each of energy flow, cycling and interrelationships, and one hour for the concept of change. So despite the emphasis on these four concepts, a relatively small amount of time is spent on each one, although learning of the concept of adaptation, for example, will tend to reinforce the learning of the concept of change. Reinforcement of concepts is also used during many other parts of the program and it would be grossly inaccurate to claim that children were only learning concepts for seven and a half hours during the whole program. Nevertheless, because the concept paths have necessarily involved simplification of the concept statement of the type described in Table 16, it must be wondered whether the cohesion that Van Matre mentions (1979,p.12), and that which can be seen from the way concepts are described (*ibid.*, p.15), is still present. To some extent the use of vehicles such as Interpretive Encounters and Discovery Parties are attempts to tie together the learning from Concept Paths, as well as being vehicles that teach a certain concept in its entirety, though they mainly reinforce links between concepts rather than focus on any one in particular. The contribution that these make to learning would be a valuable area of future research as Sunship Earth is unusual in that it is a long program, involves a great deal of conceptual learning, yet suffers from a lack of proper evaluation in this area.

4.4 EARTHKEEPERS

The Earthkeepers program (Van Matre and Johnson, 1987) was prompted by a lack of demand for the Sunship Earth program which many found too long and too leader-intensive to undertake in its entirety (*ibid.*, p.i; Van Matre, 1990, p.44) and even though much of the approach to learning had been laid down, it took four years for the program to be published. It shared the same basic conceptual goals as other Earth Education programs which were to turn ecological concepts that exist primarily as abstractions into "...focused, stimulating, concrete, participatory learning experiences in the here and now" (Van Matre and Johnson, 1987, p.*x*). Earthkeepers was the first complete Earth Education program published after The IEE replaced Acclimatization (Van Matre, 1990, p.83) in

1984 and therefore represents a certain clarification of aims and objectives summarised by the "Whys, Whats and Ways of Earth Education" (Van Matre and Johnson, 1987, pp.1-10). These are included in Table 18.

Table 18: Whys, Whats and Ways of Earth Education (Van Matre and Johnson, 1987, p.7)

THE WHYS	*THE WHATS*	*THE WAYS*
Preserving *We believe the earth as we know it is endangered by its human passengers.*	***Understanding*** *We believe in developing a basic comprehension of the major ecological systems and communities of the planet*	***Structuring*** *We believe in building complete programs with adventuresome, magical learning experiences that focus on specific outcomes.*
Nurturing *We believe people who have broader understandings and deeper feelings for the planet as a vessel of life are wiser and healthier and happier.*	***Feeling*** *We believe in instilling in people deep and abiding emotional attachments to the earth and its life.*	***Immersing*** *We believe in including lots of rich, firsthand contact with the natural world.*
Training *We believe earth advocates are needed to serve as environmental teachers and models, and to champion the existence of earth's non-human passengers.*	***Processing*** *We believe in helping people change the way they live on the earth.*	***Relating*** *We believe in providing individuals with time to be alone in natural settings where they can reflect upon all life.*

Other aspects of The IEE's approach were clarified but the same learning approach, the I.A.A. model, was used to describe the approach to learning, or the 'understanding' component of the "Whats" (Van Matre and Johnson, 1987, p.21). Furthermore the 'nurturing' aspect of the "Whys" refers to a link between understanding, feelings, health, wisdom and happiness. Table 18 illustrates the first published statement of the reasoning behind Earth Education's concentration on basic concepts although the same things had been alluded to by Figure 5.

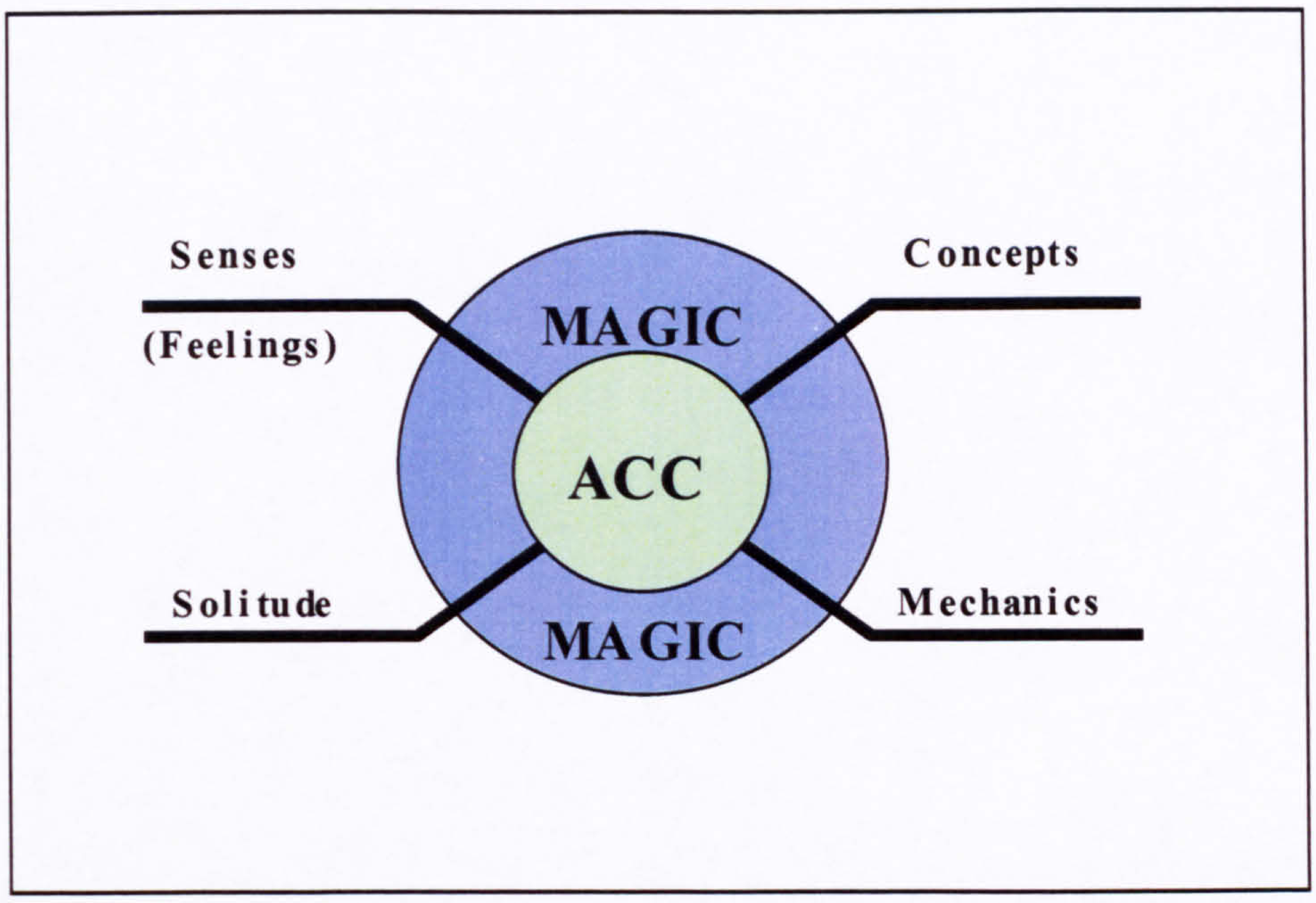


Figure 5: The Major Components of Acclimatization (Van Matre, 1979, p.6)

4.4.1 LEARNING THEORY AND EARTHKEEPERS

Earthkeepers attempted to simplify the description of concepts by referring to filing folders and filing cabinets in place of concepts and schemas (*ibid.* p25). It also contrasted the approach of traditional nature education, which sought to create thousands of folders for all of life's pieces which resulted in "...empty folders, topped with faded and tattered labels, jammed together in no apparent order" (*ibid.*), with the approach of Earth Education which was to create "fewer, more fluid folders... (and to) ...continue fattening up these folders back at home and school..." (*ibid.*). Such a description is characteristic of much of Van Matre's work as it is a clear attempt to take educational theory and make it accessible to those specialists and non specialists, wishing to undertake his programs, such as community leaders, volunteers, instructors and teachers. In this way Van Matre's simplification of educational theory has mirrored his simplification of ecological concepts in his learning programs, although there is much more to learning theory in Earth Education than the I.A.A. model, as this discussion has attempted to demonstrate.

Although Earthkeepers is the second full Earth Education program, the program literature contains only some of the detail that characterises such programs. Although Van Matre had been speaking at workshops and conferences, and giving speeches for many years before, there was a need to publish his treatise in order for it to become available to a wider audience. Much of the learning approach is therefore elaborated in one of his later publications (Van Matre, 1990) and this forms an important part of the edifice of Earth Education, and consequently (though perhaps anachronistically) this discussion.

4.4.2 ECOLOGICAL CONCEPTS IN EARTHKEEPERS

Earthkeepers is approximately half the length of Sunship Earth, although it is acknowledged that the program should be extended, by further work in the school and home environment, after the visit to the centre. As a result, the number of concepts addressed by the program needed to be fewer than those of Sunship Earth if the same balance between conceptual and affective activities was to be maintained. At the same time these concepts still had to reflect the 'big picture' of life on planet earth (Van Matre, 1990, p.105) and in order to provide this 'big picture' the concepts of Energy Flow, Cycling, Interrelationships and Change were selected. Indeed these are chosen as the minimum number necessary for *any* Earth Education program (Van Matre, 1990, p.269). As with Sunship Earth, Van Matre and Johnson (1987) attempt to demonstrate the wholeness of the four concepts chosen, although whether this is achieved is discussed later.

The approach of Earthkeepers towards the understandings component of the "Whats" of Earth Education is much less diverse than that of Sunship Earth as it uses only two vehicles to address concepts: Conceptual Encounters and Discovery Parties.

4.4.2.1 Conceptual Encounters

Conceptual Encounters (see also Table 14) were referred to as Interpretive Encounters in Sunship Earth (Van Matre and Johnson, 1987, p.62), though the reasoning for the apparent change in focus was not clarified. Conceptual Encounters are described as highly participatory, stimulating, concept building activities. The design criteria for these Conceptual Encounters are shown in Table 19, and remain very similar to the design criteria used for the Interpretive Encounters in Sunship Earth (Van Matre, 1979, p.48).

Table 19: Design Criteria for Conceptual Encounters (Van Matre *et al.*, 1987; Van Matre and Johnson, 1987, p.62-63)

Conceptual Encounters are designed to meet the following criteria...

- *focus on developing a deeper understanding of one ecological concept.*
- *emphasize peer to peer interactions in the learning process.*
- *utilize a problem-solving storyline.*
- *involve ongoing roles for the participants.*
- *require the leader to set up and direct the overall activity.*
- *designed to be used in a variety of settings.*

These criteria differ from those in Sunship Earth in two ways. Firstly, the criterion from Table 19 which refers to Encounters which were "designed to be used in a variety of settings" was considered to be an important aspect of new programs if they were to be successful (See opening comments in section 1.4.1). Secondly, the Sunship Earth criteria demanded that Encounters "include activities which flow in small steps from the concrete to the abstract" (Van Matre, 1979, p.48). This was omitted from the criteria for Conceptual Encounters, although a later publication states that Conceptual Encounters develop a deeper understanding of one ecological concept by going from the concrete to the abstract (Van Matre, 1990, p.263), and that Earth Education's "first and foremost task is to get the concept into the concrete" (*ibid.,* p.274). It would seem that the latter criterion had become a major aspect of Earth Education's approach to concepts and perhaps its inclusion would have duplicated unnecessarily what had been said elsewhere.

The following discussion of Conceptual Encounters has been produced by comparing the design criteria with the actual activities.

4.4.2.1.1 Design Criteria: Focusing on One Ecological Concept

Table 19 illustrates the difference between the Concept Path vehicles, which focused on several aspects of concepts using activities of short duration and Conceptual Encounters, which were intended to focus on building one concept over a longer period of time. Thus 'whole' concepts, such as Energy Flow or Change, were dealt with in one activity lasting approximately $1^1/_2$ hours.

Conceptual Encounters display little change from the Interpretive Encounters of Sunship Earth in the way they deal with 'single' concepts. The earlier Conceptual Encounters of 'Munchline Monitors' and 'The Great Spec-tackle", and the Interpretive Encounter 'Border Dispute', all exist as stand-alone activities requiring little prior knowledge of ecological concepts, or Earth Education. They could be easily conducted outside the context of an Earth Education program with few changes. However, the Conceptual Encounters of 'Connection Inspection' and 'Time Capsules', and the Interpretive Encounter 'Model Planets', deal with the concept of Inter-relationships and Change and they necessarily refer to other concepts, such as Energy Flow, Cycling and many of the other concepts included in Sunship Earth, all of which were developed through previous activities. With these Encounters, an understanding of the later concepts presented is contingent upon an understanding of earlier concepts and therefore, to a certain extent, knowledge is presented as being cumulative and sequential. So, the first two concepts of Earthkeepers can be thought of as contributing to a better understanding of the last two concepts. This is partly a result of the way the Conceptual Encounters have been written, as other concepts could equally form the starting point for an examination of the others, although it might be more logical, in a chronological sense, to begin with the cause (the sun's energy) and work through to the effect (the changing of ecosystems). A more complete description of these four ecological concepts, contained in a later publication (Van Matre, 1990, pp.105-119), illustrates this point nicely.

References to other concepts, largely ignored by Earthkeepers, can also be seen in the four Conceptual Encounters. For example, an understanding of energy and matter conservation are important for the activities which address Energy Flow and Cycling respectively, so an understanding of these, prior to undertaking the program, would probably enhance the learning from the program. But these Conceptual Encounters could also be said to be contributing to the construction of these very concepts, by including activities which enable new links to be made to the concept of energy, for example. In any event, Van Matre's claim (Van Matre and Johnson, 1987, p.62; Van Matre, 1990, p.263) that the Conceptual Encounter vehicle focuses on building single concepts must be interpreted alongside the knowledge that the four selected ecological concepts are so interrelated, interdependent and indeed, ecological! Furthermore the way these concepts are described tends to reinforce the idea that they are cumulative and connected, rather than emphasising their individuality...

> "In short, all living things draw upon sunlight energy for their existence (Energy Flow), and each represents a temporary ordered arrangement of matter (Cycles) interacting with its neighbors (Interrelationships). Each builds up, then breaks down as the materials of its own body inexorably crumble over time (Time)."
>
> (Van Matre, 1990, p.105, author's parentheses)

4.4.2.1.2 Design Criteria: Emphasize Peer-to-peer Interaction

Conceptual Encounters use a mixture of different learning situations. They involve periods of didactic instruction and groupwork, with both large and small groups. The time spent working in groups, perhaps with a leader contributing intermittently, is equal to, or outweighs, the time spent listening to introductions, instructions or summaries. However, the precise balance will vary for many different reasons such as the complexity of the concept, the nature of the activities or the abilities of individual participants.

Much of the peer-to-peer interaction is likely to be informal as the activities have been set up so that children will be likely to share their findings with each other, ask each other for clarification of instructions and attempt to solve problems set by the activity. Whilst some of the techniques likely to enhance peer-to-peer interaction are evident in the way the activity is organised, some of the techniques are extra to the Conceptual Encounters and apply to Earth Education as a whole. Such techniques are described as methods for achieving focused participation and are summarised in Table 20.

Table 20: Achieving Focused Participation (Van Matre, 1990, p.206)

Sharing Techniques...
• Organise the activity around teams or partners.
• Use formal opportunities to share discoveries and products.
• Use informal gatherings and set the tone by modelling sharing behaviour.
• Use a "sharing circle" to close an activity.

The use of 'sharing techniques' can be clearly seen in many of Earth Education's vehicles and are not restricted to Conceptual Encounters.

4.4.2.1.3 Design Criteria: Problem Solving Storyline

When the Conceptual Encounters folder is analysed in detail there is a certain amount of uncertainty surrounding this criterion. The aspect of a 'problem solving storyline' seems to be rather difficult to pinpoint. The Conceptual Encounters "Munchline Monitors" and "Connection Inspection" involve the participants in becoming 'monitors' or 'inspectors' but these activities have few of the aspects of a 'problem solving' approach. Although Van Matre does not define 'problem solving', it typically involves skills concerned with personal and social development (Ewert, 1989, p.53; Cooper, 1998, p.21; Keighley, 1998, p.59); skills which facilitate and enhance experiential learning (Ewert, 1989, p.53; Keighley, 1998, p.59); and most specifically, skills which are concerned with solving specific problems using the results of primary research or 'facts' (Ford, 1981, p.74). The Conceptual Encounter "Time Capsules" which deals with the concept of change has a theme throughout which asks "What was life like in the past?". This is the extent of this activity's 'problem solving storyline'. It would seem that this criterion is barely fulfilled by any of the Conceptual Encounters which is somewhat surprising given the claims to, and evidence of, detailed planning and piloting of activities throughout the literature.

If the Interpretive Encounters from Sunship Earth are examined, there are good examples of problem solving storylines in both of the activities used, that is "Model Planets" and "Border Dispute". In the former, participants attempt to design a life-support system which incorporates examples of each of the seven ecological concepts in Sunship Earth (Van Matre, 1979, p.242) and in the latter, participants attempt to decide upon an appropriate boundary between two communities of a forest and a meadow by conducting self-planned investigations (Van Matre, 1979, pp.152-160). Both of these activities use groupwork, thus enhancing personal and social development and require the solving of a specific problem with recently learned knowledge. This, in turn, enhances the learning of concepts. So whilst there is much evidence of Interpretive Encounters incorporating a problem solving approach, there is much less in Conceptual Encounters.

4.4.2.1.4 Design Criteria: Ongoing Roles for Participants

Van Matre refers to the use of roleplay, role taking and action when listing techniques for achieving focused participation (Van Matre, 1987, p.62; Van Matre, 1990, p.206), although it is sometimes unclear whether an adequate distinction is being made between these. The use of the former terms implies that participants assume the part of imaginary characters and perform tasks consistent with these characters, while the latter refers to something which merely includes some form of 'doing'.

The reference to "Ongoing Roles" (Van Matre, 1987, p.62) is most usefully explained by comments which link it to a simulation of the concept involved in Conceptual Encounters (also referred to as 'acting out' the concept), and to methods which contribute to encouraging learners to participate in the program (*ibid.,* p.206). Thus role-taking is referred to as a device for the facilitation of group management, but also as a method for developing learning and conceptual understanding. Table 21 summarises the use of role-taking in the four Conceptual Encounters of Earthkeepers, where it can be seen that all four Encounters have a considerable proportion of their time spent on activities where participants are required to do something. Furthermore, two of the Encounters, "Munchline Monitors" and "Connection Inspection" use the roleplay of 'training' to become monitors and inspectors as a general organisational tool of encouraging participation. The Conceptual Encounter "The Great Spec-tackle" also uses roleplay during its introduction where there are a small number of opportunities for short-term roleplaying in order to encourage full participation.

As with the previous section, compelling examples of the way in which Encounters use roleplay can be seen if the Interpretive Encounters are examined. In the activities of "Border Dispute" and "Model Planets", participants are given the roles of Elves or Trolls, and Planetary Engineers or Ambassadors respectively. These roles are played throughout the activity and provide a means for achieving full participation rather than a means for acting out the concept itself. Clearly, elements of roleplaying are more obvious in Interpretive Encounters than in Conceptual Encounters.

Van Matre later refers to activities which use roles as simply those where "learners actually *do* something" (my emphasis) rather than simply watch (*ibid.,* p.209). All Conceptual Encounters have roles for participants, which means that they are involved in some aspect of 'doing' during the Encounter, indeed this emphasis on action can be seen very clearly in the Encounter descriptions. But this juxtaposition of 'role' and 'action' could lead to the inference that Van Matre is conflating the notion of 'role' and hence 'action', with 'roleplay', when the notion of roleplay is probably more sophisticated than mere 'action'.

A number of references to the use of roleplay and roles exist in Van Matre's work, each referring to slightly different activities with different purposes. For example, Van Matre later explains the use of "roleplaying natural qualities" (*ibid.*, p.231) and the roleplaying of other creatures and things (*ibid.*, p.234) as methods for enhancing pupils' nature awareness by encouraging them to empathize with the natural world. This justification implies that natural qualities, creatures and things, have spirits or feelings which can actually be empathized with. Whilst this inference might be considered to be a reflection of an animist perspective, defined by Benedict (1931) as a primitive state of mind which has not distinguished between behaviour towards things and behaviour towards people, it is probably safer to assume that this reference to "empathy" is merely an attempt to encourage pupils to think in a less anthropocentric manner.

4.4.2.1.5 Design Criteria: Require the Leader to Set Up and Direct the Activity

This criterion is rather less problematic in terms of its analysis. All Earth Education activities require some degree of input by the leader and Conceptual Encounters are no different. These activities are structured so that they involve an introduction, followed by instructions for an activity, which then closes with a summary of the activity. All of the Encounters involve one or more of these 'events', although the amount of formal leader input varies between activities.

4.4.2.1.6 Design Criteria: Designed to be Used in a Variety of Settings

This is a difficult criterion to analyse as the question of whether Conceptual Encounters can be used in a variety of settings depends on a very wide range of factors, some of which could be elicited by research.

The flexibility of Encounters is likely to be affected by factors which make them more demanding to conduct. Such factors might include equipment (amount, portability, required skill or knowledge to set up, ability to withstand poor weather) and site (exclusivity of access, weather and climate, availability of shelter), although many of the factors associated with the site could be significantly affected by the skill of the leader and the approach of the participants. All of the Conceptual Encounters require a certain amount of specialized equipment. This equipment varies from painted trays to lockable wooden boxes with hinged lids, much of which would have to be specially made or bought. Indeed, such are the difficulties of obtaining items that the U.K. branch of the IEE's newsletter has included several articles detailing how equipment might be made. Conversely most of the equipment for the Interpretive Encounters (Van Matre, 1979, p.158, p.251) is likely to be already possessed by many field studies centres, or be relatively simple to make.

Whilst Conceptual Encounters might have been designed to be conducted in a variety of settings they demand more specialized equipment than the Interpretive Encounters and would require more time to set up. Whether they remain flexible enough to be conducted at a variety of sites is discussed later.

4.4.2.1.7 Internal Consistency of Design Criteria: Summary

The extent to which Conceptual Encounters meet design criteria has been discussed and compared with the Interpretive Encounters. Conceptual Encounters were found to be, in general, less consistent with the design criteria than the Interpretive Encounters. Indeed some of the design criteria seemed absent from the Conceptual Encounters. The results from this theoretical analysis have been presented in Table 21.

Table 21: Consistency of Conceptual and Interpretive Encounters with Design Criteria.

"Conceptual Encounter" ***<u>Concept</u>*** ***Design Criteria***	***'Munchline Monitors"*** ***<u>:nergy Flow</u>***	***'The Great Spec-ackle"*** ***<u>:ycling</u>***	***'Connection Inspection"*** ***<u>nter-relationships</u>***	***'Time Capsules"*** ***<u>:hange</u>***	***'Border Dispute"*** ***<u>:ommunity</u>*** ***From Sunship Earth***	***'Model Planets"*** ***<u>nterrelationships</u>*** ***From Sunship Earth***
Focusing on One Ecological Concept	• *Stand alone activity requiring little prior knowledge.*	• *Stand alone activity requiring little prior knowledge.*	• *Explicit references to Energy Flow and Cycling. Focus is wider*	• *Explicit references to Energy Flow and Cycling. Focus is wider*	• *Stand alone activity requiring little prior knowledge.*	• *References to other concepts learned during program.*
Emphasize Peer-to-peer Interaction	• *Pupils work in groups of 2 or 3 to find objects and solve minor tasks.* • *Opportunities to share discoveries, and co-operate .*	• *Groups of 2 or 3 to follow trails and read instructions. Opportunities to share discoveries and experiences on trail, and co-operate.*	• *Pupils interact as group when becoming part of the metaphorical food web established by the activity, but also in pairs for a short time.* • *Sharing and co-operation.*	• *Much group work, in pairs or threes. Discussion and decision making.* • *Perhaps sharing of ideas for final task.*	• *Pupils work in groups to collect data, discuss findings and plan approach to be taken. 'Teamwork' will need to be used.*	• *Pupils work in groups throughout activity to construct a model of a planet incorporating all features of an ecosphere. Teamwork used.*
Problem Solving Storyline	• *Pupils become monitors of food chains rather than being involved in solving a particular problem.*	• *Storyline doesn't refer to any specific problem solving.*	• *Storyline doesn't refer to any specific problem solving.*	• *Storyline refers only to the 'problem' of finding out what things were like in the past.*	• *Problem solving story-line used - gives activity a common theme, and encourages roleplay.*	• *Problem solving story-line used - gives activity a common theme, and encourages roleplay.*
Roleplay, Roles and Action	• *Roleplay of becoming a 'Munchline Monitor'.* • *Minor roleplay as organisms in a food chain.* • *Roles involve counting, collecting and classifying.*	• *Minor roleplay for a few pupils in demonstrations.* • *Roles involve following three trails which mimic nutrient cycles.*	• *Roleplay of an animal and its place in a food web. Also forms large part of conceptual learning.* • *Roleplay of becoming 'Connector Inspector' but less emphasis on this than in 'Munchline Monitors'.*	• *No 'roleplay'* • *Roles involve finding 'Time Capsules', sorting contents into appropriate periods, and locating on a geological timeline.*	• *Roleplay of mythical inhabitants of ecosystems (Elves or Trolls) to decide territorial dispute. Roles involve evidence gathering.*	• *Roleplay of planet managers or ambassadors. Roles involve discussing and modelling concepts in small groups.*
Require the Leader to Set Up and Direct the Activity	• *Little set-up required.* • *Activity needs some clear direction and didactic teaching at various points.*	• *Much equipment required.* • *Little direction once activity is under way. Some careful direction, using props, at beginning and end. Leader input during activity would be of use.*	• *Much set-up required.* • *Didactic instruction includes 15 min intro, followed by a short activity, then more explanation followed by a lengthy activity where pupils need some direction to keep on track. A short conclusion also required.*	• *Much set-up of equipment required. Didactic instruction occurs throughout activity, in introduction, during the activity and as summary.*	• *Little set up required.* • *Some didactic input towards end of activity to summarise.* • *Leaders' input needed to set 'tone' and maintain interest.*	• *Little set up required-some equip needed 'in situ'.* • *Some didactic input at end of activity to summarise.* • *Leader sets 'tone' and maintains interest.*
Designed to be Used in a Variety of Settings	• *No "fixed" equipment.* • *Specialized equipment needed.* • *Can be used in wet/ windy/cold weather with changes to equipment. Much can be done indoors.*	• *Permanent/Semi-permanent fixed equipment.* • *Specialized equipment needed.* • *Small changes required for wet/cold weather use. Parts of activity can be done indoors.*	• *Permanent/Semi-permanent equipment though could be made portable with significant changes to equipment.* • *Specialized equipment needed.* • *Few changes required for poor weather use. Much can be done indoors.*	• *Equipment need not be placed permanently but access to site by public is problematic.* • *Specialized equipment needed.* • *Few changes for poor weather use. Most can be done indoors.*	• *Equipment mainly portable. Most must be performed outside.* • *Little special equipment (other than scientific eqpt).* • *Hardly suitable for poor weather.*	• *Equipment mainly portable. Most must be performed outside.* • *Little special equipment.* • *Hardly suitable for poor weather.*

4.4.2.2 Discovery Parties

The Conceptual Encounter is the major vehicle aimed at the development of concepts in Earthkeepers, compared with the three vehicles used in Sunship Earth. Earthkeepers *does* use Discovery Parties but these are described along with the "Experience", or the affective aspects of the program. Closer examination reveals that the Discovery Party is described as an activity which can arouse curiosity, can produce marvellous and stimulating experiences from personal discoveries in the natural world and can produce a "...chilling exhilaration matched by few other experiences in life" (Van Matre and Johnson, 1987, p.32). It is also described as "guided exploration and rambling" (Van Matre, 1990, p.262), which emphasises the importance of the role of the leader in the experience. Clearly, although it could easily be used to concentrate on either developing conceptual learning or affective experience, it is most likely that it should be used to bridge the gap between a conceptual and affective approach to ecological experience. This is exemplified by the Discovery Party "Artists and Scientists" where pupils "...begin to realize that they don't have to pursue art or science; they can, and should, pursue both." (Van Matre, 1979, p.168).

The defining characteristics of Discovery Parties are given in Table 22.

Table 22: Characteristics of Discovery Parties (Van Matre, 1979, p.48)

Discovery Parties...
• focus upon building a sense of wonder and place.
• include tasks for encouraging personal exploration and making individual 'finds'.
• emphasize making firsthand contact with natural places and things.
• utilize the participants in deciding moment to moment where to go and what to do within a specific undertaking.
• involve opportunities for leaders to share both wonder and knowledge.
• require the leader to set the stage, then respond more than initiate

Many of the claims for this vehicle could only be verified by research, although all these claims would seem to be valid for the Discovery Parties in Sunship Earth and most seem to be true for the Discovery Party "E.M.'s Diary" from Earthkeepers. The only exception is the fourth point which claims that the vehicle involves "...participants in deciding moment to moment where to go and what to do within a specific undertaking" (Van Matre, 1979, p.48). "E.M.'s Diary" (Van Matre and Johnson, 1987, pp.81-88), a structured activity which should seem unstructured (*ibid.*, p.86), uses a specific route mapped out to allow participants to discover pre-placed objects. It is unlikely that participants could be considered to have much influence on where they explore outside the immediate environs of the route. Sunship Earth's Discovery Parties appear to have more flexibility than that in Earthkeepers as participants have more freedom to explore within a defined route. The corollary of this is that the former tend to require more experienced and skilled leaders so that the activities' flexibility can be most effectively exploited. Furthermore "E.M.'s Diary" has been structured around various "discoveries", both natural and anthropogenic, which have been placed en route for the participants to find and so the focus on the natural world, evident in Sunship Earth's Discovery Parties, is broadened to include other things.

4.5 'STARTING WHERE YOUR LEARNERS ARE': DEFINING CHARACTERISTICS OF EARTH EDUCATION'S CONCEPTUAL APPROACH.

Activities designed to teach concepts have been compared with their design criteria in a previous section. These criteria communicate some of the important aspects of Earth Education activities but they largely fail to illuminate some of the other characteristics that make Earth Education unique. To this end, this discussion will illuminate some significant aspects of Earth Education's approach to the teaching of concepts, will compare these with the Conceptual Encounters used in Earthkeepers and as a result will evaluate the internal consistency of this aspect of Earthkeepers.

However such an analysis of Earth Education is beset by various problems. Firstly, Van Matre's claim that Earth Education programs "...start where learners are..." (1990, p.269) is manifested by several aspects of program design including the use of "...familiar organising metaphors" instead of commonly accepted scientific terms (Van Matre and Johnson, 1987, p.63), the use of 'concrete' learning experiences compatible with children's intellectual stage of development and the use of activities which address the *essence* of major ecological understandings, or the 'big picture', in order to give children just enough information for them to begin developing a concept (Van Matre and Johnson, 1987, p.*xii*; Van Matre, 1990, p.269). Other aspects of programs could be linked with this approach, such as Van Matre's suggestions of things to avoid like naming and labelling, talking without a focal point, or playing 'twenty questions' (Van Matre, 1990, p.170) but they also reflect other aspects of Van Matre's particular approach. For example, the avoidance of naming and labelling is also due to a desire to focus on the processes of life instead of the pieces, whereby naming is a means to an end not an end in itself (Van Matre, 1990, pp.170-178), thus representing a specific approach to nature education where processes are more important than parts.

Secondly, Conceptual Encounters can be seen to exemplify many characteristics of the Earth Education approach, but a complete discussion of the way in which they achieve this would not be particularly valuable as it is often self-evident from the literature. Therefore characteristics have been chosen where this is not self evident, where there has been disagreement in the literature, or where there is inconsistency between theory and practise. Although this work concentrates on Earth Education's few areas of inconsistency in the interests of brevity and expediency, it would be a grave error if the reader was to assume that such problems rendered these activities worthless.

Finally, and perhaps more significantly, there are numerous statements in the Earth Education literature aimed at encouraging "good" learning techniques, often described as being particular to Earth Education programs. Table 23 illustrates the ways in which Van Matre perceives Earth Education to be different from other approaches.

Table 23: Ten Characteristics of Earth Education Programs (Van Matre, 1990, pp.269-270)

An Earth Education program:	
1	*Hooks and pulls the learners in with magical experiences that promise discovery and adventure (the hooker)*
2	*Focuses on building good feelings for the Earth and its life through lots of rich, firsthand contact (the immerser).*
3	*Proceeds in an organized way to a definite outcome that the learners can identify beforehand and rewards them when they reach it (the organizer)*
4	*Uses good learning techniques in building focused, sequential, cumulative experiences that start where the learners are mentally and end with lots of reinforcement for their new understandings.*
5	*Emphasizes major ecological understandings (at least four must be included: energy flow, cycling, interrelationships, change).*
6	*Gets the descriptions of natural processes and places into the concrete through tasks that are both "hands on" and "minds on".*
7	*Avoids the labelling and quizzing approach in favor of the full participation that comes with more sharing and doing.*
8	*Provides immediate application of its messages in the natural world and later in the human community.*
9	*Pays attention to the details in every aspect of the learning situation.*
10	*Transfers the learning by completing the action back at school and home in specific lifestyle tasks designed for personal behavioural change.*

Furthermore, much of his work is concerned with what has been described by one critic as the Earth Education "demonology" (Randle, 1992, p.27). This "demonology", or critique, concerns specific problems, which Van Matre believes are endemic in Environmental Education[11]. Such problems include the over-use of naming and labelling of organisms (Van Matre, 1990, pp.170-178), the playing of 'twenty questions' (*ibid.*, pp181-192), or talking to a group without a focal point (*ibid.*, pp179-181). However, many of the points in Table 23 are concerned merely with the pragmatics of pedagogy and could not be considered to be exclusive to Earth Education. For example, Gagné and Driscoll (1988) have outlined eight phases of any learning sequence, the first of which involves some form of intrinsic or extrinsic motivation in order to promote learning. In seeking a particular goal the pupil is rewarded in some way for achieving it either physically, by the experience of simple bodily pleasures, or mentally, by the mental satisfaction of feeling competent. This is what Van Matre (1990) is referring to in the first point in Table 23. Furthermore, point 7 in Table 23 refers to the need to avoid the "quizzing" approach in favour of full participation. Cohen and Manion (1989, pp.140-147) describe some of the pitfalls of poor

[11] Van Matre goes further and states that because these problems are so pervasive Earth Education should not be regarded as Environmental Education, but rather as an alternative to it (Van Matre, 1990, pp.1-48).

questioning technique and note that inappropriate questioning techniques can lead to misunderstandings, can place undue emphasis on rote learning, can encourage thoughtless responses or can reinforce a child's dependence on the teacher and undermine independent thought.

Those aspects of Van Matre's approach to conceptual learning which do appear to be different from those used in other forms of nature education have been distilled from the literature and are given in Table 24.

Table 24: Defining Characteristics of Earth Education's Approach

•Emphasis on encouraging a broad, or 'big picture' understanding of ecology, using clear statements, concept simplification and metaphors. •Emphasis on using activities which make abstract concepts concrete. •Emphasis on conducting programs in the outdoors.

The defining characteristics of Earth Education which relate to 'starting where the learners are' are discussed in terms of the four Conceptual Encounters below, in sections 4.5.1 to 4.5.3.

4.5.1 EARTH EDUCATION CONCENTRATES ON THE 'BIG PICTURE'

Conceptual Encounters include a "key concept statement" (Van Matre, 1990, p.276) which has two roles. It is intended as a summary of the essence of the activity, which helps learners identify the main outcome of the activity before it starts (Van Matre, 1990, p.269), hence simplifying the otherwise overbearing complexities of the concept (*ibid.*, p.276). In other words, apart from being important for simplifying the concept and consequently making it a realistic learning goal for the young participants, it also serves as an organisational feature which enables participants to understand better the whole activity. However, Van Matre's simplification of concepts, which has involved the use of familiar 'non-scientific' terms, extended metaphors, and conceptual generalisation involving omission of conceptual detail, has been criticised for simplifying too much, and hence being misleading (*ibid*; Robbins, 1985)

4.5.1.1 Concept Statement as 'Learning Outcome' or 'Knowledge Objective'

A concept statement is described as a coherent summary which allows participants to identify the learning outcome of an activity as they begin (*ibid.*, p.269). If this assertion can be accepted it would not be unreasonable to infer that the 'essence' statement should represent a complete, if much simplified, lucid account of the concept to be learned. Therefore learning activities should be targeted at developing understanding of this statement. These statements have been included in Table 25.

Table 25: Conceptual Encounters in Earthkeepers (Van Matre *et al.*, 1987)

Conceptual Encounter	Concept Statement (Numbered sentences below have been arranged to mirror their grouping in the program literature.)
"Munchline Monitors" (Energy Flow)	•[1]All living things need energy to grow, to move, to do anything. [2]Energy is the spark of life. •[3]The earth receives its energy from the sun in the form of light. [4]Green plants capture this sunlight energy and turn it into food. [5]Animals get this stored sunlight energy when they "munch" plants or other animals that eat plants. •[6]The flow of sunlight energy from plants to animals and on to other animals is what we call a "munch line" or a "food chain".
"The Great Spec-tackle" (Cycling)	•[1]Everything is made up of the same basic building materials, whether a plant, an animal, a rock, or you! •[2]These specks of materials that make up everything have been around a long, long time and are used over and over again by all living things. •[3]We call this movement of life's building materials, in circles powered by energy from the sun, cycling.
"Connection Inspection" (Interrelationships)	•[1]Every plant and every animal is related to every living and non-living thing on the earth. •[2]Energy from the sun provides the fuel for all life. •[3]Materials that cycle are used over again, providing the stuff of which all things are made. •[4]Together, the energy and materials connect all the things on the earth in a giant web of life. [5]As a result, everything is related to everything else.
"Time Capsules" (Change)	•[1]Over time, the flow of energy and the cycling of materials through living and nonliving things, changes those things. [2]Materials such as air and water, moving through great cycles powered by the energy of the sun, change the landscape. [3]Living things are constantly changing so they can get and use energy and materials in better ways. •[4]Everything is changing all the time. [5]It is this constant change that keeps life going.

The concept statements for 'Munch Line Monitors' (Table 25) consist of three parts which together form an overview of the concept of energy flow. The sentences in the first part make defining statements about the nature of energy, using grammatically simple sentences consisting of subject nouns, verbs and object nouns. The second group of statements (3-5) provides further information about "energy" using compound (statement 4) and complex (statement 5) sentences. The object of each of these sentences is "energy" but each statement uses a progressively more developed compound noun which summarises the previous statement's meaning. For example, statement 3 describes the general concept of "energy" as being in the form of light in this case. Statement 4 summarises statement 3 by using the compound noun "sunlight energy" and describes how it is turned into food by green plants. This is further described by the compound noun "stored sunlight energy" in the subsequent statement (5). The third part is composed of a single statement (6) which, again, is a summary of the previous statement and indeed the whole concept, but also uses the compound noun "food chain" as the complement of the object. This last statement acts as a definition of "food chain" where the emphasis is placed upon the process of the flow of sunlight energy by the statement's use of the passive voice.

The concept statements for 'Great Spec-tackle' follow a similar order, the first describing the nature of matter, the second describing in very general terms how this matter is conserved by recycling and the third names the process and relates it to the first concept of Energy Flow, albeit parenthetically. Sentences are simple, compound and complex. However, the progression from statement 1 to 3 is less obvious than for 'Munchline Monitors'. In the latter, progression is demonstrated explicitly by the use of a noun group which becomes increasingly more specific as the statements are encountered. In 'Great Spec-tackle' there appears to be greater conceptual distance between the statements and the development between statements occurs in greater steps. For example, the first refers to matter as "basic building materials", whilst the second refers to it as "specks of material". The final statement, again comprising a definition of the main concept, that is cycling of materials, is this time written in the active voice so placing emphasis on the subject "We" or the authors, rather than on the object.

These two activities' concept statements illustrate how concepts are developed progressively and sequentially, despite differences between the ways in which they achieve this. Furthermore "The Great Spec-tackle" also refers to the concept of energy flow, indicating that it might not stand alone as a learning activity in the same way that 'Munchline Monitors' might. This perhaps suggests a preferred program order for these two concepts, although the program material (Van Matre and Johnson, 1987, p.20) claims that neither need be subordinate to the other.

The third and fourth concepts of Interrelationships and Change have four groups of concept statements each (Table 25) but their structures are quite different. The first and last statements for 'Connection Inspection' (statements 1 and 5) are general definitions of the overall concept. The second and third statements comprise unrelated revision statements of the first two concepts Energy Flow and Cycling. Statement 4 mirrors the first but it includes additional references to the first two concepts as an attempt to draw all three concepts together. Hence the structure is much less linear and progressive than the previous two concepts and more hierarchical.

'Time Capsules' uses a different structure from the other conceptual activities. Progression is much less evident in these statements compared with those for the first two concepts and although the structure resembles the hierarchical structure of the third concept activity 'Connection Inspection', there are important differences. The concept statements have been duplicated in Table 26 for clarification.

Table 26: Concept Statements for 'Time Capsules' (Van Matre, 1987)

"Time Capsules" (Change)	•[1]Over time, the flow of energy and the cycling of materials through living and nonliving things, changes those things. •[2]Materials such as air and water, moving through great cycles powered by the energy of the sun, change the landscape. •[3]Living things are constantly changing so they can get and use energy and materials in better ways. •[4]Everything changes all the time. [5]This constant change keeps life going.

The first and last statements comprise a general assertion about the overall concept and include references to the first two concepts, as with 'Connection Inspection'. However, the meaning conveyed by these statements is anything but simple and this is reflected by the grammatical structure. For example, the complex sentence of statement 1 uses the complement "through living and non living things" to describe the noun group which forms the *subject*, but then it uses the demonstrative "those things" to refer back to this complement which forms the *object* of the sentence. The complexity of this statement, and indeed the next, is potentially confused by the use of the preposition "through" as its meaning is ambiguous in this sense. Furthermore, the second and third statements involve the whole concept but the second emphasises the importance of 'materials such as air and water' by taking this clause as the subject, whilst the third statement has 'living things' as its subject and 'energy and materials' are relegated to being the object of the purpose clause. The final statement is a general assertion which includes a mention of the significance of change for life on Earth. Although the noun group representing the concept shows some development as it is initially referred to as "change" (statements 1 and 2) and later evolves into "constant change", there is less progressive development than with the first two activities.

Clearly, the degree to which concept statements have clarity and hence accessibility, varies considerably. The first two have simple linear structures where a concept is developed progressively and sequentially. The third is more complex, relying on a grasp of the previous two, although the outcome is clearly stated. The final concept statements lack clarity and refer to the concept in different ways so that it is difficult to identify which aspect of the concept of Change the activity is concerned with, whether evolution, adaptation, succession or something else. Consequently whilst the first three activities might provide "definite outcome(s) that the learners can identify beforehand..." (Van Matre, 1990, p.269), the final activity might be less successful. These suggestions are examined later.

4.5.1.2 Simplification in Conceptual Encounters

Table 27 summarises the way in which Conceptual Encounters attempt to simplify concepts by using generalisation by assimilation, generalisation by omission and 'familiar' metaphors. Generalisations are most obvious in "The Great Spec-tackle" and "Munch Line Monitors". In the former, an immense diversity of molecules is represented by only three types of 'Speck', hence these three new categories of "speck" assimilate all forms of matter. In the latter the sun is described as the source of energy for all living things and organisms that obtain their energy from chemical or geothermal sources are ignored, hence the generalisation is one of omission. The former example also employs a metaphor to make the generalisation. These two examples illustrate three different ways in which attempts have been made to simplify concepts, but the question of whether these are qualitative or quantitative differences is difficult to address without reference to empirical data. That is, are these methods significantly different from each other to warrant separate analysis or are they all aspects of the same process? One might propose an analysis based upon the limits of the generalization or metaphor, that is, its contribution to children's understanding of the concepts whilst doing the activity and to future understanding. For example, while the concept of cycling is much simplified if only three kinds of matter are considered, such a consideration renders an understanding of the differences between the processes such as photosynthesis and respiration problematic. However, a consideration of the significance and importance of a concept such as "Limits of Generalisation" is most properly left to a later section where it is subject to empirical analysis.

The use of metaphor is most obvious in the first two conceptual encounters, "Munch Line Monitors" and "The Great Spec-tackle". Whilst metaphors are used in the last two encounters, their use is limited to referring to concepts, or parts of concepts already covered. Van Matre's claim that these metaphors will be familiar to the participants (Van Matre and Johnson, 1987, p63) might be valid in the centres where Earthkeepers was piloted, but its validity in other contexts and other countries awaits supporting data; certainly some workers (Robbins, Randle) have objected to Van Matre's assumption that his metaphors will be familiar to every child. Metaphors are also used to encourage the making of generalisations. For example, the term 'Specks', which is likely to be more familiar to young children than the term 'molecules', is used to evoke images of small particles, but implicit in Van Matre's use of this term is the generalisation that there are only three types of 'speck'. Hence the term "speck" is intimately associated with three categories of matter.

Concepts are also simplified by generalisation by the omission of related concepts to the extent that material necessary to an understanding of the original concept is omitted. 'Time Capsules', the activity for the concept of Change, addresses ecological change without reference to concepts such as adaptation, evolution or succession and whilst this list is not meant to be exhaustive, these are some of the ecological concepts which have great relevance for the overall concept of Change. 'Time Capsules' refers to the general notion that "...things are constantly changing..." and refers to changes in organism, landscape, climate and ecosystem with little differentiation or explanation (I.E.E., 1985, p.14). It is highly likely that any concept can be simplified to the point where it begins to lack intelligibility, but whether this is true of 'Time Capsules' or any other activity, remains to be discussed.

Clearly then, Van Matre's work attempts to simplify concepts and concentrate on the 'big picture' by using techniques such as metaphor, generalisation by assimilation and generalisation by omission. Some concept statements appear to be successful at achieving clarity, providing a clear statement of the learning outcome for learners to identify beforehand, whilst others appear to conform less with Van Matre's claims. Further analysis of the way in which children's learning has been affected by the particularities of Conceptual Encounters, using empirical data, is conducted in chapter 8.

4.5.2 EARTH EDUCATION "MAKES ABSTRACT CONCEPTS, CONCRETE"

References to this aspect of Earth Education activities are numerous. The emphasis is on the activity, rather than the leader, so that "...the activity rather than the leader gets the point across" (Van Matre, 1990, p.206). Activities "...that achieve both minds-on and hands-on engagement" (*ibid.*) involve simulation of "...the action involved in the understanding..." using props in order to "bring abstract concepts into the concrete and to serve as visual focal points" (*ibid.*). Furthermore, "Good concept building... requires concrete, participatory experiences that deal directly with the concept, not with its ramifications" (Van Matre, 1990, p.272). Clearly, the importance of 'focused activity', which should be analogous to the concept or some part of it, is paramount in Van Matre's justification of his approach to conceptual learning.

Simulation of the concept is best demonstrated by 'Connection Inspection' where children take the roles of organisms and physically connect themselves to others by means of coloured cord to represent the organism's needs for soil, water and air specks and energy. That this appears to be the most effective example of simulation, is perhaps not surprising since the children are themselves living organisms with identical needs to organisms in an ecosystem. 'The Great Spec-tackle' is another activity which is mostly concentrated upon a simulation of the concept, wherein the children follow a 'speck' as it moves around the relevant cycle. Personification of the speck used by the trail guidebooks, reinforces the idea that it is the same 'speck' throughout the cycle and provides opportunities for children to experience the cycle vicariously. 'Munch Line Monitors' has no activities which actually simulate the concept of 'Energy Flow', although it does require children to build food chains and pyramids of biomass which are the logical outcome of the concept of 'Energy Flow'. Each example of a food chain is placed in a tray which has a painted line which illustrates how energy flows and diminishes between each stage of the food chain. So although the concept is not simulated, it is modelled a number of times by the leader and the children using various props. However, 'Time Capsules' involves little which could be considered to be a simulation of the concept of 'Change'. Whilst there is much activity, it is concerned with the use of a map to find a box and the matching of its contents with a poster, rather than being a simulation of the concept. Furthermore the ambiguities of the concept statements for 'Change', discussed in section 1.4.2.3.1, suggest the problems of attempting to simulate a concept, when the initial concept statements lack clarity and specificity.

The use of props is an important aspect of Conceptual Encounters and their use can be readily seen in each of the four activities in Earthkeepers. Props are used by the leader to model the concept, to present information and to orchestrate the activity and they are used by the children to help them apply concepts. The latter includes structuring experience, simulating concepts and focusing attention. Props are also often used for more than one purpose. Table 27 describes how props are used to deal with concrete rather than abstract ideas, as well as some of the other ways in which props are used during the four activities.

Most of the activities seem to involve props in a diversity of ways- through organising experience, simulating concepts and focusing attention. These are the ways in which children use the props as tools to help them perform some mental or physical action, actions which are intended to help them make sense of the new knowledge being presented. The exception to this is the Conceptual Encounter "Time Capsules" which deals with the concept of Change. In this activity objects, or models of objects, from different geological time periods are placed in locked wooden boxes and located using ancient-looking maps. Pupils then arrange these objects upon shelving where each shelf represents one of the time periods. The most obvious use of props in "Time Capsules" is to organise the activity and focus attention. At no point during "Time Capsules" are the pupils using props to simulate any of the concepts described by the five sub-statements in Table 25. The fact that 'Time Capsules' does not use props to help children apply their knowledge in this way might indicate that it does not match the claims made for Earth Education activities in general.

4.5.3 EARTH EDUCATION PROVIDES IMMEDIATE APPLICATIONS OF THE CONCEPT BY CONDUCTING ACTIVITIES OUTDOORS

Earth Education, compared with Environmental Education, is natural world-based rather than classroom-based (Van Matre, 1990, p.252) and should include "some first hand contact with natural systems and communities" (Van Matre, 1990, p.293). Conceptual Encounters are written to be conducted outdoors so that participants might "use their new understanding by finding and recording an example of that concept operating in their immediate natural setting" (Van Matre, 1990, p.296). Thus the use of the outdoors in the Encounters is cited as that aspect of the I.A.A. model (see Table 10) which addresses concept application.

Table 27 summarises the ways in which Conceptual Encounters actually use the outdoors by attempting to provide immediate applications of concepts by conducting activities in the outdoors. Each of the four activities requires children to use examples drawn from the natural world to demonstrate that they have understood the concept and can apply it to the outdoor environment. Thus, children look for examples of how Energy Flow, Cycling, Interrelationships and Change are evident in the outdoors and record these in their Training Manuals (IEE, 1985). However, finding evidence of the operation of these concepts is not always straightforward. Whilst it may be relatively simple to find evidence of a food chain for the concept of Energy Flow, it may be more difficult for children to apply their learning in order to pick out examples of cycling of materials as 'specks', which by their nature are too small to be seen. Nevertheless, the emphasis of this Conceptual Encounter is on the three cycles, rather than on the nature of "Specks" and so the activity takes place in an area where these three cycles are obviously occurring and have been clearly labelled by the trails.

Interrelationships requires a natural outdoor setting during the introduction and the closing stages for the provision of examples of how living and non-living things are related to each other. The main part of the activity relies on previous learning concerning Cycling and Energy Flow, each of which required extensive reference to examples in the outdoor setting of the activity, but it does not actually require a natural setting itself.

Change is a concept for which it is problematic to find evidence, as Van Matre (1979) acknowledges in one of the activities for Sunship Earth. In the account for the activity "Cliffhangers" he describes Change as happening "...so slowly and our time on earth to watch them is so short that we can't believe they're happening at all" and "changes on our sunship which really end up being the biggest and probably the most important are almost totally invisible" (*ibid.,* 1979, p.109). It might, therefore, seem to be unrealistic to expect children to find examples of change happening around them particularly when there is a lack of clarity concerning the concept statements (Table 25).

Table 27: The Consistency of Defining Characteristics with Conceptual Encounters- A Summary.

Conceptual Encounter ***Characteristics of Earth Education***	***"Munch Line Monitors"***	***"The Great Spec-tackle"***	***"Connection Inspection"***	***"Time Capsules"***
The "Big picture" or the nature and extent of the simplification of concepts.	*•A "Munch Line Monitor" as organising metaphor, evokes images of "Lunch Rooms" and "Lunch Monitors".* *•Metaphor reinforced by terminology, whereby food chains are Munch Lines, green plants are Sun Munchers, herbivores as Plant-Munchers etc.* *•Metaphor focused on one thing consuming another in order to obtain energy.* *•Activity ignores geothermal and chemical energy-dependent organisms.*	*•Soil, water and air Specks are metaphors for molecules.* *•Speck types representative of either three states of matter, i.e. solids, liquids and gases, or the kinds of molecules which exist in soil, water and air.* *•Specks are presented as living characters existing in cycles.* *•Metaphor focused on the nature of matter.*	*•Metaphors from previous activities, particularly those from 'The Great Spec-tackle', used heavily.* *•Interrelationships are limited to the way in which elements of an ecosystem depend on each other for soil, water, air and energy.* *•Simplified concept statements from other activities used.*	*•The Speck metaphor used to emphasize cycling of materials over time.* *•Concepts related to Change such as evolution and adaptation simplifiedby the statements "things change to use energy and materials in better ways", and "constant change keeps life going".* *•Geological history reduced to nine periods.*
"Abstract to concrete" by simulation of action, ***...use of props*** ***and "dealing directly with the concept".***	*•Action involves counting examples of 'munching', collecting and sorting 'sun munchers', 'plant munchers' etc, and arranging a 'munchline' using preselected materials.* *•Props used in activity for modelling concept ('sun' and cord, munch trays), presenting information (leader's clipboard), orchestration of activity (tally counters, children's badges), and organising experience ('munch trays').* *•Energy Flow represented by a thinning cord, thinning line painted on munchtrays, and by pyramids of numbers.*	*•Action requires children to follow a trail which represents each ecological cycle. Children read about or watch processes within each cycle.* *•Props used for simulation of concept (trails and trail guidebooks, Speck dissector, famous specks, trails and books), orchestration of activity (trail books), and focusing attention (hand lens).* *•Cycling partly represented by a series of demonstrations and by the circular 'speck'trails. Trails rely on children reading and understanding trail books.*	*•Action involves demonstrating connections between things in an ecosystem which obtain energy and materials from each other.* *•Props used for modelling concept (web-leaf-caterpillar), organising experience (connection scopes), simulation of concept (cords and belt) and orchestration (locks).* *•Interrelationships represented by many connections between two things, firstly on a model, then outdoors and finally by children connecting to others in a web.*	*•Action involves children in using a map to find buried boxes, matching its contents with a poster and then a shelf.* *•Props used for orchestration (time capsules and contents, maps, shelves, posters), presenting information (posters and shelves) and modelling concept (final arrangement of props).* *•Change itself unrepresented. The effects of change shown by items on shelves, by leader's talk, and by posters.*
"Immediate applications by conducting activities in the Outdoors..."	*•Counting incidencies of 'munching' in outdoors.* *•Collecting evidence of 'munching' in outdoors.* *•Construction of 'munchline' using organisms in immediate environment.* *•Construction of pyramids of numbers from examples of types of "munching".*	*•Trails follow the path of specks as they become part of things at the trails' stations.* *•Finding examples of three things which would be part of soil, water and air cycles.*	*•Identification of two things in immediate environment which are connected to each other. This occurs both as part of the activity and as a final application of the concept.*	*•Identification of something, from the immediate environment, which is changing.*

(After Van Matre and Johnson, 1987; Van Matre *et al.*, 1987)

4.6 COGNITIVE DEVELOPMENT IN EARTH EDUCATION

Earth Education is based on a psychology which is somewhat cosmopolitan but few references provide explicit justifications of the learning activities. Specifically, Sunship Earth (Van Matre, 1979) refers to the work of Skinner and Bruner, (*ibid.*, pp.27-28) and Piaget (*ibid.*, p.26) and lists those aspects of Sunship Earth's activities which can be explained using these theories. More recently, Van Matre has placed a certain degree of distance between the theories discussed in Sunship Earth and the approach of The IEE and he claims that his approach is aligned with no particular psychological theory, but that program designers selected the educational approach most suited to the outcomes they had in mind (Van Matre, 1990, p.281). Given the wide variety of activities addressed by the programs this pragmatic approach to psychological theory should not be surprising. Unfortunately this does rather miss out on the opportunity to ground thoroughly the work of The IEE in educational psychology and therefore counter some of the arguments of its most vehement critics.

To this end the next section will provide a more complete analysis of the work of Earth Education, focusing on Earthkeepers (Van Matre and Johnson, 1987), and will illustrate how programs may be connected with selected psychological theorists. Such theorists were often working with different ontological and epistemological assumptions and therefore some of the difficulties of adopting an eclectic approach are explored.

4.6.1 THEORIES OF COGNITIVE DEVELOPMENT IN EARTHKEEPERS

Van Matre stresses the role of "...dynamic, and relatively shocking techniques (...and...) good, ordered instruction..." (Van Matre, 1972, p.121) in effecting the learning of concepts. This 'instruction' is described in terms of a "formula" (*ibid.*, p.5), being manipulative (*ibid.*, p.12), and having specific objectives (*ibid.*). Furthermore Earth Education programs are intended to be "focused, sequential (and) cumulative experiences" (Van Matre and Johnson, 1987, p.8). Such terms are entirely consistent with a programmed learning approach which is a direct result of the work of the behaviourist B.F.Skinner (Child, 1993, p.112; Fontana, 1985, p.169). Some elements of a Linear Programming system are outlined in Table 28.

Table 28 : Elements of Linear Programming Systems (Child, 1993, p.112)

i)	Small pieces of information presented in logical sequence at such a pace in order to guarantee success.
ii)	Active responses on the part of the learner, usually entailing writing a word or phrase in answer to a question.
iii)	Immediate knowledge of the accuracy of the result, which is usually correct.
iv)	Pupils can work at their own pace.

Examination of the Concept Statements for the Conceptual Encounters activities illustrates how they use Linear Programming. For example, in the Concept Statements for Energy Flow and Cycling (Shown in Table 29 and Table 30) sub-statements are arranged in a certain sequence where each draws on definitions and terms used in the previous sub-statement.

Table 29: Concept Statements and Sub-statements for Energy Flow and Cycling (Van Matre *et al.*, 1987)

Conceptual Encounter	Concept Statement
"Munchline Monitors" (Energy Flow)	1. All living things need energy to grow, to move, to do anything. Energy is the spark of life. 2. The earth receives its energy from the sun in the form of light. 3. Green plants capture this sunlight energy and turn it into food. 4. Animals get this stored sunlight energy when they "munch" plants or other animals that eat plants. 5. The flow of sunlight energy from plants to animals and on to other animals is what we call a "munch line" or a "food chain".
"The Great Spec-tackle" (Cycling)	1. Everything is made up of the same basic building materials, whether a plant, an animal, a rock, or you! 2. These specks of materials that make up everything have been around a long, long time and are used over and over again by all living things. 3. We call this movement of life's building materials, in circles powered by energy from the sun, cycling.

Furthermore participants give 'Active responses' at the end of the activity which comprise a drawing, word, or phrase entered in the Training Manual. The participants receive immediate feedback from the program staff in the form of a signature at the end of the activity which 'validates' that section of the manual.

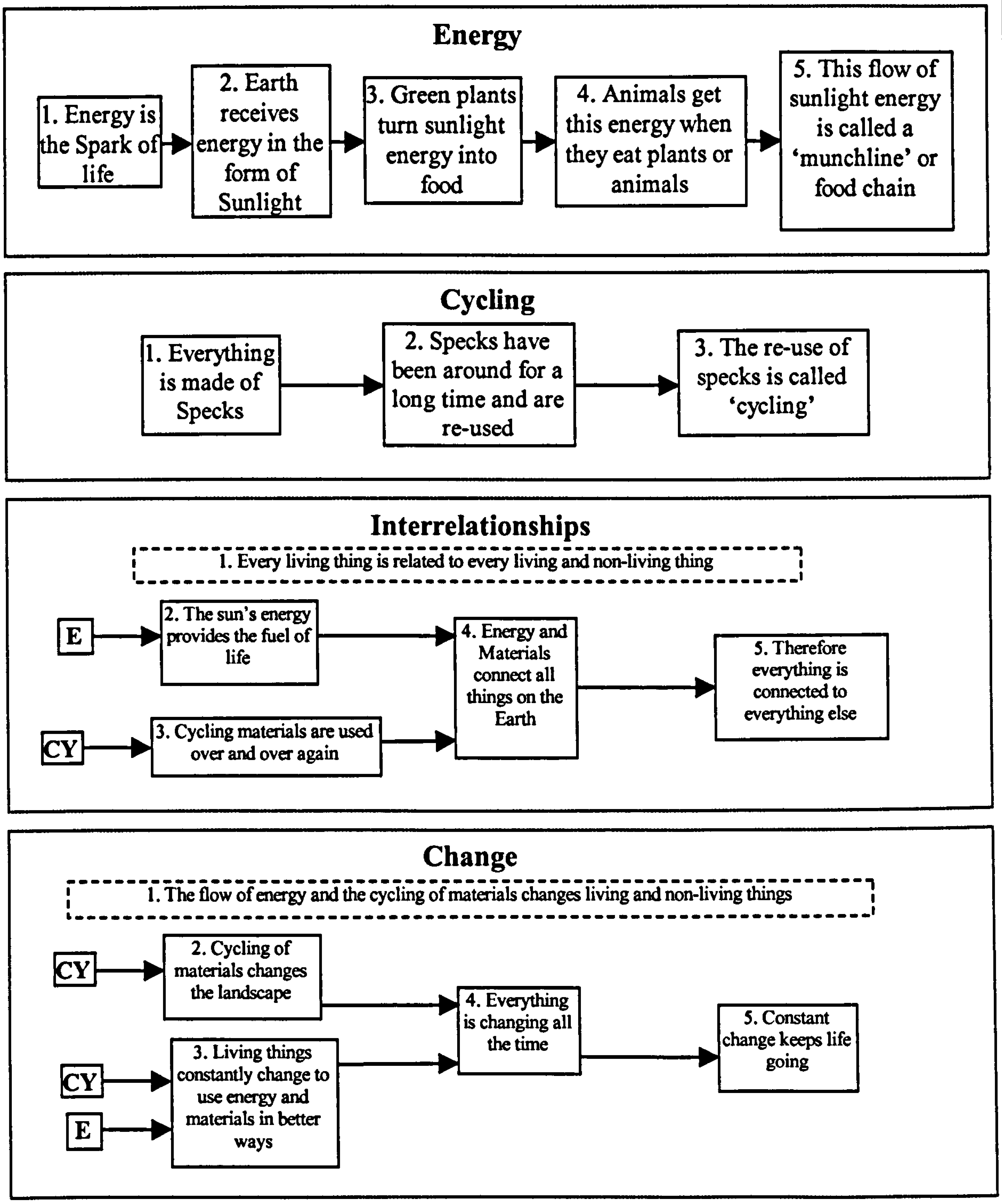
Ideally participants should be providing active responses for each of the sub-statements, nonetheless it can be seen that this is a good example of a linear learning program.

The other two Conceptual Encounters' Concept Statements are given in Table 30. The sub-statements have a much less sequential order but they draw on the learning from previous Conceptual Encounters and in this way exhibit some form of linearity in their structure. These Conceptual Encounters also use immediate feedback on participants' active responses to reinforce their learning.

Table 30: Concept Statements and Sub-statements for Interrelationships and Change (Van Matre *et al.*, 1987)

Conceptual Encounter	Concept Statement
"Connection Inspection" (Interrelation-ships)	1. Every plant and every animal is related to every living and non-living thing on the earth. 2. Energy from the sun provides the fuel for all life. 3. Materials that cycle are used over again, providing the stuff of which all things are made. 4. Together, the energy and materials connect all the things on the earth in a giant web of life. 5. As a result, everything is related to everything else.
"Time Capsules" (Change)	1. Over time, the flow of energy and the cycling of materials through living and nonliving things, changes those things. 2. Materials such as air and water, moving through great cycles powered by the energy of the sun, change the landscape. 3. Living things are constantly changing so they can get and use energy and materials in better ways. 4. Everything is changing all the time. 5. It is this constant change that keeps life going.

The structure of these four activities and how they relate to each other as programmed learning is shown in Figure 6.



Notes

i) Each Conceptual Encounter has been divided into sub-statements, numbered 'frames' or units of information, which have been given solid outlines.

ii) The first sub-statements for Change and Interrelationships are 'advanced organisers' of the *whole* concept rather than individual frames of the concept. These sub-statements have been given dashed outlines.

iii) Sub-statements for Energy Flow (EF) and Cycling (CY) are pre-requisite frames for Change and Interrelationships. Where these frames are required, they are shown in bold initials.

Figure 6: A Diagrammatic Representation of Programmed Learning in Earthkeepers's Conceptual Encounters

Linear programs also typically contain remedial loops (Child, 1993, pp.112-114) but these are not evident in Earth Education programs. Another important aspect of learning programs is the use of reinforcement (Skinner, 1969). This is defined as a form of reinforcement which affects the likelihood of the re-occurrence of a certain behaviour or response. Reinforcement can be either positive or negative. Positive reinforcement includes rewards or praise which would increase the likelihood of the behaviour being repeated while negative reinforcements, for example the withdrawal of privileges, would make certain behaviour less likely. Positive reinforcements are widely used in Earthkeepers in the form of Training Manual signatures, the presentation of keys during ceremonies and the giving of badges to participants when they demonstrate 'desirable' behaviour. The use of such 'token economies' is prevalent in Earthkeepers, indeed in much of schooling, but the *systematic* use of such a reinforcement schedule is particular to behaviour modification programs (Child, 1993, pp.109-110) and has been successfully used to treat abnormal behaviour (Tyler and Brown, 1968; Hoghughi, 1979).

Another aspect of behaviourist psychology evident in Earthkeepers involves the use of Modelling. Modelling has been discussed by Bandura (1970) as a process by which children learn by imitating and watching others. Van Matre and Johnson (1987) use this in Earthkeepers and they suggest that leaders consider what they wear, tools they carry, what they eat and drink and how it's packaged or perform simple acts like stopping to smell a flower or turning lights off (p.98). Although it is suggested that these actions will all be remembered long after the program is over, Van Matre and Johnson (1987) do not seem to expect participants to simply imitate these actions, although it is inferred that providing examples such as these will give participants ideas for how they might alter their own behaviour.

Now, Skinner was not concerned with what happened inside the organism, merely the provision of appropriate rewards in order to make a desirable response more likely (Child, 1993, p.99). His focus was upon observable behaviour and the conditions in which it occurred (Fontana, 1985, p.148). Therefore the only objects of consideration were the Stimulus (S), the Behaviour or response (B), and the Reinforcement (R). Thus, establishing predictable connections between these three aspects of a learning event (S-B-R) were of key importance to behaviourists' learning programs. One critic of Skinner's approach was Bruner (1973) who emphasised the importance of the role of the learner, in this representation of learning. Whilst Van Matre's description of how his learning programs focus on "terminal behaviour" (1979, pp27-29) through the use of positive reinforcement might indicate that he adopted an entirely behaviourist approach towards cognitive development, other aspects of Earthkeepers might suggest otherwise.

Bruner suggested that the organism was involved in the active restructuring of knowledge through interaction with the environment and learners should organize knowledge for themselves (Child, 1993, p.119). Central to Bruner's ideas was that learning was most effective when children engaged in 'guided discovery' (*ibid.*). This 'guided discovery' required the learner to manipulate and transform the information in such a way as to provide a means of checking the validity of the transformation. Thus existing categories or concepts would evolve to include the new information, or would be changed in order to accommodate it. This process involved induction, or reasoning involving moving from the specific to the general, and the use of 'errorful learning' or trial and error strategies (Child, 1993, p.105). In order to facilitate this process, learning should be organised by the teacher in such a way as to reduce its complexity. This reduction in complexity was manifested by Bruner's 'Spiral Curriculum' where the most fundamental elements of a concept were presented first.

Bruner also emphasized the importance of the characteristics of the learner where the transformation of new information depends upon the learner's previous experiences, thoughts, aspirations and perceptions (Fontana, 1985, p151). The learner's response could not be considered to be mechanistic as in Skinner's model (S-B-R), but rather individualistic and subjective (*ibid.*). A final aspect of Bruner's approach which has some relevance here is his perspective on the way in which learner's transform information. He suggested (Bruner *et al.*, 1965) that learners use three methods- the *enactive* (using action and physical manipulation of objects), the *iconic* (using imagery dependent upon input from sensory organs) and the *symbolic* (representation through language which leads to abstract and more flexible thought). Unlike Piaget, Bruner suggested that these three methods occurred throughout the learner's life and were not dependent on biological development.

Van Matre's learning activities and learning model have clear parallels with Bruner's work. Firstly, the I.A.A. model, or "Informing- Assimilating- Applying" (Van Matre and Johnson, 1987, p.21) is similar to Bruner's adaptation of Skinner's model of learning, as it attempts to take into account the learners' characteristics. To this end great emphasis is placed upon perception and affective aspects of the learning situation in Earth Education. This is indicated by Van Matre's summary statement that Earth Education "...starts where the learners are..." (Van Matre and Johnson, 1987, p.8). Secondly, Van Matre's simplification of concepts can be compared with Bruner's Spiral Curriculum. Generally concepts in Earth Education are encountered only once and there is little development throughout short programs such as Earthkeepers, but it might be argued that the earlier concepts of Energy Flow and Cycles are revisited, revised and elaborated in the later Conceptual Encounters activities of Interrelationships and Change, representing some form of 'Spiral Development'. Third, Van Matre (1972, p.121) has been critical of discovery learning when used in a disorganised or haphazard manner but uses highly structured discovery learning in his early programs (Van Matre, 1972; 1974). The "Discovery Party" - "EM's Diary" in Earthkeepers (Van Matre and Johnson, 1987, pp.81-88) also represents how Earth Education uses some discovery learning, although this activity is mainly intended to provide an opportunity for participants to build a "sense of wonder and place" (*ibid.*, p.81) rather than engage in discovery learning in a Brunerian sense, that is using induction and errorful learning. Finally, Van Matre's leaders' guidelines refer to the need to avoid "...talking without a focal point" (Van Matre and Johnson, 1987, p99) as "...most people are visual learners" (*ibid.*). Whilst this might have parallels with Bruner's iconic system, Bruner also argued that people also learn symbolically and enactively and he argued that children should be challenged to use other modes as appropriate.

The influence of other psychologists' work on Earthkeepers and Earth Education programs has been discussed in previous sections. Their contributions, and the contributions of Bruner and Skinner, have been summarised in Table 31.

Table 31: Approaches to Cognitive Development in Earthkeepers

Theory	Program Element
Skinner (1953; 1969).	
Learning Programs	•Sequential Organisation of sub-concepts in Conceptual Encounters. •Sequential organisation of Conceptual Encounters. •Small conceptual 'steps' in Conceptual Encounters.
Use of Operant Conditioning for Positive Reinforcement in learning.	•Use of 'Immediate' Feedback and Rewards
Behaviour Modification: Token Economy- Rewarding behaviour as well as Learning outcomes.	•Use of rewards such as badges, stamps, signatures and keys.
Behaviour Modification- Modelling (also Bandura, 1970).	•Leaders' modelling of appropriate behaviour
Bruner (1966; 1973), Bruner and Goodman (1947) and Bruner *et al.* (1965)	
'Active' restructuring of knowledge through experience.	•Application part of I.A.A. learning model.
Discovery Learning (Guided Discovery).	•'Discovery Party'- "EM's Diary"
Iconic System of Learning.	•Use of senses in many activities.
Spiral Curriculum.	•Concept Simplification (*cf.* Skemp, Ausubel, Gagné) •Revision of Energy Flow and Cycling in Interrelationships and Change
Importance of the characteristics of the learner for interpreting the meaning of events.	•Emphasis on guiding perception and providing positive experiences.
Ausubel (1968)	
Direct (Verbal) Instruction as opposed to Discovery Learning.	•Used in Conceptual Encounters to introduce and structure activities. •Used to organise activities prior to start.
The importance of Advance Organisers in providing meaningful verbal learning.	•Concept simplification, generalisations, omission and analogy. (*cf.* Bruner, Skemp, Gagné)
Piaget (1929)	
Stages of Development (Concrete Operations/Formal Operations).	•Provision of 'concrete' models of concepts and reference to concrete examples of concept in outdoor environment •Attempts to make abstract concepts appear concrete using tools.
Assimilation and Accommodation.	•Reference to assimilation as a form of processing conflating both Piagetian terms of 'assimilation' and 'accommodation'.
Importance of 'activity' in laying down schemata.	•Use of physical activity in Conceptual Encounters
Internalised imagery	•Representation of things using images (multisense images including sounds and smells as well as sites) and use of visual focal points. (*cf.* Bruner above)
Schemata etc.	•Reference to concept groups as schemata.
Gestalt School (Wertheimer, 1961)	
Importance of Perception for achieving closure and learning for meaning.	•Importance of meaningful learning
Skemp (1986)	
Schematic Learning (for learning of new knowledge using organising analogies and overlapping content)	•Simplification of concepts using 'big picture' statements (*cf.* Bruner, Ausubel, Gagné).
Gagné (1985)	
Discrimination of Critical Attributes as pre-requisite of concept formation.	•Simplification of Concepts in Conceptual Encounters. (*cf.* Bruner, Ausubel, Skemp)

4.7 TENSIONS IN EARTH EDUCATION

This discussion has alluded to some of the more significant tensions between Van Matre's descriptions and highlights the difficulty of attributing his approach to any one theory of cognitive development. These will now be explored in greater depth.

4.7.1 PERCEPTION AND CONCEPTION

In Acclimatization, the first of Van Matre's programs, concepts were defined as "...a cognitive abstraction used to categorize or classify human experiences and perceptions" (Van Matre, 1972, p.121). This definition suggests firstly, that Van Matre regards perceptions and experiences as the 'building blocks' of concepts, and secondly that concepts are classification devices which structure these building blocks. The organisation of these ideas is shown in Figure 7 and is broadly compatible both with Broadbent's filter model (1987) and Coren *et al.*'s phases (1979).

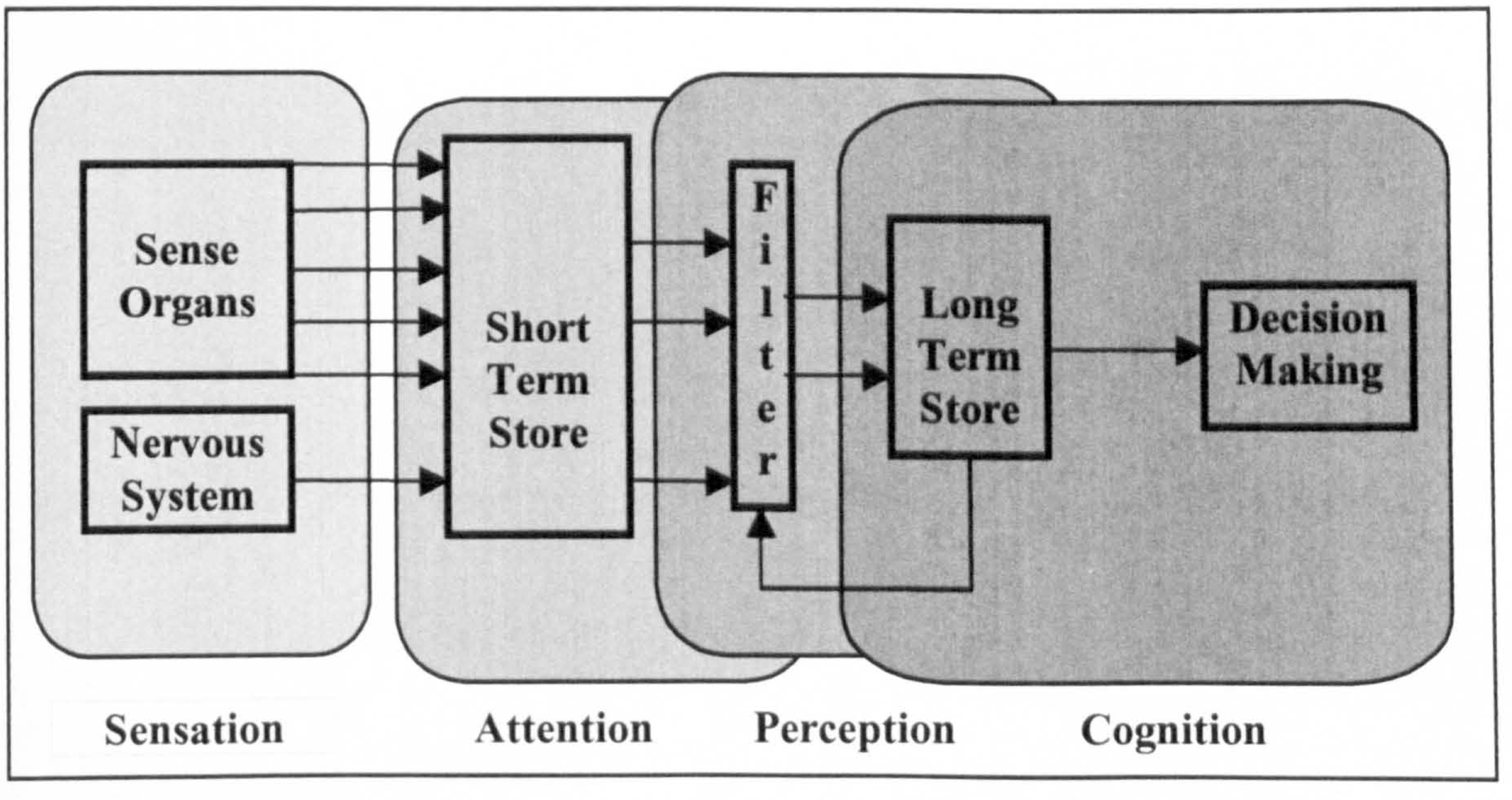


Figure 7: A simplification of Broadbent's (1987) Filter Model incorporating the Phases of Sensation, Attention, Perception and Cognition (Coren *et al*, 1979, pp.7-9)

The simplified diagram illustrates how perceptions are regarded as conscious representations of the outside environment. However Van Matre (1972, p.121) has tended to conflate the notion of perceptual frames and conceptual frames as he later equates 'Ecological Concepts' with 'conceptions' and 'perceptual forms' implying that these three terms are equivalent. This reflects a general difficulty in this field of psychology; indeed Coren *et al.* (1979, p.8) caution against drawing sharp lines between one 'phase' and another. Notwithstanding this apparent lack of clarity, Van Matre much later clarifies his description of conceptual frames as being an "...arrangement of perceptual lenses through which you view the world" (1990, p.278) reverting to a clearer distinction between perception and conception.

Whilst the problems associated with Van Matre's use of the terms conception and perception might seem to be minor, they assume greater significance when examined in light of the way in which learning activities have been designed to effect perceptual and conceptual change.

4.7.2 CONCEPTUAL SUBSTITUTION

Van Matre initially describes concepts as 'perceptual frames' which must be *refocused* by organised, "dynamic and relatively shocking... techniques" (1972, p.121). The aim of the program is described as being that of *substituting* new conceptual structures for previously held frames so that the *imposed* conceptions of Acclimatization direct the child to see a forest as an ecological community, for example. Note that the role of a learning program is described as being the 'imposition' and 'substitution' of new frames using 'refocusing' techniques. There are several issues that Van Matre's discussion highlights. Firstly, there is perhaps, difficulty in viewing 'imposition' and 'substitution' as refocusing events. That is, the term 'refocusing' implies a quantitative change whereas 'imposition' and 'substitution' imply a qualitative change. However, it is likely that a 'substitution' model of changing perception was most consistent with Van Matre's view of the role of this early learning program as he also explains that the program goal was to encourage individuals to discard 'frames' of the past (*ibid.*, p.121).

Secondly, it calls into question whether it is possible to impose on a learner, an idealised form of Ecological concepts, "... 'imposed conceptions' or perceptual forms..." (Van Matre, 1972, p.121) because any new sensations will be altered in the very act of their perception by the learner (Refer to Broadbent's Filter Model, Figure 7). Therefore it would be very difficult to predict, with any reliability, the changes likely to occur to sensations as they become perceptions. New frames would be as variable as the experiences which the learners bring to the learning experience.

Lastly, it poses the question of whether it is possible to substitute permanently an individual's framework of perceptions. Although perceptions have been found to change as the neonate develops into a child and then an adult (Coren *et al.*, 1979, pp.377-387), there is no suggestion that they can be replaced permanently by intervention[12]. Perhaps, then, because perceptual frames are the products of experience and culture (Bruner and Goodman, 1947) and have been shown to be resilient to permanent change or readjustment, then any notion of substitution of perceptual frames is problematic, particularly with an educational program which has limited time available for its delivery. It might, therefore, be interpreted that Van Matre's (1972, p.121) discussion is more concerned with the substitution of *conceptual* frames than perceptual frames. However, the notion that conceptual frames may be simply substituted by another has been called into question by the work of the Constructivists.

Later discussions (Van Matre, 1990, pp.270-278) represent a refinement of this 'substitution' model of concept learning. This discussion is centred around concepts as mental categorizers, mental filing folders (*ibid*, p.270), and as perceptual lenses (*ibid.*, p2.78). The role of Earth Education is to organise these 'folders' and build new ones (*ibid.*, p.271), provide examples for these 'folders' to organise (*ibid.*, pp.275-276) and develop them 'properly' (*ibid.*, p.278). So although there seems to be a shift in Van Matre's view of concepts and perception, his latter approach discussing concept 'development' and 'formation' rather than 'substitution', references to *proper* development and the cleansing of perceptual 'lenses' still remain. This is a softening of the 'substitution' approach but it might still imply that conceptions and perceptions would only be regarded as 'proper' or 'clean' when they match an idealised version.

4.7.3 THEORIES OF COGNITIVE DEVELOPMENT

Table 31 illustrates not only the range of psychological theories used in Earth Education programs, but also that psychologists often discuss the same phenomenon in different terms. For example, the practice in Earthkeepers of providing a simplified 'big picture' can be related to Ausubel's *advance organisers*, Bruner's *Spiral Curriculum*, Skemp's *schematic learning*, or even Gagné's *critical attributes*. On a wider level tensions exist between aspects of the theories in general. For example, one of the main implications of Piaget's work was that cognitive development was intimately tied to biological development and could not be accelerated by teaching. Bruner disagreed and suggested that teachers should attempt to get pupils through stages as quickly as possible (Sutherland, 1992, p.58). Bruner also criticized Piaget's failure to take fully into account the nature of the learner and how they construct meaning from their experiences (*ibid.*). Such tensions are evident in Van Matre's attempts to justify his approach using such theories. For example, Van Matre (1979, pp.27-28) states that Sunship Earth is built on instructional theory that strives for the "elimination of the likelihood of wrong answers..." (*ibid.*, p.27) using Skinner's work, and at the same time takes into account the "permission of mistakes (the

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[12] Research involved with perceptual rearrangement has shown that whilst it is possible to learn an entirely new set of spatial percepts (Stratton, 1897; Kohler, 1962, 1964), the change could be reversed by removing the stimulus causing the change (Kohler, 1962, 1964). Kohler's (1962,1964) experiments involved the subject in wearing optically distorting glasses.

group problem solving approach)" (*ibid.*, p.28).

On a deeper level still, tensions exist between the guiding assumptions that such theories of cognitive development depend on. Such assumptions are concerned with the nature of the learner, the nature of knowledge and therefore the nature of the instructional process. Skinner was concerned with the study of observable behaviour or responses to certain stimuli. Great emphasis was placed upon controlling the environment to produce learning irrespective of the volition of the learner (Fontana, 1985, p.148). This *behaviourist* approach assumes that knowledge is structured hierarchically[13] and that it is objective and universally valid. Furthermore it assumes that learning is a process of reproduction of transmitted knowledge (Kemmis *et al.*, 1983, pp.11-14). Such a view is typically part of the vocational/neo-classical (Fien, 1993), or normative (Cohen and Manion, 1981, pp.24-26), paradigm of social experience.

Bruner was concerned with the re-organisation of the material and the prior conceptions and perceptions of the learner. Here, emphasis was on the individual and the way he or she makes the environment meaningful rather than on the environment exclusively (Fontana, 1985, p.148). Individuals are seen as active in reconstructing meaning for themselves. This *cognitive* approach assumes that knowledge is personal and tied to particular instances and purposes, and is not necessarily hierarchical. Furthermore it assumes that learning is a process of knowledge production which is particular to the learner and cannot be explained by mechanistic behaviourist theories (Child, 1993, p.99). Such assumptions are often associated with the liberal/progressive (Fien, 1993), or 'interpretive', paradigm (Cohen and Manion, 1981, pp.24-26) of social experience.

Since Van Matre and Johnson (1987) use theories from Skinner, Bruner and others to justify the approach of Earth Education it might be concluded that the programs are riddled with theoretical inconsistencies at many levels, including those fundamental assumptions which govern ontology and epistemology. Previous sections have demonstrated that although Van Matre discussed learning in terms of transmission and knowledge reproduction in his early work (1972; 1974), later programs and publications discussed learning in terms of knowledge production in a particularistic and subjective fashion. However these later programs (Van Matre, 1979; Van Matre and Johnson, 1987) also used behaviourist techniques such as behaviour modification and programmed learning as well as dealing with perceptions, feelings and values. Even the earliest program tended to indicate a cognitive approach illustrated by the description of the teacher's role as being regarded as a facilitator of the learning experience so that he or she may "...establish a warm, sincere and searching, questioning strategy" (Van Matre, 1972, p.82). More recently Van Matre (1999) has indicated that a cognitive approach would be most preferable in an ideal situation but the demands of producing a program with limited time available preclude the adoption of such an approach in its entirety.

Such pragmatism is not uncommon in the field of educational psychology. Fontana (1985, pp.148-149) suggests that the behaviourist approach and the cognitive field approach are not mutually contradictory but rather that since the teachers are concerned with the practicalities of learning they may adopt the approach best suited to the outcomes in mind. Child argues that no one learning theory provides all of the answers, nor do all of the theories put together provide all of the answers. "The only course we can justifiably take is a pragmatic one." (1993, p.101). Finally, Sutherland concludes that teachers should use the model appropriate for the needs of particular pupils (1992, p.124). These comments echo Van Matre's comment that his approach to learning was aligned with neither a Skinnerian nor Brunerian approach. The task of program builders was to select the approach "... most suited to the outcomes we have in mind for the setting and situation within which we must operate." (Van Matre, 1990, pp.280-281). Similarly Gagné (1985) has proposed an overview which draws upon many of the

[13] This hierarchy is described both in relation to its difficulty and status. Hammersley (1977) has commented that such a view is heavily institutionalised in the English educational system.

theories presented in previous sections, drawing upon the fields of perception, selective attention and information processing models of memory, concept formation and language development. Gagné differentiates between five categories: intellectual skills, cognitive strategies, verbal information, motor skills and attitudes (*ibid.*) and suggests that each category requires different approaches appropriate to the conditions of learning. Van Matre's approach is perhaps most closely aligned with Gagné's.

4.8 POSTSCRIPT: CONSTRUCTIVISM

Many workers, particularly in the field of science and mathematics education (Sutherland, 1992, p.81; Child, 1993, p.167), have proposed an alternative framework for the analysis of pupils' learning. This framework, referred to as Constructivism is 'alternative' in two senses (Sutherland, 1992, p.79): it is often proposed as an alternative to the traditional Piagetian approach to teaching and learning, and also considers that children use ideas alternative to the accepted scientific theory in order to understand and explain the world (*ibid.*).

The main tenets of constructivism suggest that learners construct their own versions of reality from their own unique experiences. Such constructions are then used to interpret new experiences. Such knowledge production is an active process whereby relationships between new information and pre-existing concepts are formed (Sutherland, 1992, p.79). Research in students' ideas has consistently revealed five main findings which are detailed in Table 32.

Table 32: Constructivist Research Findings on Students' Ideas

i) Students frequently hold pre-existing explanatory views of phenomena which are personal, idiosyncratic and often different from accepted explanatory scientific theories. ii) These views can be remarkably unaffected by traditional instruction. iii) Particular views can be quite common and one view can be held by a variety of students. iv) Some students can hold both a 'scientific view' and their 'pre-existing view' in parallel. The scientific view is used in school contexts whereas their own view is used to interpret the world. v) Such pre-existing views are remarkably consistent across groups differing in age and nationality.

(Gunstone, 1988, pp.74-75)

Furthermore, Driver (1988) listed six issues which are relevant for a constructivist view of learning. These are summarised in Table 33.

Table 33: Epistemological and Pedagogical Issues in Constructivism

Learning outcomes depend on the learning environment, and the knowledge, purposes and motivations of the learner. Learning involves the construction of meaning. That construction of meaning is a continuous and active process. Learners will assess the validity of their new constructed meanings. Learners have the responsibility for their own learning. There are communalities between the meanings that students construct.

(Driver, 1988, pp.133-149)

Gunstone (1988, p.78) comments that despite differences in opinion and approach the central issue in constructivism is that individuals generate their own understandings. Such generation of meanings is central to the 'generative learning' model proposed by Osborne and Wittrock (1983).

Gunstone (1988, pp.84-85) has also noted that whilst Piaget's work on the acquisition of conceptual schemata was a major antecedent of constructivism, constructivists and Piagetian scholars part company when stages of development are discussed. Whilst Piagetians view reasoning skills as being dependent upon stages of development which are closely connect with biological development, constructivists regard the context and content of the discussion as being much more significant. Sutherland (1992, p82) also identifies the importance of Piaget for a constructivist approach and argues that the important commonality lies in seeing the teachers' role as being facilitative rather than didactic, although Driver (1983) has argued for a more interventionist role for teachers. Sutherland (1992, p79) also believes that Ausubel's (1968) views of the importance of 'personal constructs' and 'meaningful verbal learning' are important contributors to constructivism. Bruner's emphasis was on discovery learning and this has partly influenced the British constructivists such as Driver (1983), who argue for the importance of practical work. However, Brown and Denvir (1985) caution against the use of practical work as an end in itself for the individual must be able to strip the essential 'structure' from the 'noise' (Sutherland, 1992, p.80).

Although there is general agreement about the principles of a constructivist approach as described in Table 32, there is much disagreement about the form a constructivist teaching program should take. However, the approach can be described as a cognitive-field approach (Fontana, 1985, pp.148-149) taking a liberal/progressive stance on epistemology, the teacher-student relationship, the teacher's role, the student's learning role, and the nature of learning theory (Fien, 1993, pp.20-21).

4.8.1 EARTH EDUCATION AS CONSTRUCTIVIST EDUCATION?

Given the importance of constructivism in current approaches to pedagogy, particularly the teaching and learning of concepts, the question of compatibility between constructivist theory and Earth Education arises. Superficial analysis might suggest there is little agreement between Gunstone's (1988) five areas (Table 32) or Driver's (1988) 'Issues' and Earthkeepers's pedagogy as the Conceptual Encounters activities tend to use programmed learning, relying on a transmissive, rather than generative view of learning.

Van Matre pays little attention to the provision of experiences by experimentation in his programs, a technique used extensively by Driver *et al.* (1985) but his use of 'advance organisers' is supported by the work of Shayer and Adey (1981). Whilst discussion and interview are mentioned widely as being important 'probes' of student's alternative ideas (Gunstone, 1988, p.75), Van Matre's early programs (1972, 1974, 1979, 1987) have tended to ignore the importance of pupil talk in the generation of meaning in stark contrast to the work of Osborne and Freyburg (1985) and Driver *et al.* (1985), and earlier theorists such as Barnes (1976), Vygotsky (1962) and Bruner (1966) who believed language development was a crucial aspect of learning. But Van Matre has also suggested (Van Matre, 1979, pp.7-8; Van Matre and Johnson, 1997, p.118) that one of the most important tasks of leaders is to encourage the learners to engage in discussion in order to make experiences as meaningful as possible. Neither is such generation of meaning ignored in earlier programs such as Earthkeepers. Participants are encouraged to reflect upon their learning in various activities and to "...relate these experiences to their lives..." (Van Matre and Johnson, 1987, p.6). Whether such experiences are effective and compatible with a constructivist approach depends upon the extent to which the analogies used in Earthkeepers are intelligible, plausible and fruitful (Gunstone, 1988, pp.87-88). Clearly the resolution of such an issue depends upon empirical work and this will be the subject of Chapter 8.

4.9 SUMMARY

This chapter has examined the development of Earth Education from the Acclimatization programs of the 1970s. It has examined how the learning theory in Earth Education and the definition of concepts has evolved over two decades. Such evolution has been driven, partly at least, by forces internal and external to The IEE. Developments represent shifts in Van Matre's thinking, changes to the context in which programs have been implemented and changes in Environmental Education as a whole (if such a thing can be said to exist!). The discussion has also carefully examined the Earthkeepers program and its antecedents for internal consistency. Since Earthkeepers uses activities better defined in earlier programs, it was considered important to analyse the range of programs produced by Van Matre *et al.* in order to uncover the roots of some of the activities. Some of Van Matre's claims are difficult to support in their entirety due to inconsistencies between rhetoric and practice, but others require reference to empirical work in order to evaluate them in more depth.

Despite logical and theoretical tensions in the program, the eclectic approach of Earthkeepers is supported by psychological theory which, although it makes many references to the behaviourism of Skinner and the cognitive field approach of Bruner amongst others, cannot be identified with any single epistemology or ontology. Finally the discussion considered the Earthkeepers program in the light of Constructivism, a contemporary approach to the learning of concepts which has particular ascendancy in science and mathematics education.

5 EARTH EDUCATION AND ECOLOGICAL FEELING

Chapter 4 has discussed the evolution of Earth Education's approach to the learning of ecological concepts and has shown that there have been several changes in the Earth Education curriculum. These have included changes in the subject matter addressed by the programs involving a tighter specification of content, and also changes in the way conceptual learning has been depicted and effected. The approach to the cognitive domain in Earth Education has been linked to psychological theories and whilst some elements of Earth Education may have been influenced by these theories, other elements have developed alongside them and in some cases pre-date them. But what is the place of ecological feeling in Earth Education, how is it thought to interact with participants' behaviour and understanding and how has this developed since the first Acclimatization programs? This last question is particularly pertinent since Van Matre was probably the first to produce nature education activities that dealt explicitly with developing feeling.

This chapter is a discussion of Earth Education's approaches to the development of feelings and emotions in the programs and activities. It is organised into four main sections. The first section (5.1) discusses the role of affective development in Acclimatization. It explains how 'feeling' is a rather inadequate term, as are many of the terms used to describe affective development, and suggests that a broader term 'awareness' is more appropriate. Perception is a key aspect of developing this awareness and it is described as having four separate attributes. Other elements of affective development are introduced in a later ACC publication and include values, emotions, feelings and lifestyles.

Section 5.2 discusses the shift in approaches to affective development evident from an examination of the Sunship Earth program which was published whilst ACC was evolving into Earth Education. The main differences include the organisation of the program which appears to be shorter in duration, uses a narrower range of affective objectives, and the use of activities which are more clearly focused towards specific affective outcomes. Each type of activity, or vehicle, is discussed separately to examine how affective objectives are addressed in different ways. The section critically discusses the framework of methodology introduced earlier ("Figure 5: The Major Components of Acclimatization (Van Matre, 1979, p.6), p.79) and illustrates how this diagram relates to the program's curriculum and objectives, along with other extracts from the publications. However, it shows that the distillation of affective objectives from the program literature is no simple task. The section also emphasises the philosophical position of Earth Education and links it directly with the work of Naess (1973). This leads on to a final examination of a more focused emphasis on values and behavioural objectives through explicitly encouraging lifestyle change.

Section 5.3 examines the way in which affective objectives are addressed by the Earthkeepers program. Key developments from Sunship Earth include the reduction in program duration, the more specific statement of affective objectives, and the application of programmed learning to affective activities. Many of these changes were brought about by the changing context in which programs were delivered, from summer-long camps to short term residential and non-residential centre visits. The same range of vehicles is used in Earthkeepers although the duration and structure of these vehicles has been made comparable with the conceptual activities. Furthermore, Van Matre and Johnson (1987) made fewer claims about the extent to which Earthkeepers was capable of influencing affective development. Not only was the program described as a "Springboard Unit" (Van Matre and Johnson, 1987, p.11) for stimulating further work, but it was also more concerned with developing initial positive feelings towards the natural world, as opposed to creating a qualitative shift in awareness.

The final section (5.4) is a detailed analysis of how 'feeling' is addressed in the most comprehensive Earth Education publication (Van Matre, 1990), and how this relates to the Earthkeepers program. The chapter concludes with an analysis of the way in which values development and behaviour change are addressed in contemporary Earth Education publications, wherein the statements about values and behaviour are unequivocal.

5.1 ACCLIMATIZATION AND ACCLIMATIZING

The introduction to The Conceptual Approach of Earth Education has suggested a role for ecological feeling in Acclimatizing programs although this is not always clearly or consistently articulated, in comparison with the descriptions of ecological concepts which are regarded as "spectacles" or "conceptual frames". In the absence of a clear definition it is necessary to analyse carefully the literature, paying close attention to vocabulary, in order to develop a sense of what is meant by Acclimatization.

5.1.1 ACCLIMATIZATION

Van Matre (1972) introduces Acclimatization with a critique of schooling applied to nature education. It contains numerous pejorative references to various aspects of environmental education, where its emphasis on identification, collection, experimentation, exploration and observation, is described as "...idiocy..." (*ibid.,* p.1) or contrivance (*ibid.,* p.2). Other efforts and innovations, particularly nature study programs, including Van Matre's early efforts, are described as "meaningless" (*ibid.,* p.1), "...insipid pedantry...[,] shameless fabrications... [and] aimless wandering" (*ibid.,* p.3). However it is the failure of innovations in nature education to provide meaningful experiences for the participants that is the crux of Van Matre's (*ibid.*) argument. Such innovations fail because they are rendered moribund, hackneyed, conservative and irrelevant by their assimilation into schooling. It is the goal of Acclimatization to provide experiences that have real *meaning.*

The *meaning* referred to by Van Matre (*ibid.*, p.3) is described as a "...sense of the inter-relatedness of life, a respect for the wholeness of the environments..." (*ibid.*); paradoxically perhaps, it is a simultaneous sensing, or feeling, of the parts and the whole, which includes knowing and valuing. Furthermore, this "sensing" went deeper and involved the development of an emotional attachment where the camper "...should come to 'feel' his environment. To draw it close to him. To love it. To understand it -- not for its labels and fables and fears -- but as an intrinsic part of himself..." (Van Matre, 1972, p.5). Acclimatization was then a means of creating meaningful experiences for campers; experiences that involved developing understanding, emotions and values.

However it was clear that this could not take place using the methods of "...so called modern education" (Van Matre, *ibid.*, p.4) because this system of schooling had entrenched weaknesses. What was required was a different approach that would help the camper "feel" their environment, or become sensitised to it, by giving the camper new perspectives using the "...most sensory experiences imaginable" (*ibid.*, pp.4-5). Thus, the goal was immersion of the camper in the environment using methods loosely connected with group process techniques drawn from work in social psychology. Clearly the assumption was that one of the problems with the dominant educational system, according to Van Matre, was that people required sensitising to the environment because they had been separated from it in a physical and attitudinal sense. Barriers to the forming and maintenance of appropriate relationships are acknowledged explicitly by (*ibid.*, p.11) but he also suggests that they are a result of modern society in general rather than being specific products of an educational system. Thus, Acclimatization is described as "...a framework of methodology..." (Van Matre, p.11) aimed at unifying humanity and nature, at breaking down barriers to an appropriate relationship with the natural world.

The barriers Van Matre describes seem to be largely attitudinal barriers that have been implanted by humanity itself. The separation of humanity from nature is described as if it was a conscious choice rather than accidental and there are suggestions that economic concerns should bear at least some of the responsibility for creating this situation. However, although humanity in general seems to have made this decision, there is also the notion that individuals have had such separation forced upon them, that such notions have been implanted and that the 'way back' to an appropriate relationship may not be found through merely making a different choice. What is required are various interventions such as structured activities, gimmicks or "...perhaps even a little gentle coercion" (Van Matre, 1972, p.12). This last aspect of Acclimatization programs is discussed in some detail and Van Matre acknowledges that programs are manipulative in a psychological sense (*ibid.*). It is justified by the belief that the separation from nature is destructive because it is unnatural, insensitive and disharmonious. The over-riding concern is to stimulate awareness, increase appreciation and in so doing, motivate further involvement.

Van Matre notes that Acclimatization activities tended not to produce "...tedious conceptualization, but leaping awareness..." (1972, p.6). He claims that Acclimatization programs were so powerful that they were able to produce "...that precious second of ecstasy that comes quickly, but lasts forever in memory." (*ibid.*). So, ecological feeling was a state of being, comprising knowing, understanding, valuing and loving. It was usually necessary to achieve this using barrier-breaking activities aimed at the different senses, in a variety of environments at different times. Moreover it sometimes produced highly significant ecstatic experiences involving leaps in awareness.

Combined with these early descriptions of programs are references to values outcomes of the Acclimatization programs, described as "...most essential of all..." (Van Matre, 1972, p.15). Previous attempts at nature education had only marginal success (Van Matre, 1972, p.1) because they had little effect on young people. The Acclimatization programs were described as ways of addressing the ecological crisis through affecting the values of young people. Firstly, it was assumed that motivation to take further action would naturally follow meaningful learning and the development of ecological feeling. Secondly, it was assumed that young people would be able to translate this motivation into useful action towards resolution of the crisis. Perhaps then, this forms the clearest indication of what is meant by "meaningful" learning, referred to above- learning is only meaningful if it can help to address the ecological crisis by producing "natural commitment" in the lives of young people, towards the science of ecology (*ibid.*, p.5) and to motivate "...them to salvage what they can of their natural heritage" (*ibid.*, p.15). However, references to behaviour are mentioned almost as an afterthought, although the assumption that environmentally benign behaviour is a "natural" consequence of an environmental consciousness is an undercurrent of much of the program description. It is summed up most clearly by the declaration that once someone "...has felt this unity with Nature, he is more hesitant to destroy her; he realises that to do so would be to destroy himself" (Van Matre, 1972, p.11). There is no mention in the program literature about what kind of behaviour would be considered desirable or appropriate, apart from reference to changing lifestyles (*ibid.*, p.121), or "alternative lifestyles" seminars for the older campers.

It should be noted that the ecological crisis is presented through local issues and not global issues, using "...pollutant or destruction-impact experiences" (Van Matre, 1972, p.15), such as discussions centred around the draining of a swamp, or the use of felled areas of forest alongside untouched areas for Acclimatization activities. Global issues are not ignored, although they tend to be left to the older campers to engage with through subsidiary activities, such as seminars that run parallel with the six one-hour blocks of Acclimatization. There are indications that Van Matre (1972, p.15) is aiming to develop a critical approach in the participants. He disparages the "...sermonettes..." (*ibid.*, p.3) that can turn environmental education activities into "...forums of fear..." (*ibid.*, p.4) whilst emphasising that Acclimatization programs are only the beginning of a life-time process. Programs exist not to create an army of 'brainwashed eco-warriors', despite the references to manipulation and coercion, but to force openings in the barriers to ecological awareness and allow young people to explore other kinds of relationship with the natural world.

So Acclimatization then was an introductory program consisting of six one -hour sessions that took place in the natural world. However the literature also describes a whole raft of other activities that took place alongside the program and aimed at similar outcomes (Van Matre, 1972, pp.67-78). For this reason Acclimatization is also described as a framework of methodology as well as an introductory program. It uses various techniques and gimmicks in order to gain full participation. It makes the assumption that the eco-crisis is a result of humanity's self-inflicted separation from nature and therefore humanity must re-establish these connections in order to develop an appropriate and more benign relationship. Furthermore, because this separation is produced and reproduced by the building of barriers between humanity and nature, activities are aimed at breaking down perceptual barriers in order to develop positive values and attitudes. Values, attitudes, emotions and feelings remain undefined, although significant attention is given to conceptions and by association, perceptions. However, the relationship between feelings and behaviour is assumed to be linear and simplistic as illustrated by the diagram in Figure 8.

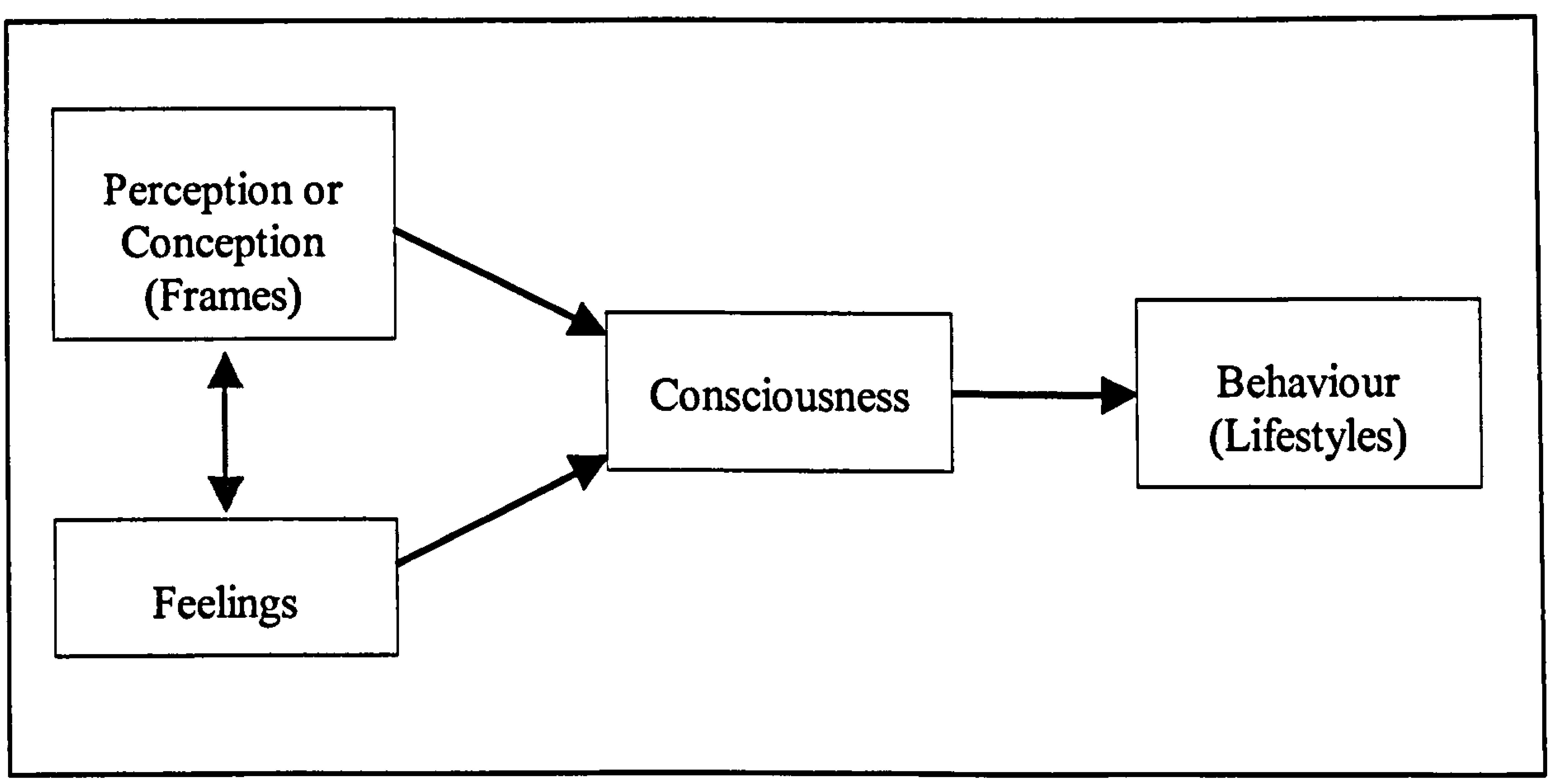


Figure 8: Feelings, Perceptions and Conceptions in Acclimatization

It is probably best summarised by the following extract from the literature.

> "We believe that a person must "feel" something about his environment before he will truly undertake to live in harmony with it. (...) Everything is a choice. Lifestyles will change only as conceptual structure is 'mated' to feelings. (...) Thus, in order to re-adjust one's focus or 'frames' and enhance the potential for 'feeling', we immerse; to convey understanding, we conceptualize. Together, the process of Acclimatization emerges."
>
> (Van Matre, 1972, p.121)

5.1.2 ACCLIMATIZING

Acclimatizing was viewed as a continued application of the approach, or framework of methodology, introduced in Acclimatization. Its focus was less concerned with breaking down the barriers to developing awareness but going beyond these by developing a personal and life-long relationship with the natural world (Van Matre, 1974, p.13). Its approach to developing this relationship was more thorough than with Acclimatization because the elements that constitute an 'appropriate' relationship, alluded to in Acclimatization, were more closely described.

For instance, in Acclimatization perception, or perceptual frames were re-adjusted by breaking down barriers through the use of gimmicks or activities directed at each of the five senses. In Acclimatizing the emphasis was on "natural awareness" (*ibid.*, pp.17-21) and was regarded as being composed of four elements only one of which was concerned directly with encouraging the use of different senses (Table 34). Furthermore, one of these activities for sharpening senses, "Feeling", had little to do with perceptual information and was more concerned with emotional states.

Table 34: The Keyboard of Perception: Exercises to Stimulate Full Awareness

Natural Awareness Component	Focus	
Sharpening Senses	Touching Tasting Hearing	Smelling Seeing Feeling
Seeking Patterns	Focusing Framing	Grouping Expanding
Perceiving Wholes	Filling Surveying	Observing Orchestrating
Distilling Essence	Scrutinizing Empathizing	Silencing Waiting

(Van Matre, 1974, pp.17-54)

So it can be seen that not only were these aimed at creating awareness, but also at enabling the individual to reach a "...crescendo of emotion (...) or a feeling of oneness unmatched by other experiences" (Van Matre, 1974, pp.20-21). The "keyboard" was regarded as an instrument to use for "...becoming tuned to the rhythms of the cosmos" (Van Matre, 1974, p.21). Clearly there was much more to Acclimatizing experiences than merely enabling individuals to have generally positive experiences of the natural environment, or the mere breaking down of attitudinal barriers or perceptual barriers; the relationship sought after was emotional, unifying and perhaps even spiritual. Similar emphases are present in the activity "Quiet Walk", although this was predominantly concerned with developing different senses and providing different perspectives. However "Quiet Walks" also contain activities for empathizing with elements of the natural environments, such as trees (*ibid.*, pp.67-68), or hatching birds (*ibid.*, p.63). Some activities were designed to break other barriers, such as those concerning negative attitudes towards camping and the natural environment (*ibid.*, p91) and others sought to integrate conceptual learning with shifts in perceptions. However perhaps the most significant activities for examining how Acclimatizing attempted to go beyond barrier breaking are the activities involving "trips", that is Crusoe Camps (*ibid.*, pp.131-158), Muir Treks (*ibid.*, pp.159-178), Seton Journeys (*ibid.*, pp.181-205) and Walden Solos (*ibid.*, pp.207-225).

The Crusoe Camp is a four day exercise in simple living with the bare minimum of equipment in order to get closer to nature and hence closer to oneself (*ibid.*, p.132). It uses solitude, silence, seriousness and sharing to develop feelings. It involves campers reflecting upon what could be termed existential questions, such as the nature of being, lifestyle choices or career paths and consequently would be most suitable for adolescents rather than young children. It is aimed at developing awareness of self and nature and helping the "...individual delve into the core of selfhood." (*ibid.*, p152). It is bound together with various exercises once again using activities that encourage the use of all of the senses, including activities from the Quiet Walk described above. "Appropriate" behaviour for campers is prescribed by the group leader and linked directly with a requirement to conserve the appearance and balance of the natural area being used for the camp. Hence, values associated with a conservation ethic are addressed through experience but as though they were common sense, due to the limitations of the equipment brought by the group. In a sense then the Crusoe Camp exists as a form of socialisation into the mores and values of simple living, or living in harmony with nature, as defined by the camp leaders.

The Muir Trek includes discovery and adventure, often a single day of exploration from dawn until just after dusk. It involves some form of journey for a small group of travellers, bound together with an atmosphere of enthusiasm and joy (ibid., p.160). Whilst the activity is described as a process of getting to know somewhere that no-one else knows (*ibid.*), as one might expect from the preceding discussion, this requires a 'knowing' based on perception and awareness in an Acclimatization sense so it does not have to involve unexplored wilderness. The focus of Muir Trek is emotion; emotions of joy, excitement and other such feelings associated with discovery, although it naturally also involves the perception-shifting activities of the methodology of Acclimatization.

A much longer journey is undertaken by the Seton Journey, a ten day walk through a wilderness area, although without a rigid time structure. It is described as an "...in-depth experience in natural awareness and brings heightened enjoyment of the natural world" (*ibid.*, p.201) and its main technique involves observation. Hence walking, with its quietude and pace, is an ideal mode of transportation for natural observation. The Journey is in many ways a combination of the self reliance and simplicity of the Crusoe Camp, and the excitement, joy and discovery of the Muir Trek.

It is probably no coincidence that the Walden Solo is the last of the "tripping" activities. The camper spends two and a half days alone where the challenge is quite simply to "BE" (*ibid.*, p.208). Once again the emphasis is on awareness, identity, individuality, self expression, contemplation and harmony..." (*ibid.*) but with such a focus on reflection the activity has the potential for being one of the "...deepest experiences of the four" (*ibid.*, p.220). The chief assumption, made explicit in the literature, is that solitude produces heightened awareness that leads to heightened enjoyment and together these lead to greater attention to environmental values. It provides the opportunity for campers to think about social values as well as environmental values, including perspectives on personal relationships, career aspirations etc. It is proposed as an opportunity for the clarification of values (*ibid.*, p.220) and the experiencing or worlds of perception and emotion that defy description by language. As campers have experienced such a lengthy period of solitude Van Matre suggests that they are more appreciative of others upon returning; it is described as an "...experience in what it means to be a human being" (*ibid.*, p221).

So, from the introductory activities described in Acclimatization aimed at an initial breaking down of perceptual barriers, through to Acclimatizing which takes this approach further, the 'framework of methodology' moves from dealing with perceptions and conceptions to addressing feelings, emotions, values and lifestyles. It is not just concerned with environmental values but also considers social values and attempts to address the human condition using the relationship between humanity and nature as a starting point and an end point. Whilst some activities are aimed at discrete elements of this, such as the Sharpening Senses exercises outlined in Table 34, the Acclimatizing activities attempt to integrate these using a theme outlined by either a camping experience or a journey.

5.2 SUNSHIP EARTH

Sunship Earth, as a five day-long program aimed at helping young children build a sense of relationship with the natural world, is not regarded as an extension of the original Acclimatization experience in the same way that Acclimatizing was. Essentially it is another introductory program but for a different context and age group. It was also published at a time when Acclimatization was changing into Earth Education and therefore contains elements of both[14]. Unlike Acclimatization, which was aimed at summer campers, Sunship Earth was written specifically so that it contributed to the school's curriculum (Van Matre, 1979, p. *xix*) and therefore incorporated training for teachers and leaders in program delivery. This section for program deliverers also included an outline of the underpinning learning theory and philosophy. Using a modular approach, Sunship Earth is composed of discrete activities (vehicles) for effecting learning outcomes in specific areas of human experience, such as concepts, perception, feelings, values, and behaviour, although some vehicles are aimed at outcomes in a range of learning domains. Sunship Earth is a much shorter experience than the earlier ACC programs, having a week of time devoted to it at the centre, followed by sessions at school. On the other hand ACC activities are described as though they were permeated throughout the entire experience at summer camps, perhaps lasting several weeks or even months.

The program uses the framework of methodology introduced through the work in Acclimatization. It shares similar general aims that address conceptual learning and the development of positive feelings and awareness. This is indicated by the "Major Components" of Acclimatization programs, shown by Figure 1. Whilst the reference to concepts is supported by a lengthy discussion of learning theory (addressed in Chapter 3) the other significant areas of learning are referred to by Senses, Solitude and Mechanics. It can be seen that there is no reference to ecological feeling or awareness in the diagram. Now, ACC activities are also

[14] ACC is used as a generic term for all activities that could be described as Acclimatization or Acclimatizing. ACC is distinguished from Earth Education by various important characteristics, some of which are incompatible.

concerned with changing perception, values and behaviour, indeed some of the activities are aimed directly at behaviour yet these do not appear in the diagram. Furthermore, Solitude is given as one of the discrete components, separate from Mechanics, Magic, Senses and Concepts. Yet in a sense, 'Solitude' could be regarded as a part of the 'Mechanics' of ACC, as could 'Magic' since they are both present in many ACC activities. Despite this problem, it would probably be safest to consider this diagram to be a description of the methodology of Acclimatization, although it should be regarded as an illustrative device rather than an explanatory model. Whilst it may serve to provide a very general impression of the ACC approach, it does not assist comprehension of how feelings, values, behaviour and awareness might be addressed in the Sunship Earth program.

Since the diagram describes some of the components of the methodology of Acclimatization, rather than the aims or objectives, the aims need to be distilled from another source, such as the literature. Perhaps the clearest summary, or definition, is given early in the publication, included in Table 35. The content of the Table, is a general indication, or working definition of the Acclimatization programs, and exists to illustrate both aims, objectives and perhaps some of the content. It lacks order or structure as, for example the first sentence could be considered to be inclusive of the last.

Table 35: A Definition of Acclimatization or "Where We're Coming From"

Acclimatization enables participants to...	Area of experience
...feel at home with the natural world.	Affective Domain (Unity)
...be aware of the ecological processes which govern life.	Cognitive Domain (Knowledge and Understanding)
...understand their role as part of ecological processes.	Cognitive and Affective Domain (Lifestyle, Knowledge and Understanding)
...increase their sensory awareness and conceptual understanding of the natural world.	Cognitive and Affective Domain (Awareness and Understanding)

(After Van Matre, 1979, p.5)

Despite these overlapping, imprecise and sometimes ambiguous definitions of Acclimatization, it would seem that the focus was always the "...stimulation of awareness (the primary goal of the program)" (*ibid.*, p.28) that leads to a unifying experience where "...understanding (...) transcends knowing" (Van Matre, 1979, p.6). These are expanded upon later where the Acclimatization rationale, or "Touchstones of Acclimatization" (*ibid*, p.11) are given explicitly and in finer detail (Table 36). It should be noted that "Principles" and "Premises" that are less relevant to the "feelings" aspect of ACC programs have been omitted from this table.

Table 36: Touchstones of Acclimatization

	Principles	**Nature of Assumption**
1	People learn best when they feel what they are learning. (...)	•Pedagogical
2	In a good learning experience the medium should be the magic: the magic of discovery and wonder and joy.	•Pedagogical
3	There are wide worlds of perception and emotion that language cannot begin to describe, nor words measure.	•Ontological and Epistemological
4	Experiencing solitude enhances the non-verbal skills of waiting, watching and receiving.	•Pedagogical •Core Values
5	Daily contact with the elements of life refreshes our sense of being and renews our certainty of becoming.	•Pedagogical •Ontological and Epistemological
	Premises	
6	The human species is neither the omnipotent conqueror nor the omniscient steward of the natural world.	•Core Values
7	Mankind's most important natural resources are not the material things, but the natural communities of life from which those things are taken.	•Core Values
8	Heightened feelings combined with increased understandings form the matrix out of which positive environmental action arises.	•Pedagogical •Core Values
9	A key facet of healthy growth is the understanding that self-awareness is increased through natural awareness.	•Pedagogical •Core Values
10	Living in a more natural environment should be undertaken primarily for the opportunity to better live with it- for the harmony and joy it brings.	•Core Values •Pedagogical
11	Because of the interrelatedness of all life, our focus should be upon activities which promote harmony instead of those which encourage a sense of power.	•Pedagogical •Core Values

(After Van Matre, 1979, p.11)

This list illustrates some of the assumptions and values that underpin the approach of ACC programs, particularly concerning the "feelings" and values elements. They deal with various aspects of the methodology of ACC in a rather disorganised fashion that struggles to assist comprehension. The third column is an attempt to categorise the touchstones into the area of human experience that they are concerned with. Statements that are concerned with the pedagogy of ACC mainly consist of those that Van Matre labels as "Principles" whereas those that articulate the Core Values of ACC are labelled "Premises", although there is considerable overlap between these two areas. Some statements lack clarity and focus. For example, the 3rd statement could be considered to be one aspect of a pedagogical approach, but it is perhaps indicative of a more general approach to theories of knowledge and reality, and exists at a higher, or more general level than pedagogy. Furthermore the third statement's *function* is unclear though it probably serves as a caution against those who would deny the validity of including activities with unmeasurable outcomes. It may also serve the purpose of excusing the paucity of structured explanation of the ACC approach to feelings. The fourth and fifth statements attempt to justify two aspects of the ACC methodology, namely solitude and primary experience of nature. So although some of the assumptions of ACC's approach to the affective domain are declared, they remain rather elusive and ill-defined. This may be indicative of a lack of a theoretical pedagogy for affective development, or it may be inherent to the world of perception which, apparently, cannot be described by language nor measured by words (Van Matre, 1979)!

The Premises in Table 36 generally relate to statements of Core Values that underpin the programs and activities. Thus statements six to eleven help to define the relationship between humanity and nature but some of these also have a bearing on the pedagogical approach of ACC. For instance, statement eight implies that "positive environmental action" should be one important outcome of ACC programs, and that it is dependant upon both cognitive and affective learning; emphasis is on the individual's role in taking action and solving environmental problems. Similarly statement nine is a mixture of a pedagogical approach that suggests that good education requires "healthy growth" which can be enhanced by developing self-awareness through natural awareness; the suggestion that experiences of nature encourage the development of self-hood, is coherent with the position articulated in Acclimatization (Van Matre, 1974). Statements ten and eleven follow on from statement nine and both are concerned with pedagogy and core values. They reinforce the position that the goal of ACC programs is living *with* the natural environment in a harmonious and joyful fashion. Here the notion of harmony is intimately bound up with statement six, the articulation of ecocentrism and values coherent with Naess's (1973) platform of deep ecology.

So the principles and premises, or "Touchstones" of ACC, attempt to provide a justification of the approach in Sunship Earth and ACC by linking practice (use of solitude, primary experience *etc.*) with deep ecology perspectives, or with notions of the development of senses and the generation of awareness. The detail that is used to describe concepts and conceptual learning is absent from the description of affective learning, although the statements relating to core values are illuminative and make explicit some assumptions that were tacit in Van Matre (1972;1974). Van Matre did not explore the idea of how the affective domain may be organised in any more detail but he did further describe and explore the behavioural outcomes of the program.

Beginning with an extended critique of the field of environmental education first addressed in Acclimatization, Sunship Earth moves swiftly onto a description of the metaphor of Earth as a Spaceship with humans as passengers *and* crew members. 'Crew-members' because humans can understand and have a limited affect upon the operation of the Sunship and 'passengers' because they are subject to the same forces as every other organism on earth. This metaphor explicitly suggests that humans have endangered the survival of all other passengers on the Spaceship by "...tearing holes in the liferaft we shared..." or by (perhaps recklessly) attempting to pilot a craft we "...didn't know how to fly" (Van Matre, 1979, pp.3-4). The metaphorical comparison has censurious overtones of human culpability in the endangering of the Sunship and there is perhaps a sense that the damage has not always been accidental. Another metaphor employed at this stage is that of humanity being a "...minor play in (...a) little corner of the galaxy..." (*ibid.*, p.4) thereby implying that humanity has become so obsessed with the exigencies of day to day life, yet in "reality" the struggles of humanity are insignificant when compared with the "...infinity and eternity of space" (*ibid.*, p.3)! Consistent with these metaphors, the means of addressing the ecological crisis is to re-learn our 'roles' as crew members and passengers, or our 'scripts' and 'lines' (*ibid.*). Clearly, these are reference to the types of behaviours and values that are required, perhaps even prescribed, for the resolution of environmental problems. Hence, there appears to be immediate emphasis in the program literature upon instilling in children what Van Matre considers to be appropriate behaviour and values, along with concepts and feelings, an emphasis that was largely absent from the earlier publications. Furthermore it is implied that much of this can be learned and reproduced by participants, in the same way that scripts can be learned and delivered by actors. Whether this is proof positive of the existence of a deterministic approach to the teaching and learning of values and behaviour remains to be seen and it would be inappropriate to make such an assessment using only evidence taken from what amounts to an introduction to the program. Such an assessment is best left until it can be set in the context of a wider examination of the program and the program's place in the schooling of the child.

Van Matre (*ibid.*, p.36) states that ACC is a product *and* a behavioural pattern which is based upon the explicit assumption, as with the earlier publications, that a 'fuller' understanding and appreciation of the humanity-nature relationship will lead to positive environmental action (see Figure 8). Van Matre has been criticised for over-emphasising the role that the individual plays in environmental problems and ignoring the role of society in these issues (Van den Berg and Margadant-van Arcken, 1999; Bosse, 2000; Mess 2000). However, a scrutiny of the objectives of ACC programs (Table 37) will reveal that whilst this may be partly true, he is certainly not ignorant of wider contexts in which environmental problems exist and has made some attempt to consider how programs may at least begin to take these into account. Table 37 describes forms of positive environmental action and perspectives, objectives of programs like Sunship Earth, that would most certainly need to explore social elements of the environmental crisis.

Table 37: Objectives of ACC Programs

People will...
...make more ecologically sound decisions in their individual life-styles. ...pursue involvement in environmental projects and programs. ...support or participate in data-gathering efforts to aid them in making wiser environmental decisions. ...develop a broader perspective from which to view the day-to-day experiences of their lives.

(Van Matre, 1979, pp.36-37)

Perhaps one final point is worth mentioning concerning the way in which Sunship Earth differs from the earlier ACC programs. In Sunship Earth there is a sense that Van Matre (1979, pp.5-6) is attempting to distance himself from some of the earlier claims made for Acclimatization activities as he suggests that they "...set out to affect the feelings of *a few kids*, to convey *a bit of understanding* (...) and *a bit of sharpened perception*" (Author's italics). The italicised noun groups act as a counterpoint to the proselytising tone of many of the comments extracted from Acclimatizing and given in the preceding section. Indeed he excuses these previous claims by saying that the earlier programs were a product of their time when work was "...fertilised by the awakening environmental movement (...and...) a buoyancy, a lightness of spirit (...) carried them along" (*ibid.,* p.6). So these comments might be considered to be a retraction of the idealism of earlier programs and activities, if not by their content, then almost certainly by their tone. Claims made for developing awareness, in its widest sense, are conspicuous by their absence in Sunship Earth when compared with earlier programs. Indeed, of the two indexed references to awareness (*ibid.*, p.260) in the entire publication one is incorrect! Instead Van Matre relies on discussions of awareness in the earlier publications, although he also, perhaps paradoxically, places some distance between these claims and Sunship Earth, despite "developing awareness" (*ibid.*, p.28) being the primary goal of the program.

The next section will explore the modular organisation of Sunship Earth and contrast it with the earlier ACC activities and programs.

5.2.1 SUNSHIP EARTH AND ACC VEHICLES.

Different activities for delivering the various aspects of ACC are described for the first time as 'vehicles' in Sunship Earth. These vehicles were separated into different categories with different design criteria, to ensure that they met their objectives. In a sense this idea rather belies Van Matre's claims that activities were derived from first principles or objectives because several of these activities had already been described (Van Matre, 1972;1974) with only very general reference to aims and objectives. So it could be argued that these activities had the design criteria superimposed onto them retrospectively. However, this conclusion might not be entirely accurate as although objectives had not been clearly articulated and differentiated for the different vehicles, this does not necessarily mean that they did not exist.

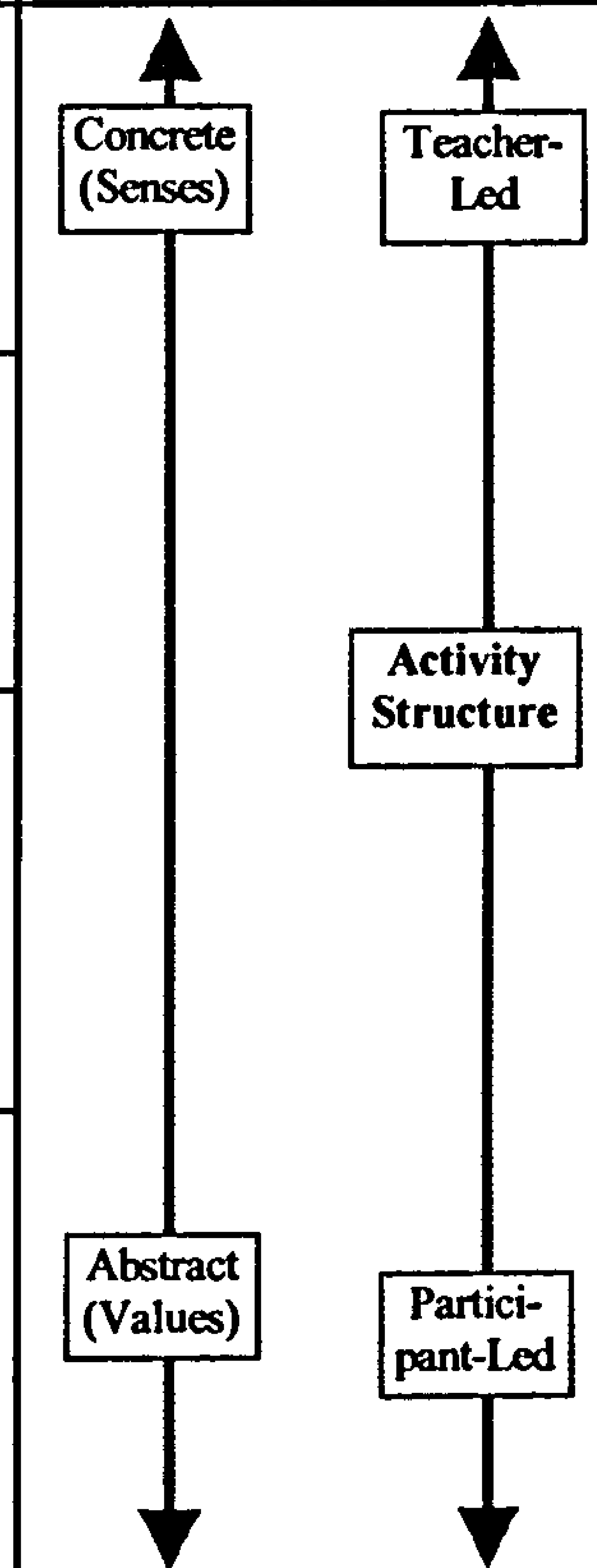
The vehicles used for addressing the "feelings" aspects of Sunship Earth were Acclimatization Walks (Touch the Earth)[15], Immersing Experiences, Magic Spots and Discovery Parties. The Acclimatization walks were essentially the same as described in Acclimatizing as they were focused on fresh, innovative experiences of nature involving sensing, empathizing and sharing of experiences (Van Matre, 1979, p.44). Although Discovery Parties are initially described as being concerned with the understandings of the program, that is developing cognitive aspects, they are probably equally important for developing affective aspects, particularly a positive emotional response towards the subject matter through attempting to build a sense of wonder and place (*ibid.*, p.48). They are also infused with the methodology of ACC, naturally, and for this reason are included as part of the "feelings" activities. If "awareness" can be regarded as being related to the simultaneous development of the concepts and the feelings then Discovery Parties are perhaps the activities most likely to facilitate this.

The use of these four vehicles demonstrates a structured, sequential and progressive approach to developing awareness (Table 38). The first vehicle to be used is the ACC Walk, focusing on different senses in a highly structured, leader-orchestrated activity. Once these senses have been "...reawoken", (*ibid.*, p.44) immersing experiences aim to develop the use of different senses in order to produce new and alternative perceptions of normally familiar aspects of the natural world. However, although Van Matre claims (*ibid.*, p.46) that these vehicles are aimed at breaking *sensory* barriers (my italics) they are probably more concerned with providing participants with positive experiences of sensations previously perceived as being negative, i.e. uncomfortable, wet, dirty or dark; the sensation experienced through the sense organs would probably be the same for any given experience, although the meaning attached to this sensation would be different. Thus it would probably be more accurate to refer to "...the breaking of *perceptual* barriers".

[15] Referred to as the Quiet Walk in Acclimatizing.

Table 38: Vehicles for Addressing Feelings in Sunship Earth

Vehicle Aims	Objective(s)	Methods	Level
ACC Walks/Touch the Earth Fresh innovative ways of experiencing the richness of nature.	•Re-awaken different senses	•Concentrating on different senses •Empathising with nature •Sharing of experiences	**Senses**
Immersing Experiences Expanding individual feelings for the natural world.	•Develop the use of different senses •Change perception/break sensory(*sic*) barriers	•Direct contact with nature •Sharing of experience •Individual expression	**Senses** **Perception**
Discovery Parties Building a sense of wonder and place.	•Encourage personal exploration and discovery	•Making direct contact with nature •Opportunities for sharing contextualised knowledge and stimulating interest	**Senses** **Perception** **Concepts** **Awareness**
Magic Spot Opportunity to develop a relationship and become familiar with one natural place.	•Building a relationship and respect for one natural place •Encourage Reflection on links between global and local environmental problems	•Solitary experience •Uses different senses and perspectives	**Senses** **Perception** **Concepts** **Awareness** **Values**



(Van Matre, 1979, pp.44-48, 188-190)

The Discovery Party is the next vehicle in the sequence of activities aimed at developing awareness. Whilst the methodology of ACC is still apparent in these activities, the emphasis is taken away from senses and perception, and is placed on discovery and exploration. The activities seem more flexible in their structure and comprise opportunities to "...poke around, explore and share... (...) ...with just enough structure to a hold a group together, enough freedom to allow for individual discoveries." (*ibid.*, p.48). The intention is that because participants are the ones making the discoveries any leader input is driven by the context provided by the participant. In this way the level at which the intended learning occurs has shifted from being focused around sensation and perception, to being concerned with developing concepts and awareness, although the methodology of ACC requires that sensory and perceptual experiences still form an important part of the activity. This could, perhaps be described as a 'higher' level activity as elements of the experience are aimed at developing perhaps more abstract notions, such as concepts, awareness or values, and as such are further removed from 'concrete' information received by the senses.

The Magic Spot is the final activity in the sequence of vehicles in Sunship Earth, occuring on each of the five days of the program (Van Matre, 1979, pp.52-53), although the duration of the activity increases as the week progresses. As an experience of solitude in a natural area it is aimed at allowing the participant to develop their own "...easy, quiet relationship with one particular place in the natural world" (*ibid.*, p.188). The Magic Spot is essentially an unstructured experience, notwithstanding the structure of the introduction and the concluding session. Any structure that does exist is intended to facilitate the experience; while suggestions for activities are contained in the participants' logs, including the kinds of multi-sense and perceptual barrier-breaking activities encountered earlier, the quality of the experience is determined by the extemporaneous explorations and engagements of the participant, and serendipity. But Magic Spots are also intended to allow time for participants to "...make the connection between the problems of the entire planet and this one special place they have begun to value"(*ibid.*, pp.189-190), and therefore have the potential for acting at an abstract level far removed from the concrete multi-sense activities of the ACC Walk.

5.2.2 VALUES AND BEHAVIOUR IN SUNSHIP EARTH

In the early ACC programs the ecological crisis was presented by special simulations, or seminars for the older campers (Van Matre, 1972, p.78), or most frequently, by short "...pollutant or destruction impact experience..." (*ibid.*, p.15) during each day's activity comprising primary experiences of issues or problems "...harmonious with the community being explored" (*ibid.*, p.15) such as clear-felling (*ibid.*, p.34). Van Matre rejected the adequacy of using limited intellectual exercises or "...bombardment with statistics..." (*ibid.*, p.15) for the motivation of positive environmental behaviour and action. Alternatively Van Matre asserted that "...we must believe that (...) personal involvement (*through enhanced feelings, alert senses and lowered barriers*) will motivate them to try to salvage what they can of their natural heritage..." (*ibid.*, p.15). Thus Van Matre saw the role of ACC as developing in young people, a relationship based upon broader understandings and feelings, and this would in turn motivate the participants to take some form of remedial action, both in terms of their own lifestyles and in terms of environmental problems.

As an approach, Sunship Earth retains the focus of early ACC programs as they were still operating on the assumption that positive long-term respect for life's systems and continuing commitment to harmonious living result from a matrix of good feelings and sound understandings (Van Matre, 1979, p.*xix*). But rather than merely hoping that participants would undertake this for themselves, Van Matre decided to build in activities to effect the transfer of learning to post-program settings (*ibid.*). These activities occur towards the end of the program and culminate in a "Sunship Meeting" (Van Matre, 1979, pp.248-251) where participants discuss their own environmental bad habits and make written promises to change something that they do. It is intended that these are continued at the pupils' school with the help of the classroom teacher who has a list of activities that would help with this. So whilst some of the lifestyle changes that the participants choose are indeed their own, they are also provided with other ideas for changing bad habits and becoming "...more sensitive, understanding and caring passengers on their journey through space" (*ibid.*, p.253).

Values are also addressed through various activities such as "Model Planets" (*ibid.*, pp.242-252) where participants attempt to place models of the Earth's cycles in a circle on the ground analogous with the planet Earth but due to a lack of space, conflict between participants results. There are also experiences that include campfires, storytelling, sharing circles *etc.* that would involve the participants in thinking about their own values, behaviour and understandings.

So children's behaviour and values are addressed explicitly by the Sunship Earth program, although it would seem that the children decide how they actually achieve this. But aspects of the program, comparable with the hidden curriculum, or the sum total of relationships, attitudes, values, invisible assets and tacit knowledge (Cohen and Manion, 1981, p.293), are also highly significant. Van Matre suggests that young people "...learn the patterns they live" (Van Matre, 1979, pp.37-38) hence the importance of having a centre's hidden and explicit curriculum as closely matched as possible. Coherent with the "living analogy" of Sunship Earth (*ibid.*), and the Touchstones of Acclimatization, are the activities that use much of the program time, time that is *not* directly concerned with concepts and feelings activities. Whilst some of these activities were used in the earlier programs they were not well articulated. These include the "...eating, sleeping, and playing (...) or, more appropriately, making the most of the opportunities for learning that these hours of time can offer..." (*ibid.*, p.38). Therefore the introductory speech, the meal times, the living quarters, the free time, the playing areas and many other aspects of the program site, or "Sunship Study Station", are all part of the Sunship Earth program.

5.3 EARTHKEEPERS

As for conceptual development, much of the justification for activities used in Earthkeepers was given by a slightly later publication (Van Matre, 1990) and so Earthkeepers will be considered alongside this even though it was published three years earlier.

Earthkeepers is not described in the same proselytising tone as some aspects of the ACC work. Comparable with Sunship Earth the program is described as a "Springboard Unit" where much of the work should be carried out at school (Van Matre and Johnson, 1987, p.11). It refers to developing lifestyles harmonious with the earth, as with previous publications, but the extent of the claims for affective development is that "Earthkeepers experience good feelings when they're in touch with nature" (*ibid.*). The program is perhaps more consistent with this rather restrained statement when compared with the inconsistencies of Sunship Earth outlined above, a program which was probably affected by its proximity to the ACC programs and the "...lightness of spirit..." (Van Matre, 1979, p.6) that helped to produce them.

5.3.1 EARTHKEEPERS AND THE FEELINGS COMPONENT

As has been previously discussed Earthkeepers was produced a considerable time after The IEE was founded from the early work in Acclimatization. The analysis of Sunship Earth suggested that programs were becoming more structured and tended to make fewer claims about the extent to which they influenced affective development. Earthkeepers is another example of this progressive structuring as it provides the first citation of the Principles of Earth Education (Table 39).

Table 39: The Principles of Earth Education

THE WHYS	*THE WHATS* (Curriculum 'Content' is underlined)	*THE WAYS* (Curriculum methods are underlined)
Preserving *We believe the earth as we know it is endangered by its human passengers.*	***Understanding*** *We believe in developing a basic comprehension of the major ecological systems and communities of the planet*	***Structuring*** *We believe in building complete programs with adventuresome, magical learning experiences that focus on specific outcomes.*
Nurturing *We believe people who have broader understandings and deeper feelings for the planet as a vessel of life are wiser and healthier and happier.*	***Feeling*** *We believe in instilling in people deep and abiding emotional attachments to the earth and its life.*	***Immersing*** *We believe in including lots of rich, firsthand contact with the natural world.*
Training *We believe earth advocates are needed to serve as environmental teachers and models, and to champion the existence of earth's non-human passengers.*	***Processing*** *We believe in helping people change the way they live on the earth.*	***Relating*** *We believe in providing individuals with time to be alone in natural settings where they can reflect upon all life.*
Notes i) Criteria shaded in grey have little or no specific relevance to the affective aspects of the programs		

(Van Matre and Johnson, 1987, p.7)

Here the assumptions underpinning the approach of Earth Education regarding its aims, curriculum content and methods were given in a hierarchical fashion, moving from the theoretical (The Whys) to the practical (The Ways). Comparison of these with the Touchstones of Acclimatization (Table 36) demonstrates how Earth Education was a more organised approach to learning, with some degree of emphasis on the structure provided by programmed learning. This emphasis is evident, either by direct reference to learning programs and specific outcomes, or by implication, where emotional attachments are to be "instilled" in people.

The Principles of Earth Education are further supported by a list of criteria that dictate what may, or may not, be called an "Earth Education" program given in Table 40.

Table 40: Ten Characteristics of Earth Education Programs

	An Earth Education program:
1	*Hooks and pulls the learners in with* ***magical experiences*** *that promise discovery and adventure (the hooker)*
2	*Focuses on building* ***good feelings*** *for the Earth and its life through lots of* ***rich, firsthand contact*** *(the immerser).*
3	*Proceeds in an organised way to a* ***definite outcome*** *that the learners can identify beforehand and rewards them when they reach it (the organiser)*
4	*Uses good learning techniques in building focused, sequential, cumulative experiences that start where the learners are mentally and end with lots of reinforcement for their new understandings.*
5	***Emphasises major ecological understandings (at least four must be included: energy flow, cycling, interrelationships, change).***
6	***Gets the descriptions of natural processes and places into the concrete through tasks that are both "hands on" and "minds on".***
7	***Avoids the labelling and quizzing approach in favor of the full participation that comes with more sharing and doing.***
8	*Provides immediate application of its* ***messages*** *in the natural world and later in the human community.*
9	***Pays attention to the details in every aspect of the learning situation.***
10	*Transfers the learning by completing the action back at school and home in* ***specific lifestyle tasks designed for personal behavioural change.***
	Notes i) Criteria shaded in grey have less relevance to the affective aspects of the programs

(Van Matre, 1990, pp.269-270; Van Matre and Johnson, 1987, p.8)

An examination of the table reveals three significant ways in which Earth Education once again appeared to have shifted slightly in the way its programs were designed. Firstly, criteria one and two reduce the affective objectives to describing experiences as "...magical experiences that promise discovery and adventure", and the building of good feelings through primary experience. The program is described as an introduction and not the sum total of everything the child will ever do. It has been written so that development **must** be continued post-program. It certainly makes no claim to be able to cause a qualitative shift in the nature of the participants' awareness, as Sunship Earth and ACC programs had.

Secondly, it might be assumed that criterion three denies the importance of anything except definite, and perhaps even measurable, outcomes. Van Matre (1990) expands upon this later by discussing this element of the Earth Education program as an "organiser", although it is discussed using examples that function as *aide memoires* for conceptual learning (ibid., p.257). There are suggestions, though, that it also refers to affective aspects of the experience, for instance the organiser in Earthkeepers is the mnemonic "K.E.Y.S." which stands for Knowledge, Experience, Yourself and Sharing. Thus the affective aspects are labelled as Experience, for which there are several separate activities. It might appear that Van Matre wishes to specify definite outcomes for affective development, that is, for feelings, emotions, values *etc.*. This contrasts sharply with Sunship Earth and ACC which went to some length to justify exactly the opposite, stating "There are wide worlds of perception and emotion that language cannot begin to describe, nor words measure" (1979, p.11). The emphasis on definite outcomes is clearly regarded as being very important for the program but the question still remains- does the omission of unspecified and unpredictable outcomes imply that these are no longer important for Earth Education programs?

Thirdly, criteria eight and ten refer to the values and behaviour aspects of the programs. Statement 8 suggests that messages, or conceptual and affective learning, may be applied firstly in the natural communities of the program and then later, and in a different way, to society. The first provides an opportunity to "apply" cognitive and affective learning in order to reinforce understandings and enhance awareness, the second to apply cognitive and affective learning, taking the role of advocate, in order to effect change in the behaviour and values of others. Criterion ten further describes the types of change expected from the program. These two criteria together represent unambiguously, the main objective of the program, that is to effect behavioural change. They are more clearly stated than in previous programs and indicate the *raison d'être* of Earth Education, namely "...helping people to live more lightly on the earth." (Van Matre, 1990).

5.3.2 VEHICLES FOR ADDRESSING 'FEELING' IN EARTHKEEPERS

Because Earthkeepers is half the length of Sunship Earth it necessarily includes fewer activities, although it has a structure very similar to that of Sunship Earth and is coherent with the template laid down in Van Matre (1990, pp.247-316). It uses the same categories of vehicles to address feelings and values, comprising those mentioned in Table 38 including Earthwalks, Immersing Experiences, Discovery Parties and Magic Spots, although where Sunship Earth may use several Immersing Experiences and Discovery Parties, Earthkeepers uses only one of each. The Earthwalk and the Magic Spot are identical to the similarly named vehicles in Sunship Earth. The Discovery Party, although it follows the same structure and uses similar techniques drawn from the ACC methodology, is different from those in Sunship Earth. It is contextually dependant on references to the activities of one of the characters from Earthkeepers, but perhaps more significantly it involves the participants finding concealed objects related to an account of a journey conducted by one of the characters from the program. This may have the effect of shifting the emphasis away from the natural environment and onto the concealed objects. It may also carry the implication that nature requires "spicing up" if it is to be made interesting to the participants. The advantage of seeding an area with objects is that since they provide a focus for the discoveries, the outcomes of children's searching is predetermined to an extent and therefore the activity leader does not have to be a specialist in the area's ecology since the "discoveries" will be limited to an extent by the objects and the leader may prepare in advance any relevant input. Clearly this somewhat contradicts the ethos of the vehicle, which is concerned with making *personal* finds (Van Matre, 1990, p.262), although Van Matre does imply that exploration and discovery are states of mind (1979, pp.161-162).

The Immersing Experience is quite different from those in Sunship Earth however. Immersing Experiences are consistently described as "...Unusual Opportunities for closeup contact and involvement with the natural world ...[aimed at]... Changing perspectives and breaking personal barriers (using multi-sensory activities with built-in sharing and self expression)" (Van Matre, 1990, p.263). Perhaps the key element of Immersion Experiences is the "immersion", or the "shoehorning" (Van Matre, 1979, p.197) of the participants into a nook, cranny, or ecological niche so long as a changed perspective is possible from the experience. The four Immersion experiences in Sunship Earth, that is the Curious Heron Walk, Nightwatchers, Earth Studios and Micro-Parks, all involve an element of immersing the participant in a particular 'space' that has marked differences with what they may be used to. The 'space' may be an ecological niche or it may be the perceptual 'space' created by darkness. In direct contrast, Earthkeepers brings the 'space' to the participant by the reading of a description of an experience of a winter's day to a blindfolded participant, whilst another participant provides sound and sensation effects, such as providing dead leaves or cold water to touch and 'wind' to feel. In this Immersion Experience, the 'space' is not created by the niche, the time of day or topography, but by a story that attempts to create the 'space' for the participant. Because of this, the 'space' is reconstructed by the participant. Therefore it is difficult to see how this reconstruction could give "...a different perspective to an already familiar setting" (Van Matre and Johnson, 1987, p.89). Seasons relies upon the description, read out loud, being meaningful to the participants and being capable of creating an altered perspective. Notwithstanding this analysis, its effectiveness as an activity would clearly need to be addressed through empirical work.

Superficially then, the structure of the program appears to be similar to that of Sunship Earth. Closer analysis of the specific vehicles reveals that some are identical but that some appear significantly different from those in Sunship Earth and perhaps even divergent from the design criteria. Activities certainly demonstrate a much closer adherence to specific outcomes and this would appear to be consistent with the Principles of Earth Education (Table 39), and also consistent with the exigencies of the context of a program such as Earthkeepers.

5.4 'FEELING' IN EARTH EDUCATION

Further examination of Van Matre (1990) reveals that the concentration on the specific, the measurable and the definite in Earthkeepers does not preclude the existence of a wider approach to the affective domain in Earth Education as a whole. For example, in a description of one of the four "primary feelings" (Table 41) to be developed by programs Van Matre describes "Joy" as being "...that heady sense of exhilaration at just being- right there, right then- wrapped up in all the elements of life around you" (*ibid.*, p.121).

Table 41: Four Primary Feelings in Earth Education

Joy at being in touch with the elements of life. Kinship with all living things Reverence for natural communities Love for the earth.

(Van Matre, 1990, pp.120-131)

Clearly the aim of generating such intense emotional states and experiences is far removed from the *stated* aims of Earthkeepers which *seem* to be concerned more with affecting senses and perceptions alone. Furthermore, Van Matre also describes various aspects of the Principles of Earth Education, given in Table 42, that is the Immersion aspect of "The Ways", which includes three areas, that is Personal Immersion, Enriched Perception and Pleasurable Experiences (Van Matre, 1990, p.225).

Table 42: Principles of Earth Education: The Ways: Immersing

Immersing *"We believe in including lots of rich, firsthand contact with the natural world"*
Personal Immersion *"Getting people out there"* Enriched Perception *"Helping people take in what's around them"* Pleasurable Experiences *"Making sure people have a good time"*

Personal Immersion is concerned with exposing people to natural experiences through repeated immersions that continue after the annual field trip to the program site (*ibid.*, pp. 227-228). The Pleasurable Experiences element merely underlines the necessity for the learning to be fun if positive feelings and emotions are to be encouraged. Enriched Perception involves developing participants' perception through various techniques, previously described in Acclimatizing as being a 'keyboard of perception' or natural awareness skills (Van Matre, 1974, pp.17-54; Table 34). Enriching Perception is addressed by activities further separated into various exercises for different aspects of perception; thus some are concerned with isolating and exercising different senses whilst some are concerned with the perception of wholes and parts (or the detail), patterns, arrangements and groups. Van Matre continues by describing how these were added to by a further four groups of activities aimed at four "senses" (Van Matre, 1990, p.231) given in Table 43.

Table 43: Special Senses in Acclimatization

Sense of Wonder looking upon the world with a habitual awe maintaining curiosity about life's comings and goings revelling in the unusual and unexpected facets of the commonplace exploring and seeking in unselfconscious ways
Sense of Place being at home in a natural community feeling caught up in the synergy of an area seeking new dimensions and forces in a familiar place absorbing over time the textures and moods and qualities of a piece of the earth
Sense of Time comprehending the continual passage of time as a constant of life seeing being as becoming feeling connected to all past and future things through the flow of life grasping that each piece of the earth and particle of life has a story in time
Sense of Beauty enjoying the color and form, pattern and texture of natural things and scenes perceiving the harmony in healthy natural communities noting the continual changes in light and shadow appreciating the rich diversity of life in the natural world seeing the "the world in a grain of sand and heaven in a (*sic*) flower"

(Van Matre, 1990, pp.231- 232)

Table 43 once again illustrates the semantic confusion between different aspects of the affective domain. These are referred to as special "senses" but they are clearly describing different realms of human experience from touch, taste, hearing, smell and sight. For example, the latter two, under the title Sense of

Time, could be said to be describing not senses but understandings of concepts. Others such as "Sense of Place: Being at home in a natural community", describes an emotional response, an aspect of a relationship which is probably connected with senses, perceptions, feelings, values and concepts. It would seem that these "Special Senses" are perhaps more to do with a definition of what Van Matre has referred to throughout his work, as Awareness. It is through these elements of Awareness, that a natural relationship may be developed. However, there is little evidence of the attention to these special senses in Earthkeepers.

Van Matre (1990, p.128) comments upon the growing tendency for environmental educators to attempt to gain credibility by supplying empirical evidence of their success. This is not merely a complaint against evidence-based practice; rather it is an objection to the exclusive concern with evidence acceptable to the dominant scientific paradigm. This is one effect of what Giroux (1981) described as a technocratic rationality, a rationality which leads to the neglect of all except that which can be measured, predicted and controlled. However, Van Matre (1990, p.131) asserts that...

> ...we must not confuse our attempt to make sense out of these feelings with the feelings themselves. In that mysterious inner well of our emotions these feelings intermix like drops of color in water. We can analyse them in their pure form for only a moment or two before they dissolve into the whole to which they belong.

Perhaps these lines constitute a useful clarification of the approach of Earth Education; feelings may be addressed in some way or another by programs such as Earthkeepers, but the lack of any provision of specific behavioural objectives does not mean that they are not important for the experience as a whole. Indeed the extract above (*ibid.*, p.131) echoes Principle 3 in the Touchstones of Acclimatization (Table 36) and also the last special sense, the Sense of Beauty, which uses Blake's lines "To see the world in a grain of sand and heaven in a wild flower" (Bronowski, 1958, p.67). It may be no coincidence that Blake's work marked the beginning of romanticism, a rejection of the age of enlightenment and its exclusive reliance on reasoning (Raine, 1979, pp.74-105).

5.4.1 SENSE OF RELATIONSHIP

There is further evidence that elements of the ACC approach to affective development were retained at least in some form, by Earth Education. Earth Education is described (Van Matre, 1990, p.94) as existing "...primarily to help people develop a better sense of relationship with the natural world". But it is acknowledged that this relationship needs "nurturance" (*ibid.*, p.95) over time and may involve a "wrenching metamorphosis [...or a...] natural unfolding" (*ibid.*, pp.95-96). Developing this relationship may include enriching the experience of the participants although, for those who are "...defective in ways they may never know..." (*ibid.*, p.6) it is more than mere enrichment and "...becomes a basic necessity for the long term health and welfare of our entire species" (*ibid.*, p.6).

5.4.2 VALUES AND BEHAVIOUR IN EARTH EDUCATION.

The approach to values education is clearly and coherently articulated in both Van Matre and Johnson (1987) and Van Matre (1990). For instance, Van Matre and Johnson (1987, p.*xi*) state that...

> The 'supplementalists' are fond of saying that their goal is to teach students how to think, not what to think. Our goal is to teach students why and how to live more lightly on the earth, and to help them develop a deeper personal relationship with it.

In Van Matre (1990, p.138) Earth Education is described as a values builder rather than a values clarifier. Values clarification, it is argued, is inappropriate because it assumes that the precursors of positive values are already held by participants and all that is required is to clarify these. But Van Matre (*ibid.*, p.138) asserts that people are so isolated from the natural world that they hold very few environmental values. Therefore Earth Education is designed to help build positive environmental values. Further, Van Matre (*ibid.*, p.139) argues that values clarification exercises and discussions produce noncommittal, passive values and therefore effective values education requires the use of experience through multiple focused exposure, much reinforcement and repeated application through addressing the lifestyles of individuals.

From the outset, Van Matre and Johnson (1987) make the main intention of Earthkeepers explicit, along with the shifted focus from Sunship Earth and the ACC programs; where the subtitle for Sunship Earth was "Getting to know your place in space" (Van Matre, 1979), that of Earthkeepers is "Four keys for helping young people live in harmony with the earth" (Van Matre and Johnson, 1987). This is supported in the introduction by various unambiguous statements about programs being a "...seedbed for the advocacy necessary... [for environmental preservation]..." (*ibid.*, p.*vii*), or being concerned with "...positive environmental action..." (*ibid.*, p.*vii*). Participants' roles as advocates entail sharing their "...insights and behaviours with others" (*ibid.*, p.11) and championing "...the existence of our fellow non-human passengers" (*ibid.*, p.6). But advocacy is not the only form of action that programs should promote. Van Matre also states that participants should make personal "...improvements..." (*ibid.*, p.*vii*) in their lifestyles. To this end, there is a collection of formal and informal activities in the curriculum and the hidden curriculum that address values and lifestyles, identical to those found in Sunship Earth.

5.5 SUMMARY

The discussion throughout this chapter has pointed out how the shift to Earth Education from ACC programs can be seen in various aspects of the programs, not least their tendency towards specification of behavioural objectives, and the use of programmed learning. There has, simultaneously, been a shift away from the proselytising tone of the first ACC activities and towards activities that make far fewer claims about affective development. Where early programs were discussing effecting awareness and enhancing appreciation, the later Earth Education programs generally restrict themselves to senses and feelings. However, the theory of Earth Education supplied by Van Matre (1990) suggests that developing awareness and a sense of relationship remain as important for the methodology of Earth Education as a whole. It is the context of the Earthkeepers program that is most relevant for explaining its structure and curriculum. In the final analysis it is written to be an introductory program designed to begin a process that will lead to an ecological awareness that may involve some of the special senses described in Table 43. It is an affirmation that developing this relationship takes a great deal of time and all that can be realistically hoped for is to begin this process.

6 METHODOLOGY

This chapter discusses key methodological issues for program evaluation. The discussion begins with theoretical issues, then considers how these issues affected the research design, and concludes with detailed description of how this design was applied in practice. The research methods are summarised in a table at the end of the chapter and this table identifies which methods were used and when, and the samples to which the methods were applied.

This research aimed to...

Investigate the effect of an Earth Education program on children's development, using the Earthkeepers program as an exemplar. These are described by Table 44.

Table 44: A Clarification of Research Aims

• an investigation of the **long term** contribution that the program made to participants' understandings. • an examination of affective aspects of children's experiences whilst on the program and afterwards. This required an investigation of values, attitudes and feelings. • an audit of the children's behaviour towards the natural world comprising a detailed estimation of the affects of the program on children's resource use.
This research project required setting in context; therefore, the research also included... • an exploration of visiting teachers' opinions of the program. • an evaluation of the potential of the program for contributing towards statutory curriculum provision in Scotland and the U.K., with reference to curricular documents *and* teachers' account of recent classroom practice.

Earth Education programs use an eclectic approach to cognitive development, being influenced by various learning theories including Skinnerian behaviourism (1953), Bruner's (1966) Spiral Curriculum and Piaget's (1929) notions of schemata (Table 31, p.114, provides a complete summary of these influences).

Furthermore, the previous discussion has demonstrated that the methodology of Earth Education, first conceived in the ACC programs, is evident in introductory programs such as Earthkeepers and Sunship Earth. This methodology deals with many different elements of awareness such as understandings, emotions, feeling, perception, values, behaviour and perhaps even spirituality. So one problem that confronts potential evaluators of Earth Education programs is the decision about which methodological approach is most appropriate for an examination of the phenomena referred to collectively by Van Matre as 'awareness'.

6.1 PSYCHOLOGICAL DOMAINS IN EARTH EDUCATION

Given the nature of the methodology of Earth Education and its potential for developing Van Matre's version of 'awareness', it was considered important to examine the quality of the 'awareness' engendered by programs. However, this posed the problem of producing a definition of awareness that was capable of being tested against the data. Initially, this problem was addressed by using the taxonomic system proposed by Bloom, Engelhart, Furst, Will and Krathwohl (1956), and Krathwohl, Bloom and Masia (1964).

Bloom *et al.*(1956) and Krathwohl *et al.* (1964) developed a tripartite system for classifying educational objectives into three areas of learning, or 'Domains'. Bloom *et al.* (1956) and Krathwohl *et al.* (1964) acknowledged that tripartite classification systems were as old as Greek philosophy, and these systems had previously comprised elements such as cognition, conation and feeling, or thinking, willing and acting. However the particular strength of Bloom *et al.*'s (1956) and Krathwohl *et al.*'s (1964) taxonomies were that they specified different levels within each domain and therefore allowed teachers to match their questioning to the type of thinking skills they were concerned with (Allen and Tanner, 2002). In the case of the cognitive domain, learning objectives were concerned with *knowledge recall* at the lowest level and progressed to *evaluation* and *critique* at the highest levels. A similar structure was evident in the taxonomy proposed for the affective domain (Krathwohl *et al.*, 1964), although this was not published until nearly a decade after the taxonomy for the cognitive domain. Such was the power of this classification system that it continues to be used widely and despite a recent review (Anderson and Krathwohl, 2001) remains largely unchanged. This system has been illustrated in Figure 9.

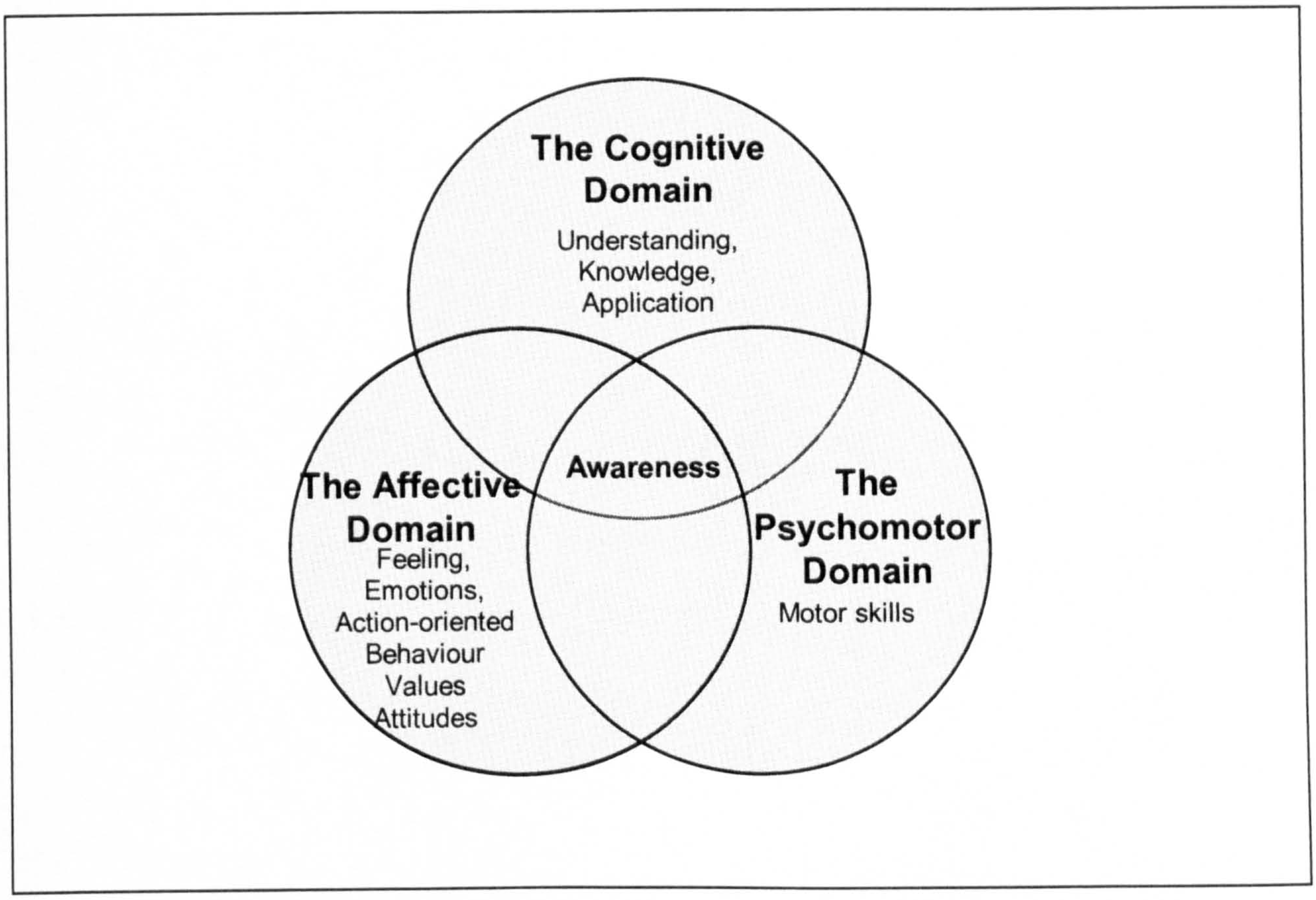


Figure 9: The Relationship Between Learning Domains and Ecological Awareness

Indeed, the programs use this tripartite structure by organising the activities into separate categories, which focus on the development of knowledge, 'feeling' and behaviour. For example, Earthkeepers is organised by the mnemonic K.E.Y.S. where K represents knowledge, E represents experience, and Y and S represent "yourself" and "sharing" which allude to behaviour. This suggests that the taxonomies had potential for revealing the level of thinking skills that were developed by the programs. The next section examines some of the research on Earth Education in light of Bloom *et al.*'s (1956) and Krathwohl *et al.*'s (1964) taxonomies.

6.1.1 THE COGNITIVE DOMAIN

The most common type of research conducted prior to 1993 examined individual programs, by attempting to demonstrate changes in knowledge or attitudes and in one case (Van Wissen, 1992), behaviour. These were generally based upon quantitative data and addressed the development of ecological understandings by assessing factual recall, or evaluating the development of ecological feeling by the use of attitude measurement. Bloom *et al.* (1956) demonstrated that cognitive educational objectives could be divided into several levels of complexity. Whilst they accepted that knowledge recall was important for building more complex and abstract forms of knowing, the corollary is that 'recall' is at a low level of cognitive abstraction. Since Van Matre has claimed that Earth Education programs and activities build an understanding that transcends knowing and can contribute to the development of an ecological awareness, it hardly seems sufficient to attempt to evaluate cognitive outcomes of Earth Education by examining the lowest level of cognition.

6.1.2 THE AFFECTIVE DOMAIN

Research in Earth Education has addressed the affective domain by generally examining attitudes. Attitudes and attitude measurement have been regarded as being central to approaches in social psychology for many years (Allport, 1954; Pennington, 1986) and have been used by the small number of studies (Payne, 1981; Bires *et al*, 1982; Mulligan, 1989; Keen, 1991a; Keen, 1991b; van Wissen, 1992) that have sought to analyse the 'feeling' aspect, often to the exclusion of all other methods. Yet the association of attitudes with actual behaviour is only weak because many other factors are involved such as social norms, habits or group pressure (Pennington, 1986, p.62). It is highly likely that this association is even weaker for children since they have less control over their behaviour than do adults. Furthermore the term 'attitude' is somewhat imprecise, being taken to refer to a group of psychological phenomena that seem to resist definition and clarification (*ibid.*, p.60). So it might seem that if the predictive power of a measurement of attitudes is weak and their nature ill-defined, then it might be reasonable to conclude that it is an inadequate method, on its own, for revealing the depth of experiences that Van Matre claims are engendered by Earth Education programs.

Affective objectives originally proposed by Krathwohl's *et al.* (1964) taxonomy comprise, from the lowest level to the highest, Receiving (attending), Responding, Valuing, Organisation, and Characterisation. These are illustrated in Table 45.

Table 45: A Taxonomy of Educational Objectives in the Affective Domain (After Krathwohl *et al.*, 1964, pp.95-175)

1. Receiving (attending)	
1.1 Awareness 1.2 Willingness to Receive 1.3 Controlled or selected attention	The learner has firstly an awareness of a specific phenomenon, becomes willing to take notice of a phenomenon rather than avoid it, and finally, actively directs attention towards it.
2. Responding	
2.1 Acquiescence in Responding 2.2 Willingness to Respond 2.3 Satisfaction in Response	This section refers to behaviour that might initially be compliant or obedient, then willingly or voluntarily undertaken, and the final level suggests that the behaviour would be satisfying and produce positive responses.
3. Valuing	
3.1 Acceptance of a Value 3.2 Preference for a Value 3.3 Commitment	Behaviour at this level is regarded as being sufficiently stable and consistent. The learner may be perceived to be holding or having a particular value or belief at the "acceptance" level, but commitment to a value involves a consistent and firm acceptance, perhaps even on non-rational grounds and the learner acts to promote "the thing valued".
4. Organisation	
4.1 Conceptualisation of a value 4.2 Organisation of a value system	Conceptualisation involves the integration of the value into the learner's value system involving cognitive processes. The Organisation of values involves bringing together a complex of values into an ordered relationship with one another.
5. Characterisation by a Value or Value Complex	
5.1 Generalised Set 5.2 Characterisation	This level describes how an individual is described by sets of value orientations which account for a range of generalised behaviour. The final level, or acme of objectives, describes the integration of values into a total philosophy or worldview.

The taxonomy of objectives in the affective domain seemed to offer a means for classifying the quality of affective development in relation to Earth Education programs, beyond the scope of attitude measurement. The taxonomy suggests that behaviour that "...is sufficiently consistent and stable...[takes] on the characteristics of a belief or an attitude" (Krathwohl *et al.*, 1964, p.139). Attitudes are largely represented by level 3- "Valuing" in the Taxonomy (Table 45). Since Valuing represents a mid point of the taxonomy, there appeared to be potential for a more precise differentiation of affective outcomes. Therefore, this had the potential for making discriminations between learners' responses to activities focused on the affective domain.

6.1.3 EVALUATION OF BLOOM'S AND KRATHWOHL'S TAXONOMIES

The original tri-partite system proposed three separate domains of learning and two of these have been discussed above. The psychomotor domain is largely inconsequential for this discussion as it was concerned with the development of physical aspects of experiences, such as the development of motor skills or neuromuscular coordination (Krathwohl *et al.,* 1964, p.7).

There is a lack of clarity in Bloom *et al*'s (1956) and Krathwohl *et al.*'s (1964) work as they conflated feeling, emotion, values, and value oriented action into their affective domain; others had placed value-oriented action, desire and volition into a domain separate from feeling and emotion, entitled Conation. There is also a certain lack or precision when referring to outcomes at specific levels. For example, the first level Awareness, is described as "... *almost* a cognitive behaviour [... We are concerned that...] the learner will merely *be conscious* of something- that he take into account a situation, phenomenon, object, or state of affairs." (Krathwohl *et al.*, 1964, p.99). This lack of clarity and consensus questions the validity and practicality of using such a system.

Furthermore, there was an acknowledgement that the taxonomy "...does some violence to the phenomena as commonly observed in natural settings" (Krathwohl *et al.*, 1964, p. 8), as "...no experience is composed of thinking without feeling, or vice versa" (*ibid*, p.7). Yet they continue by suggesting that cognitive achievement and attitudes, for example, have been shown to be statistically independent and therefore such reductionism can be supported. This apparent ambivalence presents the researcher with a dilemma and in order to resolve this tension, this discussion will examine the taxonomy in more detail.

Table 45 details the levels, and subcategories of each level, of affective objectives and these are described as "...arbitrary divisions on a continuum" (Krathwohl *et al.*, 1964, p.99) which suggests that the differences between the levels are differences in degree rather than character. Without a clear distinction between these categories, the classification of a learner's response with a particular level might also be rather arbitrary. For example, 'willingness to comply with regulations' is given as an example to one sub category (2.1 Acquiescence). However, this willingness is described as being motivated internally, or rather, the learner acts "...not out of a fear of punishment, but "on his own" (*sic*) or voluntarily" (*ibid.*, p.125). This implies that the assessor needs to be capable of making a distinction between motivations for learners' behaviour and furthermore, that learners need to be able to identify, and then articulate, a causal and single rationale for a specific behaviour. Despite offering precise definitions of terms such as "Belief" Krathwohl *et al.* (1964, p.140) still distinguish between valuing and merely believing, as being a subjective assessment of the consistency of a learner's response to a stimulus. Therefore, the difference between subcategories and levels, such as the difference between a belief and a value, appears to be a matter of degree and arbitrary and of little practical use.

The example given in the previous paragraph highlights another important weakness in the taxonomy; that is, to what extent are learners conscious of their affective response to any phenomenon, and are they capable of articulating it? For example, with respect to level 1, Awareness, "...concern with a vague awareness on the part of the student is difficult to verbalise as a specific behavioural objective..." because "...description of the behaviour [by the student,] in the very specific terms which make the behaviour recognizable (*sic*), tends to define... [the behaviour] at a higher level of attention giving"(*ibid.*, p.100). This indicates that although there may be various levels of affective response at the lowest level, "Receiving(Attending)" in this case, there may be no way of knowing this without affecting the outcome. Therefore, not only are some of the distinctions between levels arbitrary, some categories are unknowable.

The first paragraph in this section has indicated that Bloom *et al.*, (1956) and Krathwohl *et al.* (1964) were aware to some extent that the distinction between cognitive and affective processes was somewhat artificial. Indeed, because categories are intimately related to the cognitive domain there may be no practical way of assessing whether any particular behaviour should belong in the cognitive or affective domain. There is some appreciation of this in Krathwohl's *et al.* (*ibid.*) description where they state that "*Awareness* is almost a *cognitive* behaviour" (p.99). Therefore, it is problematic to characterise domains as reliable separate categories when they acknowledge that some affective levels involve cognitive processes, for example, they state that the level 'Organisation' requires a process of conceptualisation of a value which is "largely cognitive, involving abstraction and generalisation" (*ibid.*, p.157).

The higher levels of the affective taxonomy make the assumption that values systems are, ideally, harmonious and internally consistent but at the same time acknowledge that the relationship between values is likely to be other than ideal and more closely resemble a dynamic equilibrium dependant upon context (Krathwohl *et al.*, 1964, p.159). Krathwohl *et al.* (*ibid.*) also comment that "Realistically, formal education generally cannot reach this [ideal] level..." (p.165) so perhaps the higher levels (4. Organisation and 5. Characterisation) have little relevance for an evaluation of Earthkeepers, even if it were possible to distinguish between cognitive and affective aspects of the phenomenon.

6.1.4 SUMMARY

The issues discussed above indicate that this tripartite classification has what Sockett (1971) and Pring (1971) described as a naïve epistemology; it characterises experiences as being separate cognitive and affective phenomena, despite the many caveats that suggest the opposite, and this reductionism produced a taxonomy that seemed to be incapable of distinguishing and defending the classification of responses into separate types of behaviour. Combined with this, the terminology used to identify the levels was imprecise and vague. The taxonomy focuses on 'measurable' behaviours and outcomes and as such adopts a behaviourist approach to learning in its epistemological assumptions, including its reductionist approach, its proposal of a pre-ordained hierarchical system, and its concern with measurement.

It is likely that the taxonomic system would have been of little practical use for assessing affective development in Earth Education programs, as Van Matre's 'awareness' is far more than mere attitudes or facts. However the tripartite system is a useful mean of suggesting that affective and cognitive development occur on different levels and in different ways and it affirms that educational phenomena can produce a range of responses, 'measurable' or not, that have a greater or lesser impact upon the learner's thoughts, feelings emotions, values and actions. It is also significant that Bloom *et al.* (1956) and Krathwohl *et al.* (1964) acknowledge the importance of context when examining what has been learned from an experience. If 'awareness' can be considered to be an amalgam of cognitive and affective elements, rather than being divisible into separate domains, then a means for assessing the quality of this awareness is required.

This section has extended the review of research conducted in Chapter 2- Research in Earth Education by critically reviewing this literature in relation to Bloom *et al.*'s (1956) and Krathwohl *et al.'s* (1964) Taxonomy. It has argued that the Earth Education methodology regards the development of Awareness as being composed of elements that go far beyond the objectives given by Bloom and Krathwohl, and therefore the taxonomy has largely been rejected as a potential means for program evaluation.

It is clear that different approaches to research have been used on Earth Education and empirical evaluations have either tended to focus on a small aspect of the phenomenon, such as attitude development, or have attempted, rather unconvincingly, to provide a more general analysis by providing a qualitative account of learners' experiences. A consideration of their strengths, limitations and opportunities, in the previous chapters, has suggested various important questions concerned with examining the phenomenon of Awareness and these have been summarised in Table 46.

Table 46: Central Research Issues in Earth Education.

How does Earth Education contribute to the development of **Ecological Awareness;** that is basic comprehensions, deep and abiding emotional attachments and the ability to live more lightly on the Earth?
Objects of Research Earthkeepers (Sunship III) (Earth Caretakers) (Acclimatization)
Cognitive Aspects The long term effect of Earth Education upon ecological understanding. Accurate and meaningful understanding of ecological concepts. The relationship of understandings to values and behaviour. The compatibility of Earth Education with traditional schooling.
Affective Aspects How do pupils respond to the feeling aspect of Earth Education? What kinds of emotional experiences does Earth Education encourage? How does Earth Education affect values?
Behavioural Aspects How do pupils explain and justify their intentional behaviour? What effect does Earth Education have upon pupils' resource use and energy consumption?

The next section discusses the issues that these questions raise for an evaluation such as this.

6.2 PARADIGMS AND SOCIAL RESEARCH

There has been little explicit examination of research philosophy, involving theories of knowledge or reality, in relation to Earth Education and this has been a major weakness of previous approaches as a whole. The previous discussion concluded by identifying some issues connected with research philosophy, although these were not explored in detail. Therefore this discussion will now turn to a detailed account of three main traditions in social research and their implications for an evaluation of Earth Education.

Research has been regarded as being conducted according to three 'paradigms' or 'worldviews' (Robottom and Hart, 1993). These paradigms have been characterised by responses to three questions: what is the nature of reality (ontology); what is the nature of knowledge (epistemology); and how is knowledge developed? (*ibid.*). Whilst Kuhn (1996) was the first to introduce this notion to a study of the history and sociology of science (Maykut and Morehouse, 1994, p.9) he can be criticised for using the term in a rather loose sense, sometimes referring to paradigms as "...coherent traditions of scientific research" (Kuhn, 1996, p.10), or the shared components of a disciplinary matrix (*ibid*, p.182), but later as "...tacit knowledge" (*ibid.*, p.191), or embedded knowledge. Indeed he confesses that his original text contained at least 22 different usages of the term (*ibid.*, p181). Jary and Jary (1995, p.579) regard this inconsistency with circumspection and suggest that rather than supporting the rejection of Kuhn's thesis, this ambiguity is, rather, indicative of its indeterminacy which reflects the "flesh and blood" (*ibid.*, p.579) nature of the phenomenon of scientific endeavour.

Kuhn was concerned, in part, with the development of scientific theory, critiquing the commonly held view that science developed in a gradual manner with the body of knowledge accreting theory and discoveries as a result of scientific exploration and research. Instead he proposed the notion that this accretion process was interrupted throughout history by radical shifts in thinking brought about by discoveries that did not accord with accepted theories to the point that it was no longer possible to account for them by accommodating an existing explanatory theory. Lincoln and Guba (1985) and Maykut and Morehouse (1994, p.14) argue that a similar paradigm shift has occurred in the field of social science.

Various authors have described different paradigms in social inquiry that in essence deal with the central question, to what extent are methods drawn from the natural sciences appropriate for the social sciences? (Blaikie, 1993, p.11; Robottom and Hart, 1993, p.12). Blaikie explores eleven different answers to this fundamental question including "classical" and "contemporary" responses, including positivism, critical rationalism, interpretivism, critical theory, realism, structuration theory and feminism (*ibid.*, pp.93-100). In an acknowledgement of the complexity, disagreement and even confusion between various authors, Sparkes (1992, pp.9-60) simplified this categorisation by proposing three ideal-types or caricatures of paradigms of inquiry. These comprise positivism or the dominant paradigm, interpretivism, and critical theory. Robottom and Hart (1993, p.6-7) also use this simplification, including the same three paradigms, drawn from Habermas's (1972) and Popkewitz's (1984) work. However, they also admit that the debate has recently become concerned not with a trinity of paradigms but a multiplicity of perspectives.

Broadly speaking then, different approaches to research can be characterised as being allied more closely with one paradigm or another and this is determined by the assumptions made regarding questions at the levels of ontology, epistemology and methodology (Sparkes, 1992; Robottom and Hart, 1993, p.7; Maykut and Morehouse, 1994, pp.3-4). The potential for each of these paradigms for examining Earth Education is explored in the following sections.

6.2.1 POSITIVISM AND EARTH EDUCATION

Chapter 2 described how research on Earth Education has been biased towards producing evaluations of the Sunship Earth program or towards Earth Education in general. Research has also tended to rely upon quantitative methods, or upon research methodologies whose epistemological and ontological assumptions were aligned with the philosophical tradition of positivism. This bias reflects the bias in educational research in general, towards quantitative approaches, or what some (Robottom and Hart, 1993, p.18; Maykut and Morehouse, 1994, pp.7-24) refer to as the dominant paradigm.

Positivism is based upon the same principles and procedures as the natural sciences and makes the assumption that the behaviour of humans is governed by the same immutable laws as the physical world, that of cause and effect, and notions of prediction and control. It places particular emphasis on behaviour that can be directly measured by an unbiased observer in controlled surroundings. Factors that are not directly measurable by an objective and unbiased observer, such as meanings, feelings and purposes, are unimportant and can be unreliable (Blaikie, 1993, pp.13-17; May, 2001, pp.9-11), yet such factors may be crucial for understanding the quality of awareness produced by Earth Education.

Furthermore, positivists' emphasis on observable "facts" rests on the assumption that human behaviour, like the behaviour of matter, can be reduced to notions of cause and effect, and does not inquire into the nature of the meaning and purposes of matter because of their absence. Likewise the meanings and purposes of human behaviour are not open to inquiry because they are not important. Positivism regards human behaviour as a product of the environment and therefore can be explained as a series of causes and effects, or rather a series of stimulus and response events. For example, Pennington (1986, p.60) acknowledges that researchers do not have the same access to their objects of study as physical sciences and consequently psychological phenomena, such as attitudes or values may only be inferred from behaviour, that is, what people say or do. Since the power of attitude measurement to predict behaviour is weak, even when the attitude measured relates to a specific form of behaviour (*ibid.*, p.79), and the *raison d'etre* of attitude measurement is the prediction and control of behaviour, then the value of attitude measurement is questionable for developing and extending an understanding of a phenomenon such as ecological awareness in Earth Education.

Finally, research based upon positivistic assumptions of the nature of knowledge and reality, although it claims to be objective, unbiased, generalisable and reliable, can produce results so trivial as to make the research findings insignificant as it is not possible to explain accurately behaviour from the data generated by such research. Research is often conducted in artificial 'laboratory conditions' where the more the researcher attempts to control and measure different variables, the further away from the original 'holistic experience' the researcher moves (Cohen and Manion, 1981, p.23).

Earth Education programs are concerned with ecological awareness including conceptual understanding, feelings, emotions, values, and behaviours. Perhaps of central importance for understanding the Earth Education phenomenon is the production of a compelling account of the experience from the perspectives of participants, an account that is capable of describing these understandings and experiences along with the meaning that participants attribute to them. Keen (1991a; 1991b) provides an excellent example of some of the problems that can occur when applying a positivist research methodology to program evaluation. She attempted to evaluate Sunship Earth's effects on knowledge, attitudes and behaviour using predominantly statistical analyses of questionnaire responses. Although she found that participants' ecological knowledge had increased significantly this finding was produced by nine multiple choice questions that had been aimed directly at the program content, both in their choice of subject matter and their phrasing, so perhaps it was hardly surprising that the program participants achieved better results than the control group. Furthermore, these nine questions seem rather inadequate for evaluating the effects of a program that delivered conceptual learning for nearly twenty hours! Unanticipated outcomes from the program were unlikely to be discovered by this work due to its hypothetico-deductive methodological approach. Consequently the work is able to demonstrate that the program had a medium-term effect upon participants' recall of some elements of knowledge but no further claims can be made beyond describing associations between variables.

It is clear that methods that make positivist assumptions about the nature of reality and the nature of knowledge would be inappropriate to investigate some aspects of Earth Education programs but they may be appropriate for researching certain elements of the experience, such as knowledge recall, or the measurement of highly specific attitudes. Whilst a methodology that is capable of providing valid, reliable, predictive and generalisable outcomes is certainly alluring it may not be capable of adequately representing the meanings that participants make of their experiences of ecological awareness in a convincing manner.

6.2.2 INTERPRETIVISM AND EARTH EDUCATION

An alternative view of social reality is proposed by the interpretivist paradigm of social inquiry, which is often discussed as a competing perspective to positivism in the paradigm debate (Sparkes, 1992). It is essential to highlight that the difference is fundamental- that is, research underpinned by the interpretive paradigm rests on different ontological and epistemological assumptions, and therefore includes or excludes data using different criteria and hence asks different research questions (Maykut and Morehouse, 1994). Furthermore, whilst the purpose of positivist research is prediction, control and generalization, the purpose of interpretive research is variously described as being understanding, illumination but more generally, interpretation (Janson and Peshkin, 1992, pp.698-699; Sparkes, 1992, p.21; Blaikie, 1993, pp.52-58; Robottom and Hart, 1993, p27; Cohen and Manion, 1994, p.39).

Lincoln and Guba (1985) suggest several major characteristics which exemplify the interpretive stance: it has a complex world view, a heterarchic organisation of information (webs of meaning), relationships are holographic as opposed to mechanical, sources of change are indeterminate (non-causal), explanations for change are mutually causal, and the observer's position is perspectival rather than objective. However, the basic difference between the positivist and interpretivist position lies in their epistemologies and ontologies. The interpretivist position sees social reality as relative as opposed to realist, and the relationship between the knower and the known is complex, as opposed to simple (Robottom and Hart, 1993).

Earth Education deals explicitly with awareness composed of values, feelings, emotions and perhaps spirituality, as well as knowledge, understanding and behaviour. Interpretivists tend to deny simple causality between events suggesting that they are mutually causal (Lincoln and Guba, 1985; pp.51-54). Social phenomena, unlike material reality, exist only in the experiences and realities of the social actors and therefore operate not in a subject-object social world where objects are related to each other in a mechanistic fashion, but in a subject-subject world where meanings, values, emotions and purposes are negotiated, and where "*...meanings developed by active subjects actually enter into the actual constitution of that world*" (Giddens, 1976). This emphasizes the dynamic nature of social phenomena and directs us towards developing an understanding of how participants interpret their experiences of Earth Education programs, and how they act upon the basis of these experiences.

Not only can the meanings associated with values, feelings and behaviour be investigated using the interpretivist paradigm of inquiry, but also conceptual understandings. The social world includes these understandings, and these understandings are constructed in the same way as meanings (Schwandt, 1994). Indeed Phillipson (1972, p.122) warns us against the absurdity of reifying human consciousness [by using a psychology based upon the methods of the natural sciences] and comments that what is required is a coming "...to terms with the phenomena of consciousness themselves". Phenomenology, upon which perspective much of interpretivism is built, suggests that values, attitudes, feeling, awareness *et cetera* can not really be considered to have separate, objective existence and rather must be considered as being a whole phenomenon. So if Earth Education programs are concerned with generating ecological awareness, an awareness that is influenced by and is yet influential upon, various aspects of consciousness, such as understanding, feeling and behaviour, it might seem that interpretivist modes of inquiry have much potential for broadening understanding of the Earth Education phenomenon.

A consideration of the Earth Education experience in the light of this tradition opens up a great deal of what is anecdotally regarded as being significant yet has been unavailable to those approaching program analysis from a positivist tradition.

6.2.3 CRITICAL THEORY AND EARTH EDUCATION

The third paradigm of inquiry in the trinity proposed by Robottom and Hart (1993) and Sparkes (1992) is 'critical theory'. However, due to the diverse nature (Sparkes, 1992, pp.36-37) of this family of approaches, Guba (1990) prefers the more accurate, but perhaps cumbersome, description of 'ideologically orientated forms of inquiry'. Critical theory rejects some of the ontological and epistemological assumptions of positivism and the notion of value freedom in any form of social endeavour. Critical theorists seek to uncover oppressive social structures, power relationships and ideology; the aim is to provide knowledge to engage and overcome unequal power relationships through overt political struggle (Harvey, 1990, p.20). Fay (1975, 1987) summarises this by describing the role of critical theory as the exposing of false consciousness, the analysis of the development and resolution of social crises and the consequent struggle to transform society.

Critical theorists have not only been critical of the dominant paradigm, suggesting that it often fails to identify the phenomena to be explained and consequently produces trivial or useless theories (Carr and Kemmis, 1986, p.103), but are also critical of other paradigms, such as the interpretive approach. For instance, Carr and Kemmis (1986) also bemoan the failure of interpretivism to account for "...historical forces and economic and material conditions" (p.104) thereby providing an incomplete picture of social reality. Hargreaves (1980) argues that interpretivism tends to operate in a social, cultural and historical vacuum, ignoring the contexts in which members of society work, and therefore its transformative power, on its own, is weak. Whilst Robttom and Hart (1993) write from a critical perspective, they acknowledge that interpretivist environmental education is unconcerned with power relations and does not seek to transform society by challenging these power relations.

What potential might exist then, for critical research of Earth Education? There seem to be immediate constraints upon using this approach with a phenomenon designed for young children. Because of its overtly political nature the difficulties of implementing such an approach without a great deal of support from the institutions involved would probably be extremely challenging. However, since the goal of Earth Education is the development of awareness leading to a critical examination of personal lifestyles and hence social change via individual change, critical theory might be particularly useful for examining many of the assumptions inherent in the approach of The IEE. By analysing the notion of lifestyles, for example, critical theory could perhaps help to provide a more refined and inclusive model for Earth Education's perspective on behaviour change and the resolution of environmental problems. It could also usefully inform The IEE's approach to environmental action (Van Matre, 1990, pp.157-162).

Such work could, potentially, reveal ideology at many levels thereby facilitating a particular form of politically orientated inquiry (Guba, 1990). However, such forms of research require a high degree of commitment from all involved because personal and social transformation, and emancipation through criticism and liberation, are regarded as the primary interest (Sparkes, 1992, p.21; Blaikie, 1993). Not only was it necessary to identify the level of commitment of stakeholders, but the stakeholders themselves had to be identified. It was uncertain that it was going to be possible to gain this commitment from the actors in the situations involved as the program sites were unknown to the researcher, the institute had sometimes been secretive and not always helpful to those it did not know and teachers can be suspicious of what can be perceived to be interference (Sougnez, 2006).

6.2.4 PARADIGM COMPATIBILITY

The work of Sparkes (1992, p.21), Robottom and Hart (1993, pp.26-27) and Lincoln and Guba (1985, pp.51-57) delineate the three paradigms by tabling the underlying assumptions of each approach, with regards to various characteristics such as ontology and epistemology. Frequently these appear to be mutually exclusive, or at least competitive. For example, a positivist approach generally assumes social reality to be external to the observer and realist, whereas an interpretivist approach assumes it to be internal-idealist and relativist (Sparkes, 1992, p.21). It might therefore be concluded that the researcher must work consistently within one particular paradigm in order for the products of research to be coherent.

Robottom and Hart (1993, pp.13-16) review four perspectives that provide different answers to the question of paradigm compatibility. These are unity, compatibility, complementarity and incompatibility. They argue that the debate has sometimes been concentrated on research methods and therefore there has been a tendency to reduce the problematic notion of educational inquiry to one of techniques (*ibid*, p.16) where the means of inquiry are inappropriately separated from issues of purpose, value and metaphysical assumptions. They initially appear to conclude that paradigms are incompatible because they are distinctive philosophical systems and are therefore "...incommensurable almost by definition..." (*ibid.*, p.16). However, they do recognise that if it is acknowledged that inquiry is multiparadigmatic then there is no need, or reason, to reconcile different perspectives, thereby moving towards a position which might be described as complementarity. Eisner (1988, p.15) prevents conflict by suggesting that each paradigm "...slices the pie in a different way..." and therefore research should be evaluated only within the sets of assumptions that apply to that particular paradigm. It would, therefore be reasonable to surmise that different paradigms are suitable for different areas of human experience. For example, the development of the ability to recall a string of unconnected information might require a different paradigm of enquiry from an evaluation of one's own efforts at encouraging social and environmental reform.

Consideration of Table 46: Central Research Issues in Earth Education., (p.172) suggests a variety of objects and areas for inquiry regarding the Earth Education phenomenon, however perhaps the most pressing of these is the overall question of how Earth Education might contribute to the development of Ecological Awareness. This suggests that the interpretivist tradition might be most useful for understanding the meaning of the phenomenon from the participants' perspectives, particularly as the programs deal with human experience on such a wide variety of levels, without ever defining what these levels might be in any strict sense, other than for concept formation. Furthermore, the majority of work has tended to be unconscious of any tradition other than positivism for investigating programs so it might seem most useful, in terms of exploration and discovery, to use a methodology that offers the potential of producing a detailed account of stakeholders' meanings associated with Earth Education. Therefore interpretivist research can broaden an understanding of the phenomenon of ecological awareness developed during an Earth Education program.

The previous sections have discussed how advances in knowledge proceed non-uniformly and the assumption that knowledge accretes in a sequential and cumulative manner has been challenged by Kuhn's (1996) paradigm thesis. Three paradigms are discussed in relation to Earth Education, and their value for examining the notion of ecological awareness was explored. Whilst paradigms have often been presented as being competing, and sometimes mutually exclusive sets of assumptions, Robottom and Hart (1993) argued that educational inquiry is multiparadigmatic and therefore there is no need or reason to find a compromise- each approach has its own strengths and weaknesses dependant upon the context.

The analysis has shown that since awareness is composed of multifaceted aspects of the individual, not least the meanings participants have about their experiences, then an interpretive methodology has the most potential for exploring this phenomenon in relation to the Earth Education program- Earthkeepers. Interpretivism is concerned with interpreting the meanings that social actors hold and part of this involves analysing the explanations learners give about the environment. Robottom and Hart (1993) argued that interpretivist approaches have a constructivist learning theory and so this discussion will now address the significance of constructivism for an analysis of Earthkeepers.

6.3 CONSTRUCTIVIST LEARNING THEORY

Piaget's (1929) work in the field of learning theory is regarded as highly significant even today. He developed a model to help explain how children's learning developed in distinct step-like stages rather than continuously. Novak and Gowin (1984) comment that part of Piaget's genius was his development and use of the interview as a research method, but what was even more significant was that it was performed at a time when behaviourism was dominant within social science. Consequently its value as a means of explaining learning, and furthermore as a research methodology, was not recognised until nearly thirty years later.

Modern critics, such as Novak (1977), Donaldson (1978) and Modgil and Modgil (1982), have been more circumspect and have pointed out that Piaget failed to recognise adequately the link between language, conceptual frameworks and reasoning developments. However, Gunstone (1988) comments that Piaget's work was nevertheless a major antecedent to the approach of constructivism.

Driver (1988) discussed six important aspects of the constructivist approach to learning theory and these have been reproduced earlier in Table 33 (p.122). The implications of these is that learners generate their own meaning from external stimuli. Driver (1988) comments that reality is elusive; we only have access to our conceptual frames[16] which are constructed from reality. Each person's conceptual frame is unique and whilst one particular frame may be coherent and useful for that person, it may not be for another. Therefore conceptual frames will vary for different pupils and the most appropriate method of investigating these frames is to use a methodology which seeks to explore individual meaning and perspectives, such as interpretivism. The interpretivist paradigm and the constructivist approach are therefore intimately related (Schwandt, 1994).

6.4 DEVELOPING THE FOCUS OF INQUIRY

Earth Education programs, as social experiences, deal with many interwoven issues and the possible foci of inquiry are myriad. So it might seem that what is required is metaphorically to 'clear the ground' to make way for a manageable research question and hence a manageable protocol. Robottom and Hart (1993) comment that interpretive understanding is grounded in "...field based inductive methodology..." (p10) and methods cannot be preordinate but emerge as data is gathered according to the situation. The formation of *a priori* hypotheses is clearly incompatible with the interpretive stance (Lincoln and Guba, 1985; Maykut and Morehouse, 1994) but this does raise a problem of focus. Various

[16] To clarify, Driver's use of the term conceptual frame should not be taken to imply that these frames are exclusively cognitive- the previous discussion has shown how experiences cannot be

research questions commensurate with the interpretivist paradigm have been posed in Table 47 in order to focus the evaluation.

reliably separated into domains of experience. Conceptual frames are organisations and explanations about the world that make it meaningful.

Table 47: Initial Research Questions (Martin, 2002a; 2002b)

Knowledge Elements
How do participants understand, explain and describe the natural world? What do Earth Education programs contribute to this understanding? How do participants use knowledge presented by Earth Education programs? How do participants explain personal behaviour in the light of this knowledge? Where do participants get their environmental knowledge from? How do participants see the relationship between humanity and nature? What opportunities exist for participants to make meaning? How does the context of Earth Education programs affect participants' motivation?
Feelings Elements
How is knowledge valued? How are values constructed? How dynamic are values? How do values influence behaviour? To what extent are values verbalised? How are values reproduced? Are there differences between environmental values across social class? What is the relationship between Earth Education programs and future learning in related areas?
Behaviour Elements
What are construed as environmentally good/bad habits? (By participants, teachers, program leaders, parents, peers) To what extent are these habits conscious? Where does the rationale for conscious behaviour originate? What characterises a change in behaviour? How do children perceive others' environmental habits and how do they act on these perceptions? To what degree are Earth Education programs empowering/disempowering?

This list comprises a series of open questions aimed at various aspects of the phenomenon but they were not intended to be testable hypotheses; rather, they were intended to be questions for stimulating thinking and creating a focus. These were distilled into a central research question which addressed the questions above: i.e.

How do children perceive their relationship with the natural world and how do they relate to, and act upon the knowledge, values and behaviours presented through the Earth Education program, Earthkeepers?

Having adopted an interpretive approach, this discussion will now turn to a discussion of research design issues in order to explain how the questions in

Table 47 were addressed.

6.5 RESEARCH DESIGN ISSUES

Earth Education is a complex phenomenon because it operates at so many levels; although it seems to focus on the individual, it does not operate in a social or cultural vacuum. Therefore, the context in which earth education takes place is likely to be important. Strauss and Corbin (1998, pp.181-199) offer a means to illustrate this and this has been discussed previously in Figure 3 (p.23) where it was used to conceptualise the analysis of research literature concerned with Earth Education. However, it now needs to be re-examined in order to take account of methodological and practical decisions that have arisen in the subsequent discussion.

Strauss and Corbin (1998) suggest that the matrix is useful for stimulating thinking about the levels, or conditions, that pertain to a phenomenon. For example, an evaluation could be concerned with *micro conditions* such as learners' meanings, or the *macro conditions* such as the effect of government policy upon a phenomenon. Strauss and Corbin (*ibid.*) clarify that these conditions are not dichotomous, but rather exist on a continuum, from the micro to the macro level. Furthermore, these conditions can have consequences that influence both higher and lower levels; they are not unidirectional. This discussion has illustrated that a range of such micro and macro conditions are significant for the Earthkeepers phenomenon and therefore this research was originally designed to uncover the influences and relationships operating at different levels. This is illustrated by the diagram in Figure 10.

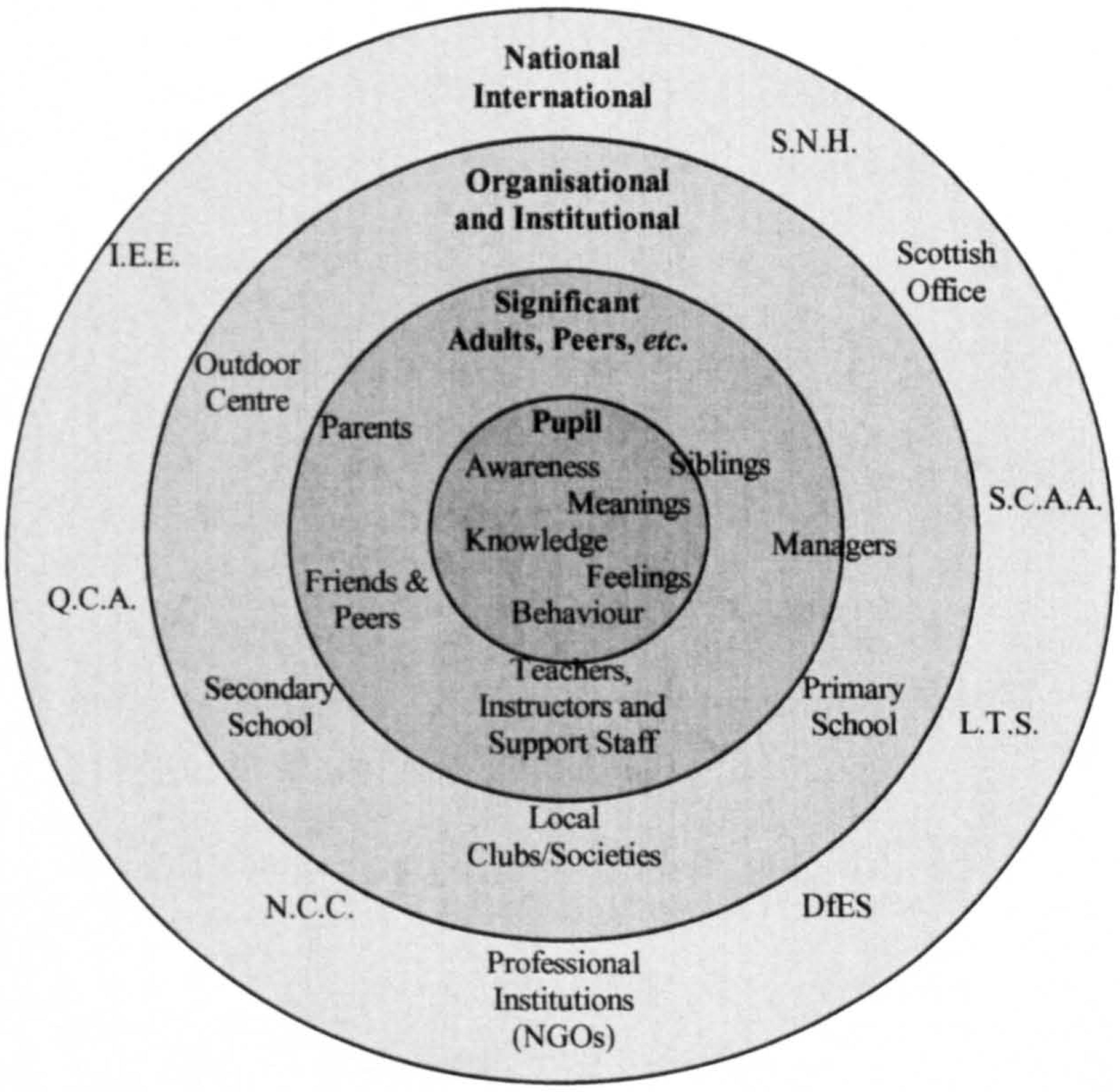


Figure 10: A Matrix of Conditions for Earthkeepers at the Scottish Outdoor Centre (After Strauss and Corbin, 1998)

The matrix (Figure 10) has various implications for the choice of methods, but before these are discussed in detail, further design issues will be addressed.

6.5.1 SAMPLE SELECTION

One of the first issues that was confronted was which program and hence, what type of sample, would be of most use for this evaluation? Such issues can only be addressed properly if the purposes of the evaluation are made explicit. These were clarified by lengthy and protracted discussions with The IEE , the chair and volunteer staff of the UK branch of The IEE , discussions with managers and staff of centres involved in Earth Education, and discussions with adults accompanying groups on centre visits such as teachers and WATCH (Young Ornithologists) group leaders. These discussions revolved around the need to demonstrate unequivocally that Earth Education 'worked'. However, this simple term has different connotations depending upon the assumptions of the stakeholders. These early discussions and observations indicated that the notion of whether the program 'worked' was conceptualised in positivistic terms; that is, whether it produced generalisable and predictable results. Indeed, the initial proposal for this evaluation comprised a large scale pre and post test questionnaire survey of a stratified random sample or a cluster sample, of both a group of program attendees and a control group. The assessment of the program's impact upon pupil behaviour was reduced to the desire to 'measure' observable changes in the ability of pupils to live more lightly on the earth. Robottom and Hart's (1993) claim that the dominant paradigm had a stranglehold on the field of environmental education seemed to be particularly apposite!

The assumption that the results had to be generalisable had far-reaching consequences; the importance of focusing on an 'accredited' program was one of these although, this was relatively easy to resolve given the resources that were made available in 1995/6 (this has been discussed in Section 3.1.1). The other consequence of this emphasis was the desire to choose a 'typical sample'. This is a common preoccupation of positivist researchers whose goal is prediction and control; clearly these goals are unattainable if the results cannot be generalised. Interpretivist approaches do not normally concern themselves overly with generalisability. Instead they seek to provide in-depth analyses and re-present these in a convincing and meaningful way. It was hoped, instead, to provide deep and accurate description of the phenomenon and present the results in such a way so that they could be interpreted appropriately by the different stakeholders. The choice of a sample that would be agreeable to stakeholders was made especially problematic by the fact that only five schools were attending Earthkeepers during the funded period; the way in which this issue was resolved is discussed in the next section.

The choice of sampling method was severely limited by the number of schools taking part in the Ardroy program. A random sample was not really practical given the small numbers of participants expected, the wide geographical distribution of the participants homes and schools and hence the difficulties of building and maintaining a productive relationship over a two year period. Consequently, purposeful sampling was regarded as being most appropriate.

When initial contact was made with the outdoor centre, five schools were identified as being potential study groups. Of these, one was due to attend in February 1996, the other four in April and May. With the assistance of Fife Council, including written letters of support from the Head of Education and the authority's Outdoor Education Advisor, the schools were approached for permission to conduct the research. A structured telephone interview with a senior manager from the primary school identified the suitability and availability of each primary school for the research where the main criterion for selection, apart from readiness to participate, was "information richness" (Patton, 1990, p.181).

One headteacher described her school as a "...town school with a countryside feel..." with pupils coming from a range of backgrounds, social classes and ability. The school was perhaps unremarkable in every other respect except that the class was small, there being only fifteen pupils. The other school was situated next to an RAF base and had many ties with the base (see Figure 11 below).

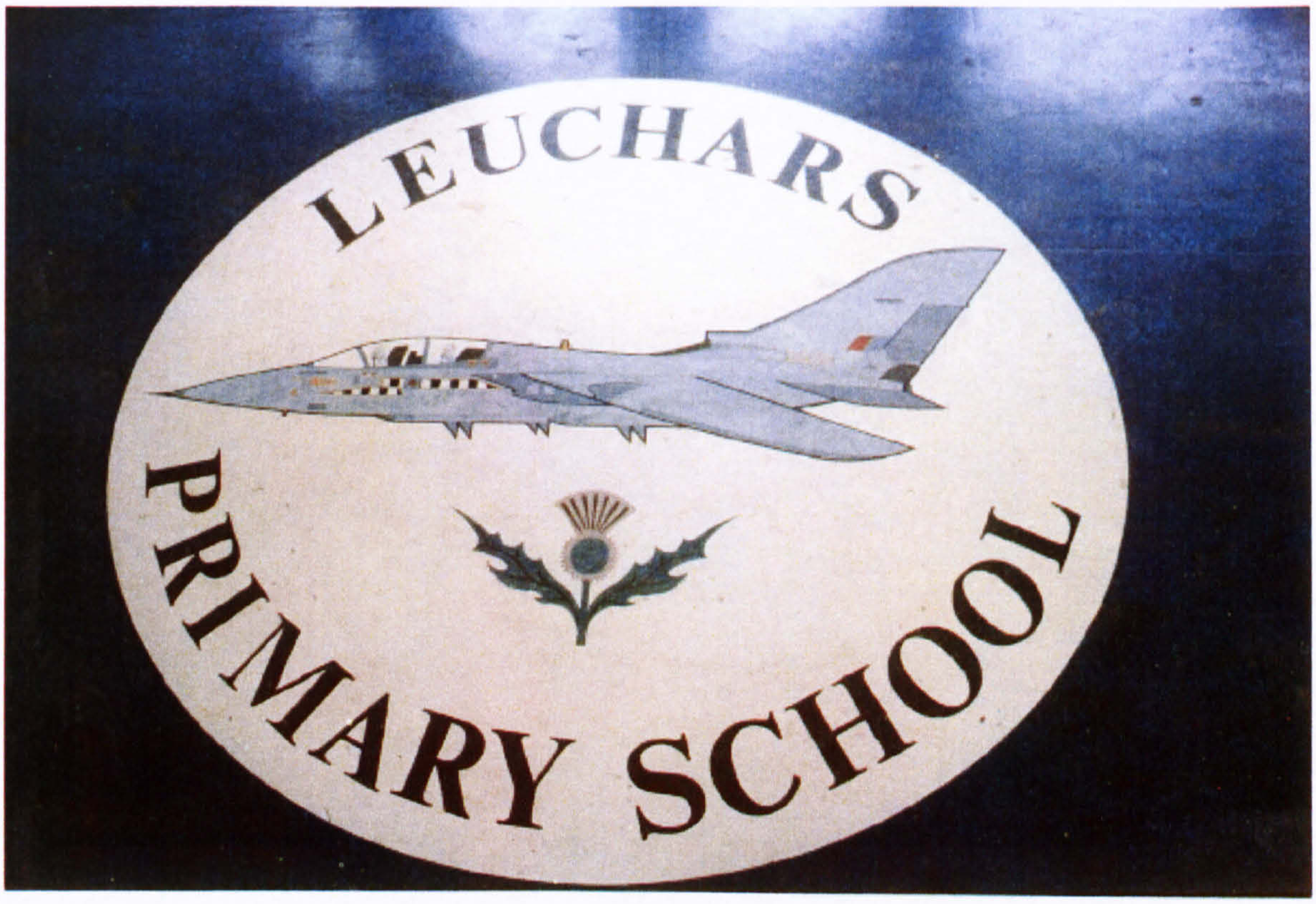


Figure 11: Linoleum Marquetry on the Floor of Leuchars Primary School

Not only was the school unusual, but also the local community. For example, due to security issues, housing estates were surrounded by tall barbed wire fences and surveillance cameras as illustrated by Figure 12.

Figure 12: A Housing Estate in Leuchars for RAF Personnel and their Families

Concepts of "violence" and "threat" were a feature of the lives of the families of the RAF personnel. The schooling of their children was frequently disrupted by the operations of the base, such as security alerts, or the Red Arrows display team rehearsing in the skies above and around the school during lesson time, although the latter probably had a greater impact upon the naïve visitor to the classroom than it did upon the pupils. In many respects this school and its community provides pupils with a very different range of backgrounds and an even wider range of abilities so enhancing maximum variation sampling. Yet this variation was counterposed against the first school. This mixture had the potential for supplying a rich sample of reasonable size, with flexibility to select interesting cases as the research proceeded and pilot appropriate research methods and data gathering styles for these young pupils.

From the results of initial telephone survey, two of the five schools were chosen; Pittencrieff Primary school in Dunfermline and Leuchars Primary School near St.

Andrews. The centre also ran a pilot of the program and this was observed with Cairneyhill Primary School, also from Fife, making a total of three schools.

To summarise, the sampling technique was of necessity, opportunistic sampling combined with maximum variation sampling, yet as the study progressed, intensity sampling was used as certain pupils exhibited unusual but compelling responses to the program. Snowball sampling was used to identify the intense cases that were likely to be productive (Patton, 1990, pp.169-183).

Sample size is connected with the information richness of the chosen sample. Patton (1990) comments that there are always trade offs between, for example, breadth and depth; sampling to the point of redundancy is ideal but is not always possible given time and resource constraints. Using one small class of pupils had the advantage that the access would be easy initially as most of the participants would live and attend school in a relatively small area. Because there could be a fading commitment from participants as time passes a larger class would have been more advantageous than a small one, to allay the problems of having a diminishing sample! However, it should be noted that Maykut and Morehouse (1994) argue that it is not possible to specify sample size beforehand; this must depend on the extent to which the situation is theoretically saturated. Different samples were used in order to provide a better saturation of theory, and the way this was done is explained later.

6.5.2 ETHICS

The notion of what constitutes an ethical research design is not unproblematic. Barnes defines ethics as arising when decisions about actions are made "...by reference to standards of what is morally right or wrong" (1979, p.16). It has been described as involving such issues as informed consent, neutrality, and gaining access and acceptance (Cohen and Manion, 1994; Patton, 1990).

May (2001, p.60) suggests that it may be valuable to examine the costs/benefits of carrying out social research. Such an analysis is given in Table 48.

Table 48: Costs/Benefits Analysis of the Earthkeepers Evaluation

	Costs	Benefits
Pupils	Potential embarrassment An altered program experience Disruption to timetable Loss of schooling time (10 hrs in three years)	Satisfaction in contributing to a program evaluation. Better understanding of ecological concepts and own emotional response.
Teachers	Loss of teaching time Disruption to timetable Scrutiny of practice	Better educated pupils Better understanding of Earth Education Clarification of thoughts
Managers	Disruption to timetable and extra administrative work	Better understanding of Earth Education Clarification of opinions
I.E.E.	Evaluation could be unfavourable Loss of time	Provision of rigorous empirical evidence to support Earth Education Promotion of Earth Education Better public and academic understanding of Earth Education Clarification of opinions
Society	Expense	Clarification of Earth Education ideology. Verification of program quality. Better educated population. Amelioration of the Ecological Crisis through more prudent resource use (by all involved in program). Greater understanding of environmental education and schooling. Educational reform

Benefits to society include an assessment of activities which have been delivered to hundreds of thousands of learners around the world. Indeed, if the more vehement allegations against Earth Education had any basis in fact then society would be in serious trouble.

However, the value of this analysis is questionable as the dichotmony implies that costs and benefits can be measured against each other by a neutral researcher, and as May comments "...value freedom is itself a value position" (2001, p.67). Furthermore, the costs/benefits analysis poses the question; do the ends justify the means? Weber's (1949) response was that they could not, rather than they *should* not. For example, Table 48 shows that the costs to society are essentially financial and these can be measured in a simple manner; one benefit is that the ideology behind earth education could be revealed and explored. Yet, the question of how one could measure something material against something metaphysical is unclear. Comparisons of these ontologically distinct positions would not be possible in any meaningful way. But this should not imply a position of relativism and a rejection of *any* ethical stance. Cohen and Manion (1994, p.349) argue that the most robust position is to use "... humane personal and professional values rooted in a shared culture if investigators are to deal effectively with the ethical challenges of the research adventure". Therefore, central to this evaluation's ethical position is its adherence to the ethical codes laid down by The University, and the circle of academics on the ethics committee.

A number of issues were pertinent for gaining ethical approval. These are discussed in detail below.

6.5.2.1 Gaining Consent

Approval from the University's ethics committee was granted several months prior to the data collection period, although this was contingent upon gaining participant and stakeholder consent. The notion of "informed consent" was used for this purpose, effectively precluding the use of covert methods of data gathering. Covert research would have been especially problematic in any case as the researcher was already known to The IEE and the centre staff.

A summary of the research methodology was sent to the pupils, along with consent forms which each child and each child's parents signed and returned to the researcher. The evaluation schedule was simplified as much as was possible but ran the risk of simplifying to the level where *informed* consent was not possible. After all, the young people can not really be expected to understand the intricacies and implications of an interpretive methodology, even if their parents could. Furthermore, even with experience of social research, participants would still not be able to predict all of the potential consequences of the evaluation. So, it is questionable whether consent can be 'informed'. To resolve this apparent contradiction the notion of *reasonably informed consent* was used (Cohen and Manion, 1994, p.351) to draft the evaluation schedule. In practice, this emphasised;

- A fair explanation of the procedures to be followed and their purposes.
- A brief description of the expected benefits and costs.
- A brief discussion of alternative approaches that might be useful.
- An offer to address any questions that participants may have.
- An instruction that the participant is free to withdraw at any time without prejudice to the participant.

6.5.2.2 Anonymity and Confidentiality

Cohen and Manion (1994) differentiate between anonymity and confidentiality. They state that "*the essence of anonymity is that information provided by the participants should in no way reveal their identity*" (pp.366-368). Clearly, since the research was likely to use interviews and field observations, anonymity was impractical. On the other hand, limited confidentiality, or reasonable confidentiality (Patton, 1990, p.356), could be assured as this is concerned with ensuring that respondents could not be identified from the information given. There were two examples where this was brought into question. Firstly, the evaluation was partially concerned with some adults who could be identifiable by their roles. This was acknowledged in the interview pre-amble and the evaluation was conducted with this in mind. The second case is concerned with disclosure of information to a third party. Patton (1990, p.355) and May (2001, p.61) caution that social scientists, unlike doctors and lawyers have no protection in law, and if children are perceived as being at risk then some information has to be reported to the authorities. One pupil's responses initially gave concern. These are detailed in Interview Extract 1.

Interview Extract 1: Post Program: SC260496

S: You're feeling it and that... that means you're getting in touch with the earth, you're looking around yourself and listening to what the earth is trying to say to you.
Interviewer: What the earth is trying to say to you...?
S: Well, I usually hear some strange noises underneath the earth, so it sounds more like the earth is trying to tell me something
Interviewer:oh right! What do you mean? Tell me a little more...
S: I hear strange noises, more like the earth is trying to contact me... or speak to me or keep me away.
Interviewer: Keep you away from (where)?
S:... (magic) Spot
Interviewer:Do you hear these noises in a certain place?
S: At the back of my garden, the field up behind the house.
Interviewer:What do you think about that?
S: Quite interesting. Go and get sherlock holmes!
Interviewer: What do they sound like, these noises?
S: Like all this screaming underneath me... and its crumbling as well, yeah and theres no leaves.
Interviewer:Does it sound like a nice sound or a nasty sound?
S: In between... just makes me want to run away from it... (...) I don't know what it is and I don't know why I'm hearing them. It's like it's coming from my mind and not from the soil...

On the face of it this would appear to be an account on the fringes of sanity. However, the context was that this was from a pupil who had a fertile imagination, who rarely made eye contact during the interview, and replied to other questions which showed that her interpretations of meanings were very different from the researcher's. In this case, the researcher was reassured by a discussion with the class teacher about the pupil's general demeanor, without mentioning the details of the interview, and it was not considered significant to take the matter further. After all, the principle of 'do no harm' applies and guarantees of confidentiality must be honoured "unless there are clear and overriding reasons to do otherwise" (British Sociological Association, 1996, p.3).

6.5.2.3 Gaining Access

Various factors shaped the challenge of gaining access to the institutions. First, the outdoor centre was situated on the west coast of Scotland, the schools on the East. The researcher was based in Liverpool, approximately five hours' drive from the locations. Resources for gathering data were limited by both the amount that was available and the timescale over which the initial work could be done; the program was scheduled for a period only a few months after the site and program had been chosen. Therefore, the resources had to be managed carefully and efficiently in order to maximise the brief window for data gathering. For example, it was decided that it would be more efficient logistically, to interview pupils in schools rather than at home, as this would reduce the amount of organisation. Access to various institutions was required to facilitate data gathering; these comprised;

- Primary schools
- Secondary Schools
- Ardroy Outdoor Centre
- Fife Council
- Scottish Natural Heritage
- The Institute for Earth Education (UK and International branches)

These institutions had their own "gatekeepers" (May, 2001, p.60) who controlled access to information and situations and so it was necessary to develop a strategy to ensure the best possible access. This was especially pertinent as an interpretive approach requires more face to face contact with participants than a survey, where large amounts of data can be generated with a questionnaire that does not necessarily require direct personal contact.

6.5.2.3.1 Outdoor Centre

The evaluation was driven by the Earthkeepers program director at the outdoor centre, who was a close personal friend of the researcher and therefore, this was the starting point for negotiation of access. The head of the outdoor centre and the program director were alumni of the researcher's employing institution and both had experience of and empathy towards Earth Education in general. These individuals were responsible for recruiting schools to the program and managing the program delivery team. The evaluation was regarded by these individuals and the sponsoring organisation, as an intimate part of the initiative rather than being perceived as an adjunct. Indeed, it was the program director who contacted the researcher with the idea of doing the research at his centre and therefore there was a great deal of commitment to the project from the Outdoor Centre. These gatekeepers enabled the researcher to stay at the outdoor centre, become involved with the program set-up and delivery, and observe and interview the centre staff. They also provided contact details of the schools, the sponsoring organisation, and the council. Once the centre had agreed that the project would take place a summary of the evaluation schedule was presented to the local authority.

6.5.2.3.2 Fife Council

Permission to conduct the research in schools and the centre had to be obtained from the controlling local authority, in this case Fife Council. They were undergoing a major reorganisation at this time and it was no small task to even identify the individuals who could give consent to the evaluation; this was obviously a turbulent time for the authority and an uncertain time for individuals, and this caused lengthy delays in the logistics of gaining official consent. Once these individuals had finally been identified they were contacted initially by letter, including the evaluation plan, and then by numerous telephone calls, many of which were not returned. The head of education finally granted permission in writing by 15th March 1996. This enabled the researcher to then contact primary and secondary schools, although the priority was the primary schools; the secondary schools would not become involved until a year after the program's completion.

6.5.2.3.3 Primary and Secondary Schools

Contact details of four schools were obtained from the outdoor centre and after the evaluation proposal was given to the schools by the centre the researcher contacted the schools by telephone to discuss the possibility of conducting research with their pupils. A number of head teachers reminded the researcher that local authority approval was required. Two schools agreed to take part at this stage; the RAF school head teacher was "*more than happy*" (Interview, IM, 15-3-96) to take part and seemed interested, congenial and positive about the proposal. The other primary school initially agreed to take part then reneged one week later. The reflections from this conversation are given in Field Note 1.

Field Note 1: Comments on Phone Interview with Primary School Head Teacher. 19-3-96

CM (head teacher) from P Primary School rang to say she'd spoken to [the LEA Advisor for Outdoor Education] re: the research and had decided not to take part in the project. She'd said the teachers had been seen a great deal recently and may well be unwilling to take part. She seems to have been put off the idea by [the advisor] as she was initially very positive about the project; also, whenever I have spoken to [the advisor]; he seems to concentrate on the negative aspects i.e. the short time frame for organising the project. I think he'd stressed this with the headteacher as this was something she highlighted today and hadn't brought up yesterday. Furthermore, he was highly critical of me and JMU ("What kind of an organisation are you running there!!!") because I was unable to answer the telephone when he finally returned my call, due to a toilet break. This criticism was in spite of the fact that someone else had answered the phone instead!

So why would the advisor be so negative?

1. Feels rushed and resents these demands on his time?

2. Is anti-educational theory and sees educational research as interference?

3. Political issues with other members of Fife Council?

4. Does not value interpretive research?

5. Does not value Earth Education in Fife schools?

This suggested that whilst there may have been official support for the evaluation, in practice this support was influenced by a number of other highly influential factors. There was a real risk that without effective support from one of the main political players, *i.e.* the LEA advisor, the evaluation was jeopardised. In order to reduce the chances of the other school dropping out and increase the chances of recruiting another school, the possible causes of this negativity were addressed by writing to the advisor thanking him for his assistance and time, assuring him of the value of the project in terms of its focus on Earth Education and use of an interpretive methodology, and assuring him that the project was in accordance with ethical standards. After the RAF school had attended the program a second primary school was recruited to the evaluation project and this was located on the outskirts of Dunfermline, approximately 30 minutes away from the RAF school.

Further conversations with the advisor enabled the objectives and focus of the evaluation to be further explained and were reassuring, in that the initial hostility appeared to have abated. Support for the research project was vital at every level if access was to be facilitated and maintained. The preliminary work, sometimes frustrating and seemingly distracting, proved effective in the long-term. Indeed, access to secondary schools one year later was relatively easy as only one school was required and the advisor seemed helpful and enthusiastic about assisting with arranging contact.

The schools visited had a number of gatekeepers that controlled access to data on a number of levels. Clearly, the managers and teachers have a great deal of control over what happens and their cooperation was assured by formal granting of permission. However, other individuals in the schools have a great deal of control of access. In general, the school administrative staff were amenable, friendly and very helpful in terms of locating pupils and arranging interviews, sending consent letters and envelopes to pupils, and arranging suitable locations for interviews. However, one school secretary at the secondary school appeared hostile and unhelpful, if not blatantly obstructive (Field Note 2).

Field Note 2: From Queen Anne High School. 21-8-1997

I arrived at the school at 8.00am to interview KC. I reported to the school secretary who told me to wait in the foyer of the school and she would call me when the pupil had been located. The interview was scheduled for the first part of the morning. Time passed and I made repeated inquiries to the secretary throughout the early morning, as to the progress of the arrangements. The last time I spoke to her she seemed annoyed that I had bothered her and told me that she would let me know when she had found the pupil. I continued to wait. During this time she walked past me at least twice but did not acknowledge my presence other than to look in my direction and show that she had recognised me. After lunch, at about 2pm she sent a part-time colleague out of the office to tell me that the pupil I had arranged to see had not been in school all day! When I spoke to her and described what had happened she made no acknowledgment that my day had been wasted.

School staff have numerous demands on their time and organising and coordinating the multiple interests involved is a complex task. Although formal consent is required from managers this is clearly not the end of the story and the researcher had to come to terms with the fact that his interests were not always shared and usually came low down in the list of priorities that schools are faced with. Sensitivity and patience were attributes that were highly significant for dealing with these issues.

6.5.2.3.4 The Institute for Earth Education

Access to The IEE was enhanced by various factors; the researcher had been a member since 1993, participating in annual meetings and member conferences. Furthermore, he also became involved as an Associate Staff member, being responsible for the editing and production of the bi-annual members' newsletter, and most recently for coordinating and conducting research on a national and international level. This facilitated access to information which was not yet readily available, was unpublished, or was historical. It also greatly facilitated access to key individuals within the organisation as many of them had many years of experience as practitioners of Earth Education and were considered to be valuable sources of data.

6.5.2.3.5 Scottish Natural Heritage

SNH were the organisation that sponsored the Earthkeepers program and evaluation at the outdoor centre. A key individual was contacted and agreed to be interviewed- it was originally considered necessary for uncovering conditions and consequences at the outer levels of the matrix (Figure 10). This was regarded as being particularly pertinent since she had been an associate staff member of The Institute for a number of years but this involvement had become considerably reduced since she had moved to Scotland. It was therefore believed that she would be able to provide detailed information about the perceptions of Earth Education from the level of policy makers. However, as the research progressed this became less important as the evaluation began to focus on the inner rings of the matrix (Figure 10, p.188).

6.6 METHODS

This evaluation was designed to uncover meanings held by those involved with the Earth Education phenomenon. It was anticipated that qualitative methods would produce most of the data in order to represent and communicate the understandings and meanings of the experience and these data would be analysed in the style of interpretivism. Lincoln and Guba (1985) propose a diagram to explain the flow of naturalistic inquiry based upon design emergence, inductive analysis, purposive sampling and grounded theory (Figure 13, p.204).

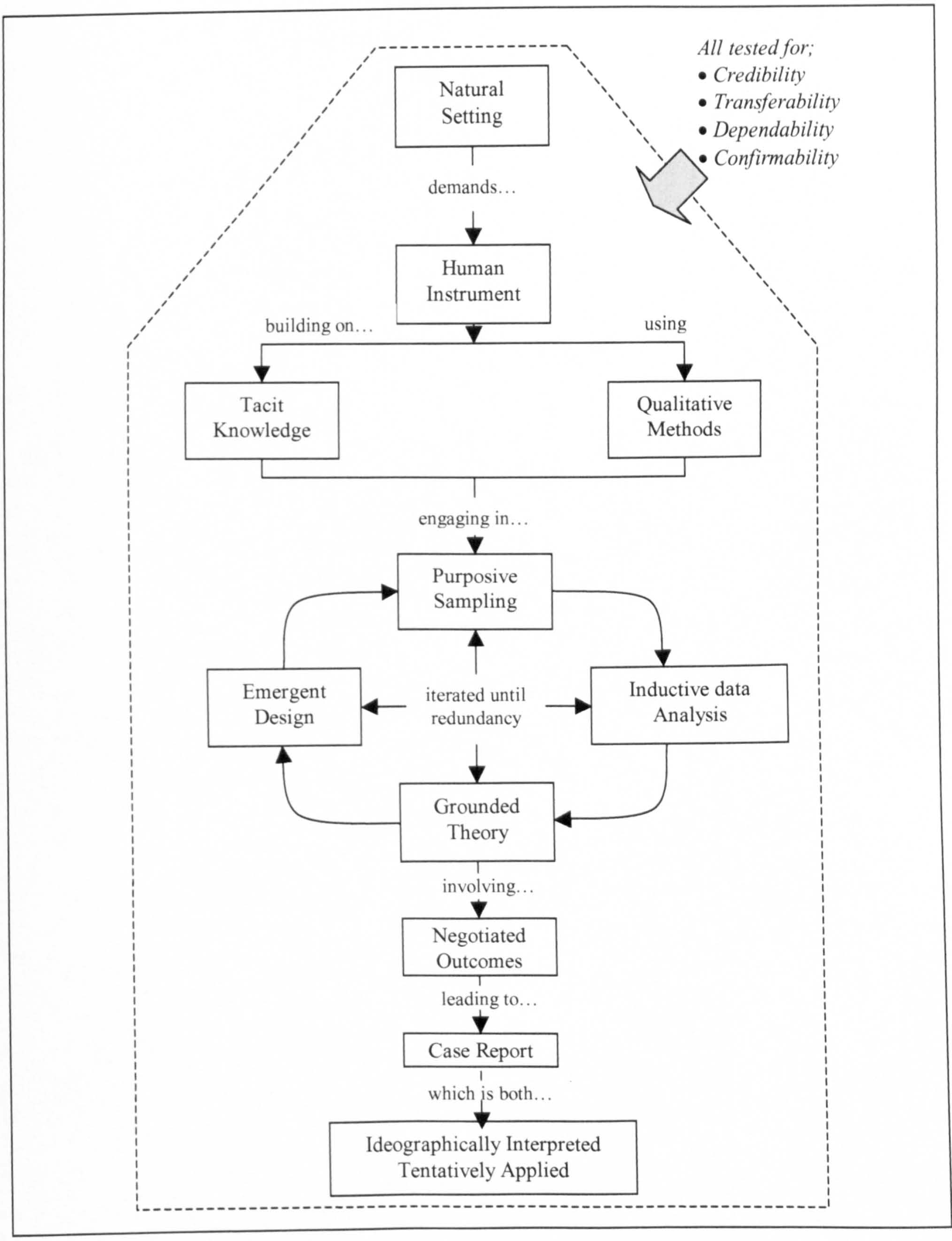


Figure 13: The Flow of Naturalistic Inquiry (Lincoln and Guba, 1985, p.188)

Lincoln and Guba (1985) argued convincingly that designs must be emergent because;

- meaning is determined by context to a great extent,
- the existence of multiple realities mitigates the imposition of a design based on the researchers pre-ordained assumptions,
- what is uncovered is a result of the interaction between the researcher and the participants,
- the situation is not fully predictable,
- and the nature of the reactions cannot be known until experienced.

Therefore, other than the desire to generate qualitative data and use this inductively to derive categories, understandings and perhaps explanations, the researcher entered the setting with a collection of different methods and these were trialled and developed constantly throught the project.

Combined with the emergence of the research design was the need to become 'immersed' in the setting (Blaikie, 1993, p.188). This has partially been described in the section that deals with gaining access (pp.197-202), but was also required in order to test the efficacy of the methods.

6.6.1 OVERVIEW OF DATA COLLECTION METHODS

A number of data collection methods were piloted during prelimary research at programs in the West Midlands and Berkshire. Data relating to Earthkeepers, from a wide variety of sources, were used to address the central research objective, which was to investigate...

How does Earth Education contribute to the development of Ecological Awareness; that is basic comprehensions, deep and abiding emotional attachments and the ability to live more lightly on the Earth?

The research also included an exploration of stakeholders' perspectives such as visiting teachers' opinions, of the program. It was also regarded as being important to assess the potential of the program for contributing towards statutory curriculum provision in Scotland and the U.K., with reference to curricular documents *and* teachers' account of recent classroom practice.

6.6.1.1 Documents

A wealth of data was available from the program, including selected participants' diaries, logbooks, pledge sheets and "Y and S task" sheets. Relevant school work such as classroom displays and murals, written work, and Edinburgh Reading Test performances were also collected where available to provide a form of triangulation, although this notion is not unproblematic- this is addressed further in the discussion. Relevant school work included work that was either connected with the Ardroy visit, or dealt with ecological concepts or issues of values and attitudes.

6.6.1.2 Field Observations

The school observation period was also important for the methodology which required that the social setting to be investigated was experienced as far as possible through the eyes of the pupil. The researcher should become immersed in the characteristics and idiosyncracies of that social world. When this immersion takes place effectively, pupils' comments take on new, deeper and more compelling meanings; only then does it become possible to fully understand the processes occurring (Schatzman and Strauss, 1973; Johnson, 1975; Burgess, 1982).

May (2001, p.170-172) has discussed the strengths and weaknesses of this approach in some depth, perhaps one of the most significant issues that these uncover, is the difficulty of making observations that are significant and capable of generating new knowledge. These are not specific to observation techniques, but are especially pertinent because the researcher is wholly responsible for observing and selecting the relevant information. As May comments researchers may end up merely confirming their own pre-established beliefs and assumptions. A framework for facilitating the interpretation of the observations may be valuable and Strauss and Corbin (1990) provided an exceptionally useful framework for enhancing the researcher's theoretical sensitivity. Furthermore, there is some evidence to suggest that observation may be particularly appropriate for small scale studies as the researcher is able to spend a great deal of time with the participants and gain a better understanding of their world (May, 2001, p.171).

The pupils were observed in the classroom setting with particular emphasis on the environmental aspects of the school curriculum, but perhaps more importantly, for them to become used to talking honestly and openly to the researcher. This latter was instrumental in building a non-judgmental relationship between the researcher and the pupils.

Field notes were written in order to record observations. Observations were recorded as precisely as possible so that interpretations could be made later (Patton, 1990, pp.273-274).

6.6.1.3 Photographs

These were used to provide interview cues as they enabled detailed interrogation of the pupils' recollection and learning without having to rely on over-lengthy descriptions or complicated questions (Collier, 1967; Wagner, 1979; Harper, 1994). They were also used as a record of the program for the researcher and for the pupils.

6.6.1.4 Questionnaires

Questionnaires were used to obtain factual data about the home lives of the pupils, such as hobbies, interests and favourite television programs. These were used to make initial judgements about variation when sampling for maximum variation.

6.6.1.5 Interviews

Interviews enabled the researcher to get closer to the world of the participant being interviewed. Cohen and Manion (1994, p. 272) present a number of strengths and weaknesses of interviews as a method, in comparison with the use of questionnaire surveys. These types of comparison are somewhat limited as they tend to imply that interviews and questionnaires are used to gather similar data about the same phenomenon; whilst this may be true, the real strength of an interview is not that it allows breadth, provides opportunities 'for asking', or has a good response rate (*ibid.*), but that it can provide access to negotiated meanings between individuals that would not be available by other means.

As well as allowing meanings to be investigated and probed, interviews allow flexibility, and allow clarification (May, 2001). Furthermore, it is possible to examine the context of the phenomenon by examining personal constructions related to the phenomenon, reconstructions of past entities, projections of such entities as they may be experienced in the future, and verification of constructions (Lincoln and Guba, 1985). Interviews can also facilitate the immersion in the situation to allow the researcher to penetrate "...the frames of meaning used by social actors, and requires the social scientist to immerse her/himself in the way of life of the group" (Blaikie, 1993, p.188). This was characterised as "standing in another's shoes" or "indwelling" by Maykut and Morehouse (1994).

All of the interviews began with a prefatory announcement regarding neutrality and confidentiality, along with rapport building questions (Patton, 1990, pp.316-321). The subsequent questions were arranged into inquiries about participants' constructions of the environment with respect to the four ecological concepts (Energy Flow, Cycling, Interelationships and Change), how these were significant for the participants in terms of their emotional reaction to these constructions, and what the implications of these were for them. These questions evolved and developed as the interviews progressed as some questions were more meaningful to some participants than others.

Both group interviews and individual interviews were used to gather data. These are now discussed in the following sections.

Group Interviews with Participants

Groups of pupils were interviewed prior to the program's inception using an informal conversation interview (Patton, 1990) to allow maximum flexibility, minimum chance of participants feeling threatened by the researcher and maximum chance of a useful discussion evolving. May (2001, p.125) suggests that group interviews typically involve between eight and twelve people and the discussion is guided by the interviewer. However, this was regarded as being too large; as Patton (1990) noted, if the group is too large, subsidiary discussions may evolve which will be hard to keep track of and indeed this proved to be the case. Furthermore, children and young people may be less conscious of the social norms expected of them in a group situation and less able to take a constructive role and participate effectively in a large group. For example, although the class teacher had assisted with group choice, the dynamics of some groups meant that not every pupil was willing to talk in front of the others. In addition, the interactions between some group members occasionally detracted from the evolving discussion, with pupils competing for attention, testing the researcher's promise of neutrality and confidentiality, and exploring the boundaries of this new social situation. As a result of these issues smaller groups were chosen in order to allow each member the opportunity to air their views. The emphasis in these interviews was to gather information about the meanings that the participant had constructed about their experiences, and to allow them to compare and contrast these meanings with others'.

Group interviews were also conducted after the program using the same groups that had been used before where possible. It became apparent that some groups were too large for some individuals to take an active part in and so these were conducted with individuals or with pairs in order to obtain better depth of individual perspectives.

Individual Interviews of Participants

The group interviews were nevertheless useful as once participants had been interviewed as a group member they appeared to feel more comfortable talking to the researcher alone. This enabled more complete articulation of thoughts and ideas without interruption or ridicule from others. It also facilitated the identification of ideas to individuals, as opposed to the group interviews with the larger groups where it was sometimes difficult to differentiate between interviewees. Since the research was concerned with a longitudinal evaluation, the tracking of participants' ideas over a lengthy time period (two years) was required.

Individual Interviews with Others

These were conducted with any others involved with the program, that is, with a member of the centre staff, the two visiting teachers from Leuchars Primary School, and an associate staff member of The IEE. These were semi-structured interviews and were concerned with different aspects of the program, ease of implementation, support from managers, reactions of children to program etc.

6.6.1.6 Interview Design

Interviews were initially unstructured or semi-structured. In order to provide a focal point, and in accordance with Patton's (1990, p.346) call for creative techniques that are "situationally responsive, appropriate, credible and useful", objects gathered from a local beach and forest plantation were used to provide cues for discussion. After all, Piaget showed that younger children found it easier to engage with concrete objects rather than abstract conceptualisations. Objects were taken from these environments were selected because many of the pupils from the school had mentioned spending their time in this area, engaging in various 'activities' such as "playing out" (Interview, LPS, G1270396), "getting mucky" (Interview, LPS, G7280396), or "making a base [den]" (G5280396). However, whilst some could talk about these objects and where they might be found, they tended to distract the pupils from the discussion so were abandoned.

Various other school commitments began to encroach upon the time available for the interviews, such as an Easter church service, and it became apparent that not enough time was available to complete data gathering using unstructured interviews so semi-structured interviews were used, where small groups or pairs of children were asked questions relating to their experiences, thoughts and understandings of the environment. These interviews drew their structure from those aspects of the group interviews that proved most productive and meaningful. Unstructured interviewing is particularly effective for immersion and indwelling but is time consuming and impractical for an evaluation of this character.

Conceptual questions were potentially more threatening so were conducted after the pupil had experienced the interview process and felt more secure. These were aimed at the concepts addressed by the program Earthkeepers which were broken down into four or five sub-concepts. Various types of questions were asked in an attempt to fully explore the level of understanding that the pupils held. Concept maps were drawn during the interview by the researcher in an attempt to represent the pupil's conceptual understanding for both pupil and researcher.

The quality of interview data was greatly enhanced by the researcher's approach to the classroom and playground. This involved the creation of an informal relationship between interviewer and participant which employed strategies such as wearing informal dress, use of first names and ensuring that the researcher never had responsibility for any form of discipline or behaviour management.

6.6.2 RESEARCH DESIGN

The first program available for research began in April which left a limited amount of time to visit schools and gather data prior to the program's commencement. Various events conspired to reduce dramatically the length of time allowed in the primary schools prior to the trip, such as the restructuring of Fife Council, school holidays and the uncertainty that was inherent in the centre's program at that stage. These issues were addressed by having a methodology that was sufficiently flexible and sensitive to the situation, for example by conducting group interviews and by switching from unstructured interviewing to a semi-structured approach.

6.6.2.1 Overview

Data were collected from participants at five specific points;

- Pre-program,
- During the program,
- Post program,
- Long Term- After the first year of schooling,
- Long Term- After the second year of schooling.

The first set of long term data was gathered eighteen months after the centre visit, as the pupils began their second year at high school. The last set of data was gathered in May and June of 1998, at the end of the pupils' second year.

Prior to the schools' centre visits the researcher spent one week in the school interviewing those who were due to visit Ardroy. Pupils were asked, in groups of between two and four, about their environmental perceptions, including their concepts, values, and behaviour concerning the natural environment. Interviews were recorded and later transcribed, both by the researcher and later by typists employed by the researcher.

6.6.2.2 School Specific Methodology- Leuchars Primary School- Pre program

Because of the large number of pupils in the year group, they were generally interviewed in groups of 2 to 4, depending on the pupils. The teachers' knowledge of the pupils was essential for choosing the group compositions as they were aware of factors that would have an influence, for example, friendship groups, articulacy, interpersonal dynamics, and maturity. Asking the teacher's advice may also have demonstrated that the researcher valued the opinions, knowledge and experience of the teacher, and this was likely to have an impact upon future access.

Each group was interviewed once for between one and two hours, producing a total of approximately 20 hours of interview data. All 37 pupils were interviewed during the week in fourteen separate interviews, although some of the recordings were inadequate and had to be done again during the first evening at Ardroy.

Leuchars Primary School was the first location for the research and provided a very useful site for the piloting of the research methods and approaches. During the time at Leuchars various interview techniques were tested and the most effective and productive method was found to be semi-structured interviews, with pairs of pupils in most cases, although in some cases the individual interview was found to be more productive.

6.6.2.3 School Specific Methodology -Pittencrieff Primary School- Pre Program

There were 16 pupils in this year group therefore the groups were smaller, usually two pupils per group, and more time was spent with each group. Eight groups were interviewed twice, for a maximum total of three hours per group, producing approximately 40 hours of interview data spread over sixteen interviews. The first interview was concerned with values, behaviours and more general aspects of the pupils' lives, whereas the second interview was concerned with ecological concepts.

6.6.2.4 Data Collection- During the Program

The researcher travelled to the centre from each school with the pupils and teachers, took part in the program alongside the pupils, and made field notes of observations of the pupils during their stay at the centre. Photographs were taken during their visit and these were used as a basis for interviewing during the following weeks back at school. Conversations between the researcher and pupils were also noted, along with any comments they made during the program. Teaching staff were also a valuable source of data in relation to their knowledge of the pupils and their accounts of the pupils' reactions to the program.

6.6.2.5 Data Collection- Post Program

On returning to the school, pupils were again interviewed. At Leuchars 25 interviews were conducted and each lasted between one and two hours. Issues arising from the analysis of data from groups interviewed before the program suggested that pupils should be interviewed as a pair or individually. Where time and curriculum allowed, pupils were interviewed individually.

At Pittencrieff, seven pairs of pupils and two individual pupils were interviewed for a maximum of three hours producing approximately 40 hours of interview data spread over 10 interviews. The longer interviews were sometimes split by a dinner break, dentists appointments, or the end of the school day and had to be continued the following day.

At both schools pupils were asked similar questions to those they had been asked before the program and concept maps were drawn to represent their new understandings. They were also questioned about their feelings regarding the program and what they planned to do to complete the final two stages of the program in their final months at primary school.

Pupils were also observed during their first week at school after the program's completion and notes were made regarding their attitude towards the program and the natural environment.

School staff also volunteered a great deal of useful data, not only about the reactions of the pupils to the program, but also about their own reactions and thoughts about the program.

6.6.2.6 Data Collection- Mid and Long Term- Secondary Schools.

The evaluation was focused not only upon the outcomes of Earthkeepers in the short term, but also on longer term outcomes. Therefore it was necessary to visit the pupils some time after the program's completion. It was decided to gather these data after the first and second years of schooling in the secondary school.

Initial analysis of the data from Leuchars Primary School suggested that it was problematic identifying individuals' contributions. Essentially, the groups were too large, even though they were half the minimum size suggested by May (2001) for group interviews. Therefore it was decided to visit only a small number of these pupils in order to track the development longitudinally. Those chosen for the long term follow up, were the ones who had initially been interviewed in pairs or individually, largely because they had not provided useful data when in a larger group due to socialisation issues. Furthermore, some of these pupils had been identified as having specific educational needs that were addressed away from the normal classroom environment. Consequently, their responses had potential for revealing more diverse interpretations of experiences in accordance with maximum variation sampling. Due to the fact that a large majority of the Leuchars pupils had moved to a different area of the UK by this time, as a result of one or both parents' employment as RAF personnel, only two of these pupils were still in the area. These pupils were interviewed at their homes, one with the parent present.

Pupils who had attended Pittencrieff Primary School were easier to arrange interviews with because most of them had moved to Queen Anne secondary school in Dunfermline, with one exception. In the latter case, the pupil's parent was a teacher of the primary school, was known to the researcher due to the earlier rounds of interviews, and was willing to allow the participant to be interviewed at home.

Analysis of the data that was being generated at this stage indicated that it would be valuable to broaden the sample, as the data were becoming theoretically saturated- no new categories were being developed. Whilst this saturation provided a compelling account of the some aspects of the program, the impact upon the 'feeling' aspects of Earthkeepers was somewhat elusive. The program director and the centre manager had indicated a very positive response and strong commitment from the first primary school to attend Earthkeepers, Cairneyhill. This was the school that had visited the centre when the program was being piloted and accredited. Therefore, the teacher from this school was interviewed, and she suggested the names of six pupils who she thought would be valuable to interview to explore this area. Coincidentally, these six pupils were also attending Queen Anne High School, and so interviews were arranged with these, once consent forms had been completed.

6.7 SUMMARY

This section began by addressing some major theoretical influences on the evaluation. Bloom and Krathwohl's taxonomic system was used as a starting point to structure the intitial thoughts about the research design in terms of identifying what kind of data would be required. This initially entailed an examination of existing empirical research on Earth Education. However, although the taxonomy appeared to have potential, it was considered to be reductionist, epistemologically naïve, and too vague and imprecise to be of much practical use. Notwithstanding these criticisms, it was considered to be a useful framework for illuminating the different levels in which phenomenon may operate. The notion of Awareness was considered to be an appropriate general focus although it was not conceived of in terms of the taxonomy. Various questions were proposed at the end of this section to focus the evaluation onto the most important aspects of Earth Education.

Having rejected the taxonomy, the discussion then considered the evaluation from the perspective of paradigms. It was noted that much of the empirical work had been concerned with a narrow range of inquiry. Much of this comprised positivistic studies that attempted to 'measure' the responses of individuals to cognitive objectives or attitude scores. The discussion identifies that this is one aspect of the way in which the dominant paradigm has, until recently, maintained a stranglehold on research in environmental education. The potential of each paradigm to explain adequately Earth Education phenomena was explored and an interpretive stance was identified as having the most value for this context.

This chapter has discussed the paradigmatic assumptions that are relevant to this evaluation and its location in the middle of the thesis could be taken to imply that these have little or no bearing up to this point, however, in reality, these assumptions have informed every aspect of the work- as Weber (1949) first noted, no form of inquiry is value free. Therefore, this discussion is a clarification of the implications of methodological theory and functions to indicate and clarify how the methods were coherent with the paradigm of interpretivism.

The practical considerations of how to generate a research design were considered next in the discussion. The conditional matrix was presented to identify the different levels at which the phenomenon operates and explain the rationale behind the sampling procedures, which were then explained in detail. Ethical considerations were then addressed, including access, consent, anonymity and confidentiality.

The discussion next addresses the methods that were used. The research began, in reality, long before the beginning of the evaluation as the researcher had some experience of Earth Education as an undergraduate, and this experience contributed to the formation of values and opinions about the phenomenon. Further experience of different forms of Earth Education in different locations up to the beginning of this evaluation comprised Phase 1, providing orientation and overview (Lincoln and Guba, 1985, pp.221-249). Phase 2 and 3, or 'focused exploration' and 'member checks and closure' were conducted on the program in Scotland, although phase 3 was ongoing. The evaluation was longitudinal as it was concerned with long term outcomes as well as short term and was conducted in the style of participant observation although action research was used in some settings. The methods are summarised, with a time-line, in Table 49 and Table 50.

Table 49: A Summary of The Emergent Research Design Prior to March 1996 (Phase 1)

When	Who	What	Where	How
Pre Sept 1993	Pupils	Pupils' experiences of Earth Education (Earth Caretakers, Earthwalks, Magic Spots)	Liverpool Primary schools St Helens Secondary Schools/Lake District	Observation Participant Observation Action Research
June 1994-Sept 1995	Pupils Adult participants and leaders	Sunship Earth.	Outdoor Centre, Wyre Forest	Participant Observation Field Notes Video Footage Informal and Unstructured Interviews Document analysis
	Pupils Adult participants and leaders	Earthkeepers.	Outdoor Centre, Berkshire.	Participant Observation Field Notes Video Footage Informal and Unstructured Interviews Document analysis
	Pupils Adult participants and leaders	Sunship III.	Outdoor Centre, Wyre Forest.	Field Notes Video Footage Document analysis
Feb 1996	n/a	Earthkeepers.	Outdoor Centre, Argyll.	**Program Quality and Accreditation** Participant Observation Photographs Informal and Unstructured Interviews Semi-structured interviews

Table 50: A Summary of The Emergent Research Design From March 1996 to Present Day (Phase 2 and 3)

Feb-March 1996	Pupils Teacher Managers	**Pre-Program** Lecuchars Primary School Immersion in the field.	Leuchars	Unstructured Interviews Field Observation
March 1996	Pupils Adult Participants/Leaders	**On Program** Earthkeepers	Outdoor Centre, Argyll.	Demographic Questionnaires Field Observation
Feb-March 1996	Pupils Teacher Managers	**Post Program** Lecuchars Primary School Immersion in the field.	Leuchars	Unstructured Interviews Field Observation
April 1996	Pupils Teacher Managers	**Pre-Program** Lecuchars Primary School Immersion in the field.	Leuchars	Semi-structured Interviews Field Observation
April 1996	Pupils Adult Participants/Leaders	**On Program** Earthkeepers	Outdoor Centre, Argyll.	Demographic Questionnaires Field Observation
April 1996	Pupils Teachers and Managers	**Post Program** Pittencrieff Primary School Immersion in the field.	Leuchars	Semi-structured Interviews Field Observation
September 1997	Pupils	Long Term (1 Year)	Queen Anne Secondary School	Semi-structured Interviews Field Observation
June 1998	Pupils Class Teacher	Long Term (2 Years)	Queen Anne Secondary School Leuchars & Cairneyhill Pupils	Semi-structured Interviews Field Observation
Sept 1993-2006	Program Authors I.E.E. Members and Associate Members Documents	Earthkeepers Pupils' experiences	Various	Semi-structured Interviews (Telephone and Face to Face) Field Observation

The way in which the data were analysed is discussed in the next chapter.

7 DATA AND ANALYSIS

This chapter discusses the way in which the data were analysed, using examples drawn from the two primary schools that were involved in the evaluation. The RAF School could be regarded as a *pilot* of the methods, and the Urban school, a *use* of the methods. However, as the methodology has pointed out, the methods emerged from the situation and developed constantly as the project progressed- there were no discrete piloting and implementation stages. Therefore, in order to represent this constant development of the methods, two Review and Reflection sections have been included within the chapter.

Notwithstanding this, the urban school produced much more focused data, in general, and this was used to identify the meanings associated with the four ecological concepts and the implications of these meanings. Despite the fact that the researcher spent longer in this second school, and there were fewer pupils in the class, it appeared that pupils' emotional responses were somewhat muted. Therefore the data relating to these responses were unable to provide evidence of the epiphanic experiences discussed previously. As a result, pupils from a third school were identified and interviewed two years after the program. The implications of these responses are addressed in greater detail in the main Discussion (Chapter 8).

This chapter begins with a consideration of the pre- and post-program data from the first school, and it identifies the pupils' meanings associated with the four ecological concepts. These meanings were grouped into broader categories to reflect the conceptions of pupils. The data from the second school are then interpreted in light of these meanings and conceptions. This shows how these conceptions, or alternative frameworks, evolved over the research period for the pupils from the second school.

7.1 OVERVIEW

A huge volume of data was collected for this evaluation, including several hundred pages of field notes and 170 hours of interview data. Analysis was focused on the notion of ecological awareness using an examination of pupils' understandings and meanings generated thereof in relation to concepts.

Data analysis was conducted in various stages. The first stage involved summarising or transcribing the first set of interviews from the first school, which was completed by the researcher. A typist was employed to transcribe most of the data, although the initial interviews with the pupils from the first primary school were summarised rather than transcribed in detail as analysis occurred simultaneously with the data gathering. Field notes and transcripts of recorded interviews were analysed by identifying units of meaning within the data (Strauss and Corbin, 1998). The constant comparative method was used to identify themes and patterns within the data, particularly relating to conceptual understanding and meanings. This occurred throughout the research process. There were episodes during the data collection that were more concerned with analysis and reflection and other periods that were more concerned with data gathering. However, the processes of data gathering and analysis cannot be separated. Table 51 gives an overview of the number of interviews recorded and transcribed or summarised and used in this evaluation.

Table 51: A List of Interviews

Interviews	Pupil	Pupil Group	Number of Participants
Pre	1	27	53
Post	19	17	53
1 Yr	13	-	13
2 Yr	19	-	19
Total	**52**	**44**	
Primary Teachers			3
Primary Head Teacher			2
Secondary Teacher			2
Centre Head			1
Centre Staff			2
I.E.E. Staff			5
Total			**15**

7.2 CONCEPT MAPS

Concept maps were used to represent the understandings of the pupils although they are not without their own special problems. Understandings are very difficult to represent in a meaningful and representative manner as concept mapping relies on the pupil having the ability to think in certain ways. For example, they require that a pupil can recognise contradictions, can use logical connectives such as "and" and "or", and can understand and respond appropriately to interrogative adjectives, pronouns and adverbs such as "what" and "why". Another problem with concept mapping is that it has to be learned as a technique (Gunstone, 1988) and therefore pupils would not have initially been capable of constructing adequate concept maps. Therefore these were constructed by the researcher and the pupil during the interview and supplemented by analysis of the interview transcripts.

There is also an element of learning involved during the construction of a concept map and there is a danger that a map may represent conceptual structure as static when it is dynamic.

Various quantitative methods for analysing concept maps have been suggested which involve examining the level of hierarchy, progressive differentiation and integrative reconciliation (Novak and Gowin, 1984). Other methods that have been suggested involve more qualitative techniques (Trochim, 1996) and confront issues such as validity and reliability. However these are of little use as terms such as these belong more in a positivistic study than an interpretivist study such as this.

It was initially intended to identify conceptual change from a qualitative analysis of concept maps constructed by each pupil from before the program to the pupil's second year at high school. For example, concept maps can be categorised according to the level of understanding they reflect and the types of alternative frameworks that are present. The way in which concept maps were drawn from interviews is illustrated by Interview Extract 2 and Figure 14.

Interview Extract 2: Pre-Program: GG160496

	As with D's interview, these two were taken on their own in order to get some data of relevance. Once again this was very difficult as Ga was reticent to speak and Gr managed to command most of my attention. However, Ga was able to speak for some of the time and it wasn't all taken up by Gr. [...] As the discussion unfolds, one can see the confusions and misinterpretations as they occur and note the difficulty of interviewing certain pupils who have different 'experiences'..
1	*Int: What do you know about the water cycle?*
2	*Gr: Nothing. What water cycle?*
3	*Int: Well when you turn that tap on, what happens?*
4	*Gr: Water comes out of it! (Turning tap on fully) That happens!*
5	*Int: Why does that happen?*
6	*Gr: 'cos there's water coming from the lake.*
7	*Ga: 'cos there's water coming from the water mains.*
8	*Gr:... and there's a lake there and that's where it's come from.*
9	*Int: So the water comes from the lake Gr? You're smiling so I wondered whether you didn't...*
10	*Ga: Well you wouldn't be able to drink it, it'd be salt water!*
11	*Gr: Yeah, I'm wrong... ...is it drinkable?*
12	*Int: Yeah. Taste it!*
13	*Gr: (tasting water) It does come from there though. Something must happen to it...*
14	*Ga: Water mains.*
15	*Gr:... when it gets into the tank...*
16	*Int: What do you mean by water mains Ga. Tell us about that.*
17	*Ga: Well there's probably the nearest water mains... (...) ...goes up to our water station.*
18	*Gr: There might be some pipes.*
19	*Int: So the taps are connected to a water station...*
20	*Gr: (examining sink and stopcock underneath) So here's the sink and the taps to switch it off by and if we untightened that it wouldn't work.*
21	*Int: So that works! That's sorted. But where does that water come from?*
22	*Gr: It probably does come from the river and the mains (...) that mains is electrical and it (...) electric box.*
23	*Int: but how does the water get to there?*
24	*Ga: Underground.*
25	*(Drawing)*
26	*Int: So the water comes out of the lake, goes to a water tank, there's a spinner there which dilutes it and cleans it, and then it goes into the taps. Okay, what happens when the water goes down the plug, or when you drink the water and it goes down...*
27	*Gr: If it does go back down, (...) through a pipe... (...) through the mains again and these two get together ...*
28	*[...]*
29	*Int: so what you're saying is that the water goes down the pipes that the taps are connected to.*
30	*Gr: Yeah and they will open when the spinner starts moving and if water does (...)*
31	*[...]*
32	*(...Gr interrupts with a megaphone he's found in a cupboard)*
33	*Gr: Separate pipes. But how come all our pipes in our house are run together into one tank.*
34	*(...)*

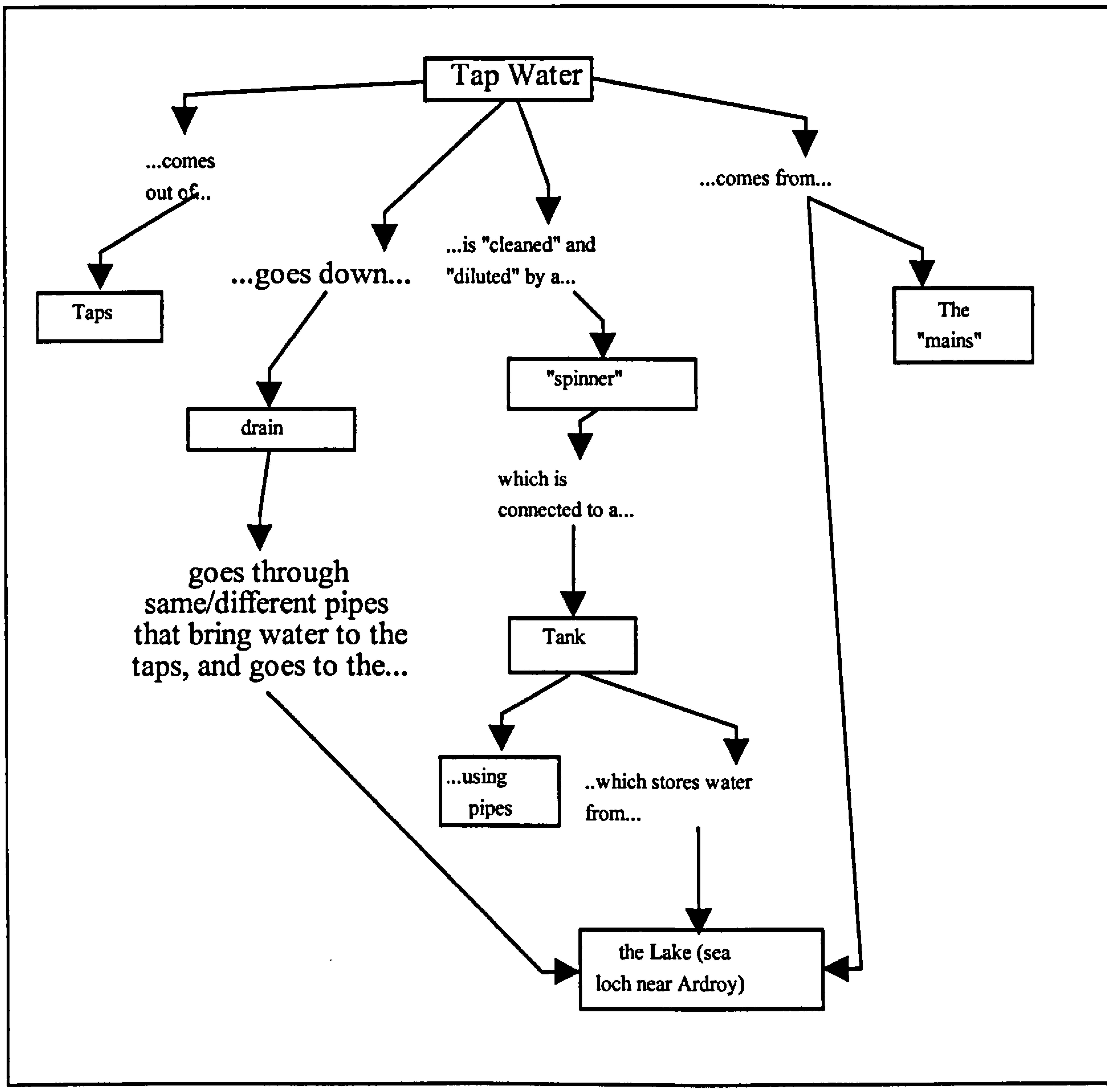


Figure 14: Pre-Program Concept Map: The Water Cycle (GG160496)

However, as concept maps show links between concepts, they are not always appropriate for representing concepts that cannot be linked together by the pupil without excessive interference or guidance from the interviewer. The previous extract illustrates this well, combined with the difficulty of drawing accurate conclusions when the interview is insufficiently engaging for the pupils.

Pupils' understandings were often so idiosyncratic that to attempt to represent them using maps drawn by the interviewer would have introduced the risk of misrepresenting pupils' conceptual structure. Without the facility for training pupils in the drawing of maps, this technique was rejected in favour of the selection of interview extracts and categorisation according to different styles of conception related to particular concepts. Diagrams of some sort were still used to represent and record pupils' responses during the interview to allow the participants to keep track of what had been discussed.

7.3 THE RAF SCHOOL- PRE PROGRAM CONCEPTIONS

Initial attempts to elicit initial understandings about environmental concepts and issues were made using unstructured and semi-structured interviews. The following analysis includes data gleaned regarding the four concepts addressed by the program.

7.3.1 ENERGY FLOW (FOOD CHAINS)

Van Matre and Johnson's (1987) activity for this concept places heavy emphasis on the concept of energy flow and implicitly, energy conservation. The Food Chains are regarded as a means of tracing the path of energy from the sun to the consumers, or carnivores. Pupils' initial understandings did not reflect this emphasis although food was regarded as providing a number of things vital for life as illustrated by the following extracts.

Interview Extract 3: Pre-Program: G6280396

Int: Take Beef, why do you eat beef, what do you get from it..., why do you eat any food?
N/M: ... 'cos we'd die...
Int: Why? What do you get from food that you need?
N: Oxygen
M: Vitamins
M: Proteins
N: Energy
(...)
Int: So thinking about cows, where do cows get their energy from?
N/M: Well they eat grass...
Int: ...and where does the grass get its energy from?
N: The floor...
M: When the rain comes...
N: When the rain comes it all grows...
M: ... it feeds it and the cow can grow and go... (claps hands together).
Int: So it gets it all from the soil and the rain. Anywhere else?
N: The farmers give them food and that and they get energy from that as well. They give them all foods and that.
Int: Is this the cows you're talking about or the grass?
N: The cows...
M: The grass! (laughing)
N: The cows!
M: You can get plant food...

Interview Extract 4: Pre-Program: DR160496

Int: Why do you actually eat?
D: To build up my energy?
Int: So you get energy from food. Do you get anything else from food?
D: ...rid of hunger...
Int: Anything else?
D: ...helps the digestion... something to digest. (...) Can't remember what else... make you ready for the next day, or wake you up, like breakfast.

These indicate conceptions of food as an energy provider but also having other functions such as providing ingredients important for other needs. The first extract also illustrates a second common conception, that green plants obtain their energy from the soil by a combination of water and fertiliser. The role of sunlight in plant metabolism and its crucial importance was not referred to by any of the pupils. Furthermore, a small number *did* refer to a green plant as the beginning of the chain, but all omitted the sun.

Examples of food chains given at this stage tended to be one of the two types shown in Table 52.

Table 52: Pre-program Examples of Food Chains

Type 1 Examples refer to connection between cows and sheep, often with BSE explicitly mentioned...	**Example** 1. Beefburger-Cow-Mad Cow's Disease **(G1029396)** 2. Lamb-Cow-Lamb-Cow-etc... **(G6280396)** 3. Grass-Lamb-Cow **(G6280396)** 4. Sheep-Cow-Humans (Disease) **(G1029396)**
Type 2 Examples use organisms from two categories- herbivores and carnivores. Relationships tend to be dictated by the size of the animal rather than knowledge of specific predator-prey relationships.	**Example** 1. Fish-Cat-Wolf-Something **(G1029396)** 2. Shrimp-Salmon-Whale-Shark **(G5280396)**

Clearly there are sub-divisions within these types; there are clear differences between the four food chains given for Type 1- the first two examples do not seem to reflect predator-prey relationships but rather reflect vague associations between terms connected by media coverage of the Bovine Spongiform Encephalothopy (BSE) 'crisis'. At around this time (Spring 1996) the discussion of BSE had assumed nationalistic elements as many Scots asserted that whilst English beef was affected by the prion, Scottish beef was safe to eat. As a common news item once again, news reports contained references to the contamination of the food chain. This illustrates the importance of the wider social and cultural context within which the interviews took place.

Many explanations involved examples with clear links to BSE in particular and the notion of disease in general as the following discussion of the extract in Interview Extract 5 illustrates.

Interview Extract 5: Pre-Program: G1029396

1	*Int: So what's a food chain?*
2	*M: You start off with a beef burger and it goes on to a cow and on to mad cow's disease... ... it's something that you have a piece of food and you go along to a disease...*
3	*G: Is it?... .... It's like a cat eats a fish...*
4	*M: (laughing) You can't get diseases... ... you eat a piece of food right...*
5	*G: That's not a food chain! ... and then something eats a cat and then ...*
6	*M: Who's going to eat a cat?*
7	*G: A wolf! (laughing).... and then something eats that and so on.*
8	*M: I know, the cow eats a sheep and then we eat the cow so we get the... thing.*
9	*G: How does a cow eat a sheep ?...*
10	*M: Maybe it's because they're doing a toilet on the grass....*
11	*G: Yeuchh! (laughing)*
12	*Int: Okay so you think it's when we've got grass being eaten by a sheep, being eaten by something else. Lets talk about natural things rather than farm animals. Someone talked about a shrimp being eaten by a trout, and then that being eaten by a larger fish which, then, we ate, so is that a food chain?*
13	*G: Kind of...?*
14	*M: I don't know!*

M's responses (line 2) begin with an explanation of a food chain which involves a specific example of BSE being connected to a cow and a beef burger. The same line contains an attempt to make the generalisation that food chains involve an item of food "going along to a disease". M's conception is challenged by G in lines 3 and 5. G 's alternative explanation offers the example of a fish-cat-wolf food chain but M disagrees... "You can't get diseases..." leaving the statement incomplete. Lines 4 and 6 suggest an appropriate completion to this truncated retort. The first statement uses the subject pronoun "you", the second (line 6) uses the interrogative pronoun "who" as the indirect object of this sentence. The uses of these pronouns indicate expectation of the answer being a person or group of people. This analysis suggests that the response in line 4 represents the conception that because humans do not generally eat cats, diseases cannot be transmitted in this way and therefore the fish-cat-wolf example does not represent a food chain. However, attempted clarification of this analysis (lines 12-14) was not fruitful.

The above extract illustrates another conception, that is, the conservation of "ills" which appears a number of times in different interviews. M's responses indicate that diseases can be passed by one organism eating another. A similar notion is expressed by S in the following discussion.

Interview Extract 6: Pre-Program: G5280396

Int: Could you explain that a bit more?

S: The fish usually eat little shrimps that actually suck up the water and they might eat some glass or something... and that....

(...)

S:The shrimp needs the water, like, to get energy or something... and then the salmon, like, eat the shrimp (laughs) and then the whale eats the fish... and then the shark gets the whale and when there's a high wave the whale gets thrown up onto the sand (...) ...and usually hasn't got any food and the fish that goes inside it... they like make the whale smell and that... and pollution!

(...)

S: ...it it's like a piece of glass and the fish ate it... and the salmon goes to the whale and the whale eats it... and the whale goes on the sand and the whale dies...

M: ...and if you go down to the beach you can smell it... and it doesn't smell nice does it?... and the whale pollutes the air...

S: ...and it smells and smells... polluting the air...

(...)

S: ...right, if we breathe it then we die... (...) ...when animals die there's a stink, right, and the stink goes up into the trees... it comes out of the ground... and goes into the trees... and the trees die.

This extract was taken from an interview of a group of four but much of the time was taken by attempts to clarify the ideas presented by one pupil whose concepts appeared to be well developed, yet also lacked internal consistency. Each of these pupils had different ideas and concepts of food chains and the group interview was extremely useful for identifying a range of meanings for this group of articulate and confident individuals.

7.3.2 ECOLOGICAL CYCLES

A well developed understanding of the water cycle, carbon cycle and nitrogen cycle would require a large number of varied but interrelated concepts. The conceptual encounter "The Great Spec-tackle" attempts to deal with some of these concepts, specifically conservation of matter implicit in the notion of a cycle, and the basics of the structure of materials. The preceding section (7.3.1) has shown how some pre-program conceptions showed aspects of matter conservation, i.e. the conservation of "ills". This section will explore whether there was evidence of conservation of other types of matter and other conceptions which arose from the initial interviews.

7.3.2.1 Air, Carbon Dioxide And Oxygen

One group's answers tend to characterise the range of replies which were elicited regarding this group of concepts. An extract from one interview has been included in Interview Extract 7 to illustrate this point.

Interview Extract 7: Pre-Program: G1270396

1	*Int: So what's carbon dioxide then?*
2	*K: We breathe it out and we breathe it in...*
3	*G: (tentative correction) We breathe air!?*
	(...)
4	*Int: What do we breathe in?*
5	*A:...two sorts of air... carbon dioxide...*
6	*?: ...and oxygen...*
7	*A: ...and carbon dioxide and when you breathe in they both go in and when you breathe out then the carbon dioxide goes out and then you breathe back in and the oxygen... and it all goes in and out...*
8	*G: It just comes out...*
9	*C: Like when you put a bottle in your mouth and you start breathing in and out of it.*
(...)	*(...)*
12	*Int: But what is it in breathing that makes you live?*
	(...)
13	*A: The air... it goes into the lungs or something like...*
14	*G: I don't see the point in that. You just breathe it in and breath it out and walk away!*
15	*A: Yeah?*
16	*G: I don't see the point in that...*
17	*Int: What is the point in that?*
	(laughs)
18	*?: I don't know.*
	(Pause)
(...)	*(...)*
22	*Int: Right, to get back onto the oxygen though, what is it in air that we need, is it the oxygen or the carbon dioxide that we need?*
23	*G: Oxygen.*
24	*A: The oxygen.*
25	*C: (quietly) Oxygen 'cos you'd die.*
26	*A: Carbon dioxide's bad for you.*
27	*?: Yeah...*
28	*Int: Carbon dioxide's bad for you?*
29	*?: Yeah.*
30	*G: Is it?*
	(laughs)
31	*Int: What does it do to you?... or is that just a guess?*
32	*A: I don't know... but in my old school um... we learnt about this stuff and it was carbon dioxide's bad for you...*
33	*K: It's good for trees though 'cos trees breathe it in...*
34	*G: Trees don't....*
	(Sound of airoplane taking off)
35	*C: (laughing) No they don't.*
36	*G: Trees produce air...*
37	*A: ...without trees we wouldn't be able to live.*
38	*K: They breathe in carbon dioxide and throw out oxygen, so they're like the opposite from us...*

This extract demonstrates competing definitions of air; G's definitions in lines 3 and 11 indicate that air is equivalent to oxygen whilst K's and A's descriptions refer to two "types" of air which are named (lines 5, 7). However, a further response by G (line 23) indicates some acceptance of the statement that oxygen is a constituent of air. Other pupils showed this tendency to discuss air and oxygen as equivalent terms, making the statement ..."air comes from trees and plants..." (GG160496).

Carbon dioxide is regarded as being "bad for you" (lines 26-29) by A and others, yet G questions this statement (line 30). This is perhaps surprising given that A also seems to believe that carbon dioxide is breathed along with oxygen (line 7), suggesting that breathing causes harm. One potential explanation for this is that carbon dioxide and carbon monoxide are being conflated as K's earlier comment refers to it being "bad to breathe (car exhaust fumes) in (...) ...'cos it's carbon dioxide".

7.3.2.2 Respiration and Photosynthesis

Without an adequate distinction between air, oxygen and carbon dioxide, understanding of the processes of respiration and photosynthesis remains elusive to G (lines 14-18). However, K makes a distinction between these terms in his description of trees' "breathing" (lines 33-38) and consequently, is able to offer a more convincing explanation (line 38).

Breathing is a process which is heavily dependent on the pupil's experience of breathing. Thus fish and plants (trees) do not breathe in the same way, although some thought that fish did breathe in the same way but could hold their breath for longer than humans (G1270396). Other parts of this interview also provided evidence for the existence of the conception that animals are biologically different from humans in the way they respire (G1270396) and indeed in other ways discussed in the next paragraph.

7.3.2.3 The "Soil" Cycle

Elicitation of conceptions of the soil, or nitrogen cycle was attempted by reference to the disposal of body waste and the decomposition of the bodies of animals. In general terms this subject was one of the most productive of data.

The process of "rotting" was variously described using scientific terms such as "decompose" (G9290396), "dissolving" (G9290396; DR160496; GG160496), "melts" (DR160496), and "disintegrating" (G1029396) but further questioning of these terms was generally unfruitful, in the context of competing world views, and on occasion produced circularity. For example, "rotting" was defined as "decomposition" and "decomposition" was defined as "rotting".. Other phrases used to describe the process of rotting included ..."goes green and flakes away" (G1115496), ..."loosens up and just disappears- goes into the ground and worms eat it" (DR160496), and ..."goes hard... white... mouldy... vanishes... goes into the soil..." (GG160496). Whilst some of these statements demonstrated circularity, others indicate that the conception of rotting involved the notion of material going into the soil or water (DR160496; GG160496), often producing ill effects (G9290396; G5280396). Although pupils often used terms such as "vanishes" or "disappears" they were never content with the notion that material ceased to exist or became less in quantity. This reluctance to accept that material could literally vanish, even in the absence of a suitable alternative, is typified by Interview Extract 8.

Interview Extract 8: Pre-Program: G9290396

1	*Int: What do you mean by "rots"?*
2	*J: Sort of...*
3	*S: (very quietly)...decompose...*
	...
4	*Int: What will happen to all that flesh?*
5	*S: Just, sort of disappear...*
6	*Int: Do you mean that it'll go completely?*
7	*J: What? Just go "plink"? No...*
8	*S: It'll dissolve...*
9	*J: Well that happens with actual dead bodies I suppose.*
10	*Int: (writing)So, dead bodies..., rotting...*
11	*J: Well the skin'll... well they usually say like they've found skulls and stuff of humans...*
12	*S: Found his head about two metres away...*
13	*Int: What about the rest of it, the flesh, muscles and skin and stuff like that?*
14	*S: Just contaminate...*
15	*J: I don't know.*
16	*Int: What do you mean by contaminate S?*
17	*S: I don't know (laughs).*
18	*Int: What does it mean?*
19	*J: Well there could be contaminated water which could be like really messy water I suppose... or something...*

The initial explanation given (line 5) by S suggests that material is not conserved but vanishes or disappears yet when the pupils are pressed to explain this, despite some apparently tangential comments, they elaborate with a tentative explanation which relates to the material having a deleterious effect on something, possibly water. This, and other interviews (e.g. G1115496), accord with the conservation of "ills" conception discussed above.

The hypothetical situation of an animal's body breaking down to leave a skeleton, was most frequently explained using the idea that it exclusively involved the consumption of the flesh by other animals, such as worms, moles, bloodsuckers, wolves and badgers (G8290396; G1115496; G1029396) and, in one case, rabbits (NM160496). Rarely was the conception described whereby material goes into the soil and is used again by plants. The one instance where such an explanation was given (G1115496) also described the products of decomposition as poisonous, able to cause the death of any plant which "...sucked it up..."(G1115496), showing evidence of the conservation of "ills" conception. However, this latter conception allowed for the material to be rendered harmless if "frozen for a long time and becomes like fresh blood... cool blood..." (G1115496).

The conception of "decomposition by consumption" can be seen in discussions which compare the decay of human bodies buried in coffins with the decay of animals. Evidence which supports this meaning is given in Interview Extract 9.

Interview Extract 9: Pre-Program: G1029396

Int: But what happens to your body?

M: Rots.

G: All the little animals, worms and stuff...

M: No! Not if you're inside a coffin.

G: (...with relish...) Maggots can get inside coffins. They eat wood. (laughs).

M: Ohhh, stop it! (mock disgust)

G: (Apparently relishing the discomfort the explanation is causing) Then the wood rots away and it's just your body.

M: It's not!

Both M and G believe that decomposition by consumption occurs but the striking difference is that M 's conception does not include the idea that wood is also subject to the same process. A similar explanation is offered by three pupils in Interview Extract 10.

Interview Extract 10: Pre-Program: G8290396

Ly: my mum said that when they put the lid on the coffin you try and sit up even though you're dead... and when you're down there it's all the things inside you that eat you away...

Int: What do you mean "rot"?

L: Go mouldy (laughs)

Ly: Then you're just a pile of bones.

Int: Where does all the flesh go.

L: It just disintegrates

T: Disappears... there might be flies down there, picking at you 'cos they're hungry.

Ly: Flies? How're they going to get in?

C: Maybe you swallowed one...

Whilst there appears to be some evidence of conservation, this is generally connected with notions of decomposition by consumption. None of the pupils explained the process of decomposition using particulate theories of matter, or with reference to micro-organisms or decomposers.

7.3.2.4 The Water Cycle

Conceptions of the water cycle were probed using explicit reference to the cycle or parts of the cycle. Questions regarding the origin of tap water and where it goes once the body has used it.

A simple water cycle was often described clearly, although evaporation and condensation were not well explained (G9290396; G1029396). Many responses concerning water supply described water being taken from sea or other source (river/lochs), cleaned (to remove salt) and drunk. Waste matter then goes back into the river or sea, perhaps via a tank or "swampy thing" (NM160496; G1115496; DR160496; GG160496). Some conceptions mentioned systems of suction and pumping (G1115496), others referred to "spinners" which cleaned the water (GG160496). Whilst it might be inferred from these findings that pupils generally thought of water as being conserved since many pupils described the process as a cycle or circle, such conclusions should be treated with caution. Further probing of these conceptions in different contexts would have been desirable but was prevented by the lack of time. What *was* possible was further exploration of concepts of evaporation and condensation, given in Table 53.

Table 53: Pre-program Conceptions of Evaporation and Condensation

	Evaporation	Group
1	... "the sun makes it go up"; "steam going up"; "coming up to the sun"	G8290396
2	... "(heat?) soaks it up (S)" and "clouds evaporate it or something (J)"	G9290396
3	... "turn into a vapour and comes up to the sun... the sun turns it into a vapour"	G1029396
4	... "sun absorbs it from puddles. (Water) evaporates and makes clouds"	G1115496
	Condensation	
5	...as dependent on cold; clouds getting "too full"; "gets colder and colder until 'boof' (it rains)" ; "gets heavier and heavier"	G8290396.
6	... "the cloud's full"... "just can't carry it anymore"-	G9290396
7	... "too much water makes clouds grey or dark. Clouds go higher and then rain happens"	G1115496

Once again, use of scientific vocabulary is commonplace in the conceptions and is used in a variety of ways. Some statements are descriptive of the processes (e.g. statement 1), whilst some pupils attempt an explanation (e.g. lines 2,3,4). Generally the explanations for condensation were less dependent on scientific vocabulary and more dependent on notions such as getting "too full" or becoming "too heavy". Some statements incorporated associated ideas in descriptive ways (line 5- "...gets colder..."), and others incorporated personal observations and experience (line 7).

The term evaporation was commonly used but was never explained in particulate terms. Such an explanation was neither a feature of any other part of the conceptions of the water cycle or ecological cycles in general. However, there were frequent references to cycles or circles, but how these were connected to matter conservation was not explained.

7.3.3 ECOLOGICAL CHANGE

This concept, perhaps one of the most difficult of the four concepts addressed by the Earthkeepers program, was also difficult to incorporate into an unstructured interview format. Furthermore, the description of the Conceptual Encounter "Time Capsules" (Van Matre *et al.*, 1987) does not clarify which aspects of change form the 'big picture' for this statement. Consequently, an approach was taken which examined pupils' conceptions of the history and pre-history of places, landscapes and flora and fauna. Data regarding this concept is available from three interviews.

Some pupils conceptualised the past landscape of their local area as consisting of "ruins" or a "castle" (NM160496), others of "...wooden huts, bamboo huts..." (GG160496). A different conception of past landscapes described them as consisting of "fields, horses and sheep"(DR160496). One conception explained how "Humans (Adam and Eve and their descendants) built nature (i.e. plants and trees) otherwise it'd be just peat" (GG160496).

Pupils conceptions seemed to be unrelated to any notion of how long ago events occurred, although they were able to discuss pre-history in relation to "dinosaur times". The landscape inhabited by dinosaurs was described as "...messy, trees, lightning, volcanoes, death, cavemen, poohs everywhere..." (DR160496). A pre-dinosaur landscape was barren of life and consisted of "...just lava..." (DR160496) or "...just peat..." (GG160496).

Pupils did not discuss how the shape of the land, the climate, nor the flora or fauna might have changed, except to mention dinosaurs and a barren pre-dinosaur landscape. Their conceptions of change incorporated ideas of the types of human-built structures that existed before the present, but their conceptions did not seem to include any ideas about the time between the dinosaurs and the first humans. One pupil suggested a mechanism of change which involved the "building" (planting?) of nature by the first humans (GG160496) but this interesting conception was not open to elaboration.

7.4 THE RAF SCHOOL- POST PROGRAM CONCEPTIONS

Post-program conceptions were explored using questions derived from the program literature in a semi-structured format for individuals, or pairs of individuals. Interview groups were chosen, where possible, to match the initial group structure. Photographs of the children doing the activities were also used to encourage them to talk about the activities.

7.4.1 ENERGY FLOW (FOOD CHAINS)

7.4.1.1 Needs of living things

Living things were consistently regarded as needing energy. This was mentioned alongside other "needs" such as "Materials", "Oxygen", "Air", "Food", "Water", "Shelter", "Warmth" and "Specks" of different types. Whilst some were able to group these needs under the program's "Energy and Materials", others were not confident with such classification.

The category "Living things"was often taken to mean animals or plants exclusively and many pupils struggled initially with the generalisation "*All* living things", although this was usually resolved with further questioning.

7.4.1.2 Formation of a food chain

Classification of organisms into categories such as plants and animals

Classification of organisms was not necessarily straightforward. Whilst some referred to all chlorophyll producing organisms as plants, many others distinguished between such categories as "plants", "trees", "flowers", "weeds", "vegetables" and "fruit". Some pupils did not regard all of these as occupying the same place in the food chain. For example, one pair did not regard grass as a plant because it did not appear to have leaves, or moss as a plant because it did not grow in the ground but on walls. An extract from this interview is given in Interview Extract 11.

Interview Extract 11: Post-Program: JS120696

1 *INT: Give me an example of some plants?*
2 *J: Sunflower.*
3 *S: Daises.*
4 *J: Does that count as herbs?*
5 *INT: Are herbs plants?*
6 *J: Well, you can get sort of [...]... plants that are sort of herbs, herbs, like mint.*
7 *INT: Can you get herbs that aren't plants?*
8 *J: Pepper's not a herb is it?*
9 *INT: Can you get herbs that aren't plants?*
10 *J: I'm not sure actually.*
11 *S: .... most of the herbs that I've had have usually been plants.*
12 *INT: Okay, so how do you know, how do you know what a plant is and what a plant isn't?*
13 *S: A plant is something that grows from the ground.*
14 *INT: Right. How about something that grows from the wall, like moss? Is that a plant?*
15 *S: No.*
16 *J: No.*
17 *S: Well moss, it would sort of grow like grass.*
18 *INT: Is grass a plant?*
19 *J: No.*
20 *S: Like loads of tiny little plants, but ...[...].... quite a lot of them around.*
21 *INT: What sort of things are plants then? Tell me more about plants then, other than that it grows from the ground.*
22 *S: Grows from the ground.*
23 *J: Some of them do. Some from gardens and fields.*
24 *S: Well they definitely do, you've got stuff like, a couple of days ago you've got some plants like mint.*
24 *J: I'm not so sure if that's a plant but.*
25 *INT: Why?*
26 *J: It's a sort of, it's a sort of herb. I'm not sure.*
27 *INT: Again, we're back on to this plant-herb thing.*
28 *J: Well it's not leaves 'cos they're like ....*
29 *INT: .... they grow, they do grow from the ground?*
30 *J: Yeah.*
31 *INT: Well according to S if it grows from the ground it's a plant.*
32 *J: Well there's flowers that grow from the ground as well.*
33 *INT: And are flowers not plants?*
34 *J: There's some plants in the graveyard.*
35 *S: Yeah. Roses and daffodils.*
36 *INT: Are they plants?*
37 *S: Yeah.*
38 *J: Yeah. We've got a lot in the back garden, so.*
39 *S: Are roses grown by seeds?*
40 *J: I'm not sure.*
41 *S: Seeds around the fields... And get 'cone' plants, you get grass.*
42 *INT: Vegetables, what are they? Are they plants?*
43 *S: Most of them, like carrots, they grow out the ground ....*
44 *INT: .... most of them?*
45 *S: Yeah, tomatoes, they're grown off trees ....*
46 *INT: .... are they plants?*
47 *S: So they're half fruit and vegetable.*

Other conceptions insisted that weeds were not plants because they did not need seeds to make them grow. The term "animal" was generally problematic as it typically referred exclusively to quadrapedal mammals, thereby excluding insects, reptiles, fish and most frequently, humans.

Use of terminology

Herbivores were described as Plant Munchers or plant-eaters. Carnivores, likewise were described as Animal Munchers or Carnivores. Sometimes these terms were used interchangeably demonstrating that pupils were comfortable using the scientific term, the simple term or the term introduced by the program. Two pupils used the term "Plant Muncher" to refer to a plant, indicating that rather than treating it as a compound noun which described an animal's behaviour, they considered the two words to be independent terms i.e. an organism which is a plant *and* a muncher.

7.4.1.3 Examples of Food Chains

Virtually all of the pupils were able to construct food chains which used the general labels of Sun Muncher, Plant Muncher and Animal Muncher and could give examples, although these were usually limited to the one given by the program. Sometimes these food chains used specific examples and the class of organism interchangeably, perhaps because they were unwilling to speculate about certain types of relationship.

Most examples of a food chain referred to The Sun-Grass-Rabbit-Fox. Other chains which included humans were sometimes given, such as The Sun-Grass-Cows-Humans (KC240496) or The Sun-"Greens"-(Hen's)Egg-Humans (MR250496). Exotic examples included...The Sun-Tree-Giraffe-Tiger (HX070696). A minority of pupils' chains included non-consumptive links, for example... The Sun-Grass-Rabbit-Fox-Human (LF050696), or The Sun-Plant-Fly-Spider-Cat-Dog-Humans. The interview extract illustrates the possible confusion between a food chain, which describes the flow of energy from the sun to carnivores, and a web of connections (line 20). In the web, interrelationships are regarded as existing because organisms obtain energy and materials from each other. The clarification and challenge of this idea by the interviewer in lines 17 and 28 suggest that although the context was "food" the pupil realised the mistake.

Interview Extract 12: Post Program: LF050696

1	*DM: So could you give me an example of one of these things?*
2	*L: A leaf [...] a beech leaf.*
3	*DM: Okay.*
4	*L: And a caterpillar, and then ....*
5	*F: .... a bird.*
6	*L: A bird, yeah.*
7	*DM: Is that complete as it is?*
8	*L: Yeah. The bird has a predator as well.*
9	*DM: Right.*
10	*F: The bird's predator could be a fox.*
11	*L: Or a cat.*
12	*DM: Right. How about the other end? Does it start at the beech leaf?*
13	*L: No, it starts at the tree, and then it's the sun.*
14	*F: Yeah.*
15	*DM: Okay. So there it is. Is that complete?*
16	*F: And then the fox has got to give it to a human. 'Cos that... humans shoot foxes for fun.*
17	*DM: Do the humans eat foxes?*
18	*F: No, but they shoot them.*
19	*DM: Right. What does this represent to each of these things?*
20	*F: Connected.*
21	*L: Yeah.*
22	*DM: Go on...*
23	*F: Food.*
24	*DM: You think it represents food?*
25	*F: Yeah.*
26	*DM: So the tree gets its food from the sun?*
27	*F: Yeah.*
28	*DM: Right. So, does anything get its food from the fox? You said humans earlier.*
29	*F: Yeah, the humans shoot them, they don't eat them.*
30	*Int: Do you know what this sort of thing's called?*
31	*F: Food chain.*

7.4.1.4 Energy

Sources of energy

Most included the sun in the food chain and referred to it as providing energy. This conception was usually refined by qualifying it with the statement that plants were the only thing that could get their energy from the sun and animals got their energy from their food. A significant number initially stated that animals could get their energy from the sun but qualified this by saying that they were dependent on plants using it first. Some pupils suggested that animals or humans *could* get their energy directly from the sun because they needed it to keep warm, to get a sun tan, to make their fur shiny or because without it they'd feel ill, but at least one of these explanations was justified by the view that this wasn't quite the same way as getting energy for living. One pupil suggested that humans could get energy from exercise because when "...we run we feel full of energy".

A small number of pupils suggested that plants got their energy from other sources such as water, soil or the atmosphere. In the latter case (LC100696)the pupil's example of a food chain, given later, did not reflect this, suggesting that plants' energy came from the sun. Some of these pupils suggested that plants obtained energy from a combination of sources; in two cases from a combination of the sun and water and in one case from the sun and soil. The conception is probably linked with this pupil's pre-program conception that plants obtained all of their energy from the soil alone. This is one of the rare cases where pre- and post-program conceptions were directly comparable for this first series of interviews.

Uses of energy

Pupils frequently suggested that energy was required for "living" or "survival" in general. Some of these pupils were able to explain that organisms needed energy to grow, to move or to hunt. Whilst such explanations might be taken to imply that energy was "used up" by these processes, not many pupils could explain how this occurred. One pupil who suggested that energy was used up by an animal moving also suggested that if that animal was entirely consumed by another then all of its energy would be passed on to the predator.

A large number of pupils could describe how energy dissipated down a food chain describing it as getting less or getting thinner. The latter term referred to the model of the sun's energy used in the program which used a yellow cord of decreasing thickness to show energy dissipation. This "thinning" of the energy was attributed to plants needing more energy than animals in two cases but most frequently by a reference to it being "used up". Further elaboration of this was unproductive.

Pyramids of numbers

The majority of pupils remembered that more plants were found than carnivores. However, only two provided explanations which involved a description of the amount of energy available at the end of the food chain. One of these was vague, suggesting that because "...animals eat off the plants there'd need to be more plants" (LT100696), but the other described how animals had to eat more to get enough energy but if "...there were other animals out for the food they might not survive..." (HX070696). A small number of pupils stated that there were more "Plant Munchers" than plants because there are lots of humans on the world and humans eat plants.

Although pupils could generally appreciate that this pyramid of numbers existed at the centre, some suggested that things would be different for other locations. One described that this would not be the same in the sea because the water would prevent the sun from giving energy to plants and so there would be more animals than plants in the sea.

REVIEW AND REFLECTION

The previous sections have examined the meanings associated with ecological concepts, before and after the program, for pupils from the first institution visited- the RAF school. This extensive and detailed examination, comprising several thousands of words has identified various ideas that pupils used to explain the natural world. Data have been extracted from interviews to illustrate the way in which these ideas were generated by the methods. In the interests of brevity and readibility, data have been used and referenced to their sources in the following analyses only to illustrate some of the most interesting and significant cases.

7.4.2 CYCLING

7.4.2.1 The Nature of Matter

Pupils consistently began the interviews by stating that everything was made from three types of "specks". In some cases they used the program's phrase "Energy and Materials" and went on to explain that "materials" was a generic label for "specks". Exceptions to this revolved around different interpretations of the phrase "...made of..."; one pupils suggested that plants were made of "...green", another that "...everything was made from God". One pupil compared specks to the elements, being "...like fire, air, water and earth".

However, these ideas by no means excluded the possibility that everything was made of specks *and* something else. The other constituents of matter were sometimes described in general terms (materials), or were related to specific examples. Thus objects also contained skin, heart, lungs and most commonly bones in the case of humans or animals, and wires, batteries, (micro)chips and "electric" in the case of computers, or a cassette recorder. When these statements were explored, some pupils suggested that "man-made objects" might have been made of plastic specks or energy specks for example, but these were offered as provisional explanations. Pupils generally made a distinction between natural and anthropogenic materials where natural objects usually contained three types of speck but "man-made" objects were made of other things. Sometimes this distinction was, instead, between living and non-living things. Explanations for these distinctions were based upon experience or known "facts". Thus a potato did not contain air specks, but mostly water and soil specks because "it grows in the ground"; metal contained soil specks because it "came from rocks".

The majority of pupils' descriptions of objects seemed to imply that matter was continuous rather than particulate and consequently that specks were contained by or attached to objects rather than exclusively constituting them. The conception that *all* matter was particulate, was consistently evident in six pupils' explanations.

In general pupils did not merely accept what they were being told. They had to have a reason for believing that soil, water and air specks were the constituents of matter. In the case of natural objects this was generally straightforward as they could appreciate that natural objects were in constant contact with these three things. For "man-made" objects pupils generally needed to know how certain substances like plastic or metal were manufactured for them to accept that all "man-made" objects were also made out of the three types of speck. However this was complicated by some pupils referring to the problems of mixing water specks with electricity and therefore they did not believe that a computer could contain water specks. One pair of pupils were willing to accept the program's assertions explaining that plastic was made out of specks because "...what else could it be made of!".

7.4.2.2 The Nature of Specks

Appearance

Specks were universally described as being "very small" although pupils' explanations of "very small" varied. Some could not go beyond a description which involved repeated use of the adverb "very", although for many, specks were the "smallest thing" and were invisible to the human eye. They were frequently compared with other small things, such as fleas, dots, or the point of a very sharp needle. Several pupils also stated that they were like molecules, atoms, particles or cells and some stated that they were the same as molecules or atoms. Two pupils suggested that there would be about five or ten specks in a coin-sized piece of paper and billions in the room but also that they could be seen with a magnifying glass or "one of those scope things".

Persistence (Age and Transformation)

Specks were, universally, considered to be very old and re-usable. Nearly all pupils dated specks' origin as some indeterminate time which was *before* some long past event, such as the dinosaurs or "the time of Christ". Others declared them to be billions of years old or age-old. More precise descriptions stated that they had been around since the earth was created, that being the "oldest thing" they were floating in space then formed into the planets, or that they had been around "for ever".

Whilst most pupils described specks as remaining as either soil, water or air specks, a minority believed them capable of changing from one type into another.

Existence

The majority of pupils believed specks to be "alive". This was commonly explained by the statement that "Specks are alive because we're alive and they make us". However this was often seen as contradicting the idea that specks had been around for billions of years since "...how could something live that long". One pair of pupils explained this by saying that specks could be "immortal". If specks died one group believed that the organism containing the specks would die; another believed that specks could die if they became poisoned or polluted.

Only one group saw the potential for circularity in the conceptions of specks being alive and all living things needing specks . For others, who regarded water as containing water specks *and* water (a continuous rather than particulate substance), these two conceptions could perhaps consistently co-exist .

Locomotion

Specks were thought to be capable only of passive movement. Thus they could be moved by becoming attached to something else. One pupil compared this to being "...carried like a baby...". Their movement was usually described as "floating" and occasionally "jumping". Specks could transfer from one object to the next by contact, or by being sucked in or sucked up.

7.4.2.3 Examples of Cycles.

Specks were universally described as following "cycles" which involved the speck being associated with various organisms, both plants and animals, and often being associated with the same animal or plant. Links betweens organisms were most often consumptive relationships where one animal ate another animal or plant. Specks were also associated with organisms by being attached to them. One example referred to a soil speck being attached to a carrot which hasn't been washed properly. Some pupils did not appear to differentiate between soil, water or air cycles describing the same cycle for each speck with predominantly consumptive relationships. Some pupils described how an air speck would need to be used by plants and animals alternately whilst others made no such distinction. Cycles were most easily explained when humans were not involved at any stage. When pupils were asked to consider how humans might be involved in the cycle many pupils seemed to be unable to consider what happened after a water or soil speck went into a sewer, although no such difficulty was experienced if the human's waste was deposited elsewhere other than a toilet. Whilst some pupils expressed surprise and disgust (and even delight!) at the thought of consuming a soil or water speck that had previously been used by an animal, others included this in their cycles without comment .

The process of rotting was described in similar terms to pre-program interviews but the idea of specks returning to the soil, water and air was a consistent feature of many of the cycles and conceptions related to dead animals or plants "turning into specks". A small number of pupils still referred to the process of rotting as being consumed by other animals but this was usually described alongside the notion of specks going into the soil.

7.4.2.4 Famous Specks

The use of Rob Roy and William Wallace as famous people escaped the notice of many of the children from this school since many of them had not been born in Scotland and had little knowledge of Scottish history[17]. One pupil believed these to be names of specks since specks were given alliterative names such as "Sally Splash" and "Dirty Dave".

No pupil denied the possibility of the bottles containing specks which Roy and Wallace had breathed or drunk but few believed that they could have contained any of those particular specks. Pupils seemed to accept that specks used by people in the distant past would be in the bottles. One pupil commented that she did not think she could have drunk any water that had been drunk previously as it would have been "dirty or stale". A different explanation described how we breathed all the time so it was much more likely that we had breathed some of the air that Roy had breathed, than drunk the water that Wallace had drunk. Pupils generally seemed doubtful of the assertion that they consisted of some soil specks that had been used by a dinosaur but they did seem willing to allow this possibility. Pupils' religious beliefs had an influence here and one pupil stated that although the story of specks might be true, she preferred to believe in a literal interpretation of the idea that "...when you die you go to heaven".

7.4.3 INTERRELATIONSHIPS

7.4.3.1 Types of Connections

Connections were initially addressed by using "Connector Scopes". "Connector Scopes" comprised a short section of plumber's pipe through which pupils could view their surroundings. One end of the "scopes" had a wire reticle dividing the view into two hemispheres. The purpose of the wire was to allow pupils to "join" two things together with a line of reference which would show that those things were connected.

The purpose of the "Connector Scopes" was understood variously as being a tool for connecting two things and also a means of dividing the view into two hemispheres. Connections between living things were described in various terms

[17] One English pupil suggested that William Wallace was the animated character from the film "The Wrong Trousers".

and with various levels of complexity.

Basic Connections

A small number of pupils could recall that "all things were connected" but could give only a very general explanation of such connections. These explanations used statements such as a tree and a human were connected because they both need soil, water and air specks.

At a simple level connections were described as single-stepped, one way and consumptive, thus a caterpillar was connected to a leaf because it obtained soil specks from the leaf. Frequently associated with this idea was the conception that the leaf did not obtain anything from the caterpillar. Pupils also believed that the caterpillar could obtain air from the leaf by consuming it, a conception which sometimes overlooked the need for the caterpillar to obtain air by respiration. Associated with this idea was that caterpillars could also obtain water specks by consuming the leaf. The provision of air by trees was conceptualised as a one-way process, or a reciprocal process; thus trees *created* breathable air for other organisms, and trees and animals provided "breathable" air for each other. A variant of this conception, which also related to the difficulty of classifying all members of the vegetable kingdom as plants, was the idea that trees provided air to animals *and* plants.

Pupils who explained connections using single-stepped relationships did not seem able to explain how two separate plants might be connected to each other and struggled to explain how an entire food web might be affected by the use of weedkiller or an oil spill.

Multiple Connections

Perhaps more frequently expressed was the conception that connections between organisms had many steps. These conceptions typically involved consumptive relationships and many pupils used examples of food chains to explain their ideas. Less common were explanations which also included ideas of respiration and photosynthesis and least common were ideas which described how plants and animals decomposed and released their specks to "make soil".

7.4.3.2 Effects of "Poisonous" Chemicals

Many ideas were offered to explain how a food web would be affected by weedkiller or a harmful substance, such as oil.

Most commonly the principal effect was described as being one of poisoning a food source which would poison all of the organisms in the food chain. Almost universally, pupils stated that anything so affected would be killed. A very small number suggested that the effects would be cumulative so that it would take "...a whole kettle-full of weedkiller to kill everything". One pupil stated that another effect might be to give the animal a "disease".

A less common idea was that the killing of a weed would remove a food source. This was also described as having the effect of causing the death of anything that would have eaten the particular plant. One pupil further explained this by referring to the increased competition for food that would result.

Least commonly expressed was the explanation that killing a group of plants would cause a shortage of air which was partially justified by the statement that "if all trees were cut down we'd die".

Mechanisms of Transfer

A poisonous substance was capable of movement around the food web by various means, most commonly by consumption. However another common idea, was that weedkiller would "go into" the soil, move through it and be "sucked up" by another plant. This "movement" was explained by saying that the weedkiller could get attached to, or eaten by a worm, get attached to a water speck and flow through the soil, or move by an unexplainable process. Larger animals were considered as possible carriers of "poison". One pupil suggested that the wind could also be a mechanism of transport for weedkiller, particularly if the weedkiller was sprayed onto a crop. This was consistent with many pupils' suggestion that specks could "float" in the air.

The chances of "poison" effecting humans were admitted as being possible by only some of the pupils and probable by even fewer, even when they agreed with a possible mechanism suggested to them. This reluctance was closely connected with most pupils' belief that poison was transferred by consumption and since humans did not eat weeds, or those things affected by oil slicks, they could not be affected. Only one pupil agreed that he might have some "poison specks" inside him but this was qualified by the suggestion that they might also be able to "...go back out again".

7.4.4 CHANGE

7.4.4.1 Types of Change

All pupils stated that change was a feature of the world and that things have always been changing. Conceptions of the types of change were much more varied. Some pupils talked about change in terms of cyclical, diurnal and seasonal changes rather than progressive long term change. Evidence of current and future change was much less obvious but one pupil suggested that things weren't changing "quite so much these days".

Landscape, Climate, Flora and Fauna

Typical descriptions of the local environment in the past referred to it looking "old", "messy", more vegetated, "cleaner" and "rocky and muddy".

A common view of the past was that it would have looked "old". This was further described as a landscape with mud huts, castles and ruins. Another common description described the landscape as being greener, although these comments usually referred to there being more fields or trees; some suggested that there might have been swamps. Most commonly the past was viewed as a place which was identical to the present, except for the presence of people, their artefacts and types of creature. Descriptions which referred to the past being "messy" were concerned with the effects of dinosaurs which would have been "killing everything and poohing everywhere", or of bare earth and rock. The pupil that mentioned that it would be cleaner explained this by saying there would be no litter or bomb sites. Uncommon descriptions referred to the landscape changing due to mountains being eroded and lowered; one pupil also used a local example of an extinct volcano to suggest the existence of a totally different landscape, although these were the exceptions.

Pupils generally did not consider that the climate could have been much different in the past. The weather was described as being quite constant with justifications of statements relating to what the climate was like now. These conceptions were sometimes held alongside recently learned conceptions about continental drift but these were only once combined to explain that a different climate was connected with the land being in a different place on the globe.

7.4.4.2 Explanations of Change

Explanations for the changing of the environment over time were various, but they rarely moved beyond the descriptive. Some pupils used the terms evolution and adaptation to explain how things changed over time, describing how things changed "little by little" and how some animals were "better" than others, for example "dinosaurs had harder eggs", or "mammals were more sophisticated and had longer legs so they could run faster". Such adaptive features were discussed in Darwinian and Lamarckian terms. For example, one pair or pupils suggested that fish came out of the sea because they wanted to explore.

Conceptions of evolution were most commonly a combination of scientific ideas with creationist ideas. Thus stories of Adam and Eve, Noah's Ark and Caine and Abel were combined with accounts of comets and meteorites, which caused the extinction of all life on earth at the time of the dinosaurs. Other theories to explain the origin of humans involved them forming from the dust after the Earth had settled down after a meteorite impact, God putting two eggs on the Earth which became Adam and Eve, or humans spontaneously growing out of dinosaur eggs.

7.4.4.3 Role of Specks

Specks were regarded as one thing which had not changed throughout the ages but had stayed the same, "didn't die out" with the dinosaurs, or had stayed in one place. They were generally considered to exist throughout the stages of evolution described by the program. Specks were also considered to exist far into the future, with one pupil suggesting that "buildings won't last for ever but the specks will".

Tensions between the idea of specks and pupils' beliefs were evident on several occasions. This seemed to occur when pupils' religious beliefs appeared to contradict the Darwinian theory and whilst some pupils were prepared to discuss the existence of specks, they preferred to believe that people literally went to heaven. Furthermore one pupil stated that he found it too difficult to believe that he was partly made of "recycled T-rex", although there was no evidence of any particular religious beliefs behind this.

7.5 REVIEW AND REFLECTION: THE CONSTANT COMPARATIVE METHOD

Strauss and Corbin (1967; 1998) and Lincoln and Guba (1985) have emphasised the importance of continual checking of inductive coding and the simultaneous collecting and coding of data. These methodological comments and decisions are best placed at this point, rather than in the methodology, because they underline the way in which the methods emerged from the situation. The decisions about efficacy of methods for generating meaning were made on the basis of the researcher's reflections on the preliminary research, discussed in the previous sections. These data, and the resultant implications for data gathering at the suburban school, are discussed in the *following* pages.

The discussion begins with a review of the interview structure in terms of the size of the group interviewed. It then follows this with an examination of some of the interactions that occurred during the interviews, by examining the *legitimising strategies* that pupils adopted when confronted with alternative frameworks of meaning.

The structure of the interview evolved in another way- it moved from an unstructured format to a semi-structured format. This comprised the use of a range of standard questions (whilst still allowing further probing) to build rapport and understanding about conceptual meanings in a more focused manner. Furthermore, various situations were used to explore the pupils' interpretations of meanings outside the context of schooling and the program. These are what Patton (1990, pp.319-320) refers to as role playing or simulation questions. These are summarised in the Interview Guide (Table 57: Interview Guide for Elicitation of Conceptions, p.270). This discussion concludes with a critique of the questioning structure used by the researcher.

7.5.1 GROUP STRUCTURE

Group interviews of two to four pupils were used for pre-program interviews. More time was available for post-program interviews and these were conducted with individuals at first and later with pairs of pupils as time became short. A further consideration was that little time was available to establish rapport and trust with the pupils and therefore the initial interviews had to be organised so that they were perceived as being as non-threatening as possible. Interviewing pupils in peer groups was one of the ways of structuring the experience so that this could be facilitated.

The initial choice regarding group structure was made by the class teacher on the basis of what she thought would "work", although this was mediated by other considerations, such as the availability of the pupil, and the likelihood of group members being antagonistic towards each other. This latter consideration was certainly found to be a problem on more than one occasion (On one occasion two of the participants began to physically abuse each other). Where this occurred attempts were made to re-interview these pupils individually, however time constraints rather mediated against this.

The disadvantages of group interviews became clear at an early stage. Whilst some groups were able to discuss questions with each member taking an equal part, other groups were often dominated by one or two members. In two of the interviews one group member made hardly any contribution to the discussion and attempts to draw them in were rebuffed with one word answers which could not be elaborated, or with "I don't know". Consequently, larger group interviews were found to be useful for eliciting a wide range of frameworks from a large number of pupils but they did not facilitate exploration of individual frames. Smaller groups were sometimes useful if pupils were given the freedom to explain their ideas properly without interruptions and criticisms from peers.

7.5.1.1 Legitimising Strategies

There were, however, other advantages to the use of group interviews. They demonstrated that pupils often were required to refine their initial conceptions in the face of their peers' alternative views and revealed some of the ways in which pupils sought to legitimise and justify their conceptions. Legitimising strategies included reference to experience, reference to consensual knowledge, enlistment of scientific vocabulary and appeals to higher authority such as parents or teachers. Examples of these strategies are given in Table 54.

Table 54: Legitimising Strategies for Conceptions

Legitimising Strategy	Example (Use of strategy is underlined)
1. Reference to experience	M: "...<u>and if you go down to the beach you can smell it... and it doesn't smell nice does it?</u>... and the whale pollutes the air..." (G5280396)
2. Reference to consensual knowledge (The example gives four responses which are numbered to facilitate the discussion below)	Int: So how do fish manage to get their oxygen? A: They open their gills (1). C: They're fish not mammals (2). G: They open their gills and get it and shut it (3). (laughs) A: '<u>cos they're different from us</u> (4) (G1270396)
3. Enlistment of scientific vocabulary	Int: What about the rest of it, the flesh, muscles and skin and stuff like that? S: <u>Just contaminate</u>... Int: What do you mean by contaminate S? S: I don't know (laughs). (G9290396)
4. Appeals to higher authority (parents/teachers)	Ly: <u>My mum said</u> that when they put the lid on the coffin you try and sit up even though you're dead... and when you're down there it's all the things inside you that eat you away... (G8290396)

There is some degree of overlap between these four strategies however. The second example, given for "Reference to consensual knowledge", shows four responses to one question. The first and third are probably references to experience, the second could involve a reference to consensual knowledge, but it also enlists scientific vocabulary. The fourth response is somewhat obvious, functions as a summary of the preceding three statements and is therefore unlikely to be challenged by the group. Therefore this last response is taken to be a reference to consensual knowledge.

Where conceptions were insufficiently justified conflicts were resolved by other means which were dependent on such factors as the child's membership of a sub-group and other beliefs. For example, one interview demonstrated how a boy felt threatened by being outnumbered by two girls in the group (G1029396). Rivalry between the sexes was a feature of some of the interviews with boys and girls complaining about each others' behaviour. Certain beliefs seemed to have lower status than others, thus "religious" beliefs were overpowered by "scientific" beliefs in interviews where this conflict surfaced. An example of this is given in Interview Extract 13.

Interview Extract 13: Pre Program: G1029396

1	*Int: What happens at the end of your life?*
2	*M: you die.*
3	*G: You disintegrate.*
4	*M: You go and see Jesus... you go to heaven.*
5	*G: See you ARE religious.*
6	*M: I'm not! Just because I believe in heaven and God doesn't mean...*
7	*G: You're religious?*
8	*M: I don't go to church every Sunday...*
9	*Int: What about your body?*
10	*M: Your spirit comes out of it...*
11	*G: See, you're religious! How?*
12	*M: 'cos I know.*
13	*(...)*
14	*Int: But what happens to your body?*
15	*M: Rots.*
16	*G: All the little animals, worms and stuff...*
17	*M: No! Not if you're inside a coffin.*
18	*G: Maggots can get inside coffins. They eat wood. (laughs).*
19	*M: Ohhh stop it!*
20	*G: (Relishing the discomfort the explanation is causing) Then the wood rots away and it's just your body.*
21	*M: It's not!*

This should be compared with the post-program comments from the pupil. Interviewed alone, Interview Extract 14 below, she accepts the school theory but the idea of ascendance to Heaven is interpreted literally and exists as a conscious decision (line 32). There is also the acknowledgement that there is something of a problem with proof (lines 19-28).

Interview Extract 14: Post Program: MR250496

1	Int: Why are there no dinosaurs now?
2	M: Extinct, 'cos sun was too hot then and water all went and they didn't have anything to drink.
3	Int: Did everything die?
4	M: No... all animals died, well most of them... I don't know 'cos I wasn't alive at that time... the earth itself didn't die
5	Int: So where did we come from?
6 *7*	M: God... I don't believe the water speck thing... well I believe in the specks just now but... not when you die you become a piece of water..."
8	[...]
9	Int: Could you have a dinosaur speck inside you?
10	M: Oh yeah... well it might still be going but it might have stayed in one place forever
11	Int: Was it true that you were pinching a piece of dinosaur
12	M: (laughs) I don't think I was ever part of a dinosaur"
13	Int: So what makes you?
14	M: blood, flesh, bones...
15	Int: What makes them?
16	M: Specks
17	Int: what kind?
18	M: Water, air , soil specks
19	Int: Do you think it's true?
20	M: Yeah... well I don't know actually... "
21	Int: You're told lots of things at school and some of the things ...
22	M: (interrupting) some people tell you God made you and then you go and get told that you're part of a river and you're made up of water and that... you don't know what to believe.
23	Int: How do you decide?
24	M: Wait till you die... when you die you say where's God and ask him, and if you become part of water then you know that's true
25	Int: But if you die and God didn't make you you'd never know would you!
26	M: Oh... then I'd probably just believe the Ardroy people.
27	Int: Then you'd be dead so you wouldn't be able to think about that...
28	M: Ohh... unless I was brought back as someone else's human if I was a water speck... water specks might be able to think... you don't know...
29	*[...]*

(Table Continues)

(cont.)

30	*M: They tried to convince us that everything was soil specks but what I want to know is how did they find out about it and how did they know that we'd be soil specks or become part of a river... It's the way he said (Inaudible) like my best friend G, has recently died, and it makes you a bit depressed thinking that your best friend could be in a river, part of soil or (inaudible)"*
31	*Int: Where would G be now?*
32	*M: It's down in [...the local church]... in a grave 'cos I've been to it... but his soul will hopefully be in heaven 'cos he was such a kind person, and I don't know why they picked him to get the cancer of all people. Some people must blame it on God for picking on him when there's like the IRA and stuff... that in a way you just want them to die... (pause)... I didn't like the thought of becoming part of a river- I said to L "Thanks but I'd rather go up to heaven and see all of the people I haven't seen for a while...".*

Where conflicts occurred between opposing belief systems other pupils not involved were virtually excluded from the discussion.

Conflicts were also avoided by pupils offering a tentative hypothesis as an explanation for a certain phenomenon. Such offerings can be regarded as being tentative and provisional as further probing revealed pupils' inability to justify their statements using the legitimising strategies outlined in Table 54. Where pupils were unable to offer an appropriate justification they often made suggestions which contained an element of humour or absurdity. For example one pupil suggested, in answer to the question "So trees get their air from us... any other ideas?", that "there's this little man that you buy it off" (G1270396).

7.5.2 INTERVIEW FORMAT

The pre-program interviews used an informal conversational interview (Patton, 1990, pp280-282). The first priority was to establish trust and rapport by asking appropriate questions. To this end the interviews began with non-controversial questions about present and past behaviour and experience, and used probes to elicit detail in a descriptive fashion. Some of these are given in Table 55.

Table 55: Questions Used to Establish Trust and Rapport

What do you do in your spare time?
What do you like to do in the holidays?
What do you want to be when you grow up?
What subjects do you study at school?
What are your favourite subjects at school?

These were useful starting points for various reasons. Firstly, they allowed pupils to talk about those things which were interesting, exciting and far removed from what could be perceived as "school-work". They were generative of large amounts of data concerning hobbies, responsibilities (e.g.such as looking after pets), games, friends, boyfriends and girlfriends, families, family holidays, adventures, escapades, pranks, "dares", television viewing habits, significant news items, hopes, fears, superstitions and folklore. Secondly, they allowed pupils to express risqué opinions or recount daring feats which helped them realise that the interviewer was neutral with respect to their answers and could not be shocked or embarrassed by their answers. Such a strategy was useful for building rapport and trust.

However, it became apparent that although this strategy was useful for revealing meanings and stimulating discussion and hence, contributing significantly to the development of breadth, it was less useful for developing detailed understandings about meanings. Pupils would too easily be drawn into discussions with their peers about subjects which had little relevance to the research question. Furthermore, the time available in the primary school meant that there was often a lack of context for certain subjects to be broached as the informal unstructured conversational interview rather precludes the interviewer taking such a directive approach. During the early interviews contexts for asking knowledge questions did arise spontaneously during these informal conversations, although these could not be relied upon to occur during each interview. Examples of such contexts are included in Table 56.

Table 56: Sources of Contexts for Knowledge Questions

Source	Specific Context	Concept
News items	BSE Road protests Asthma being linked to air pollution Oil spills.	Food Chains Cycles, Interrelationships Cycles, Interrelationships Cycles, Interrelationships.
School Work	Science experiments Discussions in religious education	Cycles Ecological Change, Cycles
Personal Experience	Deforestation witnessed whilst on holiday Dead whales and seals on nearby beach Examples of pollution Nature walks.	Interrelationships, Cycles Cycles Interrelationships, Cycles Interrelationships

Other "creative" methods of conducting interviews are available to the interviewer which depend on the situation (Patton, 1980, p346-347). In an attempt to stimulate discussion various objects found on a local nature reserve were introduced. Such objects included a pine cone, some sand, a phial of sea water, seaweed, sticks, a cuttle-bone, gorse blossom, a discarded plastic bag and a rusty soft drink can. These were to provide a context for pupils to talk about their experiences of local natural areas and their conceptions, if these topics did not occur during the course of the discussion. The objects were highly productive of comments which identified the objects or placed them as coming from the beach. Pupils also began the interview asking to see the objects, obviously having discussed the interviews with peers who had already been interviewed, but became pre-occupied with identification. Perhaps surprisingly they were not productive of conceptions. For example, when pupils were asked what might happen to the sticks over the course of time answers described sticks floating away, being burned, or being thrown for and chewed up by a dog; furthermore, cuttle-bone would only ever be "collected and used in budgies' cages". It seemed as though the provision of familiar objects restricted pupils to the description of experiences and prevented them from offering hypotheses. Questions using more abstract labels were much more likely to be elaborated even though some of their ideas were tentative or hypothetical. Therefore the use of objects was rejected as it was not considered sufficiently productive given the focus on identification.

Photographs of pupils engaged in the program were used for the post-program interviews. Generally these were useful as they helped to remind pupils about what they had done, encouraged them to give extended answers to questions and helped them to focus on the questions during what was sometimes a lengthy and difficult interview. These needed to be used with care however as pupils would often give over-lengthy descriptions of activities without actually discussing what they had learned from them, or what they thought they were expected to learn.

Post-program interviews were also conducted with the assistance of the Training Manual (IEE, 1985). The Training Manual was a document presented to the pupils before they began the program. It contained, amongst other things, pages concerned with the four concepts addressed by the program. The concept pages have a few short statements which attempt to encapsulate the essence of the concept. Questions were derived from the concept essence statements in order to provide a more useful framework for asking questions although these varied from interview to interview. The first two concept statements were easily restructured as open questions but the last two, Interrelationships and Change, contained so many interrelated concepts that it was difficult to devise meaningful and clear open questions.

7.5.2.1 Question Content- the Development of the Interview Guide

Pre-program interviews attempted to elicit conceptions as they arose during the informal conversation using the contexts provided by the pupils. As this wasn't productive of enough data in the time available the training manual was trialled as a source for questions although these were re-written in order for them to be meaningful, clear and singular. As the interviews progressed, particularly during the later post-program interviews, the interview guide approach started to be used (Patton, 1990, pp283-284), using a framework within which it would be possible to develop questions and detailed probes of responses. The guide began with rapport questions and probes, and proceeded with questions concerning each of the four ecological concepts. Questions from this guide were piloted with some of the later interviews from the first school but rarely was there time to question groups about all four concepts.

Rapport questions were still important since knowledge questions can be quite threatening on their own (Patton, 1990, p294), particularly when there is a lack of appropriate context within which to ask the questions. These formed the opening questions of the interview and were followed by questions of pupils' conceptions. The interview guide is given in Table 57.

Table 57: Interview Guide for Elicitation of Conceptions

1.	Rapport Questions
a.	What is school like? What do you like and what don't you like doing at school? Reasons for these likes/dislikes.
b.	What do you like to do in your spare time?
2.	Energy Flow
a.	What do living things need? (to grow, move, do anything)
b.	Where does energy come from?
c.	How is it used? ...by living things... e.g. plants, animals?
d.	Question to elicit a food chain?- What do you eat?, what does that eat? etc.
3.	Cycling
a.	What is everything made from? e.g. contrast pencil and diamond, wood and ash, sand and glass? or... what are people made from? ... then .... what is (answer) made from?
b.	elicit air cycle - trace path of a breath of air, e.g. do plants breathe? elicit air water cycle - trace path of some water in a rain drop elicit "soil cycle"- trace path of decaying organic matter
c.	If anything is drawn, what are these called?- Cycles
4.	Interrelationships
a.	Are living things connected in any way? If yes, How? e.g.? -e.g.1 What if I kill all wasps, or midges would anything else happen? -or ... e.g.2 Drained a swamp -or ... e.g.3 Weed killer -or ... e.g.4 Oil slick
b.	Examples of how things are connected Draw connection and ask "What would happen if...?"
5.	Change
a.	How would you describe (your home area) as it is now, to someone who has never been before? Land? Air? Water? Plants? Soil? Weather? Wild animals? Insects?
b.	How long has it been like this?
c.	What would it've been like before?- Landscape? Flora? Fauna? Climate? 20,000 yrs ago? 2my ago 200 my ago? etc?
d.	Why are there no dinosaurs now? (or any other extinct animals)
e.	In summary, does change happen? To what extent? Frequency? Reasons for change?

Previous research of Earth Education programs (Keen, 1991a) had asked pupils questions using language entirely taken from the program, yet these kinds of questions lack clarity (Patton, 1990, p.309-313) and would be unlikely to reveal pupils' pre-program conceptions. Therefore, whilst concept questions were derived from the key concept statements in the program literature (Van Matre *et* *al*, 1987), these were phrased using terms and examples which would be more meaningful to the pupils. Where concept statements could be separated into discrete elements, as with the concept of Energy Flow and Cycling, devising questions which would be truly open-ended or non-dichotomous as appropriate, clear in meaning and singular (Patton, 1990, pp.295-313) represented little difficulty. These first two concepts take a linear programming structure where each element of the program can have separate questions devoted to it. However, questions for the concepts of Interrelationships and Change were more difficult to devise as these concepts have a different structure. Questioning of individual aspects of these concepts would most likely have been confusing to the pupils so it was decided to concentrate on asking pupils to expand upon examples of the application of the concept.

It also became clear that the interview guide was rather limited for teasing out other aspects of the Conceptual Encounters which were not specifically mentioned in the essence statements in the training manual, such as Pyramids of Biomass or the particulate nature of matter. This was particularly important for identifying how learning and conceptions were differentiated for pupils of different ability. The interview guide would therefore need adapting so that pupils' conceptions of other elements of the program could be properly investigated in the next series of interviews.

7.5.2.2 Question Wording

This initial series of interviews illustrated some of the problems which can occur when conducting qualitative research (Patton, 1990, pp.295- 335).

Dichotomous questions were used at the beginning of the interview and during transition phases of the interview when the discussion shifted to a new area. These were intended to relax the participants by allowing them a simple choice of two or three responses which would then be open to elaboration. With these groups they tended not to be necessary and pupils were responsive even when the transitions were abrupt and could have been interpreted as being threatening. Consultation with the class teacher and headmaster suggested that these pupils "would not be backward incoming forward" as many had moved house several times, were used to making new friends and would not be timid in talking to a 'stranger'. Dichotomous questions can tend to program the interviewee into giving one word answers (Patton, 1990, pp.297-302) and this was noticed on a number of occasions, particularly with pupils who struggled to give accounts of their conceptions.

Clarification and probing of pupils' responses is not something that can always be planned in advance since it depends upon individual responses, although certain types of response might emerge during a series of interviews and therefore certain types of probes might become commonly useful. Probes and clarification questions were typically applied to scientific terms such as "rots" in an attempt to encourage pupils to explain their conceptions of decomposition, for example. Responses were mapped out using diagrams during the interview which enabled the researcher to allow the discussion to flow without interruption but still return to certain concepts for clarification. These diagrams also seemed to help pupils focus on the discussion and assisted in mapping it out for them. However, there may have been a tendency to impose structure upon the pupils' responses that might not have otherwise been evident. Such imposition of meaning was also evident in some of the transcripts. These impositions took two forms; questions presumed certain concepts, and they presumed the existence of logical structures such as classification. For example, the Interview Extract 15 uses questions which presume the concept of the conservation of energy.

Interview Extract 15: Pre-Program: G6280396

Int: Take Beef, why do you eat beef... (pause) ...what do you get from it?...(pause) ...why do you eat any food?

N/M: ...'cos we'd die...

Int: Why? What do you get from food that you need?

N: Oxygen

M: Vitamins

M: Proteins

N: Energy

(...)

Int: So thinking about cows, where do cows get their energy from?

N/M: Well they eat grass...

Int: ...and where does the grass get its energy from?

Whilst it may seem obvious to the adult that energy is conserved, this may not be at all obvious to the pupil. Therefore questions may have different meanings from those intended.

The first and second questions in the extract above are also a good example of how questions which presume logical structures or causal links are not always useful. The question "Why do you eat *any* food?" was attempting to elicit the pupils' conception of how animals obtain energy, yet it can have a number of responses such as "Because I like the taste (Personal Motivation reason)", "Because my mum makes it (Behaviour reason)" or "Because I feel hungry (Sensation reason)". The question was rephrased with "What do you get from food that you need?" which produced a more desirable response. This pattern of moving away from "Why" questions to other forms was continued throughout these early stages and facilitated the generation of data.

Another aspect of the use of logical structures concerns classification. Consider the following extract.

Interview Extract 16: Pre-Program: G1270396

1 K: Animals! Animals, we get our air from animals and trees get their air from animals...

2 C: Do they?

3 Int: Well we're animals aren't we?

4 A: Yeah we're mammals.

5 Int: So trees get their air from us... any other ideas?

6 K: I don't know.

7 ...

8 G: There's this little man that you buy it off.

9 A: We wish!

K's original statement (line 1) suggests that humans and animals are different from each other. Other group members were not sure about this statement but only one made a comment (line 2) . The interviewer's clarification (line 3) was confirmed but followed up with the statement on line 5 which presumes that pupils can understand that if animals get their air from trees and humans are animals then humans get their air from trees. In simpler terms, if all 'A's need 'C', and 'B' is a member of 'A', then 'B' also needs 'C'. The discussion was truncated by the interviewer's statements at this point and conflicting views evident in this transcript were not fully explored. Rather they were "corrected" by the interviewer's definition of humans as animals, followed by the statement which imposed his version of reality. After this, pupils were unwilling to explore their ideas in any depth. The tendency to begin correcting conceptions is a strong temptation for the teacher-interviewer. Sometimes the pupils themselves even encouraged the researcher to provide them with "the" answer. It also became apparent that the interviewer was giving pupils verbal clues and unconscious feedback about their answers and thus compromising his neutrality regarding their responses. Close attention to the wording and phrasing of questions and the quality of answers enabled him to move away from this rather limited form of interviewing.

Clearly these kinds of impositions of definitions and presumptions detract from the quality of the data and should be avoided, but some presuppositions are unavoidable and perhaps even useful. As Patton comments (1990, p303), natural language is filled with presuppositions; without them, making meaning from utterances would not be possible. Furthermore, making presuppositions can add to the quality of data because it circumvents more difficult or threatening issues, or in this particular case, more complex and abstract concepts. For example, critics of Piaget (Child, 1993, p168) have argued that some of his conclusions regarding cognitive functioning can be attributed to his interviewees' inability to understand the questions being asked of them. So perhaps then, there is a balance to be struck between the advantages of making suppositions and the disadvantages of imposing meaning or defining the boundaries of the interview too rigidly.

7.6 SUMMARY

Various conceptions have been tentatively identified in this section and these came out of the huge volume of interviews from the first school. They gave an indication of the meanings that pupils had regarding the concept of energy flow and food chains. The conceptions in Table 58 were derived from the meanings of the pupils in relation to Energy Flow (Food Chains). During this 'pilot' phase of the evaluation this was the concept that was generally most generative of data. These conceptions are summarised in Table 58.

Table 58: A Summary of Pre- and Post-Program Concepts of Energy Flow

Pre-Program	
•Vitalism	Food provides a number of things vital for life, i.e. Energy, Vitamins and Minerals.
•Green Plants as the 'Beginning'	Green plants form the beginning of a food chain.
•Light Independency	Green plants obtain energy from water and fertilizer which are obtained from the soil. The crucial role of sunlight in plant metabolism was absent from all conceptions.
•Food Chains	i) Associated with the BSE crisis. ii) Assumed predator-prey relationships between animals of increasing size.
•Conservation of Ills	Diseases, poisoning and other causes of death ('ills') are conserved and pass from prey to predator.
Post-Program	
•Needs of Living Things	Energy, materials, oxygen, air, food, water, shelter, warmth, specks
•Generalising From The Class 'Materials'	'Materials' is another term for matter such as air and water used by living things.
• Classification of... ... 'Living Things'	Sometimes included *all* living things, sometimes plants and sometimes animals only.
...'Plants'	All plants have leaves*ergo* grass is not a plant because it doesn't have leaves. All plants have to be planted by people who grow them from seeds *ergo* weeds aren't plants. All plants grow on the ground *ergo* moss is not a plant.
•... 'Animal'	All animals have four legs and are mammals. Insects, fish, humans and birds for example are not animals. The class 'Animals' is particularly fluid and, from the most frequent members of the class to the least includes mammals; birds and fish; reptiles and insects; humans
• Interchangeability of Terms	Plant Muncher and herbivore, animal muncher and carnivore regarded as equivalent terms. Also, some confusion with Plant Munchers being thought to be Plants which Munch.
• Examples of Food Chains	i) Quoted the example from the program. ii) Used general categories and species interchangeably. iii) All included the sun. iv) A minority referred to non-consumptive links, e.g. humans can obtain energy from foxes by hunting them, or from dogs.
• The Sun as the Sole Energy Source for Living Things.	i) The sun provides energy. Plants were the only thing that could get their energy directly from the sun- animals get their energy from their food. Animals are dependent on plants getting energy first. ii) A refinement of the above suggested that animals got energy directly from the sun to make them healthy, make their fur shiney or for warmth. This was acknowledged as being different from obtaining energy through food. iii) Animals can get energy from exercise or movement. iv) Plants get their energy from combinations of soil, water and/or the atmosphere.
• Energy Used for...	i) Living or Surviving. Further interrogation of these concepts displayed circularity. ii) Living or Surviving explained in terms of movement or animals' metabolic processes.
• Energy Dissipation	Energy gets 'thinner' or gets 'less' as it passes from the sun to the plant munchers to the animal munchers because... i) Plants need more energy than animals. ii) Energy is used up the further down the chain it goes.
• Pyramids of Numbers	i) There were more plants than animals at the centre because since animals eat plants there would need to be more plants for them to get enough energy. ii) There were more plants than animals because we found more sun munchers than plant munchers in the wood. iii) In the world there are more plant munchers and animal munchers than plants because there are so many people on the earth. iv) In the sea there would be far fewer plants than plant munchers because the water would stop the plants from getting their energy. v) There were more plant munchers than plants because there are so many people on the earth, far more than there are plants. vi) As an extension to this, there were more plant munchers than plants because there are so many people who eat plants and therefore, there must be fewer plants than animals.

The more significant issues which affected the data quality were group size and structure, for the suitability of unstructured interviewing in this context, question content, wording and phrasing. This analysis has provisionally identified some pre-program and post-program conceptions and the ways in which such conceptions are rationalised, justified and defended. It has also indicated ways in which the methods should be adjusted to provide more useful data.

One of the initial research questions was concerned with how individual pupils' understandings evolved longitudinally. It was possible to trace the development of the conceptions of Energy Flow in much detail whilst the data regarding other program aspects was less saturated. The conceptions were, partially, products of the group discussions and interactions, and whilst this was productive for theoretical saturation, it was less helpful for interpreting the development and shift of individuals' meanings. As a result, it was necessary to examine the pre-program conceptions of the pupils from the second school in smaller groups, with a semi-structured interview format, and with questions more closely tied in to the program literature.

7.7 THE URBAN SCHOOL

The main aim of this section is to illustrate the range of meanings uncovered by the evaluation and assess how these developed longitudinally, that is over a period of two years. In order that this can be communicated effectively, the following sections have been arranged so that conceptual development can most easily be evaluated.

The tables have been compiled by examining the interviews from the second school, using the groups of meanings uncovered at the first school, although these were supplemented with other meanings as they were revealed by the data.

7.7.1 ENERGY FLOW

This section analyses the meanings around the notion of energy flow and food chains in great detail, and this provides an account of the way in which these concepts were revealed. The concepts were addressed using the activity Munchline Monitors (Van Matre *et al.*, 1987). The same procedure was used for the other three concepts and these are summarised in tabular form towards the end of this chapter.

Figure 15 shows three pupils sorting out organisms into a foodchain, or munchline, using a meal tray.

Figure 15: Pupils Sorting the Contents of a Munch Bag into a Munchline

7.7.1.1 Needs of All Living Things

Pre-Program

The pre-program interviews showed that pupils regarded living things as having a wide variety of needs- indeed twenty different needs were given by the interviewees as a whole. These are given in Table 59.

Table 59: A Frequency Table for The Needs of Living Things (Pre-Program)

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	MM	MW	RT	SJ	Total
Water	X	X	X	X	X	X		X	X	X	X		X	X	X	X	14
Rain												X					1
Drink							X				X				X		3
Food	X	X	X	X	X	X		X		X	X		X	X	X	X	13
nergy									X					X		X	3
unligh	X	X	X							X	X	X	X		X		8
Sun		X		X	X												3
Light				X			X										2
Air	X	X	X					X	X	X			X				7
Oxygen														X		X	2
Home						X	X					X		X		X	5
lanet abitat		X				X		X		X			X				5
helter														X		X	2
Grass														X		X	2
Trees														X		X	2
Insects						X											1
Mates								X				X					2
arents											X						1
Life		X				X											2
iravity			X														1

Notes

i) An "X" indicates that this need was mentioned by this pupil during the interview.

ii) Needs marked in red are those which are correct in strict scientific terms.

iii) Shading/Clear rows indicate those needs which could be considered to be aspects of the same need. However this is not always reliable and should be used only as a general indication.

The table shows the meanings identified for each of the 16 pupils, shown here by initials. Strictly speaking only three of these answers are scientifically correct and these are "Water" (14), "Air" (7) and "Energy" (3). The most common replies were "Food" (13) and "Water" (14) and sunlight (8). However, if all responses which could be associated with these concepts are also included, then "Water" (18) is the most frequent, followed by "Energy" (16) and then "Food" (13). Other less common responses include "Air" or "Oxygen" (9), and "Home/Planet/Shelter" (12). Least common included needs such as "Gravity" (1), "Life" (2) and "Insects"(1). This diversity of replies reflected pupils' varying conceptions of "Needs" and of "<u>All</u> Living Things". It should be noted that caution must be exercised when examining the frequency counts given here, since it is not always clear from pupils' answers whether they associated "sunlight" with "energy", for example.

Two groups of conceptions arose from the question "What do all living things need to survive?" and whilst the difference between them is quite subtle it is a significant difference. Firstly, the answers were characterised by the degree of specificity. A Specific answer listed the needs of a specific organism, most commonly an animal. A General answer listed needs which couldn't be attributed to any specific species. A Semi-Specific answer gave a list of needs which often, but not always, began with General needs and finished with Specific needs. Secondly, answers indicated that the question had been interpreted in different ways. Some pupils had assumed that the question was concerned with the needs of *any* single living thing. Therefore the needs referred to those things of immediate necessity for an organism's maintenance of living processes. Others assumed the question was more concerned with the needs of *every* organism in its ecosystem. Therefore the needs referred to those things necessary for its immediate survival *and* for the long term survival which would include reproduction, competition etc.

The first conception demonstrated that they were rather unfamiliar as a group with the imposed classification "<u>All</u> Living Things" and found difficulty in conceptualising all living things as sharing the same basic needs. Indeed many modern biology text books define a living thing by its needs and functions therefore in a sense this question is concerned with the fundamental idea of the nature of life and what it means to be alive. Whilst all of the pupils have clear and scientifically accurate ideas about certain general needs of *all* living things, such as water, there is less compatibility between pupils conceptions and scientific ideas for other stated needs, such as food which was the second most popular response.

In summary, stated needs of living things were varied. Few of these were correct in strict terms- all pupils gave "water" (in some form) as a need but the next most common response was "food". Other generally applicable needs, such as "Air" (7) and "Energy" (3) had much fewer responses. Pupils frequently used examples of specific organisms in order to list their needs. Frequently used examples were animals such as humans, pets or animals being studied for classroom topics. Green plants were never cited as examples. Because specific examples of organisms were used pupils had difficulty in generalising the needs of living things to accommodate *all* living things, especially green plants. Nine of the pupils interpreted the question in a much wider way and the stated needs referred to the survival of species or ecosystems.

Post-Program

Post-program interviews showed much less variety in the answers that pupils gave to the question regarding the needs of all living things. Twelve different needs were given in total and are shown in Table 60.

Table 60: A Frequency Table for The Needs of Living Things (Post-Program)

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	MM	MW	RT	SJ	Total
nergy		X	X	X		X		X	X	X	X	X	X	X			11
unligh nergy							X									X	2
un			X	X	X										X		4
leat															X		1
Food	X		X	X			X								X	X	6
Water	X		X	X	X						X				X		6
Air	X		X	X	X		X				X	X			X	X	9
Mate-rials		X				X											2
Soil											X						1
Plants															X		1
Trees																X	1
Home												X					1

Notes

i) An "X" indicates that this need was mentioned by this pupil during the interview.

ii) Needs marked in red are those which are correct in strict scientific terms.

iii) Shading/Clear rows indicate those needs which could be considered to be aspects of the same need. However this is not always reliable and should be used only as a general indication.

Most common replies were "Energy" (11), "Air" (9), "Water" (6) and "Food" (6). "Energy" was referred to variously as "Sunlight", "Sun" and "Heat" with fifteen of the sixteen respondents giving it as a general need. "Heat" was mentioned alongside "Sun" so it was probably considered to be a different aspect of "Energy" from "Sun" by this one pupil. However, "Water" and "Air" had no alternative terms in stark contrast to the pre-program interviews.

The conceptions identified during the pre-program interviews had also shifted.

Pupils were giving answers which were much more generally applicable and less concerned with specific organisms or types of organisms. No pupils gave answers which were specific to one type of organism. Where Specific needs were given they tended to be given after Generalised needs, where pupils referred to examples of specific organisms as a tactic to help them to provide a complete answer. Needs which related to the perpetuation of species or ecosystems were only mentioned by one pupil.

In summary, stated needs of living things were less varied than for pre-program responses. The three most common responses were in accordance with the scientific definition, comprising "Energy", "Water" and "Air". "Food" was still given as a response for just less than half of the pupils. Only one pupil interpreted the question to refer to the needs for species/ecosystem perpetuation and immediate physiological needs.

One Year Post-Program

The one-year, post-program interviews showed that pupils regarded living things as having a similar variety of responses to the post-program responses with thirteen different responses given by the pupils as a group. These are given in Table 61.

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The one-year, post-program interviews showed that pupils regarded living things as having a similar variety of responses to the post-program responses with thirteen different responses given by the pupils as a group. These are given in Table 61.

Table 61: A Frequency Table for The Needs of Living Things (One Year)

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	MM	MW	RT	SJ	**Total**
Energy		X		-	-				-	X			-			-	**2**
Sun		X	X	-	-	X	X	X	-		X		-	X	X	-	**8**
Light	X			-	-			X	-			X	-			-	**3**
Heat				-	-			X	-	X			-		X	-	**3**
Food	X		X	-	-	X	X		-	X	X	X	-		X	-	**8**
Air	X			-	-				-	X			-	X		-	**3**
Oxyge	X			-	-	X			-				-			-	**2**
Rain		X		-	-				-				-	X		-	**2**
Water		X	X	-	-	X	X	X	-	X	X	X	-		X	-	**9**
Habita				-	-				-		X		-			-	**1**
Space				-	-				-	X			-			-	**1**
Trees		X		-	-				-				-			-	**1**
Plants		X		-	-				-				-			-	**1**

Notes

i) An "X" indicates that this need was mentioned by this pupil during the interview.

ii) Needs marked in red are those which are correct in strict scientific terms.

iii) Shading/Clear rows indicate those needs which could be considered to be aspects of the same need. However this is not always reliable and should be used only as a general indication.

Three of these answers are strictly 'correct' and comprise "Water" (9), "Air" (3) and "Energy" (2). Associated terms were again found for "Water" and "Air" when they had not occurred in the post-program interviews and if these are included then "Energy/Sun/Light/Heat" (16) is most common, followed by "Water/Rain" (11) and "Food" (8). "Air/Oxygen" (5) is less frequent than in the post-interview responses.

There was little evidence of a change in conceptions between post-program responses and one-year post-program responses. They were still concerned with generalised needs or semi-generalised needs. There was perhaps a slight increase in the number of pupils mentioning "Food" as a need from the post-program responses but one of these was qualified by the respondent who stated that "...plants get their food from the sun...". Ecosystem or species survival needs were mentioned by two pupils.

In summary, there was still less variance in the needs of living things given by pupils than in the pre-program responses. The two most common responses were still in accordance with the accepted scientific definition but "Food" again appeared as the third most frequently cited need, albeit in one case with a qualification.

Two Years Post-Program

The two-year post program interviews were conducted with a smaller number of pupils as five pupils were not available. Table 62 shows the variety of responses given by the pupils during the two-years post program interviews.

Table 62: A Frequency Table for The Needs of Living Things (Two Years)

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	MM	MW	RT	SJ	Total
Energy	X		X	X	X				-	-	X	-	-	-	X	X	**7**
Sun		X					X	X	-	-		-	-	-		X	**4**
Light	X							X	-	-	(x)	-	-	-			**3**
Heat	X								-	-		-	-	-			**1**
Food	X	X					X		-	-	X	-	-	-		X	**5**
Air	X	X				X		X	-	-		-	-	-		X	**5**
Oxyge									-	-	X	-	-	-			**1**
Trees									-	-		-	-	-		(x)	**1**
Water		X				X	X	X	-	-	X	-	-	-		X	**6**
Drink	X								-	-		-	-	-			**1**
Money									-	-		-	-	-		X	**1**

Notes

i) An "X" indicates that this need was mentioned by this pupil during the interview.

ii) Needs marked in red are those which are correct in strict scientific terms.

iii) Shading/Clear rows indicate those needs which could be considered to be aspects of the same need. However this is not always reliable and should be used only as a general indication.

iv) An "(x)" indicates that this need was qualified with reference to how it applied for certain groups of organisms.

The three most frequent responses are scientifically correct and comprise "Energy" (7), "Water" (6) and "Air" (5). Associated terms were again found for "Water" and "Air" when they had not occurred in the post-program interviews and if these are included then "Energy/Sun/Light/Heat" (15) is most common, followed by "Water/Drink" (7) and "Air/Oxygen/Trees" (7). Five responses mentioned "Food" as being a need. Three pupils qualified their statements by reference to a further piece of information which put their statement in context.

There was little evidence of changes in conceptions from the previous year's interview and nearly all of the pupils were stating Generalised needs. However one pupil stated that "Money" was a need which was set in the context of her family being unable to afford a holiday and since these interviews were conducted during the first week at school after the summer holidays, this was clearly a significant issue. It might indicate though that the pupil was still thinking in humanistic terms about needs, reasoning from the specific to the general case. Another pupil also suggested that *all* living things needed "Drinks", indicating that the pupil who could not go on holiday was not alone in her use of inductive reasoning.

In summary, there was little variance in the pupils' responses from the previous year's interviews with perhaps two exceptions which were both reverting to Semi-specific needs. Other pupils were still mentioning food as being a vital need without qualifying it, suggesting that they were also stating needs which were Semi-specific. No pupil interpreted the question as referring to ecosystem or species survival.

7.7.1.2 Overview of Conceptual Development Regarding the Needs of Living Things.

The development of concepts regarding the needs of living things is given in Table 63. Generally speaking the most significant change in the responses occurred between the pre-program and post-program interviews.

Table 63: Needs of All Living Things

Pre Program	Post Program	One Year Post	Two Years Post
Need Specificity			
"Needs "were... **Specific** •Needs were listed by pupils as they related to specific species, or types of species (eg. Humans, Black Widow Spiders) JD, MC, SJ, MW •A variation of this was that needs were related to specific topic areas. CJ.	**Specific** •Needs no longer applied specifically and exclusively to species.	**Specific** •Needs no longer applied specifically and exclusively to species.	**Specific** •"All living things" was restricted to the needs of humans by one.
Semi -Specific •A state between Specific and Generalised needs. RT, KH,	**Semi-Specific** •Much less prevalent. Where general needs were given first followed by specific needs	**Semi-Specific** •Mixture between general needs and specific needs, in this case humans or animals.	**Semi-Specific** •Mixture between General Needs and Specific Needs.
Generalised •Needs generally applicable to any species. ID.	**Generalised** •Needs generally applicable to any species.	**Generalised** •Needs generally applicable to any species.	**Generalised** •Needs generally applicable to any species. •Qualifiers used with needs. e.g. "Energy which comes from the sun via our food"
Interpretation of "All Living Things"			
Short Term Survival •"All Living Things" interpreted as meaning *any* single living thing.	"All living things" almost exclusively interpreted as any single living thing.	"All living things" almost exclusively interpreted as any single living thing.	"All living things" exclusively interpreted as any single living thing..
Long Term Species/Ecosystem Perpetuation •"All Living Things" interpreted as meaning *every* single living thing. KH	**Long Term Species/Ecosystem Perpetuation** •Some evidence (mentioned by one pupil but mixed with Short Term Survival Needs.)	**Long Term Species/Ecosystem Perpetuation** •Some evidence (mentioned by two pupils but mixed with Short Term Survival Needs.)	**Long Term Species/Ecosystem Perpetuation** • No evidence
Notes The categories Specific, Semi Specific and Generalised form a continuum rather than three discrete categories. Whilst some pupils were locked into stating needs which were related to a specific species (MC) or an ecosystem (KH) others combined these with more generalised needs.			

This table may be scrutinised alongside some extracts of supporting data for one pupil to illustrate how these ideas were generated from the interview texts. This is given in Interview Extract 17. The table shows the way in which 'All living things" is interpreted along with the way in which these needs are fulfilled (Energy Sources).

Interview Extract 17: Longitudinal Development of Understandings of Energy Flow- Needs of All Living Things and Energy Sources

AM				
Stage	PRE-PROGRAM	POST-PROGRAM	ONE YEAR	TWO YEARS Mostly inaudible and frustrating.
Reference	RAC20596	AM300596	AM200897	AM180698 AM190698
Energy Flow	**Needs of Living Things** DM: So, what do living things need? A: Food. C: Sunlight. A: Air. R: Fish don't need air. A: Yes they do. They get it from the water.... it's partly air. They breathe it from the water. They take it out the water ... From hydrogen molecules to oxygen molecules. DM: So they take out the oxygen do they? A: Yeah. DM: And then leave the hydrogen? C: Yeah. DM: Right. Okay. What else do living things need? R: Drinks. R: Water. C: Clean air, or mostly clean air. Unpolluted air. DM: Right. What else? C: Gravity. R: They don't really need .... C: .... you do if you go into space. A: Yeah. I don't think the birds like gravity very much. C: No.	**Needs of Living Things** DM: What do all living things need? A: Air, water and food. DM: Anything else? Or is that it? A: I think that's mainly three things. DM: Okay. Why do they need food? A: For energy and vitamins. DM: For energy and for vitamins. Just vitamins or other things as well? A: {LONG PAUSE} Minerals. DM: Is there a broader name for all these things, that you can think of? A: Not really.	**Needs of Living Things** DM: What do you all living things need? A: Air, oxygen, I think it's oxygen or air. DM: Oxygen or air, are they the same thing? A: Well, yeah, aye oxygen is the one that we all really need. DM: Does that include trees as well, 'cos they're living aren't they? A: Aye. ... DM: .... okay. Air, right, okay we've got air then, what else? A: Food., Light. ... ...That's it.	**Needs of Living Things** DM: What do all living things need? AM. Light... air, food and drink... (...)...heat... that's it.. DM: Why do living things need food? AM: Get their energy... DM. So plants get their energy from food? AM: ...to grow... DM: So how do plants 'eat' food? AM: Take up nutrients from the soil... it gives them energy. DM: Why do they need light? AM. I suppose they don't... (...) DM: What about plants? AM: To grow... it gives energy... to absorb it and.. it gives them energy.

Summary

The Pre-Program responses...

• were varied.

• considered instances of phenomena connected with needs such as "Rain" or "Drink" instead of "Water" specific to species or groups of species. These were often combined with responses describing general needs which were applicable to any living thing. Semi-specific lists of needs used a mixture of both. Specific and semi-specific lists of needs were an attempt to use inductive reasoning to answer the question.

• placed different interpretations on the meaning of the question.

Post-program interviews showed...

• All pupils, with one exception, gave "Energy" as a need

• much less variation in the listed needs

• a greater tendency to list needs which were generalisable to all living things, although "food" was still considered important by just under a third

• a lesser tendency to interpret the question as a reference to the needs of species' survival or ecosystem perpetuation.

Interviews conducted up to two years after the program showed that this development was a permanent change although there was a tendency for some pupils to revert back to citing highly specific needs although these were always in combination with generalisable needs. The emphasis on "Energy", and associated phenomena such as sunlight, was also maintained throughout the research period.

7.7.1.3 Energy Sources

The extracts in Interview Extract 17 above relate to Energy Sources as these questions followed on naturally from the meanings associated with the notion of what all living things need.

Pre-Program

Pre-program interviews revealed that plants were thought to obtain energy from the sun (energy taking the form of "Sun" in general, "light" and/or "heat"), combined with up to four other sources, composed of "water", "food", "soil" and "fertilizer". However, one pupil suggested that only "some" plants need sunlight, another that plants got their energy from water with the sun not being mentioned, and another that plants received energy from the soil after the soil had received energy from the sun.

Animals were almost universally thought of as getting energy from their food but a smaller group qualified this by adding that this energy actually came from the sun *via* their food. "Food" was identified as being other "animals" or "plants". One pupil tentatively suggested that some animals might be able to get energy from the air. Some pupils suggested that animals obtained energy from the sun. Further investigation showed that this was not considered to be the same mechanism whereby plants obtained energy from the sun however as animals used the sun for "heat", "warmth" and "solar power". But this difference between plants and animals was never explained in scientifically accurate terms[18]. Explanations given for the inability of animals to use the sun's energy "directly" referred to the sunlight being completely absent or too weak for animals to use it, - in theory if birds could fly high enough they *would* be able to use the sun's energy but the thinner air prevents them from flying that high. This *intensity* hypothesis was mentioned in a slightly different form by another pupil who suggested that some animals could not get their energy from the sun because they were nocturnal. Other isolated examples of animals' energy sources include statements which suggest that "very small" insects can obtain energy from the sun and that "Cats get their energy from dogs because they chase them". The first statement hints that size of creature might be considered to be an important factor and the second that energy is associated with movement.

Post-Program

Post-program interviews revealed less diversity. Indeed the answers were almost uniform in that "Energy" was considered as coming from the sun, to plants and on to animals. The majority stated that plants were the only things that could get energy from the sun and that animals had to get their energy from their food. One pupil said that he thought animals could get energy directly from the sun but was unable to explain how this occurred. Later on in the interview this statement was contradicted and he suggested that animals obtained energy from their food. The general statement that "*all* energy comes from the sun" was made by half of the pupils.

One Year Post-Program

In general, there was little change between these interviews and the previous year's. The most striking change was probably that some of the explanations offered have become more refined or sophisticated; *e.g.* pupils talk of animals being unable to "absorb" energy in the same way that plants can. Furthermore metaphors are used in the interviews to describe the concepts for the first time; *e.g.* food is referred to as being like a "fuel". The general statement that "all energy comes from the sun" is still evident in a small number of pupils, although

[18] *i.e.* that green plants, as producers, were the only organism that could use sunlight energy in order to make organic molecules from inorganic molecules by the process of photosynthesis.

other pupils' statements tended to imply this.

Two Years Post-Program

Similar to the previous year's interviews there was once again a slight development in the sophistication with which pupils justified their answers with a number of them referring to photosynthesis, although this was never explained in detail. A number of pupils also began to state that plants obtained energy from the soil as well as from the sun in the form of nutrients. This is in some respects a reversion to the statements mentioned in the pre-program interviews. The main source for energy was still given as "the sun" for at least half of the pupils.

7.7.1.4 Overview of Conceptual Development Regarding Energy Sources.

The preceding sections have shown how the analysis was conducted in fine detail for each stage of the evaluation, specifically, pre-program, post program, one year and two years. The following sections summarise this development using tables and figures.

The development of concepts regarding Energy Sources is given in Table 64. The most obvious change in responses occurred between the pre-program and post-program interviews. Pre-program responses were more varied than post-program. Food in some form was considered to be an energy source both for plants and animals. Plants were considered to get their energy from the sun and other sources such as soil and water. Some pupils considered that plants did not get energy from the sun. "Food" appeared to be a term very closely associated with "energy".

Post-program responses illustrated near uniformity in the responses. The sun had assumed universal importance as being the sole energy source for both plants and animals. Animals were regarded as being able to get energy only from food, which had obtained its energy from the sun (apart from one pupil who seemed to suggest that animals could get energy from the sun but contradicted himself with other statements).

One Year Post responses demonstrated a sophistication in responses with pupils offering explanations for the differences between plants and animals use of the sun's energy, although these were not related to detailed descriptions of photosynthesis. Two Year Post responses demonstrated a further development of concepts, this time with specific mention of photosynthesis for two pupils. However, whilst the majority of the concepts had remained in place, or become more sophisticated, a number of pupils now regarded that plants obtained energy from the soil thereby, in one sense, reverting back to pre-program conceptions.

Table 64: Energy Sources

Pre-Program	Post-Program	One Year Post	Two Years Post
General Energy Origin			
• Energy Origin tends to depend upon the organism type. Plants obtain it typically from a variety of sources (see below); animals from food (see below)	**Solar Source** • All Energy comes from the Sun	**Solar Source** • All Energy comes from the Sun	**Solar Source** • All Energy comes from the Sun.
Plants- Sun Dependence			
Dependent • Plants obtained energy from the sun and nowhere else.	**Dependent** • Plants obtained energy from the sun and nowhere else. • Plants are the only thing that can get energy from the sun directly. • Plants "feed off" light.	**Dependent** • Plants obtained energy from the sun and nowhere else. • Plants are the only thing that can get energy from the sun directly.	**Dependent** • Plants obtained energy from the sun and nowhere else. • Plants are the only thing that can get energy from the sun directly. •Plants use Photosynthesis to get energy.
Partially Dependent • Plants obtained energy from the Sun and from other sources such as Water, Soil, Fertilizer and Food.	No other energy sources given	**(Partially Dependent** • Plants obtain energy from the Sun but in order to do this they also need Water and Air.)	**Partially Dependent** • Plants obtained energy from the Sun *and* from other sources particularly the Soil and the Rain
Independent • Some plants obtain energy from water, soil, or sources other than the sun.	No other energy sources given	No other energy sources given	No other energy sources given
Animals' Energy Sources			
Food Dependent • Animals obtained energy from food. • Animals obtained energy from food which had originally come from the sun.	**Food Dependent** • Animals obtained energy from food. • Animals obtained energy from food which had originally come from the sun.	**Food Dependent** • Animals obtained energy from food. • Animals obtained energy from food which had originally come from the sun. • Food compared with a "fuel"	**Food Dependent** • Animals obtained energy from food. • Animals obtained energy from food which had originally come from the sun.
Animals use of the Sun • Energy provides warmth or heat. • Size- Very small insects *can* get energy from the sun. • Intensity- Sunlight is not intense enough to provide energy for animals.	**Animals use of the Sun** • Animals obtained energy from the sun.	**Animals use of the Sun** • Energy provides warmth or heat. • Animals cannot absorb energy from the sun in the same way that plants do.	**Animals use of the Sun** • Energy provides warmth or heat. • Animals cannot get energy from the sun. •Animals cannot Photosynthesise.
Other Sources Animals obtained energy from... • the Air. • movement.	No other energy sources given		

7.7.1.5 Energy Uses

Figure 16 and Table 65 show how pupils' suggestions for the ways in which energy is used, changed throughout the research period. Throughout the two year period, a proportion of pupils gave a general answer which related to some aspect of "vitalism" suggesting that living things needed energy in order for them to stay alive, a nice example of circular reasoning. This type of explanation did not tend to become more sophisticated through the stages, but progressively decreased in frequency, and was perhaps replaced with other explanations for energy use such as Reproduction, Growth and Movement. The frequency of other energy uses varied in an inconsistent manner throughout the period. The Table and Figure do not appear to suggest any major impact due to the program as the changes between stages appear to be progressive over the research period.

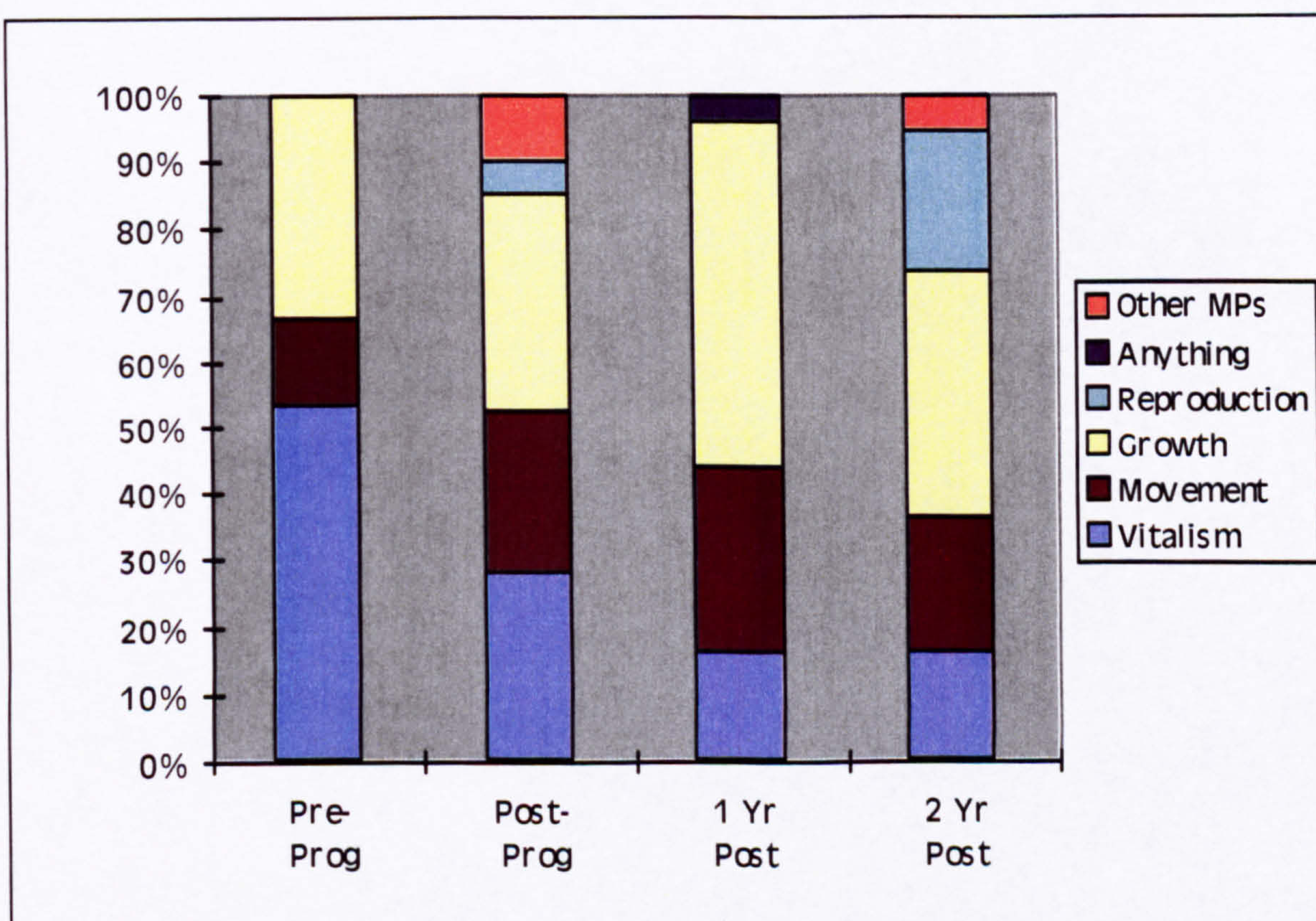

Figure 16: A Graph to Show the Change in Energy Use

Table 65: Energy Uses

Pre Program	Post Program	One Year Post	Two Years Post
Energy Uses			
Energy is used for... • Vitalism, i.e. Staying Alive, Surviving, Staying Healthy (8) • Movement (2) • Growth (5)	**Energy is used for...** • Vitalism, i.e. Staying Alive, Surviving, Staying Healthy (11) • Movement, escape predation, prey on animals and just "move". (10) • Growth, making organism "stronger". (13) • Reproduction (2) • Other Metabolic Processes, Organ function. (4)	**Energy is used for...** • Vitalism, i.e. Staying Alive, Staying Healthy (4) • Movement (7) • Growth, making organism "stronger", photosynthesis (13) • Anything (Metabolic Processes). (1)	**Energy is used for...** • Vitalism, i.e. makes you lively, Staying Healthy, Life (3) • Movement, eating. (4) • Growth, making organism "stronger". (7) • Reproduction (4) • Other Metabolic Processes, Sleeping. (1) • Sterilization of medical equipment (1)[ii]
Notes i) Numbers in parentheses refer to the numbers of statements which were of this type of response. ii) This response has not been included on the graph due to its unique appearance during the four stages.			

7.7.1.6 Energy Paths

The structure of pupils' food chains has been given in Table 66 to Table 70. These have been given in somewhat more detail as this concept was regarded as being central to the program.

Due to previous instruction these were already capable of being discussed prior to the program. Responses show though that the sun was by no means regarded as the sole source of energy for the food chain. Four of the pupils gave the sun as the only source but the rest suggested that the energy came from a combination of sources. Two of these latter pupils were perhaps interpreting the words "came from" in a slightly different way from the interviewer; whilst the energy for a food chain is received from the light of the sun, plants would not be able to make use of it without water, carbon dioxide and metabolic nutrients. However, two pupils also regarded the soil as being of prime importance for plants obtaining energy. In these cases the soil received its energy from the sun. Most common was the notion that energy could come from a variety of sources which may include the sun, **and** some other source such as "plankton", "dog droppings" or "molecules" for example. These suggestions were combined for two pupils who did not consider the sun as being associated with food chains.

Table 66: Pre-program Food Chains

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	MM	MW	RT	SJ
1) Exclusive Dependency	X	X	X												X	
2a) Combin-ation I				X						X						
2b) Combin-ation II					X						X					
2c) Alternatives						X	X	X	X			X	X			
3) Exclusive Independency														X		X

Notes

1) Exclusive Dependence- Food chains begin with the sun exclusively.

2a) Combination I- All food chains given begin with a combination of the sun and other things such as water and/or soil.

2b) Combination II- Food chains begin with the sun but energy is stored in the soil before being used by a plant

2c) Alternatives- Different food chains are given which either start with the sun (sometimes with soil and/or water), or with "plants", "dog droppings", "yuckie stuff", "molecules" or "Plankton" as the source of energy.

3) Exclusive Independence- Food chains are never associated with the sun but with other things such as soil or water.

The results in Table 67 are consistent with the findings for Energy Sources where no pupil gave sources other than the sun for energy.

Table 67: Post-program Food Chains

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	M M	M W	RT	SJ
1) Exclusive Dependency	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2a) Combin-ation I																
2b) Combin-ation II																
2c) Alternatives																
3) Exclusive Independency																

Notes

1) Exclusive Dependence- Food chains begin with the sun exclusively.

2a) Combination I- All food chains given begin with a combination of the sun and other things such as water and/or soil.

2b) Combination II- Food chains begin with the sun but energy is stored in the soil before being used by a plant

2c) Alternatives- Different food chains are given which either start with the sun (sometimes with soil and/or water), or with "plants", "dog droppings", "yuckie stuff", "molecules" or "Plankton" as the source of energy.

3) Exclusive Independence- Food chains are never associated with the sun but with other things such as soil or water.

Table 68: One Year Post-program Food Chains

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	M M	M W	RT	SJ
1) Exclusive Dependency	X	X	X		-	X	X	X	-	X	X	X	-		X	X
2a) Combin-ation I					-				-				-			
2b) Combin-ation II					-				-				-			
2c) Alternatives				X	-				-				-			
3) Exclusive Independency					-				-				-	X		

Notes

1) Exclusive Dependence- Food chains begin with the sun exclusively.

2a) Combination I- All food chains given begin with a combination of the sun and other things such as water and/or soil.

2b) Combination II- Food chains begin with the sun but energy is stored in the soil before being used by a plant

2c) Alternatives- Different food chains are given which either start with the sun (sometimes with soil and/or water), or with "plants", "dog droppings", "yuckie stuff", "molecules" or "Plankton" as the source of energy.

3) Exclusive Independence- Food chains are never associated with the sun but with other things such as soil or water.

Table 69: Two Years Post-program Food Chains

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	M M	M W	RT	SJ
1) Exclusive Dependency		X			X		X	X	-	-	X	-	-	-	X	X
2a) Combin-ation I	X			X		X			-	-		-	-	-		
2b) Combin-ation II			X						-	-		-	-	-		
2c) Alternatives									-	-		-	-	-		
3) Exclusive Independency									-	-		-	-	-		

Notes

1) Exclusive Dependence- Food chains begin with the sun exclusively.

2a) Combination I- All food chains given begin with a combination of the sun and other things such as water and/or soil.

2b) Combination II- Food chains begin with the sun but energy is stored in the soil before being used by a plant

2c) Alternatives- Different food chains are given which either start with the sun (sometimes with soil and/or water), or with "plants", "dog droppings", "yuckie stuff", "molecules" or "Plankton" as the source of energy.

3) Exclusive Independence- Food chains are never associated with the sun but with other things such as soil or water.

The tables above illustrate that the way in which food chains are interpreted changes over time. Initially there is a variety of interpretations and the sun is regarded by some as having a role. After the program, all pupils stated that the energy had to come from the sun *and nowhere else*. These interpretations then became less uniform at the one year and two year stages. There is also indication that one pupil (MW) reverted back to the initial understanding uncovered by the pre-program interviews.

7.7.1.7 Energy Dissipation

Pre-program

No pupils gave an indication that they understood that energy in general was decreasing in availability as it moved down the food chain. Whilst many could describe ways in which it was "used" there was no suggestion that it was "used up" and became unavailable or "lost" from the system.

Post-Program, One Year and Two Year Responses

The responses after the program were different however and these have been summarised in Table 70 to Table 72.

Table 70: Post-program Concepts of Energy "Loss"

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	MM	MW	RT	SJ
1) Energy Loss		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2) Loss through use		X		X	X	X	X			X	X	X	X		X	X
3) Incomplete consumption								X								

Notes

1) Energy Loss — Energy is "lost" from the food chain or gets weaker.

2) Loss through use — Energy gets "lost" because it is "used up", "sucked up" or "drained"

3) Incomplete consumption — Energy gets "lost" through incomplete consumption.

Table 71: One Year Post-program Concepts of Energy "Loss"

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	M M	M W	RT	SJ
1) Energy Loss	X	X	X	X	-	X	X	X	-	X	X	X	-		X	X
2) Loss through use	X	X		X	-			X	-			X	-		X	
3) Incomplete consumption		X	X		-	X		X	-	X	X		-			X
4) Waste				X	-				-		X		-			
					-				-				-			

Notes

1) Energy Loss	Energy is "lost" from the food chain or gets weaker.
2) Loss through use	Energy gets "lost" because it is "used up" through metabolic processes, growing, moving etc (see xxxx)
3) Incomplete consumption	Energy gets "lost" through incomplete consumption.
4) Waste	Energy is "lost" through disposal of waste products

Table 72: Two Years Post-program Concepts of Energy "Loss"

	AM	AX	CJ	CM	ID	JD	KC	KH	LC	LM	MB	MC	M M	M W	RT	SJ
1) Energy Loss	X	X		X	X	X		X			X				X	X
2) Loss through use	X			X	X	X					X				X	X
3) Incomplete consumption								X								X
4) Waste		X						X								
5) Other				X											X	
6) Heat				X	X											

Notes

1) Energy Loss	Energy is "lost" from the food chain or gets weaker.
2) Loss through use	Energy gets "lost" because it is "used up" through metabolic processes, growing, moving etc (see xxxx)
3) Incomplete consumption	Energy gets "lost" through incomplete consumption.
4) Waste	Energy is "lost" through disposal of waste products
5) Other	Energy is "lost" through "other ways" or "other stuff"
6) Heat	Energy is "lost" through heat.

The interpretations of 'energy loss' are universally accurate at the post-program stage, all being able to describe how energy is lost from the system. Most pupils are able to describe how this might happen. As the schooling progresses, and the pupils mature, these meanings are capable of being explored in more depth. What is perhaps most telling is that the basic idea that energy is lost is retained throughout the period by all participants, even though the meaning of this could not be explained by ideas other than Incomplete Consumption for a small minority. For example see Table 72 for the responses of AX and KH.

7.7.1.8 Ecological Pyramids

Pre-program

Questions regarding ecological pyramids were not asked during this stage of the research because they were not considered to be particularly important. Furthermore, the activity's concept description does not explicitly refer to this part of the concept. However, after the first round of interviewing it was considered necessary to try and discover the full extent of their understanding and to see whether their ideas about ecological pyramids bore any relation to the subject matter of the activity. Hence questions were asked during the later stages of interviews which probed deeper than the concept descriptions initially suggested would be important. These have been given in Table 73.

Table 73: Conceptions of Ecological Pyramids

Post Program	One Year Post	Two Years Post
Relationship between Numbers and Weights of P, H and C.		
•In Activity Area P>H>C (number comparison) ...From primary empirical data (Signs of Munching) (9) •In World in General P>H>C (9) (number comparison) ...From general observation (4) ...Because energy is used up (6) ...Because of plants' reproductive vigour (1) ...Because of feeding relationships requirements(1) ...Because energy more readily available to Plants (2) ...Unexplained (1)	•In World in General P>H>C (5) (number comparison) ...From general observation- number of species (3) ...Because of feeding relationships (1) ...Because energy is used up (3) ...Because of hardiness of plants (1) •In World in General P>H but C>H (number comparison) ...From general observation (4) (Because of large numbers of people) ...Because energy more readily available to Plants (1) ... and C=H because of observation (1) •In World in General P=H=C (number comparison) ...Because things would generally balance (3) •In World in General H>C>P (biomass comparison) ...From general observation- Because herbivores tend to be large animals (1)	In World in General P>H>C (number and biomass comparison) ...Because less energy is available (3) •In World in General P=H=C (number comparison) ...Because things would generally balance (1) •In World P>{H&C} (number comparison) ...From observation (1) ...Vigour of plants (1) •In World C>P>H (biomass comparison) ...From observation of numbers of people and sizes of animals(1) •In World C>H>P (biomass comparison) ...From observation- numbers of people and sizes of animals(1) ...Survival of the fittest (2) •In World C>H and C>P (biomass comparison) ...From observation- numbers of people and sizes of animals and because of deforestation but this situation is unsustainable(1) ...Survival of the fittest (2)
Justification of Stated Relationships		
Primary Empirical Data (9) General Observation (4) Reference to theoretical explanation ...involving Energy Dissipation (6) ...involving Feeding Relationships (1) ...involving Plants' specialisms (3) Unexplained (1)	Primary Empirical Data (0) General Observation (9) Reference to theoretical explanation ... Energy Dissipation (3) ... Feeding Relationships (1) ... Plants' specialisms (2) ... Balance of nature (3) Unexplained (0)	Primary Empirical Data (0) General Observation (4) Reference to theoretical explanation ... Energy Dissipation (3) ... Feeding Relationships (2) ... Plants' specialisms (1) ... Balance of nature (1) ...Survival of Fittest (2)
Notes		
i) Numbers in parentheses refer to the numbers of statements which were of this type of response.		

These data have been illustrated in the following graph (Figure 17).

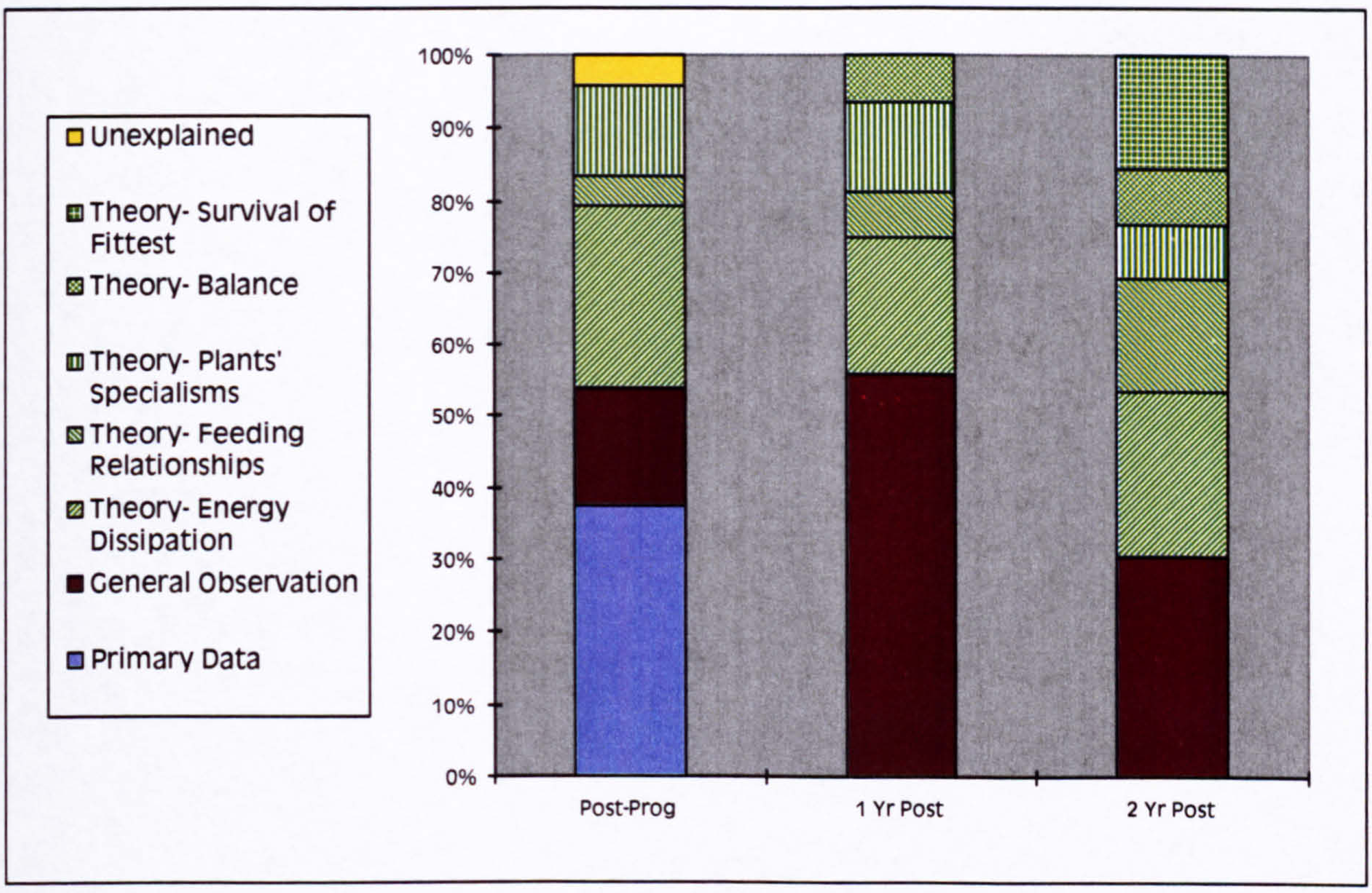

Figure 17: Pupils' Explanations of Shape of "Pyramids" of Biomass and Numbers

The graph and table above show that this difficult concept was evident up to a two years after the program in a large minority of the pupils' interpretations. The reference to primary data disappears after the initial post-program interview, and general observations take over. Furthermore, justifications relating to theory as opposed to experience, become more prevalent.

7.7.1.9 Energy Flow: Summary

The Earthkeepers program seems to have had a major effect on the pupils' conceptions of energy flow in general and food chains in particular. Post-program interviews have shown consistent changes from pre-program interviews and some of these changes have remained for a period of two years after the program.

Conceptual Change

In the majority of cases the most significant change occurred between the pre- and post-program interviews although further but less significant changes were apparent in one-year and two-year post program interviews. The major changes were not merely focused on instilling examples of food chains but were connected with the concepts noted in Table 74.

Table 74: Concepts affected by Munchline Monitors

• Definition of "living things"
• Needs of living things
• Feeding relationships between specific organisms
• Sources of energy, differences between plants and animals
• Energy Pathways and how it is used to perform specific types of work
• Laws of thermodynamics as applied to feeding relationships between trophic levels
• Laws of thermodynamics as applied to ecosystems and the ecosphere as a whole

A similar analysis was performed on the other three main ecological concepts, that is cycling, interrelationships and change. These results have been summarised in the tables and discussions that follow.

7.7.2 ECOLOGICAL CYCLES: SUMMARY

The activity that addressed this group of concepts was The Great Spec-tackle (Van Matre *et al.*, 1987). Figure 18 shows two pupils examining one stage in the water cycle for a water 'speck'.

Figure 18: Pupils Following a Water Speck around the Water Cycle

Concepts affected by The Great Spectackle are given in Table 75.

Table 75: Long Term Conceptual Development Regarding Cycles

Concept	Number of Pupils
The particulate nature of Matter.	Some
Conservation of matter applied to interactions in an ecosystem.	All
Conservation of matter though history and pre-history	All

Table 75 shows that scientifically accurate meanings have been retained by a large proportion of the participants in the Earthkeepers program. The precise numbers that retained, or held these meanings can be deduced from the next table (Table 76), although such a figure would probably mean very little; the categories outlined in the table above are not clearly demarcated. The development of concepts over the span of the research project is summarised in Table 76.

Table 76: A Summary of Pre, Post and Long Term Conceptions of Ecological Cycles

Conceptions	Pre-Program	Post Program	Long Term
Nature of Matter			
...Continuous	2		
...Continuous and Particulate	12	9	5
...Particulate	2	6	5
Interpretation of "Made from"			
"...begins with..."	2		
"...made by..."	13	1	1
"...made up of..."	8	15	14
Shape			
Dots/balls/specks	5	16	
Bacteria	1	5	2
Specks equivalent to molecules/atoms		16	13
Specks different from atoms/molecules			1
Persistence of Specks			
Antecedence	7	16	11
Life	6	3	3
Conserved (Re-Used)		12	10
Non-conserved (Used-up)	3		3
Unknown	3		1
Matter Conservation CONTEXT- ROTTING			
Disappearance by Vanishing	13	1	3
Disappearance by Encorporation	7	9	5
Disappearance by Incineration	1		
Disappearance by Disintegration	1	13	9
Famous Specks			
General Principle Accepted		14	13
Confused		2	1
General Principle Refuted			
Contextual Acceptance/Rejection			4

After the program and in the long term interviews, all pupils regarded matter as containing particles which had existed since creation and these were re-used. Some pupils were able to give examples of how this occurred, using water, soil and air cycles. Others were only able to talk about cycling in general terms. The ability to give specific examples decreased in the long term although the basic ideas were still present two years after the program. Certainly one permanent and significant change which occurred as a result of the program was the ability of all pupils to think of matter on a smaller scale, as consisting of something else. There was also evidence that pupils were able to apply this learning by using it to explain other phenomena.

Whilst there was an obvious change in concepts between pre- and post-program stages there was also some significant change between Post-Program and Long Term conceptions. This involved both a refinement of concepts which had been established at the Post-program stage, and also a reversion to some of the ideas held at the Pre-program stage, although the latter case was infrequent. Most pupils generally thought that matter had both continuous and particulate properties and this conception was hardly affected by the program.

In the long term, the conceptions regarding famous specks were heavily context dependant indicating that the air cycle, the water cycle and the soil cycle were not equally easy to conceptualise. There was no agreement as to which cycles were easiest to understand; this depended on individual experience.

7.7.3 INTERRELATIONSHIPS: SUMMARY

This concept was addressed using the activity Connection Inspection (Van Matre *et al.*, 1987). Figure 19 shows two pupils role-playing a plant and an animal and connecting themselves together to illustrate how they depend upon each other for air.

Figure 19: A Pupil Role Playing an Animal Connecting Himself to a Plant

Concepts affected by Connection Inspection are given in Table 77.

Table 77: Long Term Conceptual Development Regarding Interrelationships

Concept	Number of Pupils
General connections exist between all living and non living things in an ecosystem.	All
Significant connections refer to need satisfaction rather than mere similarity.	All
Relationships between organisms forms a web structure rather than a simple three or four-step chain.	Most
Connections can be traced to several organisms in a web.	Most
Connections involved links by energy *and* materials.	Most

The development of concepts over the span of the research project is summarised in Table 78.

Table 78: A Summary of Pre, Post and Long Term Conceptions of Ecological Connections

Conceptions	Pre-Program	Post-Program	Long Term
Connections			
Null Responses	4	4	6
Contextually Connected		3	2
"Total" Understanding		11	3
Non-Specific Connections		12	6
Connection by Energy		1	4
Connection by Proximity	9	8	2
Connection by Extended Proximity	2	3	5
Connection by Associative Similarities...			
...In Type		1	
... In Origin	7		
... In Composition	2	1	1
... In Needs	8	5	3
Interdependence			
...Air Supply	14	14	8
...Food or Water Supply.	16	16	13
...Behavioural Dependence (shelter/Support/Flocking/Succour	6	9	4
...Limited Interdependence	3		

All pupils were able to state that "all living things were connected" though about half could not give examples of this statement in the Long Term interviews. There were some significant and long term effects on conceptions which seem to have been a result of the Earthkeepers program although the impact was hard to assess due to prior instruction. Some concepts were deeply affected between pre-program and post-program stages and some of these remained for the long term. There was a certain degree of attenuation of many of the more advanced concepts as time passed. Pupils tended to provide alternative accounts to the catastrophic affect of the weed killer on the food web. This was usually dismissed with an explanation which related to the size of the food web and therefore the alternative food and air sources available to animals, for example. In the long term interviews, pupils were generally unable to perceive links beyond one or two steps, especially where links did not involve some form of consumption. The role of *every* green plant in the carbon cycle was not well explained; pupils concentrated on Trees as air producers.

7.7.4 ECOLOGICAL CHANGE: SUMMARY

The activity that addressed these concepts was Time Capsules (Van Matre *et al.*, 1987). Figure 20 shows two pupils locating and uncovering a time capsule that had been partially buried in the grounds of the centre, using a 'secret map'.

Figure 20: Pupils Locating and Retrieving a Time Capsule

Once the time capsules had been located, they were returned to the classroom where the contents from each box, representing a different geological time period, were arranged on shelves to illustrate how these layers were built up over time.

Figure 21: Time Capsule Contents Arranged on a Book Shelf with a Model of the Outdoor Centre on Top

Concepts affected by Time Capsules are given in Table 79.

Table 79: Long Term Conceptual Development Regarding Ecological Change

Concept	Number of Pupils
The effect of humanity on the appearance of the world becomes less important than natural or random development.	All
The origin of the world viewed more from the scientific perspective than the religious.	Most
Concepts of Evolution moved away from Lamarckianism.	Most
Change thought of more in terms of progressive long term change as opposed to cyclical, diurnal or seasonal change.	Most
Ability to view the past in chronological terms, rather than archaic.	All

A summary of the changes in concepts is given in Table 80.

Table 80: A Summary of Pre, Post and Long Term Conceptions of Ecological Change

	Pre-Program	Post-Program	Long Term
Conceptualising History			
...Chronological	14	16	16
...Archaic	2		
Origin of the World			
...Big Bang	7	9	11
...God as Creative Agent	5	1	1
...Humanity as Creative Agent	6	3	
...Other	5		
...Multiple	2		2
Evolution			
...Darwinian	2	2	3
...Combination of Darwinian and Lamarckian	4	10	4
...Lamarckian	8	1	2
..."Niave" Views(i)		1	6
...Alternative Views	3		3
...Unexplained		2	1
Change			
...Landscape	12	14	13
...Flora and Fauna	16	16	13
...Climate	13	13	11
...Infrastructure	10	2	1
...Society	5		
...General /unexplained	9	2	1

There is little apparent change between these three stages because of the level of knowledge which the pupils were starting with. However for the minority of pupils who were unable to conceptualise the past in any chronological sense, this activity was effective in helping them to gain a basic understanding. Initial ideas often considered the past only in human terms. Within this conception humans make the world as it is today, they build things, perhaps even build Nature herself. This conception was rare but was sufficiently different from other ideas to warrant attention. It was evident in a small number of pupils prior to the program but had disappeared permanently afterwards. If the basic understanding aimed at is merely that things have changed over time and these changes occur in landscape, climate and eco-sphere there was little change from before the program. However what change there was, was long term. The program had a long term effect on pupils' explanations of the beginning of the world. These explanations changed from relying on various explanations from the religious to the scientific during the pre-program phase, to explanations which mostly referred to scientific ideas.

Pupils struggled with certain ideas of change. Thus changes in landscape were harder to conceptualise than changes in flora or fauna, or climate. As a result several pupils thought the changes described by this activity were concerned with Ardroy only and did not apply to their school's location. Alternative explanatory theories of landscape change involved the conception that the earth begins as being flat and low, and as layers are built upon it progressively by the passage of time, or by the encroaching high tide, the landscape is changed by being raised. This, along with reference to volcanic activity, was the only explanatory mechanism which pupils used to describe how the landscape may have changed.

7.8 SUMMARY

This chapter has shown how understandings of four ecological concepts has evolved for pupils who participated in the Earthkeepesr program. It has shown that some of these ideas are retained for the whole period of the evaluation. It also showed how understandings vary according to the activity. That is, some understandings were better developed than others.

The chapter has emphasised the importance of context for pupils' meanings. Context has an influence in many different ways not least the effect of social and cultural belief systems, the effect of interactions between individuals, and the interactions between the interviewer and interviewees.

The chapter has also discussed some important methodological and methods issues that had an impact upon the emergent research design, as the methods used at the end of the evaluation process were different from those employed at the beginning.

A huge volume of data was collected and it was necessary to be selective in order to make the evaluation manageable, both in terms of the amount of data that has been included in this chapter, and the aspects of the program that were investigated in greater depth. The data selected for analysis focused on awareness from the perspective of interpreting the understandings of the pupils. Nevertheless, a broader examination of how emotions and feelings might contribute to the program evaluation would also be valuable. A small amount of data was collected for this purpose and this has been left to the discussion where it can be addressed in context.

8 DISCUSSION

This chapter begins by providing an overview of the conceptual development noted in the data and analysis. It moves on to a discussion of the main outcomes that relate to higher order thinking skills. This section answers the criticisms made of Earth Education described in the literature review.

The focus on understandings and meanings is maintained here, but there is some discussion of the effect of 'feelings' activities in general and specifically. The ability of Earthkeepers to produce epiphanic experiences is discussed although the timing of the program, located at an important transition stage for pupils, has made the uncovering of these experiences highly problematic.

The discussion also provides an estimation of the effects of the program on behaviour and was drawn from a full exposition in the appendix. This is discussed in light of literature concerned with behaviour change.

The chapter finishes with some critical comments about the research methodology and methods and discusses the ways in which the evaluation triangulated its findings.

8.1 EVALUATION OF THE CONCEPTUAL APPROACH OF EARTH EDUCATION

Despite apparent logical and theoretical tensions in the program, the eclectic approach of Earthkeepers is supported by psychological theory which, although it makes many references to the behaviourism of Skinner and the cognitive field approach of Bruner (1965) amongst others, cannot be identified with any single view of the nature of reality or the nature of knowledge. Certainly the work of Piaget (*e.g.* 1929) has much influence on Earth Education. When dealing with a subject such as learning, involving experiences ranging from physiological reactions to experiences which can only be understood by considering the meaning attributed to them, a diverse approach to educational psychology and the learning process is indicated and such an approach is advocated and exemplified by the Earthkeepers program.

Earthkeepers has much influence on pupils' understandings and these tend to be strongest immediately after the centre visit although there is evidence that they are useful and meaningful for up to two years after the program's completion. Since the program's goal is to encourage a basic understanding of ecology (Van Matre and Johnson, 1987, p7) without defining what such a basic understanding should be, it is difficult to say with certainty whether the program achieves its aims. However, if the statements in the training manual can be regarded as the basic understanding or the minimum learning expected, then it would be entirely consistent with the data to say that nearly all of the pupils had attained this level of understanding immediately after the program's completion, and a large proportion 'retain' these. For example, during the pre-program phase, conceptions of food chains were intimately associated with the notion of "food" rather than energy and energy dissipation, despite recent prior instruction. After the program, all pupils were concerned with ideas of energy flow and had moved away somewhat from the idea of food being of central importance.

The understandings generated as a result of the program have provided a solid platform for developing the concept in greater depth in the later years of the pupils' schooling. During the two-year period in which the research took place, these understandings evolved, changed and overlapped with other areas of the pupils' experiences both within and outside their formal schooling. The conceptual development that had occurred during Earthkeepers was evident to varying degrees two years after the program finished. In most cases, most aspects of the basic understandings were still evident. For example, the concept of energy loss during the post-program stage was developing into concepts of entropy and thermodynamics after two years for some pupils. In some cases sophisticated and accurate concepts relying on deductive reasoning, developed during the program, were present after two years. In other cases, some degree of sophistication had occurred but relied upon inadequate inductive reasoning or perceptual bias.

These conclusions compare favourably with other examples of constructivist-styled research on Earth Education by Farnbank (1993) and Turner (2001) who suggested that most children showed some form of immediate conceptual development as a result of the Conceptual Encounters "The Great Burger Race", "Food Factory" and "Mr Sun's Restaurant". Turner's work (2001) demonstrated the abstract nature of the concepts of energy and energy flow, described the 'unscientific' views that children hold about the natural world, and showed how these developed as a result of the program.

Conversely Black (1998), and Black and Reeve (2000) were unable to discover consistent differences between the performance of their control group and the performance of the program participants, although it is important to note that very little emphasis was placed upon ecological learning in these studies. Bosse (2000) and Mess (2000) were unable to link program attendance with conceptual development. It is highly probable that their methodology was inappropriate, as although they set themselves the task of evaluating Earthkeepers they made no attempt to find out what the children knew before the program; all data were gathered three months after the program's completion. Consequently the research only had access to children's autobiographical accounts of what they could remember. Gough (1999) has pointed out that it might not always be sensible to assume that memories are undistorted and complete reconstructions of experience. Individuals are not always conscious of how or where they learned something, especially when these individuals are young children, whose ideas of what it means to "know" or "learn" something may be vastly different from their questioner's.

This evaluation of the Earthkeepers program has demonstrated that it *can* produce more developed understandings and meanings that are retained for a number of years.

8.1.1 REASONING

Changes concerned with the ways in which pupils seemed to be thinking were evident although they were not as consistently evident as the conceptual development summarised in preceding sections.

Pre-program interviews provided numerous examples of pupils using a limited form of inductive reasoning. For example, food chains started with pupils as an example of a living thing and this was then applied to all other living things, often resulting in the (incorrect) statement that plants need food for the same reasons that animals do.

Post-program interviews showed that pupils were more likely to be able to speak in general terms about concepts and questions such as "All living things", or "What are all things made of?" compared with pre-program interviews. In many cases there was evidence in post-program and long term interviews that pupils were using deductive reasoning. Whilst it would be a bold claim to suggest that the Earthkeepers program had enabled all of the pupils to think deductively, the data indicate that some pupils used more examples of deductive reasoning after the program than they had before and that this reasoning was predicated upon concepts and categories developed during the program through direct experience.

8.1.2 TERMINOLOGY

One defining characteristic of Earth Education is that it substitutes some examples of scientific terminology in common use, with its own terms which "start where the learners are" (Van Matre and Johnson, 1987, p8). Therefore one interesting aspect of the research was to consider any possible conflict between school terminology and Earth Education terminology.

However, few of the pupils interviewed found difficulties with using terms interchangeably, such as "Munchline" and "food chain", or "Specks" and "molecules". Other terms such as "Sun-muncher", "Plant-muncher" and "Animal-muncher" were used immediately after the program but were rarely referred to again, the more common scientific terms replacing them. An important aspect of Munchline Monitors and The Great Specktackle activities, which seems to prevent confusion, is that they clearly state where terms are equivalent to standard scientific terms.

Rather than causing confusion, the use of alternative terminology in "Munchline Monitors" may have actually facilitated the development of meaningful understanding. This statement is based upon the constructivist view that learning is more concerned with developing meaningful understanding. A concept such as "Energy" is nebulous at the best of times and it is not possible to define it exactly using language. One common definition of "energy" is that it is "the ability to do work". But energy is not encapsulated by these five words; the words are merely a symbolic representation of something which may or may not have objective existence outside of human perception. Gleick (1992, pp123-126) uses a similar argument to discuss the difficulty that physicists had with causality and the phenomenon of "time" during the last century. Any representation of "energy" cannot be exact but merely an approximation to some aspect of the phenomenon. Therefore, perhaps the greater the exposure to alternative explanations of the same phenomenon, the more rounded a view the pupil is likely to develop, provided that the pupils understand that different labels actually refer to the same thing.

Munchline Monitors was successful at encouraging pupils to concentrate upon energy as being the key aspect of a food chain although there was some attenuation and adaptation of this as time passed. The aspects of the activity which are most important are probably its provision of visual models for energy, the use of the term "Munchline" rather than "food chain", and the use of "Energy Flow" as a general organising label for the activity. The visual models for energy and energy dissipation were evident in the ever-diminishing thread coming out of the model of the sun and the energy line painted on the "munch trays".

The way in which one of these simplifications may assist in developing understanding will now be addressed. A "Food Chain" is a compound noun composed of two nouns which together implicitly suggest that a "Food Chain" is made up of identical units of the substance "Food" linked together to form a chain. On the other hand the compound noun "Munchline" is composed of a verb followed by a noun. The verb "Munch" suggests the *act* of consumption and the noun suggests that these acts are arranged sequentially, but not necessarily in a chain of identical links. So perhaps the Earth Education term which is more loosely connected with the notion of "food" is less likely to reinforce the misconception that plants obtain energy from food. However, the use of organising labels such as the activity name "Energy Flow" may also have been important. This title is present in various materials including the training manual, the logo, the badges and program information. It also comprises part of one of the 'secret' meanings of "E.M.", a mysterious and elusive character who the participants almost meet on several occasions. Such constant reference to the term did not go unobserved by the pupils, some even commenting on this organising technique.

8.1.3 THE IMPORTANCE OF EXPERIENCE

The post-program and long term data show that pupils frequently justified their conceptions by reference to their experiences whilst on the program. The role of

Earth Education activities in organising this experience and directing pupil perception has had a major influence on pupils' concepts. Figure 22 shows pupils sensing an upturned tree-route and gaining primary experience of nature.

Figure 22: Pupils Sensing an Upturned Tree Root During a Structured Nature Walk (E.M.'s Diary)

However, for a small number of pupils, conceptual development based on this experience in the area around the centre seemed to be limited to the context in which it occurred. For example, although some pupils could accept that at the centre and in the wider world there were more plants than herbivores than carnivores, a few suggested that while this was true for the outdoor centre's environs, in the wider world there would be more carnivores than herbivores than plants. This type of context dependency became increasingly common from post-program to two year post-program interviews reflecting the influence of other experiences and observations upon the pupils' concepts.

Some pupils' concepts were affected more permanently than others' by the program, and experience has no small part to play in this process of conceptual development. Some pupils were able to use a combination of their experiences in the outdoors, theoretical explanations offered during the program and deductive reasoning to construct hypotheses to explain accurately the structure of ecosystems in the wider world. It is probable that the reason why the activities are able to facilitate learning which is evident up to two years after the learning experience is because of the way in which they link these three areas together in a way which seems to have meaning for the pupils.

Where some of the understandings were not well formed, or appeared to be contradictory with others held, it should not be assumed that the child was unable to think logically but rather that these concepts are loose constructions or tentative hypotheses and become more internally consistent and coherent as the child grows older. This is achieved through experience and therefore experience is vital to the continued learning of children throughout primary and early secondary education.

8.1.4 DIFFERENTIATION

One of the strengths of the program was that despite the apparent uniformity of experience presented to the pupils, there was a wide variety of outcomes, with pupils developing conceptions to different degrees of sophistication. For example, post-program interviews showed that six of the pupils were able to give explanations for pyramids of numbers in terms of energy dissipation and energy loss, linking the shape with the ways in which energy is lost from the system by organisms' activities. Whereas others, although they could remember that the numbers or masses of trophic levels formed a pyramid shape, were unable to explain this shape. This differentiation by outcome was evident for all of the four concept activities. It is the goal of the program to provide the basic comprehensions about the major ecological systems of the planet (Van Matre and Johnson, 1987, p7). This research has shown that not only did pupils develop basic understandings of all four concepts, but in some cases they developed sophisticated understandings which drew upon a range of other concepts.

Pupils who were described as having special needs seemed as able to develop sophisticated understandings as the other pupils, and in some cases their understanding was better and was retained for longer. These "special needs" included behavioural difficulties and medical conditions which affected their schooling. Whilst Earth Education has been criticised for over-reliance on literacy skills (Caddy, 1993), particularly reading, the use of direct experience, metaphor and verbal description during activities seemed to circumvent difficulties which might otherwise have occurred in activities relying solely on reading and writing skills. Indeed, it provides the opportunities for pupils to experience the environment in many different ways and make different kinds of meanings other than the purely conceptual.

8.1.5 COMPARISON WITH SCHOOLING

Van Matre (1990, pp105-108) has described how life on earth is arranged in the shape of ecological pyramids of biomass or numbers. These pyramids are the result of feeding relationships where energy is transferred from one trophic level to the next. These feeding relationships are subject to the laws of thermodynamics and so this transfer of energy is inefficient. It is the progressive attenuation of useful energy in a food chain which creates pyramids of numbers. Hence it is this group of concepts, particularly the laws of thermodynamics, which quite literally make the ecosphere appear the way it is. Therefore these concepts are arguably the most important for an understanding of the significance of a "food" chain for life on earth. The same is true for the notion of the conservation of matter. The pupils involved in this research project had been taught about food chains as part of the school curriculum before they attended the Earthkeepers program. As a result it may have been expected that they would have been relatively familiar with the significance of Energy Flow for the shape of the world's ecosystems. This research has shown that in the pre-program phase, despite this recent prior instruction, pupils' conceptions of food chains were perhaps more intimately associated with the notion of food than they were with energy and energy dissipation. For instance, water and food were the most frequently cited needs of *all* living things, including plants. Whilst "food" was mentioned much less often in the post-program interviews it was relatively persistent throughout the two year period. Furthermore towards the end of the research some pupils were beginning to refine the notion of food supplying energy to *all* living things by suggesting that plants obtained energy from food by use of their roots, showing that this conception was relatively persistent.

This emphasis on "food" is probably due to a number of reasons. Firstly, during the earliest interviews many pupils approached the questions using limited attempts at inductive reasoning of the type "I need food and I am alive therefore all living things need food". This reasoning was extended to plants which were also thought to require food for the same reasons as animals. Therefore the preoccupation with "food" is partly a result of the pupils' early attempts to use inductive reasoning to build a concept for "living things", as living things are partly defined by their needs. Secondly, the label "food" chains, used in their prior instruction, is likely to act as a powerful reinforcer of the concept of "food as a need", which perhaps misdirects pupils' attention away from the concept of "energy as a need".

Despite prior instruction in several areas, some pupils were not able to think of matter as being 'made from' something else. These pupils did know about molecules and atoms but these were thought to exist as separate from matter, they were "the smallest thing (...) that floats around in the air"! Post-program and long-term responses indicate that Earth Education was successful, where other approaches had not been, at generating the basic understandings described by the program. However, there was the possibility that the personification of these specks of matter, created by the activity, had led to the not infrequent idea that specks were alive.

Bosse (2000) and Mess (2000) claimed that the apparently didactic approach of Earthkeepers was incompatible with diverse children's backgrounds, experiences and learning outcomes. However, Bosse (2000) and Mess's (2000) assumption that Earthkeepers *aims* to produce an idealised and uniform response is not entirely confirmed by an examination of The IEE's publications and descriptions of programs, and is certainly not confirmed by the data contained herein, as they suggest that many different types of meanings result from the program for children with vastly different abilities and literacy levels.

Most pupils were able to make appropriate connections between the Earth Education curriculum and the school curriculum. Earthkeepers provided a basic foundation for school learning. What was particularly useful was the presentation of ideas at Ardroy, which were then built upon by more sophisticated refinements in school science. Earthkeepers presents a useful medium for introducing the concepts described above in a spiral curriculum.

Some empirical work (Ansell, 2000; Tate, 2001) has suggested that the negative views of some practitioners are rarely clearly articulated, accurate or coherent, perhaps indicating that the conflict has its roots in ideological differences. Those that have been specified have indicated conflicts between the school's curriculum and the Earth Education curriculum particularly regarding follow-through work

(Caddy, 1993) or resource issues (Rowbotham, 1983; Theaker, 1988; Ansell, 2000). It cannot be denied that Earthkeepers does require a great deal of time and energy to set up and run. However, in order to maximise the pupils' understandings it should be discussed explicitly in the curriculum, not merely to 'reinforce' the understandings in a behaviourist manner, but to allow opportunities for pupils to understand and reconstruct their experiences in more depth. This will have implications for class teachers, For example, recent work has examined the concepts of significant adults attending programs, especially visiting teachers (Johnson *et al.*, 2002) and investigated how teachers' understandings interacted with those of the pupils. This work showed that teachers' understandings were not always scientifically accurate and perhaps teachers have as much to learn as some of the pupils. Addressing ecological concepts through Earthkeepers may provide the teachers with the opportunity to clarify their own understandings and improve their practice as a result.

8.1.6 THE EARTH EDUCATION CURRICULUM: A CRITICAL REVIEW.

This section examines the notion of "curriculum" and analyses curriculum issues such as the organisation and selection of knowledge in its broadest sense, the justification of curriculum content and methods of delivery and concludes with a section which identifies elements of psychological theories of cognitive development in the curriculum of Earthkeepers.

8.1.6.1 Organisation and Selection of Knowledge

A previous section has suggested that two frequently occurring claims made for Earth Education programs, require further analysis, namely the claim that an Earth Education program "...gets the description (from the abstract) into the concrete..." (Van Matre, 1987, p.8) and that conceptual activities concentrate on the "...big picture of how life works here" (Van Matre, 1990, p.276). The following sections discuss the extent to which this is possible.

Young (1971) has suggested that in order to explain how knowledge and curriculum are organised it is necessary to conceive of educational phenomena such as ability or hierarchies of knowledge as being socially constructed, rather than being objective and unquestionable elements of curricula. In this way certain elements of educators' worlds which are normally taken for granted, such as the question of what counts as knowledge, can be subject to enquiry (*ibid.*, p.2). Conceptual learning activities in Earth Education take the form of scripts implying that there is one way of delivering knowledge in the context in which the programs are implemented. Indeed Van Matre has frequently expressed dissatisfaction about the way in which the subject matter and methods of delivery have been altered (Van Matre, 1990, pp.192-197; Van Matre, 2000). The following section also discusses the problems associated with taking such an apparently inflexible approach.

8.1.6.1.1 Status of Knowledge.

Various authors have commented upon the inflexibility of the approach taken by Earth Education programs (Robbins, 1985; Randle, 1992) and The IEE. Such comments have criticised the way in which The IEE has attempted to control the integrity of their programs and activities using "...quasi-legal" methods (Randle, 1992). Randle's (*ibid.*) comments were concerned with The IEE's attitudes to others' use of Earth Education programs and activities and he was critical of the way in which "...devoutly packaged curriculum materials were passed down from on high". His main argument was that teachers as professionals should be free to choose whatever activities or parts of activities they see fit to use in their particular context. Robbins's (1985) comments argued that a single program could not fulfil the needs of every child because every child is different. This rigidity and inflexibility are justified firstly as a means of quality control for an organisation which derived most (53%) of its annual income in 1999 from selling materials directly or indirectly associated with programs and activities (I.E.E., 2000, p.20). Secondly, Van Matre (1990) and Duckworth (1986) claim that the programs take into account the ways in which children learn best and therefore the *general* needs of children as learners will be met.

Considering the context in which Earth Education programs first developed, perhaps it is not surprising that The IEE has provided scripts of activities for unqualified or inexperienced educators and Van Matre (2000) has been critical of those who have carelessly or thoughtlessly deviated from these scripts. Furthermore it might also be an efficient means of distributing program material and therefore the best way of achieving the IEE's objectives. However, none of the critics of Earth Education have examined the way in which knowledge and the curriculum have been produced and defended and it is to these elements that this discussion will now turn.

8.1.6.1.1.1 Production of Knowledge

In the Acclimatization program choices of ecological concepts are justified by reference to the context in which the program is taking place. Van Matre comments that the original list of concepts numbered about seventy five from which twenty were distilled but there was "...no predetermined number available" (Van Matre, 1972, pp.122-123). This position evolves slightly in the next publication where children learn *crucial* (Van Matre, 1974, p.93) or *key* concepts (*ibid.*, p.102). Further development was evident in Sunship Earth (Van Matre, 1979) where seven *major* concepts were selected although he acknowledged the impossibility of choosing a group of concepts with which everyone would agree (*ibid.*, p.12). In Earthkeepers the four concepts chosen are referred to as "...*primary* earth education (*sic*) concepts" (Van Matre, 1987, p.21), and in 1990 Van Matre declared that all Earth Education programs *must* have at least four *major* ecological understandings, specified as Energy Flow, Cycling, Interrelationships and Change (p.269). Indeed, a program that was written by staff members of the U.K. branch of The IEE was not considered to be an Earth Education program by Van Matre because it did not contain these four ecological concepts (Rhymer, 1997). Despite Van Matre's assertions he attempts to qualify these by acknowledging that "...these concepts are arbitrary choices..." (Van Matre, 1990, p.119) yet one must pose the question of how "arbitrary" can these choices be if an environmental education experience fails to qualify as Earth Education on the basis of it not meeting an arbitrary criterion?

So it might appear that The IEE has performed a *volte-face* with regard to the curriculum content, initially appearing to adopt a liberal stance which has developed gradually into a dogmatic and apparently non-negotiable requirement. This choice of a minimum of four ecological concepts is justified as being the minimum necessary for "...developing in people a basic understanding of the major ecological systems and communities of the planet" (Van Matre, 1990, p.105). This "basic" understanding relies on a version of events which describes the flow of energy from the sun, its capture and use by 'webs' of plants and animals and the changing of forms. It would appear that this view of ecology is non-negotiable and anything which does not include these four concepts can not be considered to be a full Earth Education program.

8.1.6.1.1.2 Defending the Curriculum

The view that a basic understanding of how life works on this planet (Van Matre, 1990, p.105) is only possible through a consideration of a minimum of four ecological concepts is justified using concepts of Trophic Levels (*ibid.*, p.107), Conversion Efficiency (*ibid.*), Matter Conservation (*ibid.*, pp.109-112), Darwinist Evolution (*ibid.*, pp.115-117) and Thermodynamics (*ibid.*, pp.117-119). Van Matre (1990, p.114) also uses a parable from Eastern religion (The Hindu parable of Indra's 'net of life') and a common English language simile in his justification of the concept of Interrelationships. He states (*ibid.*) "...a thing is not a thing out of the context of its community. 'Like a fish out of water' is an old saying that harbors (*sic*) much truth...". However, justifications are predominantly scientific. Thus Van Matre uses what Young (1971, p.3) has described as commonsense conceptions of 'the scientific' and 'the rational' in order to justify his choice of concepts. This use of a scientific rationality tends to render the use of such knowledge as unproblematic since scientific rationality is one of the dominant legitimising categories used by educators and policy makers. Young comments that in treating such categories as being socially constructed rather than given, it becomes possible to treat such knowledge as the product of a socially constructed reality which has evolved in particular historical and social contexts (1971, p.3). Therefore if such knowledge is treated as socially constructed then we are able to question the assumptions in Van Matre's justification of his selection of concepts for understanding how life 'works'. Such an analysis might begin by examining the notions of "...basic understanding..." and "...how life works..." and reinterpret these in the light of other systems of thought such as sociology or philosophy.

Although it might be difficult to support the view that four basic concepts are essential for an understanding of how life works, it must be remembered that Earth Education does not exist in a social vacuum and it is by no means widespread as an educational experience, although The IEE claims to have trained over 50,000 educators world-wide (I.E.E., 2000, p.7). Van Matre's programs are used by schools and centres as part of various curricula which contain many other approaches to understanding the relationship between nature and society. Whilst these four 'basic' concepts might not be the only way of producing a basic understanding, they may be part of it.

8.1.6.1.2 The "Big Picture".

Van Matre makes frequent reference to the 'big picture' of how life on earth functions. Chapter 4 discussed how this is manifest in programs using methods of simplification such as the use of 'familiar' metaphors, generalisation by omission and generalisation by assimilation. These are employed in order to make concepts, as models of reality, intelligible and useful to the learner. But Van Matre's use of simplification of concepts has not been universally accepted (Robbins, 1985; Randle, 1992) despite the widespread use of simplification of concepts in schooling in Britain. Van Matre (1979, p.13; 1990, p.276; 1994, pp.1-13) has devoted much effort to stating and re-stating the approach to concept simplification. Objections to the simplification of concepts have argued that Earth Education activities over-simplify concepts (Van Matre, 1990, p.276) or are misleading and inaccurate (Robbins, 1985; Randle, 1992) but this idea has not been adequately explained. The criticism that Earth Education simplifies too much begs the question, "... 'too much' for what?". Robbins (1992) argued that the use of 'familiar' metaphors which were different from accepted 'scientific' terms would lead to confusion as children progressed through the science curriculum. Furthermore other critics (referred to by Van Matre, 1990, p.276) have argued that ignoring single contradictory examples is "...misleading and inaccurate...". The preceding evaluation has provided very little evidence to support this first claim; the second is discussed below.

The discussion about whether or not one can, or should, 'simplify' concepts is concerned with the debate about whether it is acceptable to say, for example, "The sun is the source of energy for all living things" (Van Matre, 1990, p.276) and hence ignore organisms such as chemosynthetic bacteria. Strictly speaking, the statement is false (See also Van Matre, 1979, p.13). Essentially this is an epistemological argument since the fact of the existence of the debate about the nature of scientific knowledge might indicate that some teachers of science regard scientific knowledge as 'objective' and 'true' and therefore seek to preserve the integrity of this truth in their teaching. Consequently they may also regard the process of learning of such knowledge as a process of acquiring small 'chunks' of information or 'facts', all of them 'accurate' and 'exact' conceptualisations of the natural world, which can eventually be brought together to form correct understandings. A method of structuring such learning was discussed by Gagné

(1985) who, in relying on psychological theories of information processing, proposed a learning task analysis which involved breaking down a complex learning outcome into its component parts, and constructing a hierarchy with subordinate skills at the base and the contingent learning outcome or task at the top. Thus the complex learning outcome is broken into parts and each part is addressed separately. Child (1993, p.386) describes a learning hierarchy (after White and Gagné, 1978) for a learning task in mathematics, which is composed of discrete skills which, when combined, would enable a learner to perform a complex task. This hierarchy can be visualised using the analogy of a structure such as a building which is composed of bricks, slates, rafters, etc.; the building represents the complex skill or concept to be learned and the bricks and mortar represent the 'facts'. The bricks are not changed in the building of the structure- they have existence independently of the structure. Thus unchanging facts are the 'bricks and mortar' of concepts. The role of education, according to Gagné's theory, is then to transmit accurate facts and then build more inclusive concepts from these.

The value of dividing complex concepts into component parts has been discussed as part of the debate about the benefits of 'whole' or 'part' learning. Gagné (1985) and Skinner (1953) tend to advocate 'part' learning, particularly through programmed learning schemes, whereas 'whole' learning is suggested by the gestalt school of psychology (Child, 1993, p.103) and others. There has been, however, no resolution of the argument concerning which approach is most effective and Child notes a range of conditions which dictate the most suitable methods, such as the nature of the material to be learned and the condition of the learner (1993, p.141). Despite this compromise position, Child (*ibid.*) states that the 'holistic' approach is useful where the amount of information is small and it can provide a better understanding of the *meaning* of information where connections and continuity between elements of the concept are clearer. Child (*ibid.*) does point out, though, that whole learning is not always possible when material is difficult and unfamiliar.

Bruner (1966) suggested that children should learn using a 'spiral curriculum' which exposes children to subject matter in such a way as to ensure overlap with previous material and represents steadily increasing complexity. Thus a concept addressed in simplest terms in primary schooling would be revisited at later stages involving more complex material. For example, the subject of electrical current flow is often addressed using this model. In the National Curriculum current flow is first investigated using the notion of 'conventional current' consisting of charges being 'pushed' by the battery from positive to negative. This is developed in stages of increasing complexity later in the curriculum to a consideration of electron movement from negative to positive under the influence of an electric field. This would tend to support Van Matre's notion of presenting the 'big picture' of ecological concepts using simplification.

Ausubel (1968) used the notion of 'meaningful learning' and suggested that one way of achieving this was to associate new learning material with the familiar using 'advance organisers' which were intended to either place material into the context of pupils' existing knowledge using analogy or 'comparative organisers' (*ibid.*, p.121), or provide a summary account of new ideas using simplification or 'expository organisers' (Child, 1993, p.119). Clearly, Ausubel's (1968) theories would also tend to support generally Van Matre's use of simplification. However, whilst Bruner and Ausubel rejected behaviourism as an adequate theory of learning they disagreed about the best way of achieving learning outcomes; Bruner emphasized active restructuring of the environment from direct experience using guided discovery learning methods, whilst Ausubel was critical of this and believed verbal reception techniques to be most effective.

Van Matre has taken a compromise position and selected ideas from both Ausubel's and Bruner's theories in order to justify his use of the 'big picture'. Furthermore, gestalt psychology offers further justification of the use of this term. Child (1993, p.106) notes that gestalt psychology emphasizes the importance of structuring educational experiences for meaning. The Law of Pragnanz (*ibid.*)

states that we try to impose the best possible meaning on perceptual experience through the use of principles such as similarity, proximity, continuity and symmetry, and closure (*ibid.*, pp.81-82). The latter principle, that is 'closure', provides further justification of the use of the 'big picture' and can facilitate 'insightful learning' (Wertheimer, 1961).

8.1.6.1.3 Concrete and Abstract Representations of Concepts.

Van Matre first refers to the importance of bringing the 'abstract' into the 'concrete' in Sunship Earth (1979, p.24). This is later supplemented by the claim that a program "Gets the description (of the concept) into the concrete through tasks that are both "hands-on" and "minds-on" (Van Matre and Johnson, 1987, p.8). Later still, Van Matre refers loosely to Jean Piaget's work with the statement "Piaget said that you learn with something in your hand (...) because it's in the concrete for you. (...) However we realised (...) that was not always practical, but (...) at least we could have something for every learner to focus upon- a visual focal point" (1990, p.179). However, this process of concretising learning is not regarded as purely visual or tactile as other references refer to the process of making the learning more concrete by using as many senses as possible (for example-*ibid.*, p.213) and indeed one of the main distinguishing features of the programs is that they use activities which are aimed at developing all five senses.

One reference which is concerned with the *general* approach of Earth Education describes how the use of props in activities helps to "...bring concepts into the concrete..." (*ibid.*, p.206). This echoes the description of Concept Path activities, used in Sunship Earth, which were designed to go "...from the abstract to the concrete..." (*ibid.*, p.262). However another reference describes how Conceptual Encounters, the activities which address conceptual learning in Earthkeepers, go "...from the concrete to the abstract..." (*ibid.*, p.263) which could be taken to indicate an emphasis which is the reverse of that in Sunship Earth. In the absence of clarification of this point it is perhaps safest to conclude that conceptual activities probably do both. They use props, or tools, in an attempt to provide a physical example of the concept (making an abstract concept concrete), but also require participants to then find examples of the concept in the immediate environment thus requiring participants to apply learning to a new situation (moving from the concrete to the abstract).

The closing sentence of the previous paragraph illustrates the difficulty of using the terms of 'abstract' and 'concrete' to describe concepts. Whilst Van Matre (1979, p.24; 1990, p.179) and Van Matre and Johnson (1987, p.8) sometimes seems to imply that a concept is *either* concrete *or* abstract they do acknowledge that concepts are not dichotomous but fall on an abstract-concrete continuum (1979, p.23; 1990, p.206, p.213, p.263).

The notion that concepts are made more concrete by the use of manipulable props or tools is however problematic for two reasons. Firstly, Van Matre's activities use tools to represent symbolically concepts or elements of concepts. It should, therefore, be obvious to the learners what the tools are intended to represent. It would not seem unreasonable to suppose that children might find it as difficult to understand the link between the symbol and what it represents, as they do the original concept. In other words, the symbol might be as abstract as the concept. Just because a learner is given something to physically manipulate does not mean that the concept is rendered concrete. Ironically Van Matre acknowledges this last point in his critique of the "experimental method" used by 'traditional' outdoor learning activities where "... kids wrap some leaves out there in tinfoil, then come back several days later and look inside to find that the leaves have died (.) ... I don't think the activity got photosynthesis into the concrete at all. (...) What they made concrete was that if by chance you ever run across some tinfoil wrapped leaves out there somewhere, you will know they are probably dead" (1990, p.274). Research (quoted in Kolb, 1984, p.14) has shown that whilst using tools sometimes facilitated children's learning of the concept of conservation, sometimes the children merely learnt how to manipulate the tools. Therefore the task of making a concept 'concrete' becomes the task of providing an experience which uses symbols *meaningful* to the learner. The second point is a consequence of the first. If external 'reality' is experienced via perceptual filters (Broadbent, 1987), through symbols associated with objects in that external world, then it must be questioned whether it is possible to have *any* kind of 'concrete' experience since, according to Kant (Kemp-Smith, 1929, pp.141-142; Child, 1993, p.72) 'reality' is not experienced as it is, but as *we* are. Any discussion of 'concrete' experiences should therefore be treated with caution in order to avoid reification of the terms 'concrete' and 'abstract'.

8.2 FEELINGS ACTIVITIES

These were the most difficult activities to evaluate. In order to gauge the success of the feelings activities interviews with participants were compared with field observation and teachers' accounts. These were also combined with the meanings attributed to the experiences of the conceptual activities. These sources of data produce the conclusions below. A small amount of data has been used to illustrate how some of the conclusions have been arrived at.

The group of pupils chosen for the main research project seemed rather reluctant to discuss any feelings experienced during the program partly due to the way in which they related to each other and partly due to their perceptions of "appropriate" adult behaviour. Therefore the centre staff suggested alternative groups which were known to have made much of the post-program work at school. The school that attended the program during the program piloting was visited and six pupils were selected for interviews. Their accounts were qualitatively different from the other pupil interviews in terms of the way they spoke of the program in general and the feelings activities in particular.

Pupils' accounts of their experiences of Ardroy tended to conflate the feelings activities into two or three making it impractical to try and separate the responses. In any event it is more important to gauge the overall reaction to the feelings activities than to try and attribute aspects of emotional development to certain activities. Therefore, findings in relation to specific activities are examined, followed by comments about the feelings activities as a whole.

8.2.1 MAGIC SPOTS

The magic spot was almost universally considered to be one of the favourite activities in the program by teachers and pupils. Some teachers were suspicious of Magic Spots before it began, thinking it to be impractical and unworkable but were amazed at how well their pupils were able to undertake it. This is not an uncommon perception.

There was some confusion regarding pupils' magic spots in their home environment. Some pupils considered magic spots to be acceptable if they were indoors. Pupils considered Magic Spots to be a time for reflection, for dozing, drawing, writing, escape, day-dreaming, for being free, relaxing, thinking, anticipating the coming events and observation. This is illustrated by Interview Extract 18.

Interview Extract 18: Post Program: MI310596

1	*Int: Right. What sorts of things do you do at magic spots?*
2	*M:Just sit.*
3	*I: Sit, think.*
4	*M:Watch, wait.*
5	*Int: Right.*
6	*I: And M fell asleep ....*
7	*Int: .... what was that?*
8	*I: He fell asleep in his magic spot.*
9	*M:I went to sleep.*
10	*Int: What, every time?*
11	*I: No, just one time. 'Cos his was like on a big ....*
12	*M:.... log ....*
13	*I: .... a big log, and he was lying back and he fell asleep.*
14	*M: It was in a big clearing in the woods and there's like a big oak tree that's fell over, it's either been struck by lightening or it's either bent in half or something. [...] There's a forest near my house, and all these signs say Community Woodland, and they put paths and picnic plots and that. I was at my magic spot and here's all these tourists sitting up eating their lunch.*
15	*[...]*
16	*M:You just walk past this garage and there's this wee path beside it that nobody really knows about. You just walk in and you're inside the woods. When you just go straight into the middle of it you can't miss this great big clearing.*
17	*Int: Right.*
18	*M:There's a big oak tree that looks like it's been struck by lightening. You can see the stump and it's all burned at the top.*

Apart from describing the experience of being at a magic spot (2-11), these pupils also describe in very great detail and with some articulacy, the particularities of the magic spot (lines 13-18). It is a place which both of these pupils know about, and their experiences seem to be shared to some extent. These two pupils were also occasionally unwilling to admit that they had a strong positive emotional reaction to their experiences, so the declaration of approval in Interview Extract 19 (line 6) is an indication of the impact of this simple activity.

Interview Extract 19: Post Program: MI310596

1	*Int: .... does anything magical happen?*
2	*I: Animals come.*
3	*M:Animals come. Animals come, like if you're really quiet and you sit really still, like animals can come up to you ....*
4	*Int: .... yeah ....*
5	*M: If you sat really still there, you have them land on you, and my dad was just like this, and they landed all over him.*
6	*I: Smart!*
7	*M:Have you ever had that happen to you?*
8	*I: Yeah, I had it when one fell on my head.*

The extract also illustrates that this activity had been shared with another person, part of the requirements for earning the 'S Key'.

Figure 23 shows two pupils at a magic spot. The one in the foreground appears to be engrossed in the diary, the other in the distance is watching from a seated position by the bridge.

Figure 23: Magic Spots

A common response was the freedom generated by Magic Spots. Pupils saw themselves as being in a place where they had more freedom than perhaps they had really experienced before; freedom from the influence of friends and the peer pressures of conformity, from the direction of adults and teachers, and from the pressure of school work. The constraints that were placed upon it, i.e. a set time limit and so on, were not part of pupils' accounts.

8.2.2 SEASONS

Seasons was hardly mentioned by the pupils in either positive or negative terms. Responses were non-committal, descriptive of what happened rather than descriptive of the emotions that they produced, or could not remember them. This is in stark contrast to the Magic Spot. This experience lacked the impact of the other E activities upon the pupils' recollections and the potential difficulties of seasons, highlighted in an earlier chapter, seem to have been borne out by empirical evidence.

8.2.3 EM'S DIARY

EM's Diary was considered to be exciting, lively yet unhurried, and interesting, although it was very occasionally described as lacking in challenge.

8.2.4 EARTHWALK

The Earthwalk was described with some relish by pupils who said that it gave them new experiences which they could remember for up to two years afterwards. Pupils described special moments when they had made surprising and unusual observations of nature either through being still, or using other senses they were unaccustomed to using. The brief extract in the table below illustrates this well.

Interview Extract 20: Two Years Post-Program: LS230698

That's like the other one, saying you've got to look at things and smell things... you'll get to discover things more than just saying "that's just a herb or something", you smell it and touch and you get to discover more about it. (...)

This authenticity of this description is enhanced by Figure 24 which illustrates one pupil 'introducing' another to a tree during an Earthwalk.

Figure 24: A Pupil About to Meet a Tree

Van den Berg and Van Arcken (1999), through participant observation and interviews with teachers and pupils attending Earthkeepers, also found the program excellent compared to the 'standard school curriculum' in terms of it being able to encourage the development of social and outdoor skills. They suggest that the program encouraged the use of senses, sharpened observation and developed a whole range of different skills. These opportunities were much less developed in the school curriculum.

8.3 EVALUATION OF THE AFFECTIVE APPROACH OF EARTH EDUCATION

8.3.1 POWERFUL EXPERIENCES

The *raison d'etre* for many practitioners involved in Earth Education is the ability of the programs and activities to generate epiphanic experiences in learners. Much of the literature has been concerned with attempting to measure this in a quantitiative manner (Payne, 1981; Bires *et al.*,1982; Mulligan, 1989; Park, 1997; Wyatt, 2001) but most recently this had broadened to the inclusion of other methods and methodologies. One of the most recent involved fantasy journeys (Bosse, 2000). In Australia, Black (1998) and Black and Reeve (2000) were unable to discover consistent differences between the performance of their control group and the performance of the program participants on attitude scores although they did see a change. Black (1998) discovered, through *ex post facto* qualitative interviewing, that Earthkeepers had an enduring effect on attitudes, that participants considered the environment in terms of its components rather than in terms of global issues, and that participants were more concerned and aware of local issues than non-participants. Furthermore, participants' relationships with the bush were encouraged by the reflection of the magic spot. But despite this positive evidence, the findings differ widely between studies. Bosse (2000) and Mess (2000), in their study of Earthkeepers, examined children's emotional relationships with nature using *ex post facto* content analysis of focused interviews with participants. They were able to make convincing links between these relationships and the program for two children out of eight in a purposive sample. What was highlighted by this research was that children's responses to experience are non-uniform and are influenced by many other factors, including social background, previous behaviour *etc.* Programs and activities provide opportunities for experiencing the natural world in many different ways and participants will have different experiences depending upon their individual perceptions and conceptions.

With respect to this study, a small number of pupils from one school regard the Earthkeepers program as having had an impact on their lives, sometimes through individual feelings activities, sometimes as a result of the whole program. This is described as a permanent change in behaviour or perspective. Self reported changes concerned increased positive feelings and behaviour towards nature, more frequent recreation in nature, more constructive attitude towards schooling in general and certain subjects, such as art or English in particular. The last line of Interview Extract 21 illustrates the desire to engage in constructive activities stimulated by experiences on the program.

Interview Extract 21: Two Years: LS230698

Int: So are you glad that you did what you did?
LS: Yeah those things are all fun, but it was a good experience... do something different, 'cos lots of kids who stay around this area they don't normally get the chance to sit in the hills ... so for some other kids it's a good experience. And just getting away from their parents as well. (...) Some kids don't even have a place to appreciate, perhaps if they were to... ... they don't know what it's about they just sit in cars and watch Tvs. Quite a lot of kids don't know what to do when they get landed with time outside 'cos they just watch TV or play computer games. Now at the most I'd say I watch 1 hour of TV a week now, whereas I've found other ways to entertain myself... don't need all these electronic gadgets, they're just a pain in the neck... Drawing for me, I'm one of the people who went on the course and I've found that it's writing, but everybody's different.

Some changes were described as being due to the whole program rather than any one activity. In retrospect, the effect was described as cumulative, rather than resulting from one telling moment of insight (Patton, 1990, p.386), or epiphany, where things take on new meaning in a sudden clarifying moment.

Other changes were described as being due to one particular activity. For example, one pupil described how her observation skills were so heightened during the program that her art work improved immeasurably during the week away and this was attributed directly to the Magic Spot. Other activities may also have had an impact, especially EM's Diary and the Earthwalk.

Changes happened on different time scales being instant or taking a longer time and occurring throughout the visit, or even initiated during the visit but continuing back at school and home. Changes were sometimes acknowledged by the pupil, sometimes pointed out by others and the pupil was unaware of any personal change. Pupils describe these telling moments as being motivating incidents.

The inability of Bosse (2000) and Mess (2000) to find convincing evidence of the program's success may be due to an inadequate methodology. They recorded strong positive responses for 25% of the sample, and it is hardly surprising that this was statistically insignificant. If the strong response, perhaps even epiphany, has a similar or even lower presence in a group, then it will not be open to assessment by simple statistical techniques, but that does not mean that it is insignificant as a phenomenon.

8.3.2 THE EARTHKEEPERS PROGRAM AS A WHOLE

The detail with which the pupils were able to describe their experiences was surprising given the length of time since the Ardroy visit. Clearly their experiences were generally memorable and significant with meaning for the pupils. Exceptionally, pupils were unable to remember much about the week away but these were in the minority.

Pupils appreciated the amount of work that had gone into setting up the program and made particular mention of the knowledge activities and EM's Lab. These were appreciated because they did not think they could have set it up themselves. Clearly then such attention to detail motivates pupils to engage with the materials provided, whether during a knowledge activity, an experience activity, or some other part of the program. Figure 25 Shows E.M.'s Lab, the room in which the elusive character 'E.M.' could be found. The pupils are introduced to the program in this space and visit periodically throughout the week. Despite almost 'catching' E.M. in the lab on several occasions, the pupils never quite arrive in time. On one occasion the chair rocks to a stationary position as if someone has just left, on another there is a freshly brewed pot of tea with one cup, on the desk.

Figure 25: E.M.'s Lab

The program 'glue', such as "Waste Watchers" at mealtimes, EM's Lab, and the Key Ceremonies all contribute to the overall atmosphere of the program and help to create a lasting impression which the pupil can describe in some detail up to two and half years after the event. Surprise, mystery, myth, story-telling, role-play, riddles, drama and fantasy are all ingredients of the program that make it distinctive and memorable to the pupils and many of them mention some of these elements in their reminiscences.

Ardroy was seen as a magical place by pupils and teachers. Pupils attempted to re-capture this magic by holding ritualised ceremonies at school when being presented with the keys. The visiting staff member from the centre assisted with this recreation. Pupils talked of moments when they were able to develop their relationship with their class teacher- in one case this involved "Pasting" the teacher, or throwing toothpaste at her; restitution was in a similar and reciprocal vein. The centre experience provides an atmosphere in which pupils and teachers are able to develop more informal relationships which allows both parties to learn more about the other.

An important quality of the visit was the way it provided time for individuals to be self reliant. One pupil caught between warring parents gained time away from them and for herself. She spoke of using this time to build relationships with old and new friends and activities like the Magic spot were particularly helpful in this, as were the activities which involved social interaction. Earthkeepers's emphasis on feelings and emotions was a catalyst for general emotional development and enhanced emotional maturity in some groups. Such maturity had not been evident in other visits by the same teacher where Earthkeepers had not been part of the week (AT160698).

Some highly significant comments, observations and interview statements began to suggest the idea that the age of the pupils was important for this program, or rather, the notion of maturity. The significance of this idea is explored with the following theoretical discussion.

The pupils from the three school groups were in the final year of their primary school attendance and were conscious of the impending transition to the big school. This was an uncertain time for them, and though apparently nonchalant and unconcerned, they made reference to support structures that would be in place to ease them through this period and this begs the question, why whould they be mentioning 'support' structures if the transition was going to be straightforward? This notion of the transition being an unsettling and scary time for these pupils was supported by data from the RAF school where a frequent fear that was mentioned by pupils was "teenagers", yet in approximately one year they would, themselves, become one! So perhaps the transition had to be managed by the pupils in order to cope with their fears, control their behaviour and survive in the environment they were moving into. Furthermore, these pupils were required to be 'grown up' or to act like 'secondary school pupils'. To them, the transition was not just about changing schools, but rejecting those things from primary school that defined them as children. To the pupils, these included unchecked, uncontrolled and visible emotional responses and irrationality. For example, laughing with joy rather than with mockery, crying, over-brimming enthusiasm, and irrational belief systems (Father Christmas *etc*).

At this time of transition, they were then taken to an outdoor centre and engaged in a number of activities specifically intended to generate strong emotional reactions, involve fantasy and myth, and were far removed from the rational, emotionless world that they believed they were moving into. The identification of emotional responses may have been difficult, not because pupils were not aware of them or could not articulate them, but because they were only too aware of them. To admit that they really liked something was tantamount to admitting a weakness which would provide a chink in the armour for someone to exploit. To then require such pupils to take part in emotionally focused activities, which some pupils see as being 'babyish', causes tension.

There are several examples that could be included here to support these tentative interpretations. The following quotation, Interview Extract 22, is included, not to prove this theory, but to support just one of the ideas discussed above, that there was a belief that pupil culture in school was dominated by 'cool'. This 'cool' was unconcerned, uncaring, amoral, and crucial for not showing weakness.

Interview Extract 22: Two Years Post Program: LS230698

1	*LS: Some people were embarrased to say that they were enjoying it but I know quite a lot of people did enjoy it but were too embarrassed to say "Oh I enjoyed that!".*
2	*That sounds like quite a funny thing that someone should be scared to say...*
3	*LS: Yeah I know that's what I think as well, but they want to seem like big shots because "Oh I don't care about the earth, I'm cool, what do I need to bother about that for?"*
4	*So is there an element... it's not cool to care about something?*
5	*LS: I suppose so, (...) I suppose if you're cool you smoke and smoking's bad for the environment.... 'spose once one person starts then everyone thinks it's fine. (...) I know what else I do for the environment, I send my clothes to oxfam. (...). 'Cos then other people can use them and then you don't have to keep making new materials.*

It may be that this socialisation process occurs rapidly. Only three months separated the visits by the first and third primary schools yet there seemed to be a marked difference between the responses of the pupils despite the fact that their catchment areas overlapped and both had a similar amount of preparation time.

Two of the three visiting primary school teachers commented about the relationship between the program and maturation or maturity. One commented on how much more mature the pupils had been on their return from the centre, compared with previous visits that had not involved Earthkeepers. Another commented that she would like to thank the outdoor centre team for providing her with "...the opportunity to become a child again." (HT040997). Perhaps, then, the program is better suited for the younger pupils, although age has less impact than the positioning of the pupils in the transition phase.

8.4 ANALYSING BEHAVIOUR: PLEDGE SHEETS

Methods to report on behaviour changes as a result of Earth Education have generally relied on the self-reporting of behaviour through interview (Black, 1998; Bosse, 2000; Mess, 2000) or participant observation (Rowbotham, 1983), although this information has usefully been augmented by verification with parents and teachers (Rowbotham, 1983; Van Wissen, 1992) on occasion. Black (1998) found that Earthkeepers had an effect on the environmentally benign behaviour of program participants and this was evident from two to five years after the program had been completed. Bosse (2000) and Mess (2000) found that environmentally benign behaviours were being carried out by many immediately after the completion of Earthkeepers but participants did not explain why these behaviours were beneficial. They also found that participants did not link their behaviour explicitly with conceptual explanations. They claimed, therefore, that because there was no evidence, they could not support Van Matre's supposition that environmentally benign behaviour was the result of increased understandings combined with an emotional attachment. They also suggested that Earth Education neglected the social aspects of environmental problems, thereby supporting the comments of Van den Berg and Margadant-van Arcken (1999).

This evaluation moved away from the idea of investigating the measurable impacts of the program upon participants' resourse use as it focused, over time, on the notion of awareness. However, some estimation of the potential benefits of the program for resource use was conducted using the analysis in the Appendix. This has been summarised in this section.

One of the Y activities involved a session where pupils discuss different ways in which they might save energy or materials and then make a written pledge to do two things. A copy of this pledge is deposited at a special place in the centre during a closing ceremony and the pupils then leave.

The effect of the program on pupils' behaviour was assessed by firstly gathering the 381 pledges deposited at the centre during one season and collating the replies. Secondly, a sample of these pupils were interviewed two years after the pupils' visit to find out about their environmental behaviour. It was revealed that 50-75% of the pupils reported that they were still doing those things two years after the centre visit. Once the pledges had been turned into savings of energy or materials, it was possible to make an estimate of the impact of the program on resource use. Such an estimate is valuable when considering the contribution of the program to sustainability education, Citizenship and Agenda 21 issues which are becoming increasingly important. Furthermore, the centres themselves may make use of the pledge sheets in order to work out the impact of their work in terms of resource use that may be highly significant for auditing purposes.

The summary results in Table 81 have been calculated assuming all pupils carried out all tasks for the whole year after the program.

Table 81: A Summary Of The Annual Savings Of Energy And Materials As A Result Of The Earthkeepers Program At Ardroy Outdoor Centre

Resource	No. of Pupils	Saving
Aluminium	61	670kg
Electricity (Lighting/General) Electricity (Appliances)	155 51	18,000 kWh 18,000 kWh
Heat	108	19,440 kWh
Plastic Bags	32	4,500
Batteries	11	500
Paper (A4 Sheets)	86	31,390
Petrol (CO_2 equivalent)	57	1,521 litres (1,208 kg)
Water (Washing) Water (Toilet Flushing) Water(Tooth Brushing)	23 1 109	358,800 litres 2,373 litres 318,280 litres
Total Savings		
Water		679,450 litres
Paper		31,390 sheets
Plastic Bags		4,500
Aluminium		670kg
Batteries		500
Energy CO_2 equivalent 39,137 kWh x 1.06 (Butala and Modic, 1998)		39,137 kWh 41,485 kg
Petrol CO_2 equivalent		1,521 litres 1,208 kg
Total CO_2 displaced (Energy & Petrol)		42,693 kg

Table 81 shows the annual conservation of resources, for one year, as a result of Ardroy Outdoor Centre's program. Carbon dioxide equivalents have been given where figures were available. Clearly this could be taken further, for example the energy associated with heating baths as opposed to showers could be calculated

(358,800 x 4,200 J/kg/K x 20 °C = 30,000,000,000 joules or 8,400 kWh), but it is not the intention of this discussion to give such detail, merely to perform a quick analysis of the data in order to give a rough indication of the effect of the program on the environment.

Children can often feel dis-empowered when they realise the enormity of the task of conserving resources or despair at persuading others to do likewise. Any information which can help them to realise that their efforts are not in vain helps to counteract this tendency and tends to make behaviour change more permanent.

8.5 METHODOLOGICAL REFLECTIONS

Previous qualitative studies have worked with various methods that have included open-ended pre- and post-program questionnaires (e.g. Farnbank, 1993), observations (e.g. Van den Berg and Van Arcken, 1999), children's drawings (e.g. Brauser, 2001) and concept mapping (e.g. Turner, 2001).

Some more recent approaches (Martin, 1997; Black, 1998; Van den Berg and Van Arcken, 1999; Black and Reeve, 2000; Bosse, 2000; Mess, 2000; Brauser, 2001; Turner, 2001) have attempted to examine the *quality* of learning. This has sometimes been achieved through the idea of individual "concept" development but has recently shifted to an explicitly constructivist approach (Martin, 1997). One of the important contributions of this evaluation is that it comprises a more coherent approach than the previous work due to the use of an explicitly interpretivist methodology. As a result, it has shown how pupils' meanings can be interpreted to illustrate the development of awareness in much broader and deeper terms than merely performing an examination of factual recall, or improvements in attitude scores.

8.5.1 TRUSTWORTHINESS

Notions of "validity" and "reliability" are generally assumed to have specific meanings related to whether a method does what it claims to, and whether the results it produces are repeatable. However, the goals of interpretive research are not generally concerned with these notions and some (e.g. Lincoln and Guba, 1985) have claimed that validity and reliability can be misleading terms. How, then, can one judge the value of such an evaluation? One way of examining this is to build in provisions for trustworthiness (Maykut and Morehouse, 1994) which are concerned with checking data against different interpretations, contradictory cases and different forms of data. In the case of this evaluation trustworthiness has been addressed by using the idea of triangulation.

8.5.1.1 Triangulation

Denzin (1970) proposes a typology of triangulation comprising time triangulation, space triangulation, combined levels of triangulation, theoretical triangulation, investigator triangulation and methodological triangulation. This evaluation has used a variety of these approaches. These are summarised in Table 82.

Table 82: Triangulation Used in the Earthkeepers Evaluation

Time Triangulation	Taking in the factors of changing meanings over time by conducting research longitudinally
Combined Levels Of Triangulation	The use of analysis from more than one level within the phenomenon (organizational, individual and cultural)
Theoretical Triangulation	Comparison of findings with competing theories.
Investigator Triangulation	The use of more than one observer
Methodological Triangulation	Use of the same method on different opccasions or different methods on the same occasions.

The strongest and most useful forms of triangulation comprised methodological triangulation and investigator triangulation. The methods section illustrates the first point well as different methods were used and results of interviews, for example, were compared with observations and written accounts. Investigator triangulation was used to an extent although the other investigators were teachers and adults and it is unclear how reflexive and critical they were able to be about their observations. It would probably be safest to say that this merged with Combined Levels of Triangulation in that others' accounts of the Experiences and reactions of the participants were used to check the data.

Another important part of this *process* is the exposure of the research to stakeholders (Strauss and Corbin, 1990, pp.249-258). This could be regarded as a summary of all of the forms of triangulation discussed by Denzin (1970). Stakeholders have included centre staff, school staff, parents, Scottish Natural Heritage, program authors, The IEE (National and International branches), and academics.

8.5.2 TALK AS TRUTH

One cannot take what has been said in an interview at face value; the literal meaning may have little relation to the meaning intended. For example, one pupil's responses described how she heard a sound like "screaming" coming from the Earth (SM260496). From a Western male academic adult's point of view, this could be interpreted as an indication of mental illness. However, as Opie and Opie (1959, p.122) wrote in their seminal work, children are "on nodding terms with the supernatural". So rather than take the talk at face value, it is necessary to know how the talk relates to the context. In this case the context is the program and the experience the pupil has had whilst on the program and the way in which these experiences are then interpreted to make them meaningful to the child. These programs were intended to provide novel experiences and these are sometimes so unusual the children have no appropriate language to conceptualise them. This is just the starting point as this will not tease out every nuance of intended meaning. It is extremely difficult to access the meanings of children. This is an extremely complex task that has been embarked upon. It reinforces the need for some form of triangulation, a sensitivity to metaphor, imprecision, undeveloped language, and insecure language skills. Whilst this process is occurring during the research through observations and interviews, the researcher has to be careful not to lead the child too much.

8.5.3 RELATIONSHIPS

One class teacher made a point of commenting on the quality of the relationships that the researcher had developed with the pupils, from observing their response to me at school and the centre, and at home, since one of her pupils was her son. Furthermore, the relationships developed at the other school were indicated by the following incident (Field Note 3).

Field Note 3: RAF School: Post Program: 240496

I needed to get a message to the class teacher but as I was in the Learning Support room and she was upstairs and there was no phone I needed a pupil to take a message. As I had just interviewed S, I asked her, as she was walking away from me and about ten metres away, if she would mind coming back as I wanted to ask her to do something for me. She said that she had to get back and was busy. I then adopted my teacher role and told her to do it, whereupon she looked at me with some bemusement, turned around and just carried on walking. I have never experienced such a situation when I have been teaching children in secondary schools, never mind primary schools.

This illustrates that the researcher had little or no authority that the pupil was willing to defer to, even for a simple request which involved taking a message to the class teacher. She accorded the researcher no automatic deference which she may have had for a teacher in similar circumstances, which implies that she did not perceive the researcher as having the same power as a teacher or parent. The relationship that was being attempted was one of neutrality. This was further tested by many groups as the neutral position was underlined in the interviews by giving them control of the recording machine, emphasising that the researcher could not be shocked, and not reacting to mischievous pupil behaviour, except when it became potentially dangerous or harmful.

8.5.4 DATA OVERLOAD

What became obvious as this work evolved is that there is a delicate balance to find between collecting and analysing sufficient data, in order to be confident of the richness and depth of the findings, and avoiding the collection of so much data that analysis becomes unmanageable. In this work, a decision was eventually made to focus on the strongest emerging categories whilst acknowledging there were others. These began by considering awareness in the widest possible sense, then narrowed down to conceptual meanings, but were expanded in the latter part of the evaluation to uncover information about transformative or existential experiences. Furthermore, data concerning effects of behaviour were gathered to illustrate the potential of the program for reducing pupils' impacts although this has more value for the centre than for the development of interpretations of the Earthkeepers phenomenon.

8.6 SUMMARY

This chapter has discussed the development of pupils' meanings by first examining the formation of pupils' conceptual understandings, then the impact of 'feelings' activities upon meanings, and then the implications of these meanings for the pupils' lives. Findings are discussed in the light of modern examples of research in Earth Education.

The concepts were found to be developed to at least a basic level, although some of the conceptions were developed to a much higher level and were retained long after the program had ended. The discussion has also illustrated how the program contributed to higher order thinking skills such as generalisation and inductive and deductive reasoning.

The use of different terminology, to start where the learners are, was not found to be a problem for the meanings of most of the pupils and the understandings gained by the pupils was readily incorporated into the understandings gained at school. Direct experience was considered valuable for the making of meaning and provided examples that pupils could use to flesh out their understandings, although sometimes these were heavily reliant on context and their previous conceptions proved hard to dispel by reference to theory presented in Earthkeepers or school. These conclusions are supported by the work of constructivists such as Driver (1983; 1988).

The chapter then addresses the defining characteristics of Earth Education identified in the earlier literature review chapter. These were explored by examining their internal consistency and comparing this with some theoretical approaches.

Due to the complexity of the program, the evaluation focused on the understandings and meanings generated, but there is some discussion of the 'feelings' activities. These are summarised briefly although there is some extended discussion on the effect of situating a program such as this on the cusp of the transition stage from primary to secondary schools.

The potential effect of the program on pupils' resource consumption is also addressed as this was an important part of the evaluation for the stakeholders. The *raison d'etre* of Earth Education is its' ability to ameliorate the ecological crisis and therefore it has implications for sustainability. This section is a summary of a paper that appears in the appendix. However, the findings are set in the context of more recent examinations of Earth Education research.

The final section includes a critical refelection of the research methodology and includes comments that situate this work within the methodologies employed by other work in the field. Whilst these have tended to be located within the dominant paradigm, this work has informed and developed Earth Education research on an international level, by demonstrating the value of using, in this, an interpretive methodology. Studies that have been influenced directly, include Black (1998), Tate (2001), Turner (2001), Wyatt (2001), Johnson *et al.* (2002) and Ansell (2000).

9 CONCLUSION AND RECOMMENDATIONS

The aim of this research was to produce a qualitative evaluation of the Earthkeepers program that would be a detailed exploration of conceptual development, emotional development and behaviour change. It was also the intention to investigate the potential that Earthkeepers could make to the delivery of the 5-14 Curriculum. A key concept used to evaluate this program was *internal consistency* or "Does the program do what it says it does?".

This work has shown that, in general terms, the answer to this question is "yes!". It achieved its aims in the short and long term in that it generally contributed to pupils' basic ecological understandings in the long term, though these did not display uniform development and some activities appeared much more successful than others. Some of the understandings were developed to a very high level.

However, two points are worth noting here. Although the program appears to be internally consistent, *i.e.* it does develop a basic understanding, it never clarifies what a "basic" understanding should be; it would be possible to define "basic" understanding in such a way as to make the understanding so basic that learning about it would be trivial. Furthermore, certain conceptions, accurate and otherwise, have been identified as existing at all stages of the research process. Recent research has shown that such "alternative" conceptions or "misconceptions" are endemic throughout schooling around the world and it would be a grave mistake to assume that these were a sole product of Earthkeepers. Therefore, caution should be exercised when making comparisons with other forms of nature education programs regarding conceptual development.

The program also facilitated the development of an emotional relationship with the natural world and had a significant and long-term effect on the environmental values of some of the participants. However, the program also had significant and long term effects on other aspects of pupils' attitudes, interpersonal relationships, attitudes towards schooling, emotional maturity and self-image, to name but a few.

Pupils' behaviour was also altered on a long-term basis, and although this was self-reported, the research has shown that the program can make a tangible and significant difference to CO_2 emissions, energy consumption and resource use.

It is difficult to overstate the effect that the program had on the motivation and enthusiasm of some of the participants. It is highly likely that carefully planned follow-through work in different aspects of the curriculum, but particularly English Language and Drama, contributed significantly to this.

The 5-14 curriculum (Learning and Teaching Scotland, 2000, p.3) states that the task of the school is to encourage the development of "*...informed values and attitudes towards the environment through relating their learning to the real world and themselves*". Furthermore pupils should "*...act in ways that are sensitive to environmental issues and consistent with the idea of sustainable development*". Earthkeepers is one of the few programs currently available that has demonstrated that it can encourage pupils to develop "*...different ways of looking at the world and of organising human knowledge*" (Learning and Teaching Scotland, 2000), and perhaps its use in the Scottish context should be encouraged as part of the educational provision for P5-P6/7 pupils.

9.1 RECOMMENDATIONS

The responses from pupils who participated in this research suggest a number of minor modifications that would enhance some aspects of the program. These are as follows:

- Concept Activities:

Earthkeepers activities can be seen as liberating experiences for the adults taking part yet "...babyish..." for some of the 'more mature' pupils. If the program were offered to pupils in later P5 to early P7 (at the latest) there would be less likelihood of inefficient overlap with schools' curricula and pupils considering the program as babyish. Younger groups benefited more from the program than older ones.

The program encourages pupils to think critically about resource use therefore staff should ensure that the centre models positive environmental behaviour wherever possible as younger pupils tend to have strongly developed senses of fairness. For example some pupils commented on the use of the minibus for transport to nearby locations where activities were taking place.

- General:

Guardians have an important role in ensuring that appropriate responses are completed in the training manuals. It is essential for correct reinforcing that pupils concentrate on the key understandings for each of the conceptual encounters. Inappropriate, yet typical, responses for Time Capsules include, as an answer to the question "Find something nearby that is changing", "Monkey- Man-Robots". It is the changing of the ecosphere that is important.

- Munch Line Monitors

It would be desirable to emphasise that the statement "There are more plants in the world than animals" applies to the world as a whole and not just to Ardroy Outdoor Centre.

- The Great Spectackle

Change the concept statement from "Everything is made of specks" to "Everything is made of specks and only specks."

Consider whether the personification of "specks" is necessary to retain the magic of the activity.

- Connection Inspection

The emphasis in this activity should be changed so that organisms sitting down are doing so not just because they have been killed but might perhaps be doing so because they feel an effect.

- Time Capsules

Emphasise that the change described in this activity applies to the world as a whole and not just to the Outdoor Centre.

Develop means of modelling the concept of change with an activity that is more related to the concept.

- Lessening Impact Tasks

These need explaining to be explained more fully, either at the centre or afterwards at school in order to both reinforce learning from the program and to increase the likelihood of pupils maintaining the activities.

- A range of examples of appropriate tasks should be offered/demonstrated to allow pupils more flexibility in what they decide to do, or are able to do.

- Auditing of tasks and assessment of their probable impact in terms of reduction in CO_2 emissions, energy savings or resources savings will be useful for calculating the ongoing effect of the centre's Earthkeepers program on the environment.

- Auditing of CO_2 savings etc is likely to enhance pupils' motivation and have economic benefits in terms of landfill or carbon tax rebates, which are increasingly appearing on the political agenda.

- Yourself and Sharing Tasks

It should be emphasised to pupils during the pledging session that Magic Spots should be in a natural area, or if one is not easily available then a garden or park but NOT inside!

- Follow Through

Schools should allow enough time to prepare for the Earthkeepers program, but it should be emphasised that follow through is more important.

- Earthkeepers should be integrated into the school curriculum and post-program work should be planned around Y and S activities.

- Examples of follow through may be collected from visiting schools, collated and released to other schools to share diverse and effective practice. There are many opportunities for capitalising on the learning and motivation achieved in Earthkeepers, a few of these are listed in Table 83.

Table 83: Examples of Follow Through Work Using the Context of Earthkeepers

Creative Writing, e.g.Stories, Poetry etc.
Factual Accounts/Writing for Audiences.
Use of Lessening Impact Tasks as a basis for further work in Environmental Studies, Information Communication Technology, mathematics etc by tracing energy and material use through water, soil and air cycles or energy pathways.
Presentations to Assemblies.
Drama - plays about local issues, stories about EM, local natural disasters where connections have been broken.
Providing a context for Expressive Arts work.

- Experience Activities

EM's diary is one of the most difficult activities to run effectively as it depends on a certain amount of factual knowledge of environment and ecology in order to exploit opportunities for sharing and contextualising learning as they appear. Perhaps staff leading this activity require most training in order to judge the moment when appropriate to deliver mini teaching activities.

- Role modelling

Program staff and teachers need to be aware of the importance of taking a full part in the activities, particularly with the older groups. This is to ensure that pupils appreciate that "feelings" are valid experiences for children and adults.

A further recommendation would address the concerns of some teachers who have been dissuaded from doing Earthkeepers because it does not include enough physical challenges. This could be circumvented by building in physical challenges to the Earthkeepers program. The Experience activities could be extended to cover whole afternoon sessions rather than the one and a half hours they currently are. Thus activities such as the Earthwalk could be conducted on a mountain walk or even a ghyll scramble. Likewise, Seasons could be done with two groups visiting separate locations such as a mountainside and a loch-side, with each group collecting the "flavours" of each place to bring back for someone from the other group. EM's diary could certainly incorporate greater amounts of adventure without losing the opportunity for natural exploration and learning. Some further suggestions are given in Table 84.

Table 84: Suggested Combination of Experience Activities and Adventure Activities

	EM's Diary	Earthwalk	Seasons
Mountain Walk	X	X	X
Mountain Scramble	X		
The Splosh	X	X	
Ghyll Scramble	X	X	
Shore to Shore Water based loch Journey	X	X	X
Bothy Visit	X	X	
Beachcombing		X	X

9.2 SUMMARY

This work began by posing, somewhat naively, the question "Does Earth Education work?". It implies a dichotomy; either it does and *must* be adopted wholescale or it does not and it must be *rejected.* Van Matre must bear some of the responsibility for influencing this position by his critical stance. However, schooling, in the UK at least is not renowned for its critical stance and many authors have made the claim that it is intensely conservative. Earth Education is implicitly and explicitly critical of many aspects of schooling and if it is to have a more prominent place in formal education these criticisms need to be explored in order to expose the ideology underlying competing positions. The question of whether Education is ready to address these issues in any meaningful manner, must be left for another time and place.

It is hoped that this evaluation has demonstrated that by and large, Earthkeepers is a successful program and can provide a wide variety of meaningful experiences which remain meaningful for much longer than many teachers would ever hope for.

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10 APPENDIX

APPENDIX 1:

EARTHKEEPERS AND THE 5-14 CURRICULUM

The following tables illustrate the potential coherence between Earthkeepers and the 5-14 curriculum.

Table 85: Earthkeepers and the 5-14 Curriculum: Art and Design

ART AND DESIGN
Opportunities for using Earthkeepers as a context for work in this element of the 5-14 Curriculum.

Table 86: Earthkeepers and the 5-14 Curriculum: Drama

DRAMA													
Outcomes	**Strands**	WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Using	Investigating and Experimenting	X											
	Using Movement and Mime	X											
	Using Language	X											
Expressing	Creating and designing	X					P						
	Communicating and Presenting						P	P	P	P		P	
Evaluating and Appreciating	Observing, Listening, Reflecting, Describing and Responding	P											

Key to Abbreviations

WP: Whole programme	MS: Magic Spot	C: Complete fulfilment
GS: Great Spectackle	EM: EM's Diary	P: Partial fulfilment
ML: Munchline Monitors	S: Seasons	X: Opportunities for extension of more able children, or a context for work in this element of the Curriculum
CI: Connection Inspection	YK: Y Keys	
TC: Time Capsules	SK: S Keys	
E: Earthwalk	EG: Earthkeepers Game Show	

Table 87: Earthkeepers and the 5-14 Curriculum: Music

MUSIC													
Outcomes	**Strands**	WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Using	Investigating: Exploring Sound	X											
	Using the Voice	X											
	Using Instruments	X											
Expressing	Creating and designing	X					P	P					
	Communicating and Presenting	X											
Evaluating and Appreciating	Observing, Listening, Reflecting, Describing and Responding						P	P					

Key to Abbreviations

WP: Whole programme	MS: Magic Spot	C: Complete fulfilment
GS: Great Spectackle	EM: EM's Diary	P: Partial fulfilment
ML: Munchline Monitors	S: Seasons	X: Opportunities for extension of
CI: Connection Inspection	YK: Y Keys	more able children, or a context for
TC: Time Capsules	SK: S Keys	work in this element of the
E: Earthwalk	EG: Earthkeepers Game Show	Curriculum

Table 88: Earthkeepers and the 5-14 Curriculum: Religious and Moral Education

RELIGIOUS AND MORAL EDUCATION												
	WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Personal Search												
The Natural World	C					C	C	C	C	C	C	
Relationships and Moral Values												
Ultimate Questions					P							

Key to Abbreviations

WP: Whole programme	MS: Magic Spot	C: Complete fulfilment
GS: Great Spectackle	EM: EM's Diary	P: Partial fulfilment
ML: Munchline Monitors	S: Seasons	X: Opportunities for extension of
CI: Connection Inspection	YK: Y Keys	more able children, or a context for
TC: Time Capsules	SK: S Keys	work in this element of the
E: Earthwalk	EG: Earthkeepers Game Show	Curriculum

Table 89: Earthkeepers and the 5-14 Curriculum: English

ENGLISH LANGUAGE													
Outcomes	**Strands**	WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Listening	Listening for Information, Instructions and Directions	P	P	P	P	P	P	P	P	P			
	Listening In Groups												
	Listening in Order to Respond to Texts	X					X	X	X	X	X	X	X
	Awareness of Genre												
	Knowledge about language	X											
Talking- Opportunities for using Earthkeepers as a context for work in this element of the 5-14 Curriculum.													
Reading	Reading for Information	P	P	P	P	P	P	P	P	P	P	P	
	Reading for Enjoyment												
	Reading to reflect on the Writers ideas and craft												
	Awareness of Genre												
	Reading Aloud	P	P	P	P	P	P	P	P	P	P	P	
	Knowledge about Language												
Writing	Functional Writing	X											
	Personal Writing	C					C	C	C	C			
	Imaginative Writing	C					C	C	C	C			
	Punctuation and Structure	X											
	Spelling	X											
	Handwriting and Presentation	X											
	Knowledge about Language												

Key to Abbreviations		
WP: Whole programme	MS: Magic Spot	C: Complete fulfilment
GS: Great Spectackle	EM: EM's Diary	P: Partial fulfilment
ML: Munchline Monitors	S: Seasons	X: Opportunities for extension of more able children, or a context for work in this element of the Curriculum
CI: Connection Inspection	YK: Y Keys	
TC: Time Capsules	SK: S Keys	
E: Earthwalk	EG: Earthkeepers Game Show	

Table 90: Earthkeepers and the 5-14 Curriculum: Mathematics

MATHEMATICS
Opportunities for using Earthkeepers as a context for work in this element of the 5-14 Curriculum.

Table 91: Earthkeepers and the 5-14 Curriculum: Environmental Studies

ENVIRONMENTAL STUDIES													
Outcomes	**Strands**	WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
People and Place	Using Maps	P				P			P		P	P	
	The Physical Environment	P	P	P		P				P	P	P	
	The Human Environment										P	P	
	Human Physical Interactions	C	C	C	C	C	C	C	C	C	C	C	C
Earth and Space	Earth in Space												
	Materials from the Earth		C D								C D	C D	
	Changing Materials		C								C	C	
Energy and Forces	Properties and Uses of Energy			C							C	C	
	Conversion and Transfer of Energy			C D							C D	C D	
	Forces and their Effects												
Living Things and the Processes of Life	Variety and Characteristic Features			C D							C D	C D	
	The Processes of Life			C D							C D	C D	
	Interaction of Living Things with Their Environment			C D	C D	C D					C D	C D	
Technology	Needs and How they are Met	P									P	P	
	Resources and How they are Managed	P									P	P	
	Processes and How they are Applied												

Key to Abbreviations

WP: Whole programme
GS: Great Spectackle
ML: Munchline Monitors
CI: Connection Inspection
TC: Time Capsules
E: Earthwalk
MS: Magic Spot
EM: EM's Diary

S: Seasons
YK: Y Keys
SK: S Keys
EG: Earthkeepers Game Show

C: Complete fulfilment at various levels.
P: Partial fulfilment
D: Contributes to development at a higher level
X: Opportunities for extension of more able children, or a context for work in this element of the Curriculum

APPENDIX 2

EARTHKEEPERS AND THE NATIONAL CURRICULUM

How delivery of major aspects of the National Curriculum may be effected using the Earthkeepers programme.

Martin, D.J.
Ainsworth, K.

INTRODUCTION

This article explains how the Earthkeepers programme may contribute to elements of the national curriculum. This contribution is given for the programme as a whole and also links the specific elements of the programme with the Programmes of Study. It begins with a general introduction to the programme's structure, continues with a general discussion of the many areas of agreement between Earthkeepers and the National Curriculum and concludes with detailed reference to the Programmes of Study in each subject area.

THE EARTHKEEPERS PROGRAMME

The Earthkeepers programme is designed to ask and suggest answers to three questions, "How do the ecological systems of the earth function?", "How are we personally tied into those systems in our lives?" and "How can we make changes (individually and collectively) in order to lessen our impact on those systems?" (Van Matre, 1990, p.25). Earthkeepers, a programme for children aged 10-12 years, is aimed at turning out youngsters...

"...who possess some basic ecological understandings and good feelings about

the earth and its life, and will undertake not only to live more lightly themselves, but to share their insights and behaviours with others." (Van Matre and Johnson, 1987)

It usually involves two and a half days in a residential outdoor centre followed by work at school. There should also be some preliminary work in the classroom before the programme begins (*ibid.*, 1987).

Children take part in a highly structured experience which involves three different types of activities directly related to the programme; there is the possibility that these activities could be added to by a further nine activities. The full programme involves a minimum of 17 hours of teaching/learning time. Table 92 contains details of the time allocation.

Table 92 :Time allocation for the Earthkeepers Programme

Activity	Time	Activity	Time	Activity	Time
Programme 'Glue' and 'Processing' Activities		Concept Activity		Feelings Activity	
Opening Ceremony- E.M.'s Lab	½ hour	Connection Inspection	1 ½ hour	Seasons	1 ½ hour
"Y" and "S" Tasks Pledging	¾ hour	Time Capsules	1 ½ hour	Magic Spots x 3	2 hours
Closing Ceremony- E.M.s Lab	½ hour	Great Spec-tackle	1 ½ hour	Earthwalk	1 ½ hour
"K" box	1 hour	Munchline Monitors	1 ½ hour	EM's Diary	1 ½ hour
"E" box	1 hour				
Earthkeepers game show	1 hour				

The Earthkeepers programme is described as a "*two and a half day experience for preparing to use less energy and material*'"" (Van Matre, 1990). It attempts to achieve this by using the concept building activities, the "Feeling Component" activities and the "Processing Component" activities.

- Concept building activities include "Munchline Monitors" (Food Chains), "Great Spec-tackle" (Soil, Air and Water Cycles), "Connection Inspection" (Interrelationships) and "Time Capsules" (Change).
- The "Feeling Component" activities include "Magic Spots" (Solitude and

Reflection), "E.M.'s Diary" (Discovery and Adventure), "Earthwalk" (Observation) and "Seasons" (Immersion).

- The "Processing Component" activities comprise "Earthkeepers Game Show" (A lively quiz which reinforces learning outcomes and rewards the learners), "Closing Ceremony", "Pledging" (Recording of promises to alter environmental "bad" habits), and "Y and S Tasks" (Continuation of individual and independent natural world based discovery and learning, and the sharing of this with another person).

SPIRAL CURRICULUM

The new National Curriculum 2000 is an example of an integrated, spiral curriculum where ideas, theories, issues, topics and skills are revisited throughout a child's education. The Earthkeepers programme provides a basic understanding of some complex curriculum areas that can, in some cases, underpin and inform learning up to level 7/8 (i.e. the simplified theory of energy and matter conservation in Science or the recognition of humans' responsibility for their actions regarding the environment in Geography). This means that the knowledge, skills and understanding gained through the programme will be relevant for both current and future learning. For example research has shown (Martin, 2002a) that whilst most children develop a simple understanding of feeding relationships from Earthkeepers (AT2: Level 4) and that this evolves further throughout the child's schooling, some achieve a complex and sophisticated understanding of food webs, food chains and population sizes (AT2: Level 7) immediately after the programme.

PROMOTION OF VALUES

The statement of values in the National Curriculum is generally agreed to reflect the common values of society and that these values should therefore form the basis of a school's ethos and teaching (DfEE/QCA, 1999c).

The set of values concerning 'The Environment' is completely supported by the Earthkeepers programme. For example, issues such as the need for balance and diversity in nature are addressed in the activities 'Munch Line Monitors' and 'Connection Inspection'. Parts of the 'Self' and 'Society' values are inherent in the post-programme 'Y' and 'S' key tasks. Here children consider the effects of their own actions on the environment and take responsibility for them. They are also required to work co-operatively with others, which contributes to the building of interpersonal relationships.

KEY SKILLS

There are four main types of 'skills' addressed within the curriculum; those that are subject specific, those that are common to several subjects, universal skills (i.e. creative thinking) and the Key Skills (communication; application of number; IT; working with others; improving own learning and performance; problem solving).

The Earthkeepers programme provides an excellent context for the development of all these skills. Earthkeepers's strongest contribution to the Key Skills aspect of the National Curriculum would be made during the centre-based part of the programme, and would comprise communication and working with others.

EDUCATION FOR SUSTAINABLE DEVELOPMENT

"Education for Sustainable Development enables pupils to develop the knowledge, skills, understanding and values to participate in decisions about the way we do things individually and collectively, both locally and globally, that will improve the quality of life now without damaging the planet for the future." (DfEE/QCA 1999b).

Earthkeepers completely supports this statement.

LITERACY

Earthkeepers provides opportunities for Shared/Guided Reading, Independent Writing and Speaking and Listening opportunities within the programme. Research has also shown that there are many possibilities for developing Extended and Independent Writing within the follow-up work.

INCLUSION AND EQUAL OPPORTUNITIES

Participation in the Earthkeepers programme should be achievable for all children. The programme is largely based on learning through experience and the senses in a variety of engaging outdoor activities that are highly motivational. It requires very little written work and any recording can be done equally well through symbols or drawings. In this respect, the programme can be tailored to suit most special educational needs.

ENGLISH

Key Stage 2 and 3

Earthkeepers presents children with the opportunity to work in groups of varying sizes where they are required to solve intellectual and physical problems by discussion with their peers (En1:3a,c,d). These situations vary according to purpose and audience and children are presented with the opportunity of using various forms of speech (En1:3b). The programme could also be used to provide a rich context for drama work (En1:4a-d).

During the programme pupils are required to read a range of materials and interpret and respond to their meaning. Appropriate pre-visit planning would normally include reading for information (En2:3a-g) and the use of non-literary or non-fiction sources such as print and ICT-based reference materials, newspapers, magazines and articles (En2:9b,c). This could be extended after the centre visit.

Earthkeepers provides pupils with experiences, which may be used as a context for composition (En3:2a-f). Such composition would involve a range of styles of writing including the exploration of feelings and ideas (En3:9a), explanation of concepts (En3:9b) and the formation of a persuasive argument (En3:9c). Writing may be produced for a range of audiences (En3:11) and the programme is noted as being particularly useful for providing a context for the production of a range of imaginative and expressive writing forms (En3:12).

Table 93: Earthkeepers and the English National Curriculum

ENGLISH														
P.o.S.			WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Key Stage 2														
En1: Speaking and Listening	Group Discussion & Interaction	3a	P, X			P		P, X	P, X	P, X	P, X			P
		3c	X			P								P
		3d	X			P								P
	Drama	4a-d	X	X	X	X	X	X	X	X	X	X	X	
Breadth of Study (B.o.S): Speaking		8a	P	P	P	P	P	P	P	P	P			
B.o. S: Listening		9c	P	P	P	P	P	P	P	P	P			
B.o. S: Discussion		10a,b	X					X	X	X	X	X	X	
		10c	X											C
	B.o. S: Drama	11a-c	X											
En2: Reading	Reading for Information.	3a-g	X											
		9b,c	P											
En3: Writing	Planning and Drafting	2a-f	X											
	B.o.S.	9a	X					X	X	X	X			
		9b	X	X	X	X	X							
		9c	X									X	X	
		11	X											
		12	X											

Key to Abbreviations

WP: Whole programme	S: Seasons	C: Complete fulfilment of PoS
GS: Great Spectackle	YK: Y Keys	P: Partial fulfilment of PoS
ML: Munchline Monitors	SK: S Keys	D: Contributes to development at a higher level
CI: Connection Inspection	EG: Earthkeepers Game Show	X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.
TC: Time Capsules		
E: Earthwalk	P.o.S.: Programme of Study	
MS: Magic Spot	B.o.S.: Breadth of Study	
EM: EM's Diary		

SCIENCE

Key Stage 2

Elements of the KS 2 P.o.S. which are *completely fulfilled (marked "C" in the* Table) by Earthkeepers are KS2:Sc2:5e,f, where pupils should be taught "...to use food chains to show feeding relationships in a habitat (...and...) about how nearly all food chains start with a green plant" (DFEE/QCA, 1999a). Some elements of Sc1 are partially addressed (marked "P" in the Table) by the programme, for example where Earthkeepers provides explanations which assist the pupil to understand cause and effect relationships between human behaviour and environmental problems. Many other elements of Sc2 are partially addressed by the programme such as Life Processes (1a-c) and Living Things in their Environment (5a-c). Earthkeepers also provides a basis for learning in other areas and offers a range of experiences of the growth and nutrition requirements of plants and animals for example (marked "D" in the Table). The programme also provides a rich context for the development of other areas of the P.o.S. or opportunities for extending the most able (marked "D" in the Table), which will be dictated by the teacher; for example Sc1 investigations may be planned around the topic of the environment using comparisons between the centre and school environments (Sc1:2a-m).

Key Stage 3

As with Key Stage 2, elements of the National Curriculum at Key Stage 3 are also addressed by the Earthkeepers programme. For example, the programme provides simplified theory and examples of energy (Sc4:5d-g) and matter (Sc3:2a) conservation at an early stage in the pupils' learning. Whilst research has shown that the most able pupils retain a firm grasp of these fundamental scientific concepts up to two years after the programme's completion, other pupils have illustrative examples of energy and matter conservation with which they make links, when they receive formal instruction in the normal course of their schooling.

Table 94: Earthkeepers and the Science National Curriculum

SCIENCE															
P.o.S.			WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Key Stage 2															
Sc1: Scientific Enquiry	Ideas and Evidence	1a	P	P	P	P						P	X	
	Investigative Skills	2a-m	X	X	X	X	X						X	
Sc2: Life Processes and Living Things	Life Processes	1a-c	P, D	P	P	P							X	P
	Green Plants	3a	P, D	P, D	P, D								X	P
		3b	P, D	P, D	P, D								X	P
		3c	P	P	P	P							X	P
Living Things in their Env.		5a	P	P	P	P	P					P	X	P
		5b	P	P	P	P	P						X	P
		5c	P											
		5d	C	C	C	C						X	X	P
		5e	C	C	C	C						X	X	P
Sc3: Materials and Properties	Changing Materials	2d	P	P								X	X	P
		2e	P	P			P					X	X	P
Breadth of Study		1a	X											
		1d	X									X	X	
		2a,b	X									X	X	
Key Stage 3															
Sc1: Scientific Enquiry		1-2	X									X	X	
Sc2: Life Procs	Green Plants as Organisms	3a	P	P	P	P						P	P	P
	Living Things in Their Env.	5a	P	D	D	D	D	P	P	P	P	P		P
		5b				P								P
		5c					D							
		5d			D									
		5e			P	P								P
		5f		P		P								P
Sc3: Materials & Properties	Solids, liquids & Gases.	1b		P										
Changing Materials		2a		D			D							
		2e					D							
		2i	P			P						P		P
Sc4: Physical Processes	Energy Resources	5a	X									X	X	
		5b	P				D							P
		5c										X	X	
		5d-g	P		D									P
Breadth of Study		1a	X									X	X	
		1c	X									X	X	

Key to Abbreviations

WP: Whole programme GS: Great Spectackle ML: Munchline Monitors CI: Connection Inspection TC: Time Capsules E: Earthwalk MS: Magic Spot EM: EM's Diary	S: Seasons YK: Y Keys SK: S Keys EG: Earthkeepers Game Show P.o.S.: Programme of Study B.o.S.: Breadth of Study	C: Complete fulfilment of PoS P: Partial fulfilment of PoS D: Contributes to development at a higher level X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.

MATHEMATICS

Key Stage 2

The Earthkeepers programme might not normally be considered to have much relevance for the mathematics national curriculum. However, the mathematics curriculum should be delivered in such a way as to provide pupils with the opportunity to "... explore features of shape and space and develop their measuring skills in a range of contexts". Furthermore, pupils should "...be taught the Knowledge, skills and understanding through (...) using mathematics in their work in other subjects." (B.o.S.:1h). Earthkeepers is an excellent programme for encouraging pupils to engage with numbers and calculations (Ma2:1b-i, 3a-k), the application of mathematics in order to solve various problems (Ma2:4a-d), and make estimations.

Table 95: Earthkeepers and the Mathematics National Curriculum

MATHEMATICS														
P.o.S.			WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Key Stage 2														
Ma2: Number.	Using & Applying Number	1b-i	X									X	X	
	Calculations	3a-k	X									X	X	
Solving Numerical Problems		4a-d	X									X	X	
Ma3: Shape, Space and Measures	Using and Applying Shape	1a	X									X	X	
	Understanding Measures	4a,b	X									X	X	
Ma4 Handling Data	Using and Applying Handling Data	1a-h	X									X	X	
Processing, Representing and Interpreting Data		2a-f	X									X	X	
B.o.S		1a–h	X									X	X	

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GEOGRAPHY

Key Stage 2

At Key Stage 2, Earthkeepers provides direct links to the Geography curriculum. The conceptual activities 'Munch Line Monitors' and 'Connection Inspection' introduce children to the understanding that people can both improve and damage the environment (5a) and therefore suggest why people may seek to manage environments sustainably (5b). These areas also underpin developmental work at a higher level where children are expected to, 'recognise that human actions, including their own, may have unintended environmental consequences' (A.T. Level 7).

Other strengths of the Earthkeepers programme include the conceptual activity 'Time Capsules'. In this activity, children use maps (2c) to find hidden boxes and then examine their contents to help identify reasons why landscapes and places change over long periods of time (1a; 3d,e; 4a,b). Part of the 'S' key task could also require the drawing and use of maps (2e).

The whole programme can also be used to provide a basis for the environmental issue theme in the Breadth of study (6e). There is great scope for school-based extension work as Earthkeepers provides a context for the appropriate communication of information (including through the use of ICT) and viewpoints based upon decisions made by the pupils (1d,e; 2g).

Key Stage 3

Many areas of Geographical Enquiry work at Key Stage 3 can be accomplished through the context of Earthkeepers. These are very similar to those covered at Key Stage 2 (not fulfilled as completely) as the underlying concepts are the same at both key stages. The main difference is that the programme addresses ecosystem, environmental and resource issues (three themes from the B.o.S.) although this is generally at a conceptual, rather than specific, level (6e,j,k).

Table 96: Earthkeepers and the Geography National Curriculum

GEOGRAPHY P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 2													
Geographical enquiry and skills	1a					P	X	X	X		X		
	1d	X											
	1e										X	X	
	2c	P				P			P			X	
	2e											P	
	2g											X	
Knowledge and understanding of places	3d					X							
	3e	X				P,X							
	3g					X							
Knowledge and understanding of patterns and processes	4a,b					P							
Knowledge and understanding of environmental change and sustainable development.	5a	C, D	C, D	C, D	C, D						X, D	X	
	5b	P, D		C, D	C, D						X	X	
B.o.S	6e			X	X						X	X	
	7a-b			X	X						X	X	
KEY STAGE 3													
Geographical enquiry	1a					X							
	1b-e	X											
	1f											X	
	2c	P				P			P			X	
	2e											P	
	2f	X											
Knowledge and understanding of places	3c										X	X	
	3d					X							
Knowledge / understanding of patterns and processes	4b					P							
Knowledge / understanding of environmental change and sustainable development	5a,b	D, X	D	D	D						X, D	X	
B.o.S	6e			P	P								
	6j	X		P	P								
	6k	X	X								P,X		
	7a-d	X	X	X	X						X		

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HISTORY

Key Stage 2

The link to the History P.o.S from Earthkeepers is made through the activity 'Time Capsules'. The children find hidden boxes containing evidence from different periods of History and have to organise them in the correct order on the timeshelves (1a; 5a). They then explain the contents of their box and their reasons for choosing that time period to the rest of the group using appropriate language (1b; 5b). By tracing the progression of a 'speck' of matter through the timeshelves, the children learn about how things change through time. School-based follow up work could build on this aspect of the programme and use it as a context to help them communicate their knowledge and understanding of history in a variety of ways (5c). The study may focus on long-term changes in the local area and information to support this type of enquiry could be obtained from a number of sources, including those that are ICT based (2c; 4a,b).

Key Stage 3

At Key Stage 3, the 'Time Capsules' activity provides a sound basis for chronological understanding and a useful context for a study of the recent and more distant past (1; 5a-c;7a,e).

Table 97: Earthkeepers and the History National Curriculum

HISTORY													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 2													
Chronological understanding	1a,b					P							
Knowledge and understanding of events, people and changes in the past	2c					X							
Historical enquiry	4a-b					X							
Organisation and communication	5a,b					P							
	5c					X							
B.o.S	7					X							
KEY STAGE 3													
Chronological understanding	1					X							
Organisation and communication	5a-c					X							
B.o.S	7a,e					X							

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ART AND DESIGN

Key Stage 2 & 3

Earthkeepers provides children with many chances to experience the natural world. These experiences, recorded in various ways during the programme, provide an excellent range of first-hand visual ideas or starting points for practical work at school (1a,c; 5a). The scope for follow-up work based upon Earthkeepers is wide and only really limited by time, materials and imagination! Clear links could be made through the investigation of the properties and uses of different materials or the variety of methods and approaches available to communicate ideas (1b; 2a-c; 4a; 5c). Work could be completed individually or in collaboration with other members of the group (5b).

Table 98: Earthkeepers and the Art and Design National Curriculum

ART AND DESIGN													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 2 & 3													
Exploring and developing ideas	1a-c	X					X	X	X	X	X	X	
Investigating and making art, craft and design	2a												
	2b											X	
	2c	X					P	P		P		P	
Knowledge and understanding	4a						X					X	
	5a	X					P, X	P, X	X	X		X	
B.o.S	5b,c	X										X	

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PHYSICAL EDUCATION

Key Stage 2

Perhaps the most obvious opportunities presented by the Earthkeepers programme can be found in Outdoor and Adventurous Activities element of P.o.S. (11a-c). To completely fulfil these aspects the programme requires pupils to follow trails in unfamiliar and changing environments (11a). Pairs of pupils also use a map to locate and uncover a "Time Capsule" thereby using orienteering skills (11b). As groupwork is a feature of many of the programme's activities, often when presented with mental and physical challenge, co-operation and communication skills are addressed (11c).

Physical challenges, involving exploration of a natural or countryside area, could be undertaken by the pupils in order for them to complete the programme. Thus further links between the P.o.S. (11a) exist for pupils who choose to complete the programme by taking part in outdoor activity challenges unfamiliar environments.

Much of the Earthkeepers programme is aimed at providing multi-sense, stimulating learning experiences. These have provided a context for pupils to develop self expression through the medium of Dance (6a).

Key Stage 3

Elements of Earthkeepers contribute to the development of map reading and following skills (11b) albeit at a simple level. These skills may be honed at Key Stage 3. Furthermore there is the potential for pupils to develop this aspect of their learning in their own time.

Table 99: Earthkeepers and the Physical Education National Curriculum

PHYSICAL EDUCATION													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Key Stage 2													
Dance Activities	6a	X	X	X	X	X	X		X	X			
Outdoor and Adv. Activities	11a								C		X	X	
	11b					P			P				
	11c	P				P			P			C	
Key Stage 3													
Outdoor and Adv. Activities.	11b					D			P			X,P	

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DESIGN AND TECHNOLOGY

Key Stage 2 and 3

The two main aspects of the Design and Technology curriculum that may be addressed by the Earthkeepers programme involve the pupils in making equipment for the communication of concepts to peers, and in the evaluation of processes and products. Post-centre work could involve pupils in developing, planning and communicating ideas (1b-d), and working with tools, equipment, materials and components to make equipment (2a-f) which should be based upon a knowledge and understanding of materials (4a,b). Pupils could also begin the evaluation of processes and products (3a-c) using not only design considerations which may involve product testing, but also using environmental considerations. Environmental evaluations would be based upon concepts first addressed during the programme.

Table 100: Earthkeepers and the Design and Technology National Curriculum

DESIGN AND TECHNOLOGY													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Key Stage 2													
Developing, Planning And Communicating Ideas	1b-d	X										X	
Working with Tools, etc	2a-f	X										X	
Evaluating Processes & Products	3a	X										X	
	3c	P	D		D							P	
Knowledge and Understanding of Materials	4a,4b	X										X	
Key Stage 3													
Evaluating Processes & Products	3c	P	D		D							P	

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INFORMATION AND COMMUNICATION TECHNOLOGY

Key Stage 2 & 3

The Information and Communication Technology curriculum can be very usefully enhanced by the context provided by the Earthkeepers programme. Furthermore certain aspects of the programme would perhaps be most easily accomplished by a school which had access to library, encyclopaedia or internet facilities (1a-c). Follow-up work could be accomplished using various other aspects of ICT, apart from merely using ICT to produce and present pupils work. For example, environmental projects could be enhanced using remote sensing and controlling equipment (2b); simulation software such as SimCity 2000 or SimLife could be used to teach pupils about society's needs (2b); spreadsheets could be used to monitor the effects of pupils' behaviour upon the environment (2c). Because Earthkeepers is produced by an international organisation, opportunities exist for sharing information with schools all over the U.K. and the world via e-mail and the internet. Pupils could produce information for sharing with a national or international audience (3a,b; 5a,b).

One of Earthkeepers many benefits is that it can produce highly motivated learners who are willing to work in their own time on personal projects and so attainment may be guided through KS2 to KS3 and beyond with the most able.

Table 101: Earthkeepers and the Information and Communication Technology National Curriculum

INFORMATION AND COMMUNICATION TECHNOLOGY													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
Key Stage 2													
Finding Things Out	1a-c	X									X	X	
Developing Ideas...	2a-c	X									X	X	
Exchanging and Sharing Info.	3a-b	X									X	X	
Reviewing, Modifying and Evaluating	4a,c	X									X	X	
B.o.S.	5a,b	X									X		
Key Stage 3													
Finding things out	1b,c	X									X	X	
Developing ideas...	2a,c	X									X	X	
Exchanging and sharing information	3a-c	X									X	X	

Key to Abbreviations

WP: Whole programme GS: Great Spectackle ML: Munchline Monitors CI: Connection Inspection TC: Time Capsules E: Earthwalk MS: Magic Spot EM: EM's Diary	S: Seasons YK: Y Keys SK: S Keys EG: Earthkeepers Game Show P.o.S.: Programme of Study B.o.S.: Breadth of Study	C: Complete fulfilment of PoS P: Partial fulfilment of PoS D: Contributes to development at a higher level X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.

MUSIC

Key Stage 2 & 3

Although there are no direct links between Music and the Earthkeepers programme, it does provide a rich and diverse range of stimuli that could inform follow-up work. Children's experiences in the natural world and throughout the programme would be an ideal non-musical starting point for individual, group or class work (5b,c). They will have the opportunity to develop an awareness of sounds in the world around them that could form the basis of work focused on the musical elements or composition (4a,b; 5a).

Table 102: Earthkeepers and the Music National Curriculum

MUSIC													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 2													
Listening, and applying knowledge and understanding	4a						X	X	X	X	X		
	4b						X	X	X	X	X		
B.o.S	5a-d	X											
KEY STAGE 3													
B.o.S	5a-d	X											

Key to Abbreviations		
WP: Whole programme GS: Great Spectackle ML: Munchline Monitors CI: Connection Inspection TC: Time Capsules E: Earthwalk MS: Magic Spot EM: EM's Diary	S: Seasons YK: Y Keys SK: S Keys EG: Earthkeepers Game Show P.o.S.: Programme of Study B.o.S.: Breadth of Study	C: Complete fulfilment of PoS P: Partial fulfilment of PoS D: Contributes to development at a higher level X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.

MODERN FOREIGN LANGUAGES

Key Stage 3

As an internationally run programme, participation in Earthkeepers encourages the understanding of being a citizen of the world as well as of the UK. The major branch co-ordinators of participating countries (i.e. Germany, Holland, Italy, Canada etc.) may be able to help teachers establish links with other schools or centres. Through follow up work towards earning the 'Y' and 'S' keys, it provides the ideal opportunity for work with authentic materials and for communication with native speakers in the target language (especially through ICT-based resources) for a real purpose (4a,b; 5e,h). Within this, there would be scope for children to, 'use the target language creatively and imaginatively' (DfEE/QCA 1999f) (5f) to express and discuss their personal feelings and opinions (5c) about the issues raised through the programme. This level of communication with other schools or centres involved in Earthkeepers could satisfy part of A.T. 4 (Writing) up to Level 8.

Table 103: Earthkeepers and the Modern Foreign Languages National Curriculum

MODERN FOREIGN LANGUAGES													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 3													
Developing cultural awareness	4a-d	X									X	X	
B.o.S	5c-i	D, X									X	X	

Key to Abbreviations

WP: Whole programme	S: Seasons	C: Complete fulfilment of PoS
GS: Great Spectackle	YK: Y Keys	P: Partial fulfilment of PoS
ML: Munchline Monitors	SK: S Keys	D: Contributes to development at a higher level
CI: Connection Inspection	EG: Earthkeepers Game Show	X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.
TC: Time Capsules		
E: Earthwalk	P.o.S.: Programme of Study	
MS: Magic Spot	B.o.S.: Breadth of Study	
EM: EM's Diary		

CITIZENSHIP

Key Stage 3

Earthkeepers provides an ideal framework for involving many aspects of Citizenship, especially through the completion of the 'Y' and 'S' key tasks. The programme can be used as a context for participation in both school and community-based activities (3b,c) through topical environmental issues that would require the pupils to research and communicate various opinions, including their own (2a-c). The nature of Earthkeepers involves the focus on global environmental issues that can begin to be tackled at a local and personal level, encouraging participation and responsible action (3a-c).

Table 104: Earthkeepers and Citizenship

CITIZENSHIP – Statutory from August 2002													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 3													
Knowledge and understanding about becoming informed citizens	1f,i	X									X	X	
Developing skills of enquiry and communication	2a-c	X									X	X	
Developing skills of participation and responsible action	3a-c	X									X	X	

Key to Abbreviations

WP: Whole programme GS: Great Spectackle ML: Munchline Monitors CI: Connection Inspection TC: Time Capsules E: Earthwalk MS: Magic Spot EM: EM's Diary	S: Seasons YK: Y Keys SK: S Keys EG: Earthkeepers Game Show P.o.S.: Programme of Study B.o.S.: Breadth of Study	C: Complete fulfilment of PoS P: Partial fulfilment of PoS D: Contributes to development at a higher level X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.

NON-STATUTORY CURRICULUM AREAS

MODERN FOREIGN LANGUAGES

Key Stage 2

As an internationally run programme, participation in the Earthkeepers encourages the understanding of being a citizen of the world as well as of the UK. The major branch co-ordinators of participating countries (i.e. Germany, Holland, Italy, Canada etc.) may be able to help teachers establish links with other schools or centres. Through follow up work towards earning the 'Y' and 'S' keys, it provides the ideal opportunity for work with authentic materials and for communication with native speakers in the target language (especially through ICT-based resources) for a real purpose (2a-c; 3g). Within this, there would be scope to, 'use their knowledge of the language creatively and imaginatively' (DfEE/QCA 1999f) (3f) to express and discuss personal feelings and opinions about the issues raised through the programme. This level of communication with other schools or centres involved in Earthkeepers could satisfy part of A.T. 4 (Writing) up to Level 8.

Table 105: Earthkeepers and Modern Foreign Languages (Non Statutory)

MODERN FOREIGN LANGUAGES												
P.o.S.	WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 2												
Understanding and using the foreign language 2a-c	X									X	X	
3f,g	X									X	X	

Key to Abbreviations		
WP: Whole programme GS: Great Spectackle ML: Munchline Monitors CI: Connection Inspection TC: Time Capsules E: Earthwalk MS: Magic Spot EM: EM's Diary	S: Seasons YK: Y Keys SK: S Keys EG: Earthkeepers Game Show P.o.S.: Programme of Study B.o.S.: Breadth of Study	C: Complete fulfilment of PoS P: Partial fulfilment of PoS D: Contributes to development at a higher level X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.

PSHE AND CITIZENSHIP

Key Stage 2

Explicit within the post-programme Earthkeepers material ('Y' and 'S' key tasks) is the opportunity for pupils to make real decisions and choices to take a positive and responsible role in lessening their impact upon the earth's natural resources (1a,c; 2j; 5a,b,d). This work could easily be extended using Earthkeepers as a context as it provides an ideal framework for involving many aspects of PSHE and Citizenship. The programme can be used as a context for participation in school and community-based activities (2d) through topical environmental issues that would require the pupils to research and communicate various opinions, including their own (5c,h). This would provide ideal opportunities for involvement with community members and groups (2h; 5e).

The nature of Earthkeepers involves the focus on global environmental issues that can begin to be tackled at a local or personal level, encouraging participation and responsible action (2e,f; 4a). Through contact with other school and training centres involved in the Earthkeepers programme both nationally and world-wide (i.e. Germany, Holland, Italy, U.S.A., Canada, Australia etc.), relationships with other children could be developed through a variety of media (5f).

Table 106: Earthkeepers and PSHE and Citizenship (Non Statutory)

PSHE AND CITIZENSHIP													
P.o.S.		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
KEY STAGE 2													
Developing confidence and responsibility and making the most of their abilities	1a,c	X									P	X	
Preparing to play an active role as citizens	2a,b,d-f,h,k	X									X	X	
	2j										P	X	
Developing good relationships and respecting the differences between people	4a	X									X		
B.o.O	5a,b,d										P	X	
	5c,e,f,h	X									X	X	

Key to Abbreviations

WP: Whole programme GS: Great Spectackle ML: Munchline Monitors CI: Connection Inspection TC: Time Capsules E: Earthwalk MS: Magic Spot EM: EM's Diary	S: Seasons YK: Y Keys SK: S Keys EG: Earthkeepers Game Show P.o.S.: Programme of Study B.o.O.: Breadth of Opportunities	C: Complete fulfilment of PoS P: Partial fulfilment of PoS D: Contributes to development at a higher level X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.

PSHE

Key Stage 3

Explicit within the post-programme Earthkeepers material (i.e. 'Y' and 'S' key tasks) is the opportunity for pupils to make real decisions and choices to take a positive and responsible role in lessening their impact upon the earth's natural resources (4a-d,g). Issues arising from the programme may encourage pupils to find information, or work with people in the community, in order to understand them more fully (4e,h). Through contact with other school and training centres involved in the Earthkeepers programme both nationally and world-wide (i.e. Germany, Holland, Italy, U.S.A., Canada, Australia etc.), relationships with other children could also be developed through a variety of media (4f).

Table 107: Earthkeepers and PSHE (Non Statutory)

PSHE														
P.o.S. KEY STAGE 3		WP	GS	ML	CI	TC	E	MS	EM	S	YK	SK	EG
B.o.O	4a-f,h	X											
	4g	X									P		

Key to Abbreviations

WP: Whole programme GS: Great Spectackle ML: Munchline Monitors CI: Connection Inspection TC: Time Capsules E: Earthwalk MS: Magic Spot EM: EM's Diary	S: Seasons YK: Y Keys SK: S Keys EG: Earthkeepers Game Show P.o.S.: Programme of Study B.o.O.: Breadth of Opportunities	C: Complete fulfilment of PoS P: Partial fulfilment of PoS D: Contributes to development at a higher level X: Opportunities for extension of more able children, or a context for work in this element of the P.o.S.

APPENDIX 3

1 THE IMPACT OF PLEDGES

The effect of a personal lifestyle on the environment *is difficult to assess* accurately without collecting detailed information about a large number of people. Consequently it is even more difficult to assess the change in impact as a result of a *change* in personal behaviour. Although such detailed assessments are outwith the scope of this study, it would seem valuable to make an attempt to estimate the likely impact of the participants' pledges to change their behaviour. Such an estimate is valuable when considering the contribution of the programme to sustainability education and Agenda 21 issues which are becoming increasingly important.

1.1 TABULATION OF DATA

The following tables were created using the "Pledge Sheets" completed by 381 pupils attending the programme from February 1996 to February 1999. They include the results from the two primary schools involved in the research project. Although there are a total of 777 pledges there should be 762 (two per pupil). This discrepancy is due to some pupils writing down three or more pledges, whilst others wrote down one or left this section blank.

The columns have been arranged to show the Pledge first, followed by Type, Type (prob), Level and Number.

Pledge refers to the pupils' environmental tasks. Accurate recording of the variety of these has been attempted and they are represented in the tables as they appear on the sheets. Occasionally the grammar or spelling has been clarified, the sentence shortened or the statement generalised, e.g. pupil's promises to "Switch tv off', "Don't leave things on stand bye" and "Stop leaving computer on" were recorded as "Turn off at plugs" in the table; furthermore "Don't watch T.V. too much", "Read a book instead of watching T.V.", and "Play on my computer less" were recorded as "Use appliances less".

Pledges were then categorised into **Type** according to the programme material. The types were...

ALU	Recycling of aluminium cans.
ELE	Using less electricity.
HEA	Conserving heat, or using less.
PAP	Using less paper.
TRA	Using powered, private transportation less.
WAT	Conservation of water supplies.
OTHER	These refer to activities not explicitly mentioned by the training manual.
REC	Recycling of material other than aluminium.

This categorisation was performed to facilitate a quantitative estimate of the effect of the programme.

Where pledges were seen to belong to the OTHER category yet could probably be put in an already existing category, these were re-labelled in the column **Type (prob)**. These are only *probable* category allocations because it wasn't possible to check these allocations with interviews as it was with the research participants.

Analysis was further facilitated by labelling the pledges **B** or **G**. These labels show whether the pledge is concerned with specific behaviour or a general type of activity, respectively. Thus "Recycling Cans" is a specific statement about behaviour whereas "Aluminium" is a very general statement about the type. Both statements have been interpreted as indications that the pupil will "recycle aluminium cans". The validity of this assumption is drawn from observations of the programme during which, pupils were sometimes encouraged to write down one word to summarise their pledges.

The following tables and notes form an attempt to quantify the effect of the programme on the consumption of energy and raw materials. Where figures were available, CO_2 emission equivalents have also been given.

1.2 ANALYSIS METHODS

Various techniques were used in order to make estimates of the impact of the programme. These have been described below.

1.2.1 LITERATURE

Firstly, a search of literature was conducted which examined energy and resource management journals. Figures concerning electrical energy consumption were gathered in this way. These figures were used to establish a daily or weekly consumption value from which an estimate of the likely saving in energy or materials was made.

1.2.2 INTERNET RESOURCES

The internet was used to provide information about water consumption (North West Water), to provide census data about family sizes for example (British Government's Statistical Service), to provide figures concerning CO_2 emission (London Research Centre) or petrol consumption of an average car in an urban environment (TSO).

1.2.3 MEASUREMENT

Where no data were available from the literature the impact of the activity was estimated by measuring its resource consumption in the laboratory, for example the amount of water used when brushing one's teeth. Assumptions were then made about the duration and frequency of the activity, the annual figures being calculated and extrapolated from these. The symbol $_m$ appears where this kind of approach has been taken.

Electricity consumption figures were obtained either by using the power rating of the device, or by measuring the power consumption with a joule meter.

1.2.4 INTERPRETATION OF PLEDGES

Where the pupil's statement referred to the resource to be conserved e.g. "Electricity" or "...use less electricity..." rather than a specific behaviour or activity, an assumption had to be made about the activity the pupil was promising to do. This assumption was based on the discussions that took place when the promises were made and on interviews with pupils, both of which tended to indicate that when pupils wrote down general statements rather than specific behaviours they were referring to the specific activity mentioned by the programme material under general headings such as "Heat", "Electricity" or "Water" etc.

Where statements didn't seem to refer directly to resources to be conserved, or to a specific behaviour or activity, an attempt was made to fit them into an existing type of activity in order that their effect might be quantified.

Some of these estimates will be more accurate than others. For example an estimate of the amount of water saved by placing "...a brick in a toilet cistern..." is likely to be more accurate than an estimate for the amount of electricity saved by a pupil who promises to "...use less electricity".

1.3 CAVEATS

1.3.1 ENVIRONMENTAL TASKS- SINGLE ISSUES VERSUS MULTIPLE EFFECTS

It should not be inferred that consumption of energy or materials, or the production of CO_2 are the *only environmental* effects of the activities mentioned below. Any human activity has a wide range of effects on the environment and rarely can these be reduced to single issues such as resource consumption. Rather, these estimates are an attempt to evaluate the effect of the programme on the environment *in the stated terms of the programme* i.e. the lessening impact tasks tend to be linked to the environment by simplistic routes. Thus, reducing paper consumption will stop trees and forests being cut down needlessly; recycling aluminium cans will prevent a build-up of rubbish and litter; switching off lights will save electricity. The activities' effects are quantified in terms of what they will save in terms of materials or resources except with transportation where figures for CO_2 have been included as pupils often mentioned "pollution" as one of the reasons for cutting down on the use of cars.

1.3.2 DEGREE OF SPECIFICITY

For some of the environmental tasks it is particularly difficult to estimate the changes in the consumption of energy or material for various reasons. This is dependent on...

...the way in which the activity is described, from being a highly specific description of the activity to being a general statement about the "area" the task is concerned with (Heat, Water, Electricity etc.).

...the type of activity described, either likely to produce a measured effect each time it's carried out ("brick in toilet cistern") or something which will vary depending upon its duration or frequency ("turning lights off when not in room").

Because the pupils' pledges varied, estimates have been on the conservative side. All assumptions made during analysis have been stated after each table of results so that the reader can assess the value of making such quantitative estimates from such variable pledges.

1.3.3 APPLICATION OF LITERATURE TO THIS STUDY

The sources quoted below were concerned with areas other than Scotland, being set in the English, British and Slovenian context. The validity of the application of these figures to the Scottish context is uncertain and given the dearth of work in this area, will remain so.

1.3.4 OTHER ASSUMPTIONS

In making these estimates it has been assumed that...

...environmental tasks were carried out for one year by all of the pupils with none dropping out or performing them intermittently.

...pupils weren't already doing these activities as part of their lifestyle. This would seem an appropriate assumption because pupils often justified their choice of an obscure environmental task by referring to the fact that they already did the others.

...the programme has been solely responsible for the pupil carrying out these activities. The effect of any previous encouragement to perform these activities has been ignored.

1.3.5 AMBIGUOUS PLEDGES

Some pledges were unclear, confused, too general, or involved too few pupils to make analysis worthwhile. The overall effect on the final results will be minimal.

Such data have been shaded in the table and the numbers of pupils involved have been subtracted from every total.

Although it would have been possible to estimate the effect of recycling in its various forms (a popular choice- 28 pupils pledged to recycle things) the degree of choice the child has regarding this activity is likely to be limited as recycling often requires the co-ordinated efforts of several groups of people, be they parents, teachers or the local council. Therefore an estimate of this was difficult as each child would have access to highly variable recycling facilities.

Aluminium

Table 108: Estimate of the amount of aluminium saved annually

Pledge	Type	Type (Prob)	Level	Number of pupils
Recycle Cans	ALU		B	9
Recycle Aluminium	ALU		B	8
Aluminium	ALU		G	28
Recycle(General)	NEW	ALU	G	16
		Total		**61**

If it is assumed that each pupil uses and recycles one aluminium can per day then daily and annual totals can be estimated thus...

No. of cans recycled per day	61
No. of cans recycled per year	22,326
Weight of Al recycled per year if each can weighs ≈30 g_m	**670kg$_m$**

Electricity

Table 109: Estimate of the amount of electricity saved annually

Pledge	Type	Type (Prob)	Level	Number
Lighting/General				
Switch Off Lights	ELE		B	48
Electricity	ELE		G	89
Use Less Or Save Electricity	ELE		G	15
Open Curtains Instead Of Turning On Lights	NEW	ELE	B	3
Use Energy Saving Bulbs	NEW	ELE	B	1
			Sub total	155
Appliances				
Turn Off At Plugs	NEW	ELE	B	18
Turn Off Appliances	ELE		B	23
Use Appliances Less (T.V., Comp, Hair Dryer)	ELE		B	10
			Sub total	51
Other				
Re-Use Electricity	ELE		G	1
		Total		**207**

Lighting/General

Consumption
The following estimates for **illumination** are based on...
•...the third or fourth members of a household using 80kWh[19] per year, which is equivalent to a daily consumption of 219Wh or one 60W bulb used for just under four hours (Butala and Modic, 1998).

Conservation
•...each pledge for **Lighting/General** could result in a 60W light bulb used for 30 minutes less each day (60W x 0.5 = 30Wh[20]).

No. of Pupils Focusing on Lighting/General	**155**
Daily Energy Saving	**155 x 30 = 4,650 Wh**
Annual Energy Saving	**365 x 4,650 Wh = 1,697 kWh**

(continued over)

[19] A kWh (kilowatt-hour) is a unit of electrical energy. It is equivalent to 3.6×10^6 joules, or the amount of energy consumed by an electrical device, rated at 1,000watts, in one hour.
[20] A Wh (watt-hour) is equivalent to one thousandth of a kWh.

(Table 109: continued)

Appliances

Consumption
The following estimates for **appliances** are based on...
•...the third or fourth household member using 40kWh per year for radio/ music system (Butala and Modic, 1998), equivalent to 110Wh per day, or 22W for five hours.
•...the third or fourth household member using a second television (power rating of 70W) for two hours, equivalent to 140Wh.
•...the third or fourth household member using a personal computer/games console for one hour each day, equivalent to 100W x 1 hr = 100Wh. The same computer being left on "standby" for 23 hours, equivalent to $40W_m$ x 23 hrs = 920 Wh^2
•...the third or fourth household member using a hairdryer twice a week, equivalent to 8kWh per year (Butala and Modic, 1998).

Conservation
Each pledge for **Appliances** results in a savings with...
•...radio/music systems used for one hour less per day (1h x 22W = 22Wh per day). Television used for half hour less per day (70W x 0.5 h = 35Wh per day). These can be averaged to give a daily saving of 28.5Wh.
•...computer/games console switched off at plug (40W x 23h = 920 Wh per day_m).[21]
•...Hairdryer used only once a week (4kWh per year)

No. of Pupils Focusing on Appliances	**51**
Daily Energy Saving	**51 x (22+28.5+920) ≈50kWh_m**
Annual Energy Saving	**18,000 kWh_m**

[21] Estimate based on consumption of Apple Macintosh Performa 630. Other appliances were found to have negligible energy consumption when on "standby". Therefore there is a high degree of uncertainty about this figure.

Heat

Table 110: Estimate of the amount of heat saved annually

Pledge	Type	Type (Prob)	Level	Number
Wear More Clothes	HEA		B	32
Switch Off Heaters	HEA		B	1
Heat	HEA		G	70
Use Less Heat	HEA		G	3
Save Heat	HEA		G	2
Close Doors Or Windows	NEW	HEA	B	8
		Total		**108**

Consumption
• The third or fourth member of the household uses a 1kW heater for 2 hours per day for six months (Butala and Modic, 1998) of the year.

Conservation
• Each pupil uses the heater half as much (1h x 1 kW = 1kWh).

No. of Pupils Focusing on HEAT	**108**
Daily Energy Saving	**108 x 1kWh = 108 kWh**
Annual Energy Saving	**108 x 30 x 6 = 19,440 kWh**

Other

Table 111: Environmental savings from means other than in the programme material

Pledge	Type	Type (Prob)	Level	Number
Re-Use Things-Plastic Bags/Plastic Bottles/Glass Bottles/Wood	OTHER		B	32
Use Rechargeable Batteries	OTHER		B	11
Don't Leave Soap In Bath	OTHER		B	3
Share Cars	OTHER		B	3
Use Jars For Storage	OTHER		B	2
Avoid Disposable Cameras	OTHER		B	1
Buy Clockwork Radio	OTHER		B	1
Hang Clothes Out To Dry	OTHER		B	1
Keep Place Tidy/Use Bin	OTHER		B	9
Make Compost	OTHER		B	1
Reduce Waste Food	OTHER		B	1
Replace Cans And Bottles	OTHER		B	1
Take Stuff To Charity Shop	OTHER		G	1
Use Computer When Bored	OTHER		B	1
Use Stairs Not Lifts	OTHER		B	1
Waste Food To Dog	OTHER		B	1
Plant Flowers or Trees	OTHER		G	4
Reduce Pollution In Lakes, Rivers And Seas	OTHER		G	2
Repair	OTHER		G	2
"Take What I Need. Use What I Take."	OTHER		G	1
Energy	OTHER		G	1
Glass	OTHER		G	1
Use Less	OTHER		G	4
Re-Use Water	OTHER		G	1
Solar Power	OTHER		G	1
		OTHER Total		**43**

Consumption
• Each pupil goes shopping once a week and receives three plastic bags with their purchases.
• Each pupil uses batteries for a personal stereo music system, computer game or similar device at the rate of four per month.

Conservation
• Each pupil takes their own plastic bag shopping which lasts for one month.
• Each pupil uses rechargeable batteries.

(*cont.*)

(cont.)

No. of pupils focusing on Re-use	**32**
Plastic consumption	**32 x 3 x 52 = 4,992**
New plastic consumption	**32 x 12 x 1 = 384 bags**
Plastic conserved per year.	**4,992 - 384 = 4,608** **≈4,500 bags**
No. of pupils focusing on Rechargeable batteries	**11**
Annual battery consumption	**11 x 4 x 12 = 528**
New annual battery consumption	**11 x 4 = 44**
Batteries conserved per year	**528 - 44 = 484** **≈500 batteries**

Paper

Table 112: Estimate of the amount of paper saved annually

Pledge	**Type**	**Type (Prob)**	**Level**	**Number**
Write On Back Of Paper	PAP		B	20
Re-Use Paper	PAP		B	5
Won't Waste Paper Or Wood	PAP		B	2
Paper	PAP		G	56
Use Less Paper	PAP		G	3
		PAP Total		**86**

Consumption
• Each pupil uses two A4 sheets of paper per day and writes on only one side.

Conservation
• Each pupil writes on both sides of the paper, using only one sheet per day.

No. of pupils focusing on PAPER	**86**
Annual paper consumption	**86 x 365 x 2 = 62,780**
New annual paper consumption	**86 x 365 = 31,390**
Paper conserved per year	**31,390 sheets**

Recycling

Table 113: Numbers of pupils *stating recycling* on pledge sheets

Pledge	Type	Type (Prob)	Level	Number
Recycle Clothes	NEW	REC	B	9
Recycle Paper	NEW	REC	B	8
Recycle Christmas And Birthday Cards	NEW	REC	B	4
Recycle Glass	NEW	REC	B	4
Recycle Toys	NEW	REC	B	2
Recycle Car Parts	NEW	REC	B	1
		REC Total		**28**

Transport

Table 114: Estimate of the amount of petrol saved annually

Pledge	Type	Type (Prob)	Level	Number
Don't Leave Engine Running	NEW	TRA	B	1
Use Public Transport	NEW	TRA	G	3
Walk More	TRA		B	14
Cycle More	TRA		B	3
Stop Using Cars	TRA		B	1
Transportation	TRA		G	36
		TRA Total		**57**

Consumption
- Each pupil is given four lifts per week for distances of approximately 2 miles in a petrol car with a cold engine on urban roads.
- The car produces 63.68g of CO_s per km on average[22].
- The car consumes petrol, at the rate of 35mpg[23].

Conservation
- The pupil walks, cycles or takes a bus for half of these journeys.

No. of pupils focusing on TRANSPORT	**57**
Annual mileage	**57 x (4 x 2 x 52) = 23,712**
Annual petrol consumption	**19,968 ÷ 35 = 677 gall =3,042 litres**
Annual petrol conservation	**1,521 litres**
Change in annual CO_2 emissions	**(11,856 x 1.6) x 63.68 = 1,208 kg**

[22] London Research Centre/NETCEN (AEA Technology). Accessed: 20.3.99.
[23] TSO publication, 1998; Dept of Environment, Transport and the Regions. Accessed: 20.3.99.

Water

Table 115: Estimate of the amount of water saved annually

Pledge	Type	Type (Prob)	Level	Number
Take A Shower Instead Of A Bath	NEW	WAT	B	13
Have Fewer Baths	NEW	WAT	B	10
Put A Brick In Cistern	NEW	WAT	B	1
Turn Off Water	WAT		B	10
Turn Tap On Gently	WAT		B	4
Water	WAT		G	81
Use Less Water	WAT		G	13
Save Water	WAT		G	1
		WAT Total		**133**

Consumption

- A shower uses a third of the water that a bath uses[24]. An average bath uses 150 litres$_{m}$ so a shower uses 50 litres. Bath taken three times per week.
- Tooth brushing can take over 30 seconds$_{m}$ during which time a tap might deliver six litres of water.
- Pupils brushes their teeth twice each day.

Conservation

- A brick in a toilet cistern will save 22 x 10 x 6 cm^3, or 1.3 litres$_{m}$ per flush. An average household size of 2.4[25], with each person using the toilet twice a day, might use a toilet five times each day.
- Cleaning teeth using a tap turned on only when needed can use two litres$_{m}$ of water.

No. of pupils focusing on Shower/bath	**23**
Weekly water consumption (bath)	**450 litres$_{m}$**
Weekly water consumption (shower)	**150 litres$_{m}$**
Weekly saving	**300 litres$_{m}$**
Annual saving	**15,600 litres$_{m}$**

No. of pupils focusing on Brick-Cistern.	**1**
Daily saving.	**1.3 x 5 = 6.5 litres$_{m}$**
Annual saving	**2373 litres$_{m}$**

No. of pupils focusing on some aspect of Water	**109**
Daily saving	**2x4 litres$_{m}$ x 109 pupils = 872 litres$_{m}$**
Annual saving	**872 x 365 = 318,280 litres$_{m}$**

[24] North West Water (www.nww.co.uk/home.htm. Accessed: 20.3.99)
[25] Government Statistical Service (www.statistics.gov.uk/stats/ukinfigs/pop.htm. Accessed: 29.3.99)

1.4 SUMMARY

Table 116 shows the annual conservation of resources. Carbon dioxide equivalents have been given where figures were available. Clearly this could be taken further, for example reduction in SO_2 emission could be given, but it is not the intention of this discussion to give detailed and accurate information, merely to perform a quick analysis of the data in order to give a rough indication of the effect of the programme on the environment.

Table 116: A summary of the savings of energy and materials as a result of the Earthkeepers programme at Ardroy Outdoor Centre

Energy/Material	**Annual Saving**
Aluminium	670 kg
Electricity (Lighting/General)	1,697 kWh
Electricity (Appliances)	18,000 kWh
Electricity equivalent[26] (Heat)	19,440 kWh
Plastic Bags	4,500
Batteries	500
Paper (A4 sheets)	31,390
Petrol CO_2 equivalent	1,521 litres 1,208 kg
Water (Washing)	15,600 litres
Water (Toilet Flushing)	2,373 litres
Water (General)	318,280 litres
Total	
Water	336,253 litres
Paper	31,390
Plastic Bags	4,500
Aluminium	670 kg
Batteries	500
Energy CO_2 equivalent	39,137 kWh 39,137 kWh x 1.06[27] = 41,485 kg
Petrol CO_2 equivalent	1,521 litres 1,208 kg
Total CO_2 displaced from Energy Production and Petrol combustion.	42,693 kg

[26] Some of this heat may have been generated from sources other than electricity.
[27] The figure of 1.06kg of CO_2 per kWh is an average taken from Butala and Modic (1998).