Tracing Changes in Teacher Environmental Education Understanding

Josephine R. Lang
The University of Melbourne

A B S T R A C T

After more than twenty years of contemporary environmental education, there is still an inferior representation of it in schools. By 1990, UNESCO recognised that to improve the effectiveness of teacher implementation of environmental education in schools, teachers needed training. To date, there is insufficient research into teacher training in environmental education that could provide insights into teacher understanding and how to positively change teacher understandings about environmental education. The aim of this research was to document and examine the changes in teacher understandings of environmental education during an in-service training program in environmental education.

To examine teacher change in detail, this research used a qualitative and naturalistic inquiry methodology while using a case study approach. The case study showed that teacher understanding was complex and affected by many factors that contribute to personal and professional growth, development and learning.

As evidence of environmental degradation mounted, the international community represented by the United Nations resolved that environmental education in schools and communities would provide the appropriate changes in society to promote sustainable practices to save the planet. Environmental education was enshrined in the international arena by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) meeting in 1976 which developed *The Belgrade Charter Framework for Environmental Education*. The framework outlined the elements of environmental education that would assist schools to act as change agents to modify human behaviour through a change of attitudes and values towards the environment.

After more than twenty years of contemporary environmental education there is still an inferior representation of it in schools. At best teachers are teaching about environmental issues and ecological concepts (e.g. Gough 1997, Robottom 1987, Wilke *et al* 1987, Linke 1979) as it is described in curriculum frameworks and syllabuses. But environmental education goes beyond teaching about environmental concepts and issues (e.g. Fien 1997, 1993, Hart 1997, Gough 1987). It is about changing attitudes and values for the environment and making decisions and taking actions to conserve the environment while maintaining a quality of life for people.

UNESCO identified that one reason for this incapacity to implement environmental education in schools was the lack of teacher training. In the past two or more decades there has been much research into teacher training as well as the subject of environmental education. However, there has been relatively little research that combines these two subjects (Filho 1996, Ballantyne 1995).

The aim of this research was to document and examine the changes in teacher understandings of environmental education during an inservice training program in environmental education known as *Environmental Education Programs in Classrooms* (*EEPIC*).

Research design and procedure

This research used a case study approach that focused on participants of the environmental education professional development program *EEPIC*. *EEPIC* consists of seven units that are presented over seven weeks. Each unit is delivered within a two-hour block. The *EEPIC* program was developed under the auspices of the Victorian Association for Environmental Education. The setting for *EEPIC* was the Melbourne Zoological Parks and Gardens and delivered by its education officers.

The structure of *EEPIC* lends itself to an inquiry approach. It covers aspects of the three fundamental pillars of environmental education i.e. education *about*, *in* and *for* the environment. Each unit sets a theme for participants to explore within the context of environmental education and their teaching (see Figure 1 for an outline of *EEPIC* themes). Each *EEPIC* unit identifies outcomes that are clearly defined at the beginning of each unit in the participant's folder containing the program's support materials. Every unit incorporates the following sessions:

- reflection of previous week via journal sessions;
- understanding/exploration of the week's aspect of environmental education;
- classroom strategies appropriate to exploring the week's theme;
- sharing of curriculum ideas/teaching and learning strategies in *This works for me* segment;
- discussion of issues related to the readings associated with the unit.

Every week, two participants were nominated to prepare and lead discussion in the following week's sessions i.e. *This works for me* and *Readings*. Every participant was given the opportunity to lead at least one of these sessions during the program.

https://doi.org/10.1017/S0814062600002615 Published online by Cambridge University Press

Figure 1: Outline of *EEPIC*'s themes and descriptions for the seven units

Unit Theme	Unit Description
Unit 1 Introduction	The unit introduces the *EEPIC* program and allows program participants to get to know each other through the sharing of experiences in teaching. The unit also begins to explore the definition of environmental education.
Unit 2 Environmental Issues	This unit builds on the environmental knowledge and skills of teachers within the group. It increases teacher understandings on various environmental issues such as ecological sustainability, global environmental issues, interrelatedness between components and processes within ecosystems. Further definitions, principles and characteristics of environmental education are examined, as are the implications for teaching and learning environmental education.
Unit 3 Environmental Education and the Integrated Curriculum	Definition and benefits of integrated curriculum are discussed during this unit. Issues such as 'how does one fit in environmental education into already crowded curriculum?' are explored in the context of inquiry learning and integrated curriculum. Strategies for integrating environmental education into the classroom and/or school curricula are investigated.
Unit 4 Environmental Education Outdoors	The outdoors is a focus of this unit to show how it can be used to create student awareness and stimulus, and encourage positive and enjoyable learning experiences.
Unit 5 Environmental Education Values and Action in the Curriculum	The unit explores the roles of values and attitudes of both students and teachers within the classroom curricula. The links between values and action are also investigated.
Unit 6 Assessment and Evaluation	In this unit the need for diverse assessment and evaluation strategies are discussed to address the unique nature of environmental education.
Unit 7 Whole School Approach	This final unit analyses how environmental education can be placed within the school curriculum program. Identification of an environmental education policy within the school curriculum program can assist in the process of change within the school.

EEPIC was selected as a suitable case study for the research project because it had met many of the demands and challenges for effective professional development programs for teachers. For example, *EEPIC* incorporated the concept of the reflective practitioner, which has been identified as an important characteristic by Fien & Rawling (1996). *EEPIC* used reflective journals and provided opportunities for participants to reflect on their environmental education understandings throughout the program. Using the work of Grant (1984) and Zeichner & Teitelbaum (1982), Fien & Rawling (1996) wanted environmental educators to become reflective practitioners as a result of participating in their training (Masters) program. Other researchers (such as Moon 1999, Murdoch 1996, Baird & Northfield 1995, McTaggart 1995, Hargreaves & Fullan 1992) have also discussed reflection as a powerful tool in the educational change process. Reflection, argued Fien & Rawling (1996), would allow environmental educators to:

- be *openminded* to listen and consider all viewpoints;
- show *responsibility* to consider causes and consequences of actions;
- be *wholehearted* to continually critically analyse the personal and professional influences, decisions and consequences.

Another characteristic of *EEPIC* that contributes to its effectiveness as a teacher professional development program is that it presents environmental education with social-change objectives and strategies that challenge conventional education implementation and is committed to the principles of professional development in environmental education as outlined in Fien & Rawling (1996) and Robottom (1987). *EEPIC* also implemented strategies which effectively introduce change in teacher behaviour and values such as recommendations by Hargreaves & Fullan (1992) on development of knowledge and skills, and delivery of professional development as intensive on-going inservice training (Joyce & Showers 1984).

The case study research involved documenting and analysing the growth and development of teachers who had volunteered to become involved in the research, while undertaking the inservice training program on environmental education (*EEPIC*). Of the seven teachers that expressed interest in the research project, six participated in all aspects of the project. The six research subjects completed the *EEPIC* program, established and maintained reflective journals, completed a survey and participated in an interview towards the end of the *EEPIC* program. Each of these tasks were utilised as research instruments for qualitative data collection.

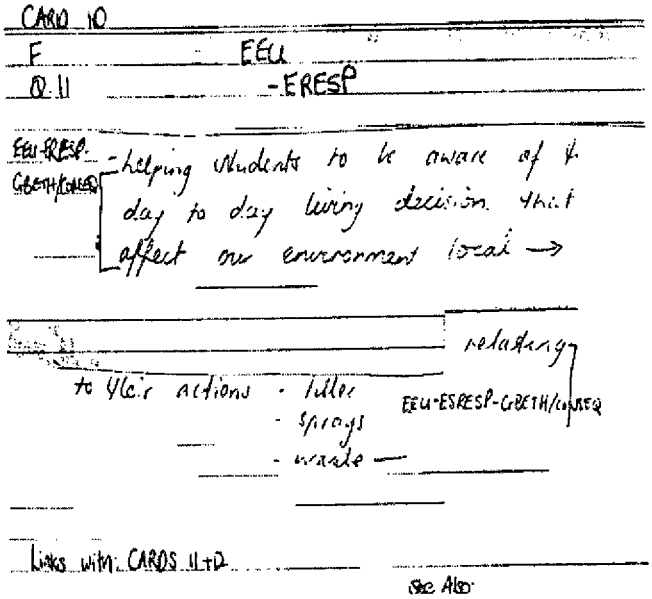
The use of a combination of data gathering techniques ensured that data collected had reliability and data interpretation was validated through triangulation of the different data gathering techniques (Stake 1995; Lincoln & Guba 1985). Initially, baseline data was collected to determine the current understanding of environmental education for each teacher prior to participating in *EEPIC*. It was decided to use the conventional written questionnaire to collect this quantitative data (Neuman 1997) which '*avoids potential interviewer bias*' (LoSciuto 1981, p. 148) because the interactions between interviewer and interviewee are minimised. Open-ended questions in the questionnaire also allowed the opportunity to incorporate the collection of qualitative data (Merriam 1998, 1988).

Qualitative interviewing, which is a very different activity from quantitative interviewing (Bogdan & Biklen 1998, 1992), was used to gain insights into the teacher changes in environmental education understandings during *EEPIC*. In successful qualitative interviewing, the interviewer develops a rapport with the interviewee rather than maintain distance as is often required by quantitative methods. This relationship, argues Bogdan & Biklen (1998), assists in gathering descriptive data in the subjects' own words which the researcher can then use to develop insights on how subjects interpret a part of their world. The interview was a necessary and critical component of data gathering because it allowed the opportunity to obtain interpretative data on teacher perceptions and understandings on environmental education that could not be observed (Merriam 1998, 1988, Burns 1997, Stake 1995).

The study uses the grounded theory approach that develops from inductive analysis. Huberman & Miles (1994) classify

this inductive analysis as iterative research. Such analysis develops theories, or constructs to explain the regularities observed (Merriam 1998, 1988). The reiterative procedure involves cycles of questions and answers to develop valid inferences from the data. Coding of data (Bodgan & Biklen 1998; Merriam 1998, 1988; Miles & Huberman 1994) to find patterns, or emerging regularities, in individuals and comparing them to others in the group was used to develop understanding of teacher perceptions of environmental education prior to and during *EEPIC*. Refer to Figure 2 for a sample card that shows the coding process. The responses from questionnaires (and interviews) were coded using the reference codes that were derived from the data (see Figure 3). The coded data was then pasted on index cards, identifying the codes and relationship to other relevant data, within the context of the data type (colour of card) and research participant (alphabetically coded). This method of analysis and interpretation where the researcher deconstructs and then reconstructs the meaning the data carries is described by Stake (1995), Huberman & Miles (1994), and Lincoln & Guba (1985).

Figure 2: Sample of card depicting the coding process



Results and Discussion

The research participants in the first week of the *EEPIC* program completed a preliminary questionnaire. This questionnaire provided baseline data of the research participants' understandings of environmental education prior to undertaking the professional development program (*EEPIC*). The data showed that generally, these teachers had little if any training in environmental education within their preservice or inservice education.

In contrast, when asked if they had recently taught environmental education in their classes, five of the seven teachers participating in the research identified they had taught some elements of environmental education.

Figure 3: Sample of coding categories for Q. 11 "What is your current understanding of environmental education?" from questionnaire

EEU Environmental Education Understanding

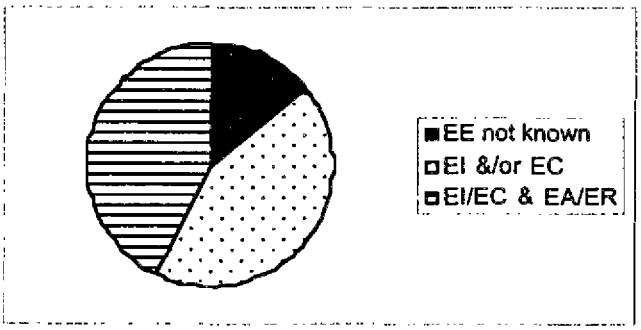
Major category		Sub category		Minor category	
Code	Interpretation	Code	Interpretation	Code	Interpretation
EEU -Environmental Education Understanding		EISS -Environmental Issues		GEN -general awareness & understanding of;	
				LCOM -local community	
				POL -pollution	
				DHAB -destruction of habitat;	
				REC -recycling	
				REG/GLOB -regional &/or global	
EEU -Environmental Education Understanding		ECON -Environmental Concept		NAT -physical nature of environment;	
				HAB -habitat	
				INT -interactions between components;	
		Explore concept and understanding of the environment and its processes		DIV -diversity of environments/habitats	
				BIOD -biodiversity	
				ESD -awareness of ecologically-sustainable development	
				TYPES -natural/ built envts; local/global	
				FUNC -functioning of natural systems	
EEU -Environmental Education Understanding		EACT -Environmental Action towards environment		RIND -role of individual	
				RGRP - role of group	
				CONS -practices to conserve environment	
				IMP -practices to improve environment	
EEU -Environmental Education Understanding		ERESP - Environmental Responsibility		ATT/VAL -positive attitudes and values towards environment	
				IBETH/CONSEQ -linking individual behaviours to env'tal consequences	
				GBETH/CONSEQ - linkg group behaviours to env'tal consequences	
				LOC/GLOB -understanding links between environmental behaviour & its implications at local & global scales	
EEU -Environmental Education Understanding		APP - Appreciation of the environment		NAT -nature	
				RESPT - respect for nature & natural processes	
				VAL/CLAR -clarification of values towards environment	
				CARE -care for the envt/ stewardship	
				EXP - experience the envt to gain appreciation for it	
EEU -Environmental Education Understanding		NKNOW - Not Known		LAC -perception held that she lacks understanding of EE	
				NIMP - feels she needs improving	

The teachers were then asked to define their understandings about environmental education. The responses were surprisingly quite broad and diverse as is summarised in Figure 4. Only one teacher did not define her understanding of environmental education. The element of environmental education (Lucas' model 1991, 1979) most strongly represented was education *about* the environment (i.e. environmental issues and/or environmental concepts) and this was anticipated from the reading of the literature (eg see Gough 1997, Wilke *et al* 1987, Linke 1979). Three teachers defined that environmental education was not only about environmental issues and/or environmental concepts, but that it also included teaching students to take responsibility for their actions towards the environment and/or taking action to improve this environment. These three teachers were beginning to define the concept of education *for* the environment.

While most teachers did not have formal training in environmental education, some had relatively complex understandings of environmental education prior to undertaking *EEPIC*. So what formed their understanding of environmental education? The researcher decided to explore the relationship between teacher motivation and teaching practices with environmental education understanding.

https://doi.org/10.1017/S0814062600002615 Published online by Cambridge University Press

Figure 4: Teachers' initial understandings of environmental education



EE = environmental education

EI = environmental issues EA = environmental action

EC = environmental concepts ER = environmental responsibility

The preliminary questionnaire asked the teachers to identify their motivation for environmental education. They gave diverse reasons for being motivated about environmental education, which are summarised in Figure 5. The motivations for environmental education could be divided into two major categories:

- teacher oriented i.e. motivation for self to gain personal or professional understanding on environmental education;
- student oriented i.e. motivated for environmental education to develop student understanding and skills.

Figure 5: Teacher motivation for environmental education

Motivation for environmental education	Stephanie	Frances	Sarah	Liz	Margaret	Carmel	Felicity
Teacher oriented							
Awareness & knowledge	✓	✓					✓
Value for the environment			✓			✓	
Concern for the environment					✓		
Apply EE to the classroom	✓						
Perceived need for conservation			✓			✓	
Perceived need for environmental response			✓				
Student oriented							
Awareness & knowledge			✓				
Responsibility to environment				✓			
Teacher modelling environmentally responsible behaviour	✓						
Value for the environment				✓			

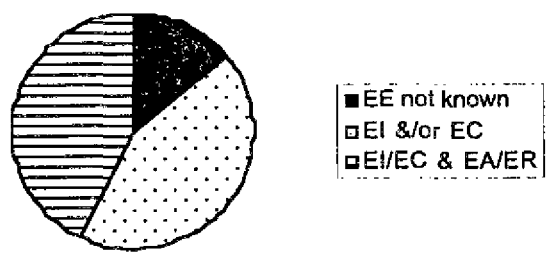
Further analysis of their responses illustrate that underlying many of the teacher motivations were their values for the environment. This value and interest in the environment may be one factor that has contributed to the development of teacher understanding of environmental education. It may also begin to explain the relatively broader understanding of environmental education than expected by a group of teachers who had little experience of formal training in environmental education. The significance of motivation, particularly intrinsic motivation (i.e. inner desire to accomplish a task or goal for its own value), in metacognitive learning has been examined by others (e.g. Baird & Northfield 1995, Spaulding 1992). These data suggest that these teachers have an intrinsic motivation for environmental education, which may have contributed to their own learning and understanding of environmental education and its integration into their curriculum.

Figure 6 attempts to demonstrate the patterns emerging from the data, which seems to identify factors that contribute to teacher understanding and uptake of environmental education in their classrooms. There seems to be interconnectivity between:

- motivation for environmental education;
- values for the environment;
- access and use of resources.

These factors contribute and influence the implementation of environmental education in classrooms. It also seems that without diverse sources to support teachers in developing the ideas (the significance of access and use of resources to support environmental education teachers is also recognised by others e.g. see Filho 1996, Hopkins *et al* 1994), teacher interest and motivation for the environment will not translate into the implemented curriculum.

Figure 6: Factors contributing to understanding and implementation of environmental education by teachers prior to undertaking *EEPIC*



* EE = environmental education; UND = understanding
CD = curriculum development (which includes classroom teaching)

Six of the participating teachers in the research project agreed to participate in individual interviews towards the end of the *EEPIC* program. Data was coded (as described earlier) to associate with categories to identify patterns emerging from the data. Figure 7 sumarises the patterns form the coded data and maps the teacher understanding of environmental education from the interviews conducted and then compares them to their earlier understandings as described in the initial questionnaire. Figure 7 represents the changes in the responses of the teachers to the question: *What is your understanding of environmental education?*. This question was asked in both data collection methods.

Figure 7: Mapping the changes in teacher understandings of environmental education*

Coding Category	Relationship to aspects of Lucas' model (1991, 1979) in Education ...	Stephanie		Frances		Sarah		Liz		Margaret		Carmel	
		BE	AE	BE	AE	BE	AE	BE	AE	BE	AE	BE	AE
Environmental issues	*about* envt	✓	✓	✓	✓	✓			✓			✓	✓
Environmental concepts	*about* envt	✓	✓				✓	✓	✓	✓	✓	✓	✓
Environmental action	*for* envt		✓			✓		✓	✓				✓
Environmental responsibility	*for* envt		✓		✓	✓	✓					✓	✓
Appreciation & value for the environment	*in* and *for* envt		✓		✓		✓		✓				

* Key for table: BE = Before *EEPIC*; AE = After *EEPIC* envt = environment

The changes in teacher understanding were discernible. Of the six teachers who participated in both these data collection processes:

- three teachers (Stephanie, Frances & Liz) reflected large changes in their understandings;
- two teachers (Sarah & Carmel) demonstrated subtle changes, or a refinement of their understandings;
- one teacher (Margaret) exhibited no change in her response on environmental education understanding.

Prior to *EEPIC*, Stephanie and Frances understood environmental education to be about teaching environmental issues and concepts. This type of understanding reflects the category identified by Lucas (1991, 1979) as education *about* the environment. Such an understanding of environmental education reinforces the research that this understanding is most commonly held by teachers (see e.g. Gough 1997, Linke 1979).

However, after six units of *EEPIC* (which was when the individual interviews were undertaken for these participants), these two teachers articulated the development of their understandings of environmental education to incorporate the other two aspects of environmental education—education *in* and *for* the environment. Stephanie identified the significance of values in environmental education when she recognised students needed to

> '*understand the link between their lifestyle and the environment/ nature ... as well as clarifying their values*' (Interview log, Q. 1).

Stephanie also recognised the need for environmental education to develop opportunities for her students to take action for the environment

> '[children and adults] *become responsible by taking action e.g. recycling, composting etc*' (Interview log, Q. 1).

Frances demonstrated a greater understanding of environmental education in her responses towards the end of *EEPIC*. Her understanding of environmental education now integrated the role of values in taking environmentally responsible action.

> '*Being aware of your environment and how to live in it so that you can appreciate what it has to offer.*' (Frances' Interview log, Q. 1)

These responses indicate that there has been a shift in environmental education understanding from one of education *about* the environment to one that is developing towards education *for* the environment. Such a change in teacher understanding is encouraging as it corresponds with the aims of the *Tbilisi Declaration*, the *Belgrade Charter* and the environmental education academic communities, which are seeking to ensure that there is ongoing development of environmentally literate and responsible citizens (e.g. Fien 1997, 1993, Gough 1997, Hart 1997, Lucas 1991, 1979, Hall 1977).

Sarah and Carmel showed subtle changes in their responses regarding their understanding of environmental education. Since their understanding prior to *EEPIC* was quite broad (see Figure 7) which encompassed education *in* and some elements of *for* the environment, *EEPIC* seemed to give them the opportunity to reflect and refine their understanding.

Carmel illustrates the subtle changes as she articulated her environmental education understanding explicitly in the interview. Her responses on teaching ecological concepts and environmental issues were highly developed:

> '[student] *understanding of how that world functions i.e. understanding of science of the world that they live ... understand the interrelationships ... and the impacts of these interactions. Students become aware and understand the issues around them and become aware that issues can change over time.*' (Carmel's Interview log, Q. 1)

Carmel begins to construct education *for* the environment within the framework of social critical theory as suggested by Fien (1997, 1993) when she asserts:

> '[environmental education is] *Helping students to realise that there are different action/ alternatives to issues ...*' (Interview log, Q. 1).

The idea of pursuing citizenship issues through environmental education as described and promoted by Hart (1997) and Fien (1993) is encapsulated by Carmel's next comment:

> '*Put these understandings and experiences in the context of their own world such as the playground and the school community, and their home town ... as this provides a relevant and real life context ... it is about students understanding and knowing their world.*' (Carmel's Interview log, Q. 1)

Ballantyne (1995) reported on similar research which included recording changes in teacher understanding during a Queensland University of Technology postgraduate course. He also found that the teachers showed changes in their environmental education understanding, from education *about* the environment to an understanding that '*involves the*

investigation of environmental attitudes and behaviour' (Ballantyne 1995, p. 39).

Margaret was the only teacher that portrayed no significant change in her responses on understanding of environmental education towards the end of *EEPIC* (see Figure 7). Her understanding of environmental education continued to be consistent with education *about* the environment. However, her initial response on environmental education understanding in the questionnaire was *'plants, animals and people living naturally and harmoniously'*. Her final statement after *EEPIC* was more explicit and demonstrated links between local and global issues.

In addition, Margaret's weekly journal entries exposes that Margaret has strong environmental values and beliefs. Margaret's statements give an insight into her internal struggle with the role of values and attitudes in environmental education. The literature discusses that education *for* the environment involves teaching and learning in the affective domain—values clarification and critical analysis of environmental issues are significant components. While Margaret has strong personal environmental values and commitment for the environment she has not, it seems, translated this into her understanding of environmental education within the context of classroom teaching and learning. Joyce & Showers (1984) describe this as the 'transfer of training'. If there is a lack of transfer then the

> *'integration of new skills and strategies into classroom practice* [by the teacher] *will require the additional training component "coaching"'* (Joyce & Showers 1984, p. 80).

Further collection and analysis of data showed that the teachers also perceived that there were changes in their understandings of environmental education during the professional development program.

The conservation of the environment is only possible if both the individual and the society develop values for the environment (Cosgrove *et al* 1994, Fien 1993, Gough 1987, Pepper 1984). So environmental values are integral to environmental education. Both students and teachers alike require opportunities to develop and clarify their values for the environment. Figure 8 summarises the changes in values that teachers described in their interviews.

The teachers had diverse experiences about how *EEPIC* contributed to their values for the environment. The changes referred to were not always associated with their own personal belief system on the environment, which is what the question had asked. Teachers seemed to personalise the *EEPIC* experience in their own way.

This is not surprising as Fullan & Stiegelbauer (1991) have observed:

> *'Change is a highly personal experience—each and every one of the teachers who will be affected by change must have the opportunity to work through this experience in a way in which the rewards at least equal the cost'* (p. 127).

Figure 8: Relationship of *EEPIC* to changing values/ attitudes

***EEPIC* provided opportunities ...**	Stephanie	Frances	Sarah	Liz	Margaret	Carmel
for reflection on environmental values/ attitudes			✓			✓
experiencing/ raising awareness of diversity in environmental values/attitudes			✓			
for experiencing & developing teaching strategies for values clarification			✓			
to recognise that values are reflected in people's actions for, & understandings of the environment			✓			✓
for clarifying own values for the environment	✓				✓	
For renewing interest in the environment		✓				
For increased appreciation for the environment	✓	✓				
no change – already committed				✓		

Stephanie illustrates the types of changes that occurred among the teachers. She broadened her definition of the environment, and consequently her value for the local environment, when she said that

> *'it also made me appreciate that the environment has so much to offer...and that you don't have to travel far to utilise it (schoolgrounds!)'* (Stephanie's Interveiw log, Q. 4).

Conclusion

The teachers participating in the study reflected many of the findings in the literature. The teachers commonly understood environmental education as education *about* the environment. However, the teachers also exhibited contrary characteristics that reflected some complexity in their understandings of environmental education prior to participating in *EEPIC*. This led to an inquiry into why this anomaly had surfaced.

https://doi.org/10.1017/S0814062600002615 Published online by Cambridge University Press

It was soon evident that this group of teachers was committed to the environment. They held environmental values and many had participated in environmental action. Consequently, the teachers who had voluntarily undertaken *EEPIC* had already overcome the initial barriers to change, as they had the willingness to accept change. This meant that the teachers had the preparedness to participate on a journey of growth and development in environmental education.

As a result, the teachers made significant changes in their understandings of environmental education. *EEPIC* provided the teachers with opportunities to learn, reflect and clarify their environmental values, attitudes and understandings. Teachers commented on the importance of sharing learning experiences with one another to develop their understandings of environmental education. The teacher change resulted in a deeper understanding of environmental education and its implications for the classroom.

Values are personal constructs that assist people to make sense of their world. Integral to effective environmental education is the underpinning of environmental values and attitudes, which assist in decision-making and responsible environmental action. Consequently, understanding change in the teachers' values is an important element of this research. Change in values is difficult, as it requires an individual to reconstruct their paradigms. Large changes did not occur in this group of teachers, probably due to their high commitment to the environment even before undertaking *EEPIC*. However, *EEPIC* provided teachers with the opportunity to reflect and clarify their values towards the environment and this resonated in the changes within their perceptions and understandings of environmental education.

This case study showed that teacher understanding of environmental education is complex. It is not static, but rather a dynamic process. A study of external factors associated with imposed teacher change was not within the scope of this research. Instead, there was an attempt to understand the factors that contributed to personal change. There seem to be many personal factors that contributed to the teachers' growth and development of their environmental education understandings. These included:

- teacher's preparedness or capacity for change;
- teacher motivation;
- teacher values for the environment;
- teacher environmental education competencies;
- teaching experience;
- participation in formal training in environmental education;
- access to & use of resources relevant to support environmental education;
- sharing teaching and learning experiences with other teachers;
- teacher's experience in action for the environment; and
- reflective practice to improve teaching and learning.

The entry point for teacher change will depend on the original understandings of environmental education. Any one or combination of the above factors will influence the development of the understandings. This has implications for any environmental education in-service provider because it signifies that programs should be individually tailored to meet the needs of a group of teachers. Or, it should at least be delivered within the context of the workplace, which would provide consistency to some of the above variables. This study demonstrated that the individual perceptions and understandings of environmental education were critical in understanding the teacher change process. Therefore, in-service programs need to take serious consideration of, and work with, the initial teacher perceptions and understandings to ensure positive teacher change.

Recommendations

This case study would be supported by further longer term research which could investigate:

- sustainability of teacher change after the in-service program to ensure longevity of environmental education programs in schools
- how the teacher implements the three aspects of Lucas' model in the classroom
- tracing the growth and development of student understandings of environmental education.

References

Baird, J. R. & Northfield, J. R. (eds) 1995, *Learning from the PEEL Experience*, 2nd edition, Monash University Printing Services, Melbourne.

Bogdan, R. C. & Biklen, S. K. 1992, *Qualitative Research in Education: An Introduction to Theory and Methods*, 2nd edn, Allyn and Bacon, Boston.

Bogdan, R. C. & Biklen, S. K. 1998, *Qualitative Research in Education: An Introduction to Theory and Methods*, 3rd edn, Allyn and Bacon, Boston.

Burns, R. B. 1997, *Introduction to Research Methods*, 3rd edn, Addison Wesley Longman, South Melbourne.

Ballantyne, R. 1995, 'Evaluating the impact of teaching/learning experiences during an environmental teacher education course', *International Research in Geographical and Environmental Education*, vol. 4, no. 1, pp. 29-46.

Cosgrove, L., D. G. Evans & Yencken, D. (eds) 1994, *Restoring the Land*, Melbourne University Press, Carlton.

Fien, J. 1993, *Education for the Environment: Critical Curriculum Theorising and Environmental Education*, Deakin University, Geelong.

Fien, J. 1997, 'Stand up, stand up and be counted: Undermining myths of environmental education', *Australian Journal of Environmental Education*, vol. 13, pp. 21-26.

Fien, J. & Rawling, R. 1996, 'Reflective practice: A case study

of professional development for environmental education', *The Journal of Environmental Education*, vol. 27, no. 3, pp. 11-20.

Filho, W. L. 1996, 'Environmental Education and Teacher Education: Some European Perspectives', in *Teacher Education for the Environment: European Perspectives*, eds W. L. Filho & K. O'Loan, Parthenon Publishing, New York.

Fullan, M. & Stiegelbauer, S. 1991, *The New Meaning of Educational Change*, 2nd edn, Cassell Educational Ltd, London.

Gough, A. 1997, *Education and the Environment: Policy, Trends and the Problems of Marginalisation*, The Australian Council for Educational Research, Melbourne.

Gough, N. 1987, 'Learning with environments: Towards an ecological paradigm for education', in *Environmental Education: Practice and Possibility*, ed I. Robottom, Deakin University Press, Melbourne.

Grant, C. 1984, *Preparing for Reflective Teaching*, Allyn and Bacon, New York.

Hall, W. 1977, 'Where next for environmental education?' in *UNESCO Seminar Report: Education and the Human Environment*, ed R. D. Linke, Curriculum Development Centre, Canberra.

Hargreaves, A. & Fullan, M. (eds) 1992, *Understanding Teacher Development*, Teachers College Press, New York.

Hart, R. A. 1997, *Children's Participation: The Theory and Practice of Involving Young Citizens in Community Development and Environmental Care*, Earthscan Publications, London.

Hopkins, D., Ainscow, M. & West, M. 1994, *School Improvement in an Era of Change*, Cassell, London.

Huberman, A. M. & Miles, M. B. 1994, 'Data Management and Analysis Methods', in *Handbook of Qualitative Research*, eds N. K. Denzin & Y. S. Lincoln, Sage Publications, Thousand Oaks.

Joyce, B. & Showers, B. 1984, 'Transfer of Training: The Contribution of "Coaching"', in *Alternative Perspectives on School Improvement*, eds D. Hopkins & M. Wideen, The Falmer Press, London.

Lincoln, Y. S. & Guba, E. G. 1985, *Naturalistic Inquiry*, Sage Publications, Newbury Park.

Linke, R. D. 1979, *Environmental Education in Australia*, George Allen & Unwin, Sydney.

LoSciuto, L. 1981, 'Questionnaires and Interviews', in *Selltiz, Wrightsman & Cook's Research Methods in Social Relations*, 4th edn, ed L.H. Kidder, Holt, Rhinehart and Winston, New York.

Lucas, A. M. 1979, *Environment and Environmental Education: Conceptual Issues and Curriculum Implications*, Australia International Press and Publications Pty Ltd, Kew.

Lucas, A. M. 1991, 'Environmental Education: What is it, For Whom, For What Purpose, and How?', in *Conceptual Issues in Environmental Education*, eds S. Keiny & U. Zoller, Peter Lang Publishing Inc., New York.

McTaggert, R. 1995, 'Reflection on Teaching: Creating an Enquiry Culture in Education', *Reflect: The Journal of Reflection in Learning and Teaching*, vol. 1, issue 2, pp. 32-39.

Merriam, S. B. 1988, *Case Study Research in Education: A Qualitative Approach*, Jossey-Bass Publishers, San Francisco.

Merriam, S. B. 1998, *Qualitative Research and Case Study Applications in Education*, Jossey-Bass Publishers, San Francisco.

Miles, M. B. & Huberman, A. M. 1994, *An Expanded Sourcebook: Qualitative Data Analysis*, 2nd edn, Sage Publications, California.

Moon, J. 1999, *Learning Journals: A Handbook for Academics, Students and Professional Development*, Kogan Page, London.

Murdoch, K. 1996, '"The difference, I think, is in my head"--Reflection and Teacher Learning in Integrated Curriculum', *Reflect: The Journal of Reflection in Learning and Teaching*, vol. 2, issue 1, pp. 33-39.

Neuman, W. L. 1997, *Social Research Methods: Qualitative and Quantitative Approaches*, 3rd edn, Allyn and Bacon, Boston.

Pepper, D. 1984, *The Roots of Modern Environmentalism*, Croom Helm, London.

Robottom, I. 1987, 'Towards inquiry-based professional development in environmental education', in *Environmental Education: Practice and Possibility*, ed I. Robottom, Deakin University Press, Melbourne.

Spaulding, C. L. 1992, *Motivation in the Classroom*, Mc Graw-Hill, New York.

Stake, R. E. 1995, *The Art of Case Study Research*, Sage Publications, California.

Wilke, R. J., Peyton, R. B. & Hungerford, H. R. 1987, *Strategies for the Training of Teachers in Environmental Education: Discussion Guide for UNESCO Training Seminar*, UNESCO-UNEP International Environmental Education Program, Environmental Education Series No. 25, UNESCO, Paris.

Ziechner, K. & Teitelbaum, K. 1982, 'Personalized and inquiry-oriented teacher education: An analysis of two approaches to the development of curriculum for field based experience', *Journal of Education for Teaching*, vol 8, issue 2, pp. 95-117.