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Investigating teachers' pedagogical approaches in environmental education that promote students' action competence

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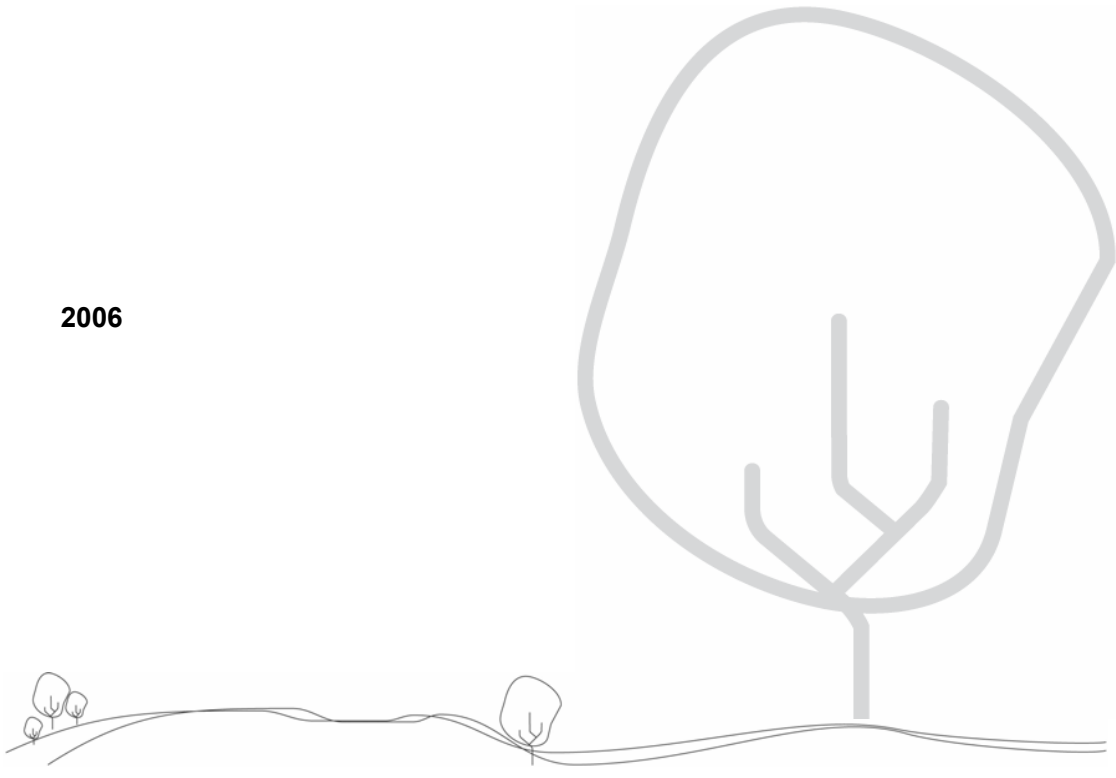

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1. Aims, objectives and research questions

Introduction

There is currently no mandatory requirement for New Zealand schools to teach Environmental Education (EE). However, in 1999 the Ministry of Education published the *Guidelines for Environmental Education in New Zealand Schools* (Ministry of Education, 1999). The *Guidelines* are intended to assist teachers and schools to plan and provide education "in, about, and for the environment" in a way that integrates with learning objectives from the seven mandatory learning areas of the *New Zealand Curriculum Framework* (Ministry of Education, 1993). As such, schools are encouraged to develop EE programmes through a process of school-based curriculum development. More recently, a concept of education for sustainability has been promoted that broadens EE approaches to include concepts of human rights and social justice for sustainable development (Parliamentary Commissioner for the Environment [PCE], 2004; Tilbury, Stevenson, Fien, & Schreuder, 2002).

In 2002–2003 a national research project (commissioned by the Ministry of Education) was conducted to investigate the practice of EE in New Zealand schools (Bolstad, Cowie, & Eames, 2004). This project provided evidence that in teaching EE some teachers were developing student-centred pedagogical approaches. The study also reported a general under-emphasis on the dimension of education *for* the environment. The project report concluded that further research was needed to "evaluate whether EE teaching practices promote long-term learning value for students (i.e., whether it acts to develop students' 'action competence' and ability to be decision-makers with regard to environmental issues in the present and the future)" (p. 72).

An action orientation is seen as a key feature that defines EE (Fien & Greenall Gough, 1996; McLean, 2003; Tilbury, 1995). The concept of action competence acknowledges this orientation (Breiting & Mogensen, 1999; Jensen & Schnack, 1997). Action competence refers to students' abilities to act with reference to environmental concerns, as active participants in EE. It includes the ability to identify problems, make decisions about solutions, and take action that develops the students' competence to participate in future action on environmental issues. Development of students' action competence can be seen as promoting democratic and participative education that can be valuable across all aspects of schooling.

Aims and objectives

This research was conducted in five New Zealand classrooms that were delivering EE. It was focused on the development of student environmental action competence in response to particular pedagogical approaches used during the delivery of EE in those classrooms.

The research involved five teachers, each working together with a Regional Environmental Education Co-ordinator (school adviser). These research partnerships planned the delivery of an EE unit, the teacher delivered it, and the teacher and co-ordinator collaborated in researching the outcomes.

The aims of the research project were to:

- inform future teaching and learning classroom practices in EE;
- build research capability in the Regional Environmental Education Co-ordinators and teachers, particularly for EE; and
- widen the understanding of teaching and learning of EE in the school community and education sector.

These aims had the following objectives:

1. To investigate which pedagogical approaches used by teachers in EE lead to student action competence. Regional Environmental Education Co-ordinators conducted the research in partnership with classroom teachers. Together they planned an EE unit and the use of pedagogical approaches within it. The teacher implemented the unit and, together with the researcher, evaluated it, focusing particularly on the development of students' action competence.
2. The co-ordinators were mentored through the research process by experienced researchers. This enabled the co-ordinators to develop their own research practice. They worked alongside teachers to scaffold the teachers' research and pedagogical capability into their EE practice. Through their partnership with teachers, the co-ordinators modelled the action research process and gained the teachers' full participation. This contributed to the teachers' understanding of research and informed both the co-ordinators' and the teachers' own practice.
3. To use the findings of the research to inform future teaching and learning of EE in schools. This objective is being achieved through the co-ordinators disseminating their research-informed practice to other schools with which they are working, the co-ordinators sharing their findings with the national group of environmental education co-ordinators, the teachers sharing their experiences with their colleagues, and the co-ordinator and teacher jointly disseminating their findings by means of conferences and published articles.

Research questions

The research question that originally guided this project was:

- What pedagogical approaches are successful in promoting student action competence in environmental education?

This research imperative led to the following questions that were explored in the course of project:

- What skills relevant to achieving action competence did students possess before the unit?
- What pedagogical approaches did teachers select before and during the unit, and why?
- What skills relevant to achieving action competence did students demonstrate during and after the teaching and learning?
- What, in the opinion of the teachers, led to any changes in students' skills relevant to achieving action competence during and after the unit?

2. Research design and critique

Environmental education research

Research in EE is a nascent field, having evolved out of a need to better understand an intensely practical endeavour. This understanding requires a theoretical base and empirical data to support the theory, hence the need for research. Early research in EE typically employed a positivistic approach to collecting quantitative data (Marcinowski, 2000)—for example, statistics that were thought to show either the need for or the outcomes of some educational design. However, in parallel with the acknowledgement of the vital social and cultural components of EE has been the realisation that a positivistic approach using controlled variables and experimentation is not fruitful in examining the complex realm of EE (O'Hearn, 1982).

Consequently, environmental education researchers have turned towards approaches that are known as naturalistic or interpretive (Guba & Lincoln, 1994) to probe more deeply into the rich interconnections and complexities that underlie their discipline. These approaches seek to understand the natural settings of the research, and delve into the experiences of people and their interpretations of the world around them.

A move towards interpretive research has concomitantly taken researchers away from the use of quantitative methods and promoted interest in qualitative methods of data collection, which attempt to understand the meanings that people have for phenomena in their world (Denzin & Lincoln, 1994). A perceived lack of published rigorous research in EE led educators in North America to a workshop with the intention of establishing guidelines for research in EE (Smith-Sebasto, 2000). Debate over the nature of research in EE and the respective merits of the qualitative and quantitative methods raged, but ultimately led to the initial development of guidelines for qualitative research (Smith-Sebasto, 2000). These guidelines addressed how to pose research questions, data collection methods, and issues of credibility, trustworthiness, and ethics. While they have been criticised as being in need of refinement (Marcinowski, 2000), they provide a useful basis for research that is recognised in the design of this study.

Research design

This project utilised a case study design (Bassey, 1999; Merriam, 1998). Such a design permits researchers to gain an in-depth understanding of the issue and to explore meaning from a number of angles (Merriam, 1998). It allows the influence of context to be acknowledged and explicated. The case study involves a study of a particular case through the collection of data in a variety of ways. Analysis of data seeks to fully describe the interactions and practice within the context, and to provide insights and reasons for the findings. Multiple sources of data allow triangulation of the findings, which enhances its validity and reliability. Conclusions on the case can be drawn which, when situated in the context of the case, permit the reader to decide to what extent the findings can be generalised to another context.

A number of researchers (Bolstad, Eames, Cowie, Edwards, & Rogers, 2004; Fien, 2001; Hart, 1998; McLean, 2003) have previously used case studies to investigate EE. Recent critiques of the use of case study research into sustainability and EE have argued that researchers have rarely underpinned their studies with theory or adequately described their methods (Corcoran, Walker, & Wals, 2004). These authors argued that a case study "should provide a critical analysis of practice and be documented in such a way that it can have transformative value to others" (p. 9). They further note that inter-case study research that seeks trends across contexts would be of value. Other critics have cautioned that case studies need to clearly describe what they are a case of (Dillon & Reid,

2004; Kyburz-Graber, 2004), and that they should contain triangulation within analysis of the data (Kyburz-Graber, 2004).

This study comprised five case studies of New Zealand classrooms, in an action research model (Wals & Alblas, 1997). The study involved mentors, researchers (co-ordinators) and practitioners (teachers) working together in the design, implementation, and evaluation of an EE unit. Mentors provided the direction for the project, support and advice in methodology and evaluation, and oversight of reporting. The researchers and practitioners (see below) collected and analysed the research data. The work was informed by a literature review carried out by the mentors.

The primary research data collectors in this study were Regional Environmental Education Co-ordinators. These co-ordinators normally work with their schools to provide advice and support in the delivery of EE. Much of their practice is not informed by their own research, and this study represented an excellent opportunity to develop a research culture in their practice. Each co-ordinator identified a teacher in one school who was willing to partner them in this research.

Rickinson and Robinson (1999) have noted the value and difficulties of researcher–teacher partnerships in conducting EE research. They saw the value of combining the diverse understandings of theory and practical experience in EE and, equally importantly, the greater understanding by the researcher of what it means to be researched, and the benefits of "forced" reflection brought on by being the subject of the research (this notion became apparent in this study—see Section 5, Building Capability and Capacity). They noted that difficulties resulted from a lack of common expectations at the outset, unacknowledged concerns by each party, and certain aspects of research design. These findings were considered before the design of this study was completed, and are discussed further under the heading "Research critique", below.

In the first phase of the study (March 2005), the environmental education co-ordinators and the teachers met with the team leader and mentors in to discuss case study methodology and agree on a consistent approach to the research.

In the second phase of the research, each co-ordinator met with their teacher partner to discuss the EE unit that the teacher would deliver to their class. These discussions included student interest and perspective, as befitted a participative approach. This meeting also included discussion of appropriate pedagogical strategies for the teacher, as described in the literature. The teacher and co-ordinator then co-planned the research strategy for their classroom. The co-ordinator's research began with an interview with the teacher about their views on environmental education, pedagogy, and action competence. Together, the co-ordinator and teacher gathered information from the students in the teacher's class concerning students' views about the environment before starting the EE unit.

In the third phase of the research—implementing the EE unit—the teacher kept a journal, recording observations on classroom activity and in particular elements of student critical thinking, input and decision making. The co-ordinator spent time observing the classroom and talking to the students and the teacher. The co-ordinator also analysed documents that were relevant to the EE unit (i.e., teacher unit plans and school policies).

In the fourth phase of the research, the teacher and the co-ordinator evaluated the unit with regard to development of students' action competence. This involved interviewing the teacher about their experiences in the unit, interviewing students in groups about their views of EE, and analysing student work. They drew conclusions on their case study, and reflected on what their teaching experience in the unit could contribute to an understanding of students' action competence in a New Zealand context. The co-ordinator and teacher collaborated in writing up the case study. The mentors played a key role during this phase, providing support and advice to the co-ordinators for the evaluation. A summary of each of these case studies appear in the appendices.

In the final phase of the research, the environmental education co-ordinators and the teachers met with the team leader and mentors in November 2005 to discuss the findings of the six case studies and draw general conclusions. The mentors then met to summarise the outcomes and write an overview.

Validity and reliability were enhanced in this study by the multiple methods of data collection used, echoing the call for data triangulation made by Kyburz-Graber (2004). These methods included student and teacher interviews, observations, and document analysis. Ethical approval was gained from the University of Waikato Human Research Ethics Committee. Where necessary, applications were made to partner institutions and approval was gained before collection of any data.

Research design critique

This project progressed very smoothly. The partnerships were built on solid foundations. At each level of partnership, a positive relationship already existed between the partners. The mentors were known to and, in most cases, had previously worked with the co-ordinators who conducted the research. Each co-ordinator chose as a research partner a teacher with whom they already had a professional working relationship. While in most cases the mentors had not previously met the teachers involved, relationships were developed through the team meetings and through the co-ordinators, who acted as links. In one or two cases the research partners said that careful selection of partner would be a major factor in any future research they did.

The teacher–co-ordinator research partnerships generally worked well, as all parties were genuinely committed to the goals of the research. Early on these were clearly negotiated and discussed in order to create ownership among all involved. These discussions mitigated the issue raised by Rickinson and Robinson (2001), discussed earlier. On the other hand, the design of the study clearly recognised the practice of each of the parties in the partnership. The teachers' mandate was to specify the unit that would be taught and to deliver the unit according to their practice. The co-ordinators had input into the unit planning, but then stepped back from their advisory capacity to take on the role of researcher. Naturally, there was potential conflict in these roles, and the mentors were careful to discuss them with the co-ordinators before the unit was begun. The mentors were also careful to discuss with the co-ordinator–teacher research partnerships the need for objectivity and rigour in research, to avoid reporting only the good news. We also needed a critical analysis to enhance our confidence in the findings (Corcoran et al., 2004).

The case-study approach allowed clear stories of contextualised practice to emerge, and some rich data that provided insights into the conditions for the development of action competence. Importantly, each case stands alone and provides an example of what EE can be like. The inter-case study analysis (Corcoran et al., 2004) described in the findings sought to determine commonalities and differences across the cases. Some themes emerged that can illuminate general practice in EE to develop action competence.

Feedback from the researchers and teachers at the end of the project indicated that they would have liked a little more direction early on in the project, an opportunity to meet as a team to discuss how to analyse the data, and more time to complete the report-writing phase.

The next section describes and discusses the findings of this project.

3. Findings

This section begins a review of the literature that framed this research. This opens with some background on the development of EE, nationally and internationally. In particular, it reviews some of the recent New Zealand literature about EE in school settings. The focus then turns to action taking and the concept of action competence. The section concludes with a look at theorising and research about pedagogies that may be useful in enhancing action taking in EE. The literature review is followed by presentation of the framework of action competence and the pedagogies that could enhance its development as agreed by the research team for use in this study.

A summary of each case study is then presented. The themes that emerged from the analysis are discussed and the responses to the research questions are analysed. The section concludes with implications for future practice.

Literature review

A background to environmental education

From the early beginnings of the environmental movement that arose in response to major environmental issues in the 1960s and early 1970s, a series of international meetings called for education that would lead to protection of the environment. An intergovernmental summit in Tbilisi, Georgia, in 1977 led to an international declaration calling for EE that included opportunities for people to be actively involved in working towards the resolution of environmental problems (UNESCO, 1978). This focus on existing environmental problems was only mildly effective (Bolstad, 2003) and was reoriented in the 1980s to include consideration of the environment, future economic and social development, and political contexts (World Commission on Environment and Development [WCED], 1987). This transformation was cemented in place at the 1992 Earth Summit in Rio de Janeiro. The resulting document, *Agenda 21*, called for education for sustainable development which, among other things, would involve a multidisciplinary approach to school curricula that would acknowledge social, cultural, and environmental dimensions, and actively involve students in planning environmental activities to improve and protect the environment for the future (UNESCO, 1992). This movement towards education for sustainability (PCE, 2004; Tilbury, 1995; Tilbury, Stevenson, Fien, & Schreuder, 2002) began to have major policy impacts in many countries, including New Zealand (Bolstad, 2003).

These impacts began to take shape in a meaningful way in the late 1990s. The publication of the *New Zealand Curriculum Framework* (Ministry of Education, 1993) had left EE on the margins. The environment as a context was mentioned in the science, social studies, and technology curricula, but it was left to schools whether or not to include it. In the mid 1990s, the Ministry for the Environment published significant statements on the need for EE at all levels of society, including compulsory schooling (Ministry for the Environment, 1995, 1996). These included a call for informed participation in decision making. Meanwhile, the Ministry of Education commissioned the writing of guidelines for environmental education in schools, which were eventually published in 1999 (Ministry of Education, 1999). These *Guidelines for Environmental Education in New Zealand Schools* represented the first official mandating of EE in New Zealand and, although they were recommendations and not requirements, it was a significant step forward.

The *Guidelines* framed EE in terms of five aims (awareness and sensitivity, knowledge and understanding, attitudes and values, skills, and participation and action), four concepts (biodiversity, sustainability, interdependence, and personal and social responsibility for action), and three dimensions (education *in, about* and *for* the environment). As can be seen, action taking was seen as a fundamental part of EE by the *Guidelines*. The document provides a planning guide for EE

programmes, ideas for integrating EE into the seven learning areas, and—crucially—a guide to how an "action approach" may be adopted in EE.

Interestingly, the New Zealand approach until now has been to conceive of these endeavours as *environmental education* in schools, resisting the trend towards *education for sustainability*. In part, this may be due to educators' lack of understanding or agreement on what sustainability means, and concomitant concerns about students' ability to come to terms with the concept. This may have led to the current *Guidelines* positioning of sustainability, which has been addressed by Barker (2001), and a criticism of its *Guidelines* description as "confused green woolliness" (Birdsall, 2005). In view of this uncertain position of the term "sustainability", and the prevailing use of the term "environmental education" in the school sector, the latter term is used in this report.

Since the introduction of the *Guidelines*, growth in EE in schools has been slow but steady. Professional development provided by the Ministry of Education from 2001–2003 led to a number of pilot schools delivering pilot EE programmes. Then, in 2003, 17 Regional Environmental Education Co-ordinators were appointed to Colleges of Education to act as school advisers (McConnell, 2003). Their role was to upskill teachers in the use of the *Guidelines*, and to support teachers in the pilot schools.

In 2002–2003, a national study of the development of EE in New Zealand schools and kura found evidence of involvement at all levels of the compulsory education sector (Cowie et al., 2004). In many schools the initiative was at the individual teacher or syndicate level, and only a few schools reported adoption of a whole-school approach to EE.

A separate initiative that is proving to be successful in developing whole-school approaches to EE is the Youth Enviroschools programme (Keown & McGee, 1999; Keown, McGee, & Carstensen, 1995). Developed in Hamilton by local government, it has now spread throughout the country. The programme emphasises a whole-school approach to EE and sustainability, and has recently introduced an awards scheme (Chidlow, 2003). The programme has been particularly successful in helping students to take action for the environment.

Action in environmental education

As noted earlier, an action component for EE has been implied from its beginning. Lucas (1979) described EE in terms of *in, for* and *about*, and it has been claimed that EE should ultimately be directed towards education *for* the environment (Fien & Greenall Gough, 1996). An action orientation is also seen as critical in the reorientation towards education for sustainability (Tilbury, 1995). Additionally, as described earlier, the New Zealand *Guidelines* highlight action taking as one the five aims of EE, one of the three dimensions (and a fundamental part) of personal and social responsibility for action, and one of the four concepts (Ministry of Education, 1999; Russek, 2003).

Therefore, the rhetoric and theorising support the crucial role of action taking by students as part of EE in New Zealand. A national survey of schools involved in EE revealed some teacher reports that students took action in their EE programmes (Cowie et al., 2004). The most frequently mentioned activities were recycling, worm farming, gardening, and composting. Additionally, a number of recent articles have highlighted the actions taken by students in the Youth Enviroschools programme (Crawford, 2003; Hooper, 2003; Oliphant, 2002; "Student-driven environmental focus", 2004).

Yet there is evidence that student action taking is not a consistent part of EE in New Zealand. The national school survey of 2002–2003 showed an underemphasis on education *for* the environment among respondents' descriptions of EE (Cowie et al., 2004). Only 62 respondents (18 percent of a total of 344) mentioned action taking as part of their description of what EE is. When asked about their purpose in delivering EE to students, only a slightly greater proportion (33 percent, $n = 261$) mentioned educating students to take action for the environment. The report of the survey concluded

that teachers lack the time to plan and take action with their students, and sometimes lack the equipment and resources to facilitate student action such as creating gardens or planting trees.

Some New Zealand research studies have suggested factors that can enhance student action taking in EE. Vowless (2002) studied two schools in the Northland region and concluded that successful education for the environment needs to include practical action as a component of the learning, and that the goals and outcomes of the educational programme need to be achievable. Chapman (2003, 2004) notes that a critical evaluation of values is necessary for student action taking, and provides evidence from his study of a recycling and waste management project in a small school on the West Coast of the North Island. The potential for student action taking to be transformational was identified by Papprill (2004) and McLean (2003). In her investigation of education *for* the environment in Otago primary schools McLean (2003) noted two criteria required for action—students being involved in the decision making process, and the resolution of environmental issues as the focus for learning.

These few recent studies aside, the literature review for the national school study of EE (Bolstad & Baker, 2004) concluded that there was a general lack of research, both nationally and internationally, investigating the perceptions or learning outcomes of students engaged in education *for* the environment. This study aims to address that deficit by investigating student outcomes in the area of action competence.

Action competence

The notion of action competence was first posed in the 1990s by researchers in the Royal Danish School of Educational Studies. Jensen and Schnack (1997) defined action competence as the ability to act—in this case, with reference to the environment. They argued that "the aim of environmental education is to make students capable of acting on a societal as well as a personal level" (p. 164). In order to do this, students need to study the root causes of environmental problems within the context of their society (Wals, 1994). Jensen and Schnack (1997) further argued that education is not about simple behaviour modification without understanding, but about creating a democratic process of participation in which students decide for themselves the action they will take.

In this paradigm, actions are considered to be consciously taken and targeted, since they are intentions based on experiences. Action is not seen as behaviour change—the process of influencing students in a predetermined direction (Breiting & Mogensen, 1999; Courtney-Hall & Rogers, 2002). Equally, action is seen as different from activity, in which students undertake environmental tasks that do not involve solutions to the underlying environmental problem. (An example of an activity would be litter collection, whereas an action would be addressing how to prevent littering.) Action competence, then, is a process in which students identify environmental issues, determine solutions, and take actions in ways that develop their competence for future action to solve or avoid environmental problems (Jensen, 2002).

Jensen and Schnack (1997) noted that actions could be direct or indirect. Direct actions contribute directly to solving environmental problems, whereas indirect actions are those which seek to influence others to contribute to solving the problems. The authors are careful to emphasise, however, that any action taken should be placed in the context of the problem to be solved. They noted that in classroom work actions are often taken at the individual, class, or even school level, but that unless students are made aware of the greater problem their action is helping to solve (i.e. turning lights off helps reduce overall consumption of unsustainable energy sources), education may be limited. It is important that children not only take action but also understand why they are taking that action (Palmer, 1995).

Jensen and Schnack (1997) identified four aspects of action competence:

- knowledge and insight of the environmental problem;

- commitment to solve the problem;
- a vision for the future without the problem; and
- action experiences to draw upon.

A further component noted by Breiting and Mogensen (1999) is student confidence in their ability to influence environmental outcomes. Jensen and Schnack (1997) conclude their discussion of action competence by calling for further research into how these components are constructed and interconnected through teaching. This study is an attempt to contribute to that call, by examining the pedagogies that could lead to development of student action competence in the classroom.

Pedagogies for action competence

This section examines theoretical ideas in education that have been used to guide the development of pedagogies in EE. It focuses particularly on pedagogies that could encourage learning for action taking and, more specifically, for the development of student action competence.

Behaviourism was for many years the dominant theoretical approach to education. In this approach, the goal of education is to change the behaviour of the student in response to teaching. More recent theoretical ideas have focused rather on cognition (knowing and understanding) to explain how students learn. Ideas such as constructivism suggest that learners develop their own personal constructs through learning experiences, and that teaching should attempt to help them examine these constructs in the light of new knowledge to reach new understandings of the current state of knowledge in society. This approach has been broadened to emphasise the social nature of the learning process, and sociocultural perspectives have highlighted the role of social interactions and participation in communities of practice in learning.

The trend away from behaviourism in education in general has not been so evident in EE. It has been noted that claims that the aim of education is behaviour change have appeared relatively recently in the environmental education literature (Courtney-Hall & Rogers, 2002; Kyburz-Graber, 1999). These claims, Courtenay-Hall and Rogers argue, risk directing teaching towards indoctrination, removing the opportunity for student critical thinking.

In the early 1990s EE theorists and researchers turned to constructivism and critical education. Klein and Merritt (1994) argued for a strong fit between EE and constructivism. They identified the components of a constructivist pedagogy as work on real problems, student-centred instruction facilitated by a teacher, group interaction during learning, and authentic assessment. These components parallel EE in requiring students to take an active role in learning to improve investigation and critical thinking skills (Klein & Merritt, 1994).

The need for the development of critical thinking skills in EE led some theorists to suggest socially critical theory as underpinning pedagogy (Fien, 1993; Huckle, 1991; Robottom, 1993). As Kyburz-Graber (1999) notes, a critical approach to EE "allows young people to explore social issues in the real world by questioning values, perceptions, conditions and opinions" (p. 416). This, she notes, creates meaningful, contextual knowledge that opens up discussion on all sides of issues. The approach, it is claimed, is concerned less with the aim of teacher-directed behaviour change and more with the development of independent, self-thinking learners. Kyburz-Graber (1999) describes the teaching and learning situation in terms of a partnership in which reflection is crucial. Socially critical theory has been used to describe emancipatory action research as a form of pedagogy for EE. In this form, students identify environmental problems, conduct investigations, collate data, suggest solutions, and develop and implement action plans. Each step involves critical reflection on the social and political contexts for the problems. Such critical thinking and reflection on discursive social practices affect teachers' ability to meet specific teaching and learning objectives in EE. A programme that has emphasised this area is the Environmental and School Initiatives (ENSI), which focused on teacher professional development and provided insights from cases in 20 countries into the value of underpinning both curriculum development and professional development with research

(Kyburz-Graber & Robottom, 1999). The programme supported the use of reflective action research that led teachers to develop their own pedagogy for EE. It also encouraged students to participate in action research as they investigated local environmental issues.

Proponents of the socially critical approach to EE recognise it as challenging existing teaching and learning practices—in particular, the traditional transmissive practice of teaching and the position of the learner as a passive receiver. It encourages both teacher and learner to question the practices that have led to current environmental, social, and political problems. This could create some difficulties, as teachers struggle to adopt a socially critical stance in the face of organisational and social constraints (Gayford, 1991; Walker, 1997). Indeed, Walker (1997) goes so far as to argue that the reason for the lack of success in the growth of EE in schools has been the inability of teachers and students to come to terms with the advocated socially critical approach, claiming that it is too difficult. In a similar vein, Bonnett (1999) has questioned the practicality of value-free teaching of sustainability, as advocated by some (e.g., Jensen & Schnack, 1997), in a world that is values drenched. Fien and Corcoran (1996) identified these challenges as the "social change objectives" of EE, which require its practitioners to adopt pedagogical approaches that are markedly different from traditional teaching styles, alerting teachers to the transformative nature of environmental education, and encouraging them to be critically reflective practitioners. Support could come from school-based communities of reflective practitioners, including both experienced and beginning teachers (Law, 2005).

The ideas of constructivism and critical education are contained in a recent move to promote transformative learning as a way forward for EE pedagogy. Transformative learning (Mezirow, 2000) has been generally characterised as involving active construction of knowledge, attitudes, and values through the processes of critical reflection and reflective discourse. These processes involve cognitive as well as affective domains, uncover underlying assumptions, integrate collective experiences, examine alternative perspectives, and arrive at tentative judgements (Feinstein, 2004). Feinstein's (2004) study of adult students from different cultures indicates that these processes could lead to transformation in EE.

Stephen Sterling (2001) has been a powerful advocate for transformative education towards sustainability. He articulates an ecological view of systems thinking that emphasises extension, connection, and integration. In this view, teaching and learning is seen as oriented to process, development, and action, and involving mutually informing, active participation. Learners construct their own meanings through critical, collaborative enquiry supported by reflection.

A small number of researchers are also examining sociocultural views of learning, such as situated learning theory (Lave & Wenger, 1991), for help in understanding learning in EE. Hogan (2002) argues that to become an environmental practitioner—one who acts on behalf of the environment—entails developing an understanding of the social world of environmental practice. Her study of senior high school students in the USA was underpinned by situated learning theory, which posits that learning occurs in social interactions and increasing participation in a community of practice. In this case, the community was a citizen-run environmental management and advisory council. Hogan found that, with careful planning, students can learn the meaning of environmental practice (or action) in sociocultural ways, through involvement with environmental agencies. She notes that, for younger students, this type of learning could be brought about by involving them through school-based programmes in the social and cultural practices of environmental agencies.

Research into learning in EE has provided some evidence of useful pedagogy for action in EE. In his extensive review of studies between 1993 and 1999 focused on learning in EE, Rickinson (2001) noted that targeted classroom programmes can be effective in "altering students' environmental attitudes, knowledge and actions" (p. 264). The author described two studies, those of Ramsey (1993) and Bogner (1999), that appeared to encourage students to act in an environmentally friendly way. Ramsey's (1993) study examined the impact of an instructional strategy based on issue

investigation and action training, and reported that overt environmental behaviour and knowledge (and perceived knowledge) of environmental action skills were significantly improved in the 14–15-year-old students. Bogner's (1999) study investigated how an experiential programme that focused on both cognitive and affective domains influenced changes in Swiss secondary students' attitudes and intentions to act concerning a locally endangered bird. However, Rickinson (2001) cautions that these studies do not show any evidence of long-term impact on the learners. He quotes only one study, that of Bogner (1998), in which any durable change was evident in students' willingness to plan and take action for the environment. The impact on the 11–13-year-old students in this study appeared to last at least six months.

Rickinson's (2001) review also noted a small number of studies that examined how particular pedagogical strategies affected students' environmental learning. Evidence from these studies suggests that approaches such as teacher role modelling and experiential learning, and social constructivist activities such as collaborative learning, discourse reasoning, and argumentation, were all effective. Rickinson concluded that, while there is some evidence that certain pedagogical approaches are effective in facilitating positive learning outcomes, more empirical work is needed in this area, particularly in investigating student action taking.

The lack of theoretical work underpinning EE research is a theme picked up by Dillon (2003). Indeed, he criticises Rickinson's (2001) review for not examining the empirical work it discusses in the light of learning theory—a criticism which is partly justified. Dillon (2003) argues for greater consideration of learning ideas such as constructivism and situated cognition in theorising about how students learn environmental knowledge, attitudes, and actions.

Action competence concerns the ability to act with reference to environmental problems, through informed student decision making underpinned by critical thinking about the root cause of problems and reflection on experiences at both a personal and societal level. Such a transformative approach to EE appears to offer the best way of developing pedagogy to enhance students' action competence. Such an approach would offer students experiences that would help them to identify and resolve problems, think critically, and reflect as they work collaboratively towards action. A recently published example (Lewis, 2004) of this type of pedagogical approach, and one that led to genuine student participation and ownership, points to the importance of student-centred learning in which the role of the teacher is that of facilitator.

This review of the literature helped the research team frame their planning of the EE unit to be taught, the research data gathering tools, and the analysis of the data that were collected. This framework, which included notions of action competence and pedagogies that could be used in the classroom to develop it, is discussed in the next section.

The research framework

At the project meeting in March 2005, the research team debated the components of action competence. The team started with the components of knowledge and insight of the environmental problem, commitment to solve the problem, a vision for the future without the problem, action experiences to draw upon, and student confidence in their ability to influence environmental outcomes (Breiting & Mogensen, 1999; Jensen & Schnack, 1997), and delved deeply into what these components would look like in the classroom. First, the notion of competence itself required some definition. In the current review of the New Zealand curriculum it has been described as the "ability to successfully meet complex demands in a particular context through the mobilization of knowledge, cognitive skills but also practical skills, as well as social behaviour components such as attitudes, emotions, and values and motivations" (Rutherford, 2004). When considering taking action for the environment, we agreed that students need to be involved in deciding what to do, and that what is done should be focused on solving an actual problem. In linking these ideas of competence in taking action together, we identified five components that underpin action competence:

- Knowledge and understanding for decision making—students require knowledge on which to base soundly reasoned decisions. This knowledge could include technical, social, political, historical and economic factors.
- Planning and taking action—students require the skills and confidence to identify and solve problems, set goals, gather information, communicate, and manage time and logistics to take action (indirect or direct).
- Participation—students require skills in making decisions in a way that is consultative, democratic, collaborative, and co-operative.
- Emotional response—to be able to decide the appropriate action to take, and their own personal responsibility and commitment, students need to understand their own and others' attitudes and values towards issues.
- Critical thinking and reflection—students require the skills to be able to think critically about the causes of issues and the possible actions that could be taken, and to make meaning by reflecting on their knowledge, actions, participation, attitudes, and values.

The challenge for us in this research study was to be able to determine the students' development of these elements through teaching and learning in EE. This dimension of the study led to some promising ideas of how the development of action competence can be determined in students. This involved collection of data on student action competence both before and after the unit (see "Response to the research questions", below).

The other dimension of interest is the use of particular teacher pedagogies and strategies to foster the development of action competence. The five elements that we identified led us to consider that a transformative mode of teaching and learning was likely to be more appropriate for developing action competence than the transmissive mode. As discussed above, a number of authors have previously argued for transformative learning in EE (Sterling, 2001).

We explored the possible pedagogies that could lead to a transformative mode. A "pedagogy", we understood, was more than just "what the teacher does"; pedagogy also refers to the values, aims, and philosophy of education—it is a "method of teaching interpreted in its widest sense" (Winch & Gingell, 1999). We recognised that transformational learning may involve at least six pedagogies and strategies, which we described as:

1. *Experiential learning.* This is an over-arching concept that appears to be useful in the transformative approach. Characteristics of experiential learning include:
    - involving students in meaningful experiences, decision making, and taking action for an agreed purpose;
    - helping them to think critically and reflect upon their experiences;
    - engaging them in questioning and discussion;
    - acknowledging and valuing their prior knowledge and experiences; and
    - assisting them to develop knowledge to inform their decision making (Law, 2005).
2. *Enquiry learning.* This is a process of identifying and solving problems, thinking critically, and reflecting to gain understanding or make informed decisions.
3. *Co-operative learning*. Students work together and share knowledge, ideas, and opinions. This involves both class and group work, and emphasises learning through social interaction.
4. *Reflective practice*. The teacher analyses the state of learning and makes strategic decisions for future implementation, either consciously (usually afterwards, by hindsight) or intuitively (on the spot, in the classroom). The students also need to consciously reflect on their learning, values, attitudes, and actions for the environment.

5. *Student-centred learning*. The learner is placed at the centre of the learning experience. In environmental education this is seen in holistic (not merely cognitive) terms.
6. *Affective-aware teaching.* As well as considering cognitive learning, the teacher needs to be aware of how individual learners or groups of learners feel about a situation. This component also acknowledges the dimensions of values and attitudes in teaching and learning.

We recognised that these pedagogies and strategies are not mutually exclusive, and that some combination of them was likely to prove most effective. When the research team reached agreement on this framework, the task for the teacher–co-ordinator partnerships was to decide how they would use it to plan and deliver the EE unit, and research how the unit may help students develop action competence. The partnerships were given autonomy to choose which pedagogies and teaching strategies they felt were most appropriate for developing action competence in their unit.

The next section provides brief summaries of the five case studies and their outcomes.

The case studies

Five case studies were conducted in classrooms throughout New Zealand. The classrooms represented included a range of levels between Year 1 and Year 9, and different types of school. The stories that emerged from each case study are summarised below (the case studies are described in more detail in the appendices). To protect the identity of the participating schools for ethical reasons, the names used here are pseudonyms.

1. *Te Wāhapū School.* A term-long unit entitled "Healthy water—who is responsible?" was delivered to a Year 7, ethnically highly diverse class in a decile 1B intermediate school in a large city. The unit was underpinned by knowledge development through English language competence, a matrix of Gardners' multiple intelligences (Gardner, 1999) and Bloom's taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956), experiential learning, and action learning. The context for learning was situated in the culture and history of the local environment, helping students to make connections between their backgrounds and that environment. Allowing students to make a choice about context, content, and resources empowered and emotionally engaged them in their progression towards action competence. Students worked collaboratively, and communicated verbally and through PowerPoint presentations with peers and other adults. This built up their self-confidence and self-esteem. Importantly, they learnt that when they presented well-written and accurate information other people listened to them, and that they *could* make a difference to their school and wider environment. The boys' engagement in learning was observed to improve.
2. *Green School.* A class of Year 1 children in a decile 9 primary school in a small city were taught a term-long unit on the topic of "our space", which focused on a review of the appearance and use of the junior courtyard area. A strong culture of EE drives the school-based curriculum. The unit was delivered using a mixture of teacher role modelling, co-operative learning, and experiential learning pedagogy. Teacher role modelling was the most significant pedagogy, which is hardly surprising considering the age of the children and the need to consistently show them a good deal to get them started. The case study at Green School suggested that, while at this age the children were less likely to engage in critical thinking, some did become emotionally engaged, which led to decision making and greater willingness to be involved in activity, if not action. It may not be possible to develop all components of action competence with this age group.
3. *Coast College.* A six-month case study followed the teaching of an EE unit "Clean, green New Zealand: Yeah, right!" to a Year 9 combined English and social studies class from a decile 9, co-educational secondary school in a small town. The unit was underpinned by experiential, enquiry, and co-operative learning pedagogies and strategies such as brainstorming, teacher-facilitated

discussion, scaffolding in research skills, and the use of action planners. The students were encouraged to make decisions about whom to work with, identify local issues, and choose and take their actions. The teacher experienced a certain amount of risk in allowing students more control over their own learning. These strategies led to students demonstrating emotional engagement, increased confidence in their abilities, and greater willingness to give opinions. This was shown by their ongoing concern about environmental issues (such as the pollution of New Zealand lakes, litter in the school, and waste management and water use in the community) and enhanced engagement in subsequent units not related to EE. The boys' engagement improved.

4. *City School.* A unit entitled "Seeing our city with new eyes" was facilitated in a mixed Years 5–8 group of students in a decile 6 special-character school in a large city. The special character of the school revolves around a collaborative teacher–student relationship, with students taking an active role in planning their own, largely individual, learning path. Within this context, the teacher planned an enquiry to build awareness of the city neighbourhood and its associated environmental resources, challenges, issues, and concerns. The pedagogy used was enquiry learning, incorporating critical thinking and reflection (with some teacher scaffolding to plan actions). A matrix was developed for evaluating student action competence and was used to map development over the unit. Student engagement was related to how much support they received in their enquiry, and the continuity of their learning. The findings highlighted the importance of achievable action taking for students.
5. *Beach Head School.* A two-term unit on eco-housing for birds in the school environment was delivered in a sole-charge, decile 4, rural primary school. The school caters for 22 Years 1–6 students. The unit was part of a long-term plan that immerses students in EE projects and is characterised by a flexible timetable, continuity of learning, and a strong relationship with the community. The unit was underpinned by the notion of place-based education, with elements of experiential learning, enquiry learning, and student-centred learning. This created experiences that were meaningful for the students and based in their milieu, with a high degree of their input into decision making and action taking. On the one hand this was risky for the teacher, but on the other it was empowering for the students. The boys' engagement improved.

The data from these five case studies were then subjected to a cross-case analysis. This was initiated at the team meeting in November 2005, drew on the perspectives of all participants, and was further refined by the mentors. Several themes emerged and are discussed in the next section.

Emergent themes

The following themes arose from the analysis of the case studies for similarities and differences. Most of these themes flow across all five cases, but some emerged from a smaller number of the cases. The themes are discussed and exemplified with instances from the data within the cases.

The role of the teacher

Three themes emerged under this heading.

Teacher decision making on pedagogy

The teachers in the project exhibited a range of decision making with regard to the pedagogies they chose. Decisions ranged from a deliberate and carefully planned use of specific pedagogies at certain points in the unit, through the use of pedagogy embedded in the class or school, to the relatively free use of a range of strategies not constrained under pedagogical goals. Evidence suggested that choice of pedagogy affected student development of action competence. The deliberate planning and use of pedagogies that were seen to hold potential for that development were the most successful in achieving student action competence. This was exemplified by the teacher at Te Wāhapū School in

her comment about teaching EE in her class that "I have to have a differentiated programme so that all the different learning styles are accommodated for".

The pedagogies that teachers chose

This appeared to be an important factor in contributing to the students' development of action competence. In all cases the teachers employed a blend of pedagogies and a range of teaching and learning strategies to achieve their pedagogical goals. There was evidence that teacher craft—an ability to know what will work in the classroom, which in turn is a reflection of their own practitioner theories (Walker, 1997)—was highly influential in student learning. This was exemplified by the teacher at Te Wāhapū School, who blended Bloom's taxonomy and Gardner's multiple intelligences with experiential, enquiry, and co-operative learning to successfully engage her ethnically diverse class (see Appendix 1). It seems clear that no single pedagogy provides the key to teaching EE, but that certain pedagogies offer good opportunities to students to develop action competence. These are discussed further in the next section, "Implications for practice in environmental education".

The changing relationship between the teacher and the students

It was evident from the data collected that as the EE units progressed the teacher and student roles changed. There was evidence of a shift from a traditional teacher–student relationship (in which the teacher is the provider of knowledge and the students are the receptors) to a more facilitative co-engagement model. This was particularly marked in the junior secondary school setting at Coast College, where students became strongly engaged, worked independently of the teacher and collaboratively with each other, and freely gave up their own time to continue working on their action. In particular, two girls in the Year 9 class spent many hours gathering information and help from the community to learn how to create a video on their topic, a task that continued beyond the end of the unit. In contrast, students at the younger end of the age spectrum tended to be more reliant on teacher direction. This theme is discussed in more detail below.

The student approach to learning

Three themes emerged under this heading.

Students' emotional engagement

In all five case studies, the students showed significant emotional engagement. In some cases this manifested as student excitement at experiential activities, both in the classroom and outside it. At Beach Head School, all the primary-level students took ownership of "their bird" as the one they were studying for the unit on building eco-birdhouses. The students also exhibited an understanding of their moral responsibility for their school and community environment, commenting that "we have to make responsible decisions. We don't want it to be just another city area". In the older students, evidence of changed attitudes and values was recorded. At Te Wāhapū School this was evident in the way that the students behaved on their school camp, taking collective responsibility for keeping the camp clean. Images of polluted streams in New Zealand shocked the Year 9 students at Coast College, changed their thinking about a "clean, green New Zealand", and stimulated their action taking. The shift in their attitudes towards the environment was evident in a post-unit survey.

Student participation

Students demonstrated significant levels of active involvement in their learning and encouraged other students to become involved also. The students at City School were used to an environment in which they were considered partners in their own learning. With facilitation from their teacher, this helped them to make excellent progress in their EE-based inquiries within their city. At Coast College the students developed a sense of what they needed to learn themselves, as evidenced by their questions, which were about where to find resources, not what to do next. At Beach Head

School the primary students liked the opportunity to make their own decisions, commenting that "we have a vote or group talk and what most people say is what we do".

Student collaboration

The small-school environment at Beach Head led to Years 1–6 students working together, with significant mentoring of the younger children by the older ones, which helped everyone to participate. They demonstrated support for each other—for example, when one student commented to another about a suggestion to use harakeke as a nest-building material, "That's a good idea! We should try that with our bird house". Student interaction at Te Wāhapū School was significant when they were constructing their own action plans. Students were constantly slipping in and out of different groups to help out when people's partners were absent. There was co-operation and collaboration. The groups formed were mixed in gender. Everyone knew about everybody else's projects and students defined their own roles within their group. At Coast College, the secondary students remarked how they really enjoyed working together, in ways they saw as different from the approaches used in their other classes. The students also helped each other across their groups, particularly with computer skills.

The assessment of action competence

The team's initial planning in March 2005 identified five components of action competence that were to be examined in the research (see the section on the research framework, above). The co-ordinator–teacher partnerships were not given any guidance on how they would assess the development of these components in students. This was to encourage the partnerships to develop their own measures using their own knowledge and skills in classroom assessment techniques. Their experiences in this project have indicated that assessing the development of action competence is a complex process. The multidimensional nature of action competence, incorporating the cognitive, affective, and behavioural domains, calls for assessment tools that are equally multidimensional. Several models for assessment were developed in the course of the research that provided a view of student action competence. The model developed by the City School partnership appears to offer a potentially useful framework and is discussed in more detail in the City School case study in Appendix 4.

Action taking

It became apparent during this study that action taking in EE needs to be both manageable and achievable. In one case, an otherwise successful and well planned unit failed to elicit student action because of the complexity of the issues. In this case (at City School), the teacher found that a facilitative mode in the classroom did not sufficiently support the students in their planning and taking action, and in fact hindered the development of the students' action competence. It was evident that more scaffolding was required. Such scaffolding was provided to the Year 9 students at Coast College and contributed to empowering the students to take their actions. These students and those at Te Wāhapū continued with their actions long after the unit had finished, either at school, in the home, or in the community, indicating that the action competence development may have been durable (Rickinson, 2001). The teacher at Beach Head School was careful to ensure that the students' plans for actions were achievable for all levels, with help from the older students. In contrast, it proved difficult for Year 1 students at Green School to take meaningful action, as is discussed below under "Age-related development".

The school structures

Two themes emerged under this heading.

The continuity of learning

The length of the unit taught and its continuity proved to be decisive factors in the development of student action competence. All the units were taught over at least one term, and sometimes two. Participants saw this time frame as vital to allow development of student understanding and collaboration (including decision making), and for planning and taking action. When the unit was part of a long term plan, such as at Te Wāhapū and Beach Head Schools, it was possible to make strong links with prior learning and develop holistic views. This continuity of learning seemed important for student engagement. This was achieved even in the secondary school environment, where students regularly change their learning focus. The teacher attributed this success to the fact that the EE unit was taught within an integrated English/social studies class, which meant that double teaching periods were available as well as more periods per week, allowing focus to be maintained. In contrast, City School experienced difficulty with student focus as the unit was regularly interrupted for days at a time while students pursued other learning goals.

School support for EE

While school support did not appear to be a determining factor, it did nevertheless impact on the students' learning. The underlying philosophy of both Beach Head and Green Schools includes a commitment to EE. This provided a sort of immersion for the students in EE ideas and practice, and was credited by the teacher at Green School as contributing strongly to the development of some of the components of action competence among her 5-year-old students. The other three schools had each had some exposure to EE ideas in the past, but did not exhibit a whole-school approach to EE. At both City School and Coast College, the teachers were seen largely as lone operators in EE. At City School, the lack of support for EE may have contributed to hindering the development of student action competence, as the teacher and students were unable to gain a dedicated focus on their EE work. At Coast College, however, the lack of school support was not an inhibiting factor, and may have been overcome by a combination of teacher enthusiasm and good planning.

The impact of the learning environment

The learning environment was regarded as an influence in all the case studies, with the setting for the EE unit being a key factor. For example, at Te Wāhapū School the use of the culturally and historically situated local environment was important in developing connections for the ethnically diverse students between their cultural history and the locality of the school. At City School, an emphasis on the local environment of the school also provided engagement early on in the unit, when the students had a sense that they could bring about change. The Coast College students were offered a range of learning environments that satisfied their interests and motivated them to take actions that were relevant to them. Finally, the two schools that included junior primary students, Beach Head and Green Schools, naturally chose the school environment as their focus, which gave the students a sense of place that they could be proud of.

Gender achievement

In three of the case studies, particular achievement by boys was reported. These reports noted the improved engagement of boys in experiential activities, group work, and action taking. At Te Wāhapū School, all six students in the two groups that attained the highest level of action competence were boys who had some of the lowest PAT scores in the class. At Coast College, a visit from the head of department during the unit elicited the surprised comment that "the boys [were] as engaged as the girls". Also during this unit the teacher received an email from the mother of a previously quiet boy who usually contributed very little in class to say that her son, for the first time, was talking about his learning at school and was busy researching information locally to help with planning his group action. He was researching types of plants best suited for the local environment and had rung several people in the community to gain some support for his group's issue. Finally, at Beach Head the boys responded well to the physical activity that came with taking action.

The role of culture

This theme is mentioned because of its absence rather than its presence. In only two schools was culture seen to be a factor in the EE unit that aimed to develop students' action competence. At Te Wāhapū School, culture was evident in the use of the Māori history of the local waterways, and the connections made to the students' own culture. At Beach Head School, the strong links to the local Māori community were a foundation for the school activities rather than an overt influence on the unit taught. In both these cases, elements of local and student culture were recognised during the unit and contributed to the engagement and understanding of the students. In each of the other three cases, there appeared to be no clear recognition of the role of culture in environmental education. What influence this lack of recognition of culture may have on the future development of action competence is unknown.

Age-related development

This theme was particularly evident in the case study on the Year 1 class at Green School. The case study indicated the difficulties of developing all five components of action competence in such young children. In particular, the children seemed to require much teacher direction to plan and take action, raising doubts as to whether that action could easily be identified as intentional. It is likely that 5–6-year-old children can develop knowledge and understanding for decision making, participate, and carry out limited critical thinking and reflection. It is undeniable that students of this age can have an emotional response, even though they may not be able to clearly explain their attitudes and values. The focus of this case study, and the findings among the older, secondary school students, led us to consider the idea of age-related development in action competence and whether it is possible to identify such a progression.

Development of language and meaning

The case study at Te Wāhapū School raised the issue of the link between language and meaning and the development of action competence. In a class where over 50 percent of the students were not native English speakers, the teacher found that it was essential to focus on vocabulary and associated meanings in order to provide a foundation for learning in EE. This focus paid dividends, not only in improved language competence, but in strong student engagement in the unit when language no longer posed a barrier to learning.

Implications for practice in environmental education

From the emergent themes we identified the following implications for EE practitioners.

- Teachers need to:
  - think pedagogically and be able to consider the most appropriate pedagogies that would underpin their teaching of particular units. They need to acknowledge the relationship between the theory and practice of teaching. A greater focus during pre-service teacher education and in-service professional development on pedagogy may be necessary;
  - be aware of their role in relation to their students as they move between the functions of teacher and facilitator of learning;
  - be aware of the affective domain in their students' learning and their action taking;
  - be prepared to allow and support students in directing their own learning and taking risks;
  - guide and support student action taking in EE;
  - understand that effective EE requires time for students to have experiences to reflect upon, work collaboratively, and plan and take action;
  - recognise the multicultural nature of New Zealand society in delivering EE. The development of action competence is both enabled and constrained by the culture of the student, the teacher, and the school. Language is a key factor in this;

- consider what aspects of action competence can be developed in the age group of the children they are teaching. In particular, they need to consider the degree of teacher direction required to assist the children to take action; and
- be aware that language and meaning underpins the development of action competence.

- Specific professional development may be required to help teachers gain pedagogical knowledge for student action taking.
- Teachers need a well constructed tool to assess the development of action competence. A matrix such as that employed in the City School study holds promise, but requires more work to determine its validity.
- Teachers may be most successful in delivering EE through integrated units.
- The *Guidelines for Environmental Education in New Zealand Schools* need to be revised to acknowledge modern views of sustainability and sustainable development, and to take into account New Zealand's increasingly multicultural society.

Response to the research questions

This section addresses the research questions directly.

What skills relevant to achieving action competence did students possess before the unit?

As described earlier, the research team saw the concept of action competence as including five components. The response to this question is discussed in terms of those elements.

1. *Knowledge and understanding for decision making*. Students in most of the case studies lacked specific knowledge about their topic before the unit started. Only the students at Beach Head School had some foundation in knowledge about their topic (eco-housing), because of prior learning at the school.

2. *Planning and taking action.* The students exhibited a range of capability in this component. Students at Te Wāhapū and Beach Head Schools had already been exposed to planning actions. Some students at Coast College and City School indicated that they took environmentally friendly actions outside school. The students at Green School had been involved in lots of environmental activities at school.

3. *Participation.* In all the case study classes, levels of participation were generally low. While students at Beach Head already had experience at decision making and group work, the students in the other four schools had generally only been exposed to group work.

4. *Emotional response.* Before the unit started the emotional engagement in the topic issue was generally low. This seemed to vary between students, depending on what sense of connection they felt towards the issue (at Te Wāhapū School, for example, the students who had never been to the sea had difficulty expressing an attitude towards it).

5. *Critical thinking and reflection.* Before the unit students across all case studies showed low levels of critical thinking. As noted earlier, this was not surprising for younger children, but was also evident in the intermediate children. The students at City School, who had been exposed to development of these capabilities previously through the school's focus on enquiry learning, felt that they were well developed in this area.

What pedagogies did teachers select (before and during the unit) and why?

As discussed under "Emergent themes" above, pedagogy selection by the teachers in this research ranged from deliberate planning of specific pedagogy throughout the unit to a looser choice of strategies not clearly linked to particular pedagogy. Where there was conscious planning, the teachers selected predominantly experiential, enquiry, and co-operative learning to underpin their teaching. These pedagogies had been identified by the research team as potentially successful in

developing student action competence. The teachers saw experiential learning as important in developing an emotional response, and in planning and taking action. Enquiry learning was valued as developing critical thinking, reflection, knowledge, and understanding for decision making. Co-operative learning was thought to enhance student participation. What is clear from the research experience and this analysis is that no single pedagogy offers the solution to developing student action competence. Rather, it is the teacher's skill in combining pedagogies and using deliberately chosen strategies that is important in determining student outcomes. This was clearly seen in the eclectic combination of pedagogy that suited the ethnically and academically diverse class of Te Wāhapū School, and in the need for greater teacher input for the much younger children at Green School,

What skills relevant to achieving action competence did students demonstrate during and after the teaching and learning?

The development of action competence will again be discussed in terms of the five components introduced earlier:

1. *Knowledge and understanding for decision making*. In all cases the students showed evidence of significant development in the knowledge and understanding of their topic. This ranged from a greater understanding of the issues affecting the "clean, green New Zealand" image at Coast College, to identifying that natural-looking birdhouses were more likely attract birds than miniature dolls houses, to the 5-year-olds at Green School learning about what might work in their courtyard.

2. *Planning and taking action.* In some ways, this component can be viewed as the most significant for development, defining as it does the unique goal of EE. Not surprisingly, then, it was also seen to be the hardest outcome to achieve, and one that required intensive teacher management (see "Emergent themes", above). The development in the case studies ranged from significant to not achieved. At Coast College the students planned actions during the unit and continued to take them after the unit had been completed. Significant progress towards action was seen at both Te Wāhapū and Beach Head Schools, where strong engagement of the students led to effective action taking. However, at City School the difficulty of taking the actions that had been planned resulted in no action, while the young children at Green School engaged in activity but not action, leading to a consideration of whether students at this age are capable of taking intentional, self-directed action.

3. *Participation.* All the case studies reported an increase in participation during the EE units. This was characterised by a strong commitment to learning, self-directed research, collaboration within and between groups, a sharing of ideas and skills, and an increase in confidence in making decisions. There was evidence of a genuine desire among the students to work together to provide a solution to the issues with which they were engaged.

4. *Emotional response.* In most cases there was evidence of the development of an emotional response, characterised by changes in attitudes and values towards the environment. At Coast College School a pre- and post-unit survey indicated a shift in student thinking about their responsibility for, and plans for involvement with, the environment. At Te Wāhapū School the students' experiences during the EE unit developed in them a strong sense of enjoyment and connection with the environment.

5. *Critical thinking and reflection.* There was evidence of development in these areas in some case studies. Students demonstrated reflective ability as they began to explore their own impact on the environments, and showed more complex thinking as they learned more about the sources of environmental problems. They indicated that they were able to consider other perspectives and understand the complexity of finding solutions that are both socially and environmentally desirable.

What did teachers feel led to changes in students' skills relevant to achieving action competence during and after the unit?

While the nature of this study and the methodology employed does not allow the establishment of causative relationships, it is possible to make inferences that merit further investigation. Factors suggested by the teachers included:

- development of students' knowledge and language, enabling them to engage with the issues and to communicate their ideas to others;
- the use of a combination of pedagogies that suit the students' needs and the context of the EE unit;
- provision of experiences in the environment, to enable students to develop emotional engagement and a sense of connection with the issue;
- progression from teacher direction to teacher facilitation in a more transformative learning style that encourages students to take more ownership of their own learning; and
- scaffolding in planning and taking action, so that they become both manageable and achievable.

Summary

This research has provided some insight into the teaching and learning approaches that can develop action competence. Its focus on five case studies has delivered five rich stories about the enactment of EE in the classroom. While these stories are highly contextual and resist generalisation, some themes have emerged within them that are worthy of further consideration and research. This study has provided a potential framework for understanding action competence and assessing its development in students, and some classroom-based evidence of the types of pedagogies that can be successful in achieving student outcomes in EE.

4. Limitations of the project and recommendations for future research

This section briefly discusses some of the limitations of this project, and makes recommendations for future research in this area. The limitations focus mainly on aspects of the study design and the teachers' and researchers' experiences.

Limitations

In a study involving a large number of researchers it was imperative that some measure of commonality be imposed in terms of understandings of research intentions, case study design, data collection, and analysis and reporting of the case. It was also understood that this project required research capability to be developed by relative research novices who needed guidance. On the other hand, EE is concerned with the development of critical thinking practitioners (Corcoran et al., 2004) and—as the researchers were all adults—about self-directed learning. It was hoped that the researchers would develop their own "action competence" for research through a process of guided experiential learning. The research design, therefore, was structured to provide sufficient scaffolding and support, yet allow exploration and discovery.

On the whole, this design worked well. At the completion of the project the researchers were generally satisfied with the way the research had progressed, and claimed that they had learnt a lot. In some cases the researcher felt that the study design did not allow for enough research direction, so that valuable time was lost in what was a very short-term project. In particular, some researchers felt that more support was needed during the analysis of the research data, to help make sense of the findings. An additional team meeting in the middle of the project to share ideas and provide stronger direction might have achieved this. There is a sense, too, that having a clearer common framework for data collection might have resulted in greater rigour across all case studies, but possibly at the expense of the emergent findings particular to each case.

The design of the study, with three levels of involvement in the research, had both strengths and weaknesses. It drew together experienced researchers as mentors, researchers who were relatively inexperienced in research, and teachers who mostly had no experience in research. This design provided excellent opportunities for scaffolding in research thinking and ability across these dimensions, but also tended to stretch the research wisdom thinly. The design placed the researcher as the key link between the mentor and the teacher, and this worked well when communication was regular and help was sought at appropriate times.

Recommendations for future research

Several issues emerged at the conclusion of the project that suggest directions for future research (see Findings, "Emergent themes" and "Responses to the research questions"). Research is needed into:

- the development of an assessment tool for action competence and how teachers use this assessment tool in their classroom;
- whether there is a correlation between students' age and their ability to take action for the environment, and therefore (by definition) to participate in environmental education;
- how school-wide approaches to EE (such as the Youth Enviroschools programme) meet the key competencies being advocated in the revision of the curriculum framework;
- boys' approach to EE and how that can be used to foster their achievement at school;
- teacher and student perceptions of the role of culture in EE;

- EE in kura kaupapa;
- age-related student progression in EE, to help teachers understand what can be achieved at each level of schooling. This requires more researched examples of EE at each schooling level, from preschool to Year 13; and
- the durability of change through EE. As Rickinson (2001) noted, there have been few studies of the long-term impacts of learning in EE. Research is needed on whether development of action competence under the guidance of a skilful and passionate teacher is durable in the face of competing academic and social pressures in the following years of a student's life.

5. Building capability and capacity

The project team

Project director	Chris Eames	The University of Waikato
Mentors	Barry Law	Christchurch College of Education
	Miles Barker	The University of Waikato
Researchers		
	Hilary Iles	The University of Auckland
	Jock McKenzie	Massey University
	Rosemarie Patterson	Dunedin College of Education
	Pam Williams	Victoria University
	Faye Wilson-Hill	Christchurch College of Education
Teachers		
	Cathy Carroll	Green School*
	Melanie Chaytor	Coast College*
	Tracey Mills	City School*
	Ngaire Rolleston	Te Wāhapū School*
	Anne Wright	Beach Head School*

*These affiliations are pseudonyms to protect the identity of the schools involved for ethical reasons.

Building the capability of the researchers

This project has provided an opportunity for a group of educators who have typically found it difficult to undertake research into their practice, and yet who are working under an increasing expectation to conduct research, to engage in research. This group, the Regional Environmental Education Co-ordinators, fulfilling school advisory roles, have experienced the achievements and challenges that research has to offer.

The structure of the project allowed the researchers to design and implement their own research under the guidance of research mentors. The framework of the project allowed the researchers to be involved initial planning and their viewpoints to be considered, such that they had a sense of ownership about their research. Feedback at the end of the project indicated that they had learnt a lot about the constraints of carrying out research, the need for careful planning on data gathering and writing up findings, the difficulty of finding enough time to collect data and think critically about findings, and the success of research partnerships that work well.

One issue germane to this study was the convergence of the researchers' roles as both researcher and professional developer. The research team was careful to explore that area before undertaking the research project, and to help the researchers see the difference in these roles. A key benefit the researchers found in these dual roles was that they learnt about their own practice in a very meaningful way.

Building the capability of the teachers

This project provided an opportunity for teachers to work closely with researchers already known to them and to engage in a form of action research. Through this engagement and their involvement with both the planning and the analysis of the research findings, the teachers experienced how research could inform their practice. Their feedback suggested that they had found being involved in the research both challenging and (sometimes) frustrating, but ultimately rewarding and inspiring. They noted that it had caused them to think more deeply about their own practice, to reflect upon *why* they do what they do (Rickinson & Robinson, 1999). They felt they had learnt a lot about the process of research, and were empowered at being able to generate knowledge for their own profession.

Enhancing researchers' understanding of teaching and learning

This project enabled researchers to take an in-depth look at classroom practice and gave them the opportunity to question teachers on their practice. It sought to investigate the outcomes of what teachers do, and understand the complexity of the learner and learning within an educational setting. The findings of the study, emphasised by the emergent themes described in the findings, indicate that the researchers have developed a greater understanding of the issues of teaching and learning in EE.

Teachers' expertise as researchers

This project provided an opportunity for the teachers to gain expertise in research. Feedback indicated that teachers valued the research process, experienced the constraints of a research time frame, particularly when working within a budget, and came to understand the rigorous nature of research. Opportunities to be involved in the data collection and analysis helped them to understand how these processes are conducted. The teachers emphasised the need for regular face-to-face meetings as a research team to ensure a consensual and consistent approach to the research. Some teacher participants would have liked to have more time for writing up their case study.

Final comment

We believe that this study has been successful in a number of ways. It has brought together a large group of educators across New Zealand to focus on a single topic. It has provided opportunities for school advisers and teachers to be involved in research. Ultimately, it has given us some insight into the complexities of teaching EE in our classrooms, and pointers towards the work that still remains to be done.

A final implication of this study relates to the broader goals of education. This study has provided some evidence for the value of a transformative approach to education. When students were allowed to have a strongly participative role in their own education, under the expert facilitation of a pedagogically strong teacher, their achievements in developing competence in EE were significant. While this approach to teaching and learning was undoubtedly challenging for the participants in the project, the dividends are clear. Policy makers, professional developers and teacher educators need to consider making a commitment to fostering this transformative approach in all areas of our students' schooling.

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Appendix 1: Te Wāhapū School—Case Study 1

The context of the study

Te Wāhapū Intermediate School, established 42 years ago, is situated in a large metropolis. The ethnicity of its 440 Year 7 and 8 students comprises Pasifika (53 percent; mainly from Samoa and Tonga, but also from Niue, the Cook Islands and Tokelau), Indian (19 percent), Māori (18 percent), New Zealand European/Pākehā (3 percent), and other ethnicities (7 percent). There are 16 classroom teachers, 4 specialist teachers, a teacher of English as a second language, and 3 part-time teacher aides. The school has a decile (targeted funding for educational achievement) rating of 1 on a 1–10 scale. This low socioeconomic rating qualifies it for special Ministry of Education funding.

Te Wāhapū Intermediate School has one overarching goal: to develop ambitious attitudes towards challenges, learning, and the striving for personal standards of excellence. It has four locally-oriented goals: integrating cultural diversity into its programmes; seeking local partnerships to enhance learning; developing programmes that target the understanding and shaping of this special community; and promoting a holistic environment within which all learning is able to occur.

A key feature of the school is its location—it is bordered on two sides by streams and on a third side by an estuary. For centuries the latter has been an important portage way for Māori between two magnificent harbours. Indeed, the existence of this portage was reported back in Havaiki from the very early stages of Polynesian colonisation of Aotearoa New Zealand. The school acknowledges this in its emblem, which includes a waka (canoe), and in its efforts to raise community awareness of the historical and cultural significance of the portage. In 2004 the school created better access between the its playing field and the estuary, and students are working with the community on a re-vegetation programme that aims to plant 7500 native trees in the interfacing area.

The environmental education unit

This case study describes an environmental education unit entitled "Healthy water: who is responsible?" which was taught in one home room over a period of 10 weeks in Term 2 (May to July), 2005. The 25 Year 7 students had all scored lower than the national average for their age in PAT tests (the standardised national progress and achievement tests in vocabulary, reading comprehension, listening, and mathematics). Their ethnicity reflected the composition of the school at large.

The teacher designed the unit to resonate with the school's overall environmental themes for each term, which were to be taught through complete integration of all subjects except physical education and, sometimes, mathematics. However, it had been an in-service course in environmental *education* in 2003 that had prompted her, after a successful trial in 2004, to adopt the specific approach in "Healthy water" in 2005. She had considered that environmental education might provide a way of addressing the students' difficulties in formulating questions; it might engender an enhanced sense of place (in keeping with the school's local goals); it had potential to encourage students to adopt leadership roles in the school; and, most importantly for her, it might help them to become independent critical thinkers. With the enthusiastic support of the principal, she had therefore implemented a unit entitled "Origins, connections and pepeha" in Term 1. The units planned for Terms 3 and 4 (which were subsequently implemented) were "Free places" and "Issues—on a local, national, international or organisational scale".

The unit itself broadly progressed through a number of phases: identifying existing and new knowledge (Weeks 1–2); applying the knowledge as the students experienced new environments

beyond the classroom (Weeks 3–4); questioning and proposing action (Weeks 5–6); investigating and completing action for the environment by carrying out projects of the students' own choice (Weeks 7–9); and reflecting on the whole process by giving PowerPoint presentations (Week 10).

Selection of pedagogies

The unit was underpinned by an eclectic mix of four consciously chosen, sequentially and cumulatively applied pedagogies.

1. Enhancing knowledge through increasing English language competence

English was a second language for over 50 percent of the class. It appeared to the teacher that the English vocabulary of many of these students (and the meanings associated with many words) was so significantly impoverished that it was a barrier to their learning. Right from Week 1, therefore, she focused strongly on the students' language needs, using a wide variety of texts to allow for missed learning—"I keep revisiting words in lots of different ways". Developing language and meaning was a core component of the students' knowledge needs. The teacher rather cryptically compressed this thought into a few words: "I see knowledge as a teaching strategy". She also tried to provide concrete examples of the words and, later, used the environment as a visual resource. This enabled students to experience real examples, and it reinforced their language learning. In the teacher's view, building a knowledge base formed an essential step in the progression towards acquiring action competence.

2. Creating a matrix of Gardner's multiple intelligences against Bloom's taxonomy

The teacher also drew on an interest in the work of Howard Gardner and Benjamin Bloom that she had developed during her studies at a college of education. She was attracted to Gardner's belief that the concept of intelligence had been too narrowly defined, and was interested in his 1983 proposal that at least seven basic intelligences exist—linguistic, logical-mathematical, spatial, bodily-kinaesthetic, musical, interpersonal, and intrapersonal—and that everyone possesses these, but at different levels, with different interactions and abilities (Armstrong, 1994, p. 11). Bloom's hierarchical taxonomy of cognitive skills (Bloom, Engelhart, Furst, & Krathwohl, 1965)—remembering, understanding, applying, and so on—provided guidance as the demands in terms of thinking on students in the unit become gradually more sophisticated. Combining the ideas of Gardner and Bloom provided her with a progressive framework for planning students' progress through the unit—a framework that gave them choices in the way they worked (the multiple intelligences) and a structure to their learning in which they could see the progression (Bloom's taxonomy). Interestingly, the teacher had used this approach in her classroom for a number of years in a spontaneous and undocumented way; it was only when she knew that she was to be involved in the current research that she systematically framed up this approach on paper before the unit began.

3. Providing a range of experiential activities "in" the environment

In the teacher's mind, the holistic aspects of her Bloom–Gardner approach linked closely to what she considered to be a key element of environmental education, namely, experiential education. By Week 3 the students were engaging in various new experiences outside the classroom. Experiential education involves providing students with practical, relevant learning experiences. After the experience students reflect on what they have done and then are encouraged to conceptualise their understanding. Once students have made links between their experience and their ideas they can start to apply that knowledge and take it forward into the next activity, or their daily lives. Carver (1996, pp. 9–10) considers that experiential education is holistic in that it addresses students in their entirety as thinking, feeling, physical, emotional, spiritual, and social beings. It enables students to understand the authenticity of the learning activities and their consequences.

4. Using an action research model

The teacher also saw her role changing as students' knowledge and language base increased and they progressed through Bloom's taxonomy. She would become less of a transmitter of knowledge and, especially from Week 5 onwards, move towards facilitating their learning through using an action learning model. "Action learning is a continuous process of learning and reflection that happens with the support of a group of colleagues, working on real issues with the intention of getting things done" (McGill & Brockbank, 2004, p. 11). Such a model enables students to use all of Bloom's three domains of learning: cognitive, affective, and psycho-motor. Action learning is student-centred and, because the teacher is a facilitator, learners start to take responsibility for their learning, responding, questioning, and supporting each other, and working collaboratively. Learning becomes a social activity, which can occur at the students' own pace and in a democratic environment (McGill & Brockbank, 2004, p. 12). The process of action learning, with its emphasis on reflection before action, coupled with students' ability to choose their own "real-life" projects helps overcome the tendency for them to be passive. If students are to become action competent, they have to be active rather than passive in order to effect change towards sustainability.

The action learning model was used once the students had decided on their focus question(s). It took students through a series of steps: deciding, finding, recording, using, presenting, and evaluating. The teacher felt that providing students with the opportunity to decide on their own choice of investigation would give them a sense of responsibility and ownership of their learning. The steps in the model help students to focus on their investigation and give them a structure for working through it. Evaluation is a continual part of the process and does not just occur at the end.

Research design

The researcher gathered data from the teacher and the students in four ways. First, students were interviewed in five randomly selected groups of four to five students in Week 1 of the unit, and (in different combinations of students) three weeks after the completion of the unit. The researcher also interviewed the whole class 10 weeks after the unit was completed. Second, the researcher interviewed the teacher in the second week of the unit, and again four weeks after its completion. Third, the researcher observed the class twice, once in Week 3 on a visit to a nearby mountain stream and dam (the source of their drinking water), and once in Week 4 on a visit to the stream and estuary adjacent to the school. Fourth, the students' work was used as documentation. Their "before" views about water were gathered at the start of the unit. Students' written work in art and mathematics, photographic evidence of their vocabulary used about the water cycle, water, and weather, and records of their science planning were collected throughout and used (together with assessments of the final PowerPoint presentations) to assess their level of action competence.

Findings

These are presented as responses to the project's four research questions.

What skills relevant to achieving action competence did students possess before the unit?

Apart from the initial teacher interview, most of this data was obtained from the student interviews in Week 1. These were characterised by a high level of non-response and the researcher's frequent need to reframe questions that were not initially understood.

"Action competence" was considered to be the five elements (italicised below), identified by the research group. The students' prior *knowledge and understanding for decision making* about water was based on their home and direct personal experiences; they were uncertain about the differences between salt water and fresh water, and few had visited the sea even though it was close to where they lived. Their *emotional response* to the sea and water (as a measure of their responsibility

towards it) was generally limited to issues of direct contact: some voiced concern that toilets empty into the sea, and some mentioned as significant that water is needed to make the brain work, for washing clothes, and that people die if they don't drink. However, the students' skills in *planning and taking action* were more advanced: in Term 1 they had been introduced to the action learning model and they had been thinking about their role as community members; and in Term 2 they also focused on time management, effective communication, and taking responsibility for decisions that affected their learning overall. They were also well disposed towards *participation*—encouraged by their teacher's accounts of actions taken by her class last year, they thought that they had the potential to change things around the school. They were already sometimes working in groups, and the majority thought that their teacher listened to their opinions. By contrast, the teacher had concluded that *critical thinking and reflection* were not well advanced in her class. An intensely practical person, she nevertheless set great store by a quotation from Immanuel Kant: "You will not learn philosophy from me, but how to philosophise. Think for yourselves, enquire for yourselves, stand on your own feet".

What pedagogies did teachers select (before and during the unit) and why?

Probably because they were based on the teacher's positive experiences the previous year, the four pedagogies (described above) selected before the unit began sustained the teaching and learning without any need for major redirection. As a nexus of strategies, they can be summarised as follows.

The teacher's views on environmental education reinforced her choice of pedagogies used for this unit. She was clear that she needed to raise students' knowledge about water in all its forms, and that to do so she needed to improve their language and skill base. To achieve action competence they would need to have higher order thinking skills, which could be gained through using the Gardner–Bloom matrix in an action learning context. These enabled all students to participate because of the range of different options of learning styles possible. In other words, the matrix meant that she was always conscious of offering a range of choices to students.

What skills relevant to achieving action competence did students demonstrate during and after the teaching and learning?

These data were obtained from the researcher's observations of the whole class in action, from the second round of student group interviews, the whole-class interview 10 weeks after the unit, and the second teacher interview.

The later student interviews revealed a much more pervasive and articulate *knowledge and understanding for decision making*. Their ideas about the importance of clean water ranged over all living things, rather than just humans. Having investigated water in drains, pipes, streams, mountain lakes, and estuaries, they had gained knowledge that was much more graphic and contextual but were also able to express more sophisticated views about what constitutes "environments" at large. Their level of *emotional response* was considerably elevated and targeted: they felt positive about "playing, walking, learning in the environment"; they were moved to present information about their research into the condition of the school grounds at school assembly, and they demonstrated rare responsibility in a school camp, delighting in its natural environs ("they were mesmerised with it"). *Planning and taking action* were now more targeted and proficient—their ability to ask and write down questions was enhanced, they were confident enough to engage other students and adults in research and planning, their ICT skills were more widely incorporated in the planning, and they kept log books, made display boards, and wrote articles for newsletters. Quite exceptional levels of *participation* were demonstrated in Weeks 7 to 9, when students were engaging in their own chosen projects in groups, although it took six weeks to build to this level of intensity. Interviews after the unit suggested that *critical thinking and reflection* had been augmented: Twenty-two of 23 students believed that their actions significantly affected the environment, and 16 of 19 students thought that their experiences with environmental water problems had helped them to think more deeply and act

more effectively as regards other environmental issues (a substantial level of participation in other voluntary tasks was still occurring 10 weeks after the unit had ended).

As an overall gauge of the achievement of action competence, the researcher adapted Barker and Roger's (2004) analysis of activities *for* the environment to produce a three-way categorisation of levels of action competence. Of the 11 projects:

- three were judged to be at Level 1 (emerging skills and attitudes): "Water for trees", "Birds", and "Freshwater creatures";
- six were at Level 2 (emergent action): "Weather forecasting", "Estuary", "Glaciers", "Rubbish in the estuary", "Drains for rain', and "Mud crabs'; and
- two were at Level 3 (full action competence): "Rubbish 2" and "Cleaning the drains".

All six students in the last two groups were boys, and had some of the lowest PAT scores in the class.

What did teachers feel led to any changes in students' skills relevant to achieving action competence during and after the unit?

The teacher considered that a major factor in achieving action competence with these students was the way she steadily built up the students' knowledge and language skills to a level where mature and sophisticated engagement with the complexity of the issues addressed in the projects was possible. In 9 weeks, the means for initiating responses from the students had progressed from using visual prompts to using short language statements, and to reading and comparing three different texts, both fiction and non-fiction.

Secondly, most (but not all) students had also progressed through Bloom's taxonomy, moving from remembering and understanding to analysing and evaluating. The teacher had also encouraged a wide range of learning styles and intelligences in the students—for example, by Week 4 the students were giving presentations to the rest of school. To do this, they constantly had to put what they had learnt into a different mode, format, or application.

Thirdly, a great variety of experiences were provided for the students to extend their life experience and knowledge. These experiences were woven through the different curriculum areas. For example, students collected leaves from the school grounds and used them for mathematics. They followed the path of the rain from the roof through the drains out to freshwater streams and the estuary. They visited a water catchment to compare different waterways and start thinking about where their tap water came from. They were constantly encouraged to think about why there were differences between streams and waterways.

Lastly, the objective of providing multiple pathways for learning was still possible to achieve in the action research aspect of the unit because the students were able to choose and design a project that best fitted their competencies.

However, the teacher was less than jubilant about the progress that was made. She was disappointed that only two projects out of 11 achieved full action competence at Level 3 and regretted the lack of community involvement, in view of the very high cultural significance of the portage way. Barriers to learning were the entry of new children into the class halfway through the unit, insufficient time ("the school day isn't long enough"), and the difficulty of finding text and information at the basic level some of the children needed.

Summary and implications

This case study describes the acquisition of action competence in a class of 25 Year 7 students who had all scored lower than the national average for their age in PAT tests (the standardised national progress and achievement tests in vocabulary, reading comprehension, listening, and mathematics).

In the teacher's view, augmenting the students' English language skills, and the knowledge base underpinning that language, formed an essential initial (and ongoing) element in the progress towards acquiring action competence.

Diversity was the second key feature of this class: eight of the nine kinds of diversity observed by Paterson (2005)—cultural, linguistic, religious, motivational, intellectual, physical, socioeconomic, and behavioural—were present. In the teacher's view, this diversity needed to be accommodated by the provision of a sophisticated menu of diverse learning pathways and choices; namely, tasks with appropriately stepped cognitive demand, challenges that provided opportunities for the diversity of "intelligences" possessed by the students, and group projects on topics that could be freely chosen by the students themselves.

In the face of such complexity, this astute and experienced teacher sought not one single "magic bullet" pedagogy, but rather an eclectic mix of pedagogies that were chosen in advance and then applied sequentially and cumulatively during the 10 weeks of the unit. Of the four major pedagogies chosen, the first two—*enhancing knowledge through increasing English language competence* and *creating a matrix of Gardner's multiple intelligences against Bloom's taxonomy*—had a generic, cross-curricular flavour. Later in the unit two pedagogies drawn more specifically from environmental education also became important. One was *providing a range of experiential activities "in" the environment.* Significantly, the environment chosen for the students to work "in" (the portage) had deep cultural resonances for the local community. The other was *using an action research model.* Also significant was the fact that the teacher was very clear about the final goal (learning "for" the environment), and therefore the knowledge building (learning "about" the environment) on which she placed initial emphasis never became an end in itself. The criteria for the success of the unit were based securely on a three-level scale for achieving action competence, and not on the students' language ability itself. This is borne out by the fact that all six students in the two groups that attained the highest level of action competence were boys who had some of the lowest PAT scores in the class.

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Appendix 2: Green School—Case Study 2

The context of the study

Green School is a decile 9, Years 1–6 full primary school situated in an established suburb of a provincial city. The ethnicity of its 380 students comprises New Zealand European (87 percent), Māori (6 percent), Asian (4 percent), Pasifika (1 percent), and other ethnicities (6 percent). There are 15 full-time teachers. The school has a reputation for meeting special needs, and there are strong links with local iwi and kaumātua (Māori tribes and elders).

The school's physical surroundings are very attractive, with a variety of gardens, an abundance of native trees, and high quality grass play areas. This is in keeping with the fact that for the last three years the driving force behind the school's curriculum has been environmental education, which serves as an umbrella for all teaching and learning. This programme is the result of extensive community consultation and staff professional development, and is subject to ongoing and robust review. As a result, a range of environmental actions is evident in the school and in the community.

The environmental education unit

This case study describes an environmental education unit entitled "Our space", which was taught in one home room over a period of 10 weeks in Term 2 (May to July), 2005. Twenty-three Year 0 and Year 1 children (12 boys and 11 girls) took part.

The unit was framed by the school's policy of selecting four major environmental education teaching and learning contexts (one for each term) and then having teams of teachers working together to implement these contexts across the whole school. In 2005 the junior school syndicate decided to look at "Our space" as a major study for the second term. This was because the extensively used courtyard adjacent to the junior school lacked the interest and general attractiveness of other parts of the school. The challenges involved in improving this space seemed to provide an ideal opportunity for introducing the children to the environmental practices and culture of the school. The plan of the unit "Our space" is shown in Table 1.

Table 1 **The 24 sequential teaching and learning activities comprising the unit "Our space"**

ACTIVITY		DURATION
1	Looking careful at other spaces within the school.	4 x 30 minutes
2	Looking at the courtyard. Taking photos and discussing how we and others use the courtyard.	2 x 30 minutes
3	Making a list of all the activities that happen in the area. Using white thinking hat as tool.	30 minutes
4	Listing the features: sun, shade, living things, sights, sounds.	30 minutes
5	What are the problems with the area? What do we like/not like about the area? Yellow, black hat thinking.	30 minutes
6	How can we record what is already there? (Children draw own maps.)	45 minutes
7	Looking at landscaping plans, visits by ex -Room 3 students, landscaper. Discussing maps, symbols.	30 minutes
8.	Looking at other areas within the school and neighbourhood. Research magazines, books, to find possibilities for our area.	30 minutes
9.	Generating some ides about what could be in our area—establishing some criteria in terms of safety, shade, etc. Green hat thinking.	30 minutes
10	Meadow Fresh competition. Making plans of the peaceful garden—reinforcing observational drawing skills, ideas of perspective, bird's eye view. Teacher introduces and models key for plants.	2 x 30 minutes
11	Room 3 children visiting to show and discuss plans they have made for their quiet space. Room 15 children talking about plans for buildings and the process they are going through.	2 x 15 minutes
12	Drawing plans to record desired courtyard space—teacher modelling and recording ideas for all children to make a class plan. Children then go off to do their own plans.	30 minutes
13	What do plants need to grow?	15 minutes
14	Let's look at soils—different soil types collected from different parts of the school grounds, including compost from the chook run. Also using samples from other areas to show clays and heavier soil types than we have at school. Using magnifying glasses and microscope to look at what makes up soils. Adding water—what happens? Which soil is best to grow in? What are our plants going to need in the courtyard? Providing print resources for children to look at and have read to them.	45 minutes
15	"Ben's Beans, Sally's Beans" — read story and plant bean seeds.	30 minutes
16	The Pamela Allen story "The Potato People": generating discussion about possibilities.	15 minutes
17	"Pumpkin Soup": read by a group of children. Bringing a pumpkin to school to make soup, using for watercolour painting.	2 x 30 minutes
18	Winter garden trip planning—simple task cards to encourage the children to look closely at the details in the plantings and how the spaces have been modified for the enjoyment of different age groups.	Whole afternoon
19	Beach combing trip planned to Kai Iwi. Abandoned because of the weather—wrong time of year to be doing this. Spring, summer weather is much more reliable.	
20	Beginning to make changes to the space.	
21	Writing a letter to the principal asking how we go about getting a hopscotch grid in the courtyard.	
22	Carrying out ongoing maintenance of the space.	
23	Creating a garden for butterflies, with plants for eating. Deferred until later in the year when it is warmer.	
24	Deciding what to do with the Potato People, who have all grown horns!	

Research design

The researcher gathered data from the teacher and the students in three ways—interviewing the teacher before and after the unit, observing two whole class lessons during the unit, and through the four types of written documentation provided by the teacher. These were:

- a written plan for the whole unit;
- individual learning summaries (a procedure being trialled in the school) for two students. These documented the students' general level of initiative and engagement;
- two completed student assessment checklists, each of which contained evidence of the degree of action competence achieved by each child on a number of learning criteria; and
- the teacher's written evaluation of the unit.

Findings

These are presented as responses to the project's four research questions:

What skills relevant to achieving action competence did students possess before the unit?

While there were no specific data relating to the students' action competence before the start of the unit in May 2005, a general indication of their readiness can be gained from two sources: their performance on general tests of numeracy and literacy, and their previous school experiences in environmental education.

Numeracy data for 21 of the children, collected at the end of 2004, showed a generally high level of attainment: Five children were working at the "emergent" stage with numbers between 0–5, 2 children were at Stage 1 (numbers 0–10), and 14 children were at Stage 2 (numbers 0–20). Reading data (collected in March 2005) for 22 of the students showed that 15 were "emergent" readers but that 7 were beyond this point. Writing data, collected at around the same time, revealed that 8 children were "emergent" whereas 15 were more advanced. Despite these results, the teacher commented that her Year 1 classes in previous years had been further advanced.

The high level of school-wide environmental engagement at Green School was signalled by the children's numerous prior activities: sharing responsibility for the class and school environment; recycling classroom waste; caring for school hens (which consumed the carefully sorted and collected food scraps); carrying out weeding and planting projects; worm farming; rearing day-old chicks in the classroom, etc.

What pedagogies did teachers select (before and during the unit) and why?

In her initial interview, the teacher preferred not to nominate any particular pedagogies she intended to use in the unit. She did, however, indicate that there would be plenty of what she called "action learning", "student-centred learning" and "experimental learning". However, subsequent analysis by the researcher of the two teacher interviews, the two classroom observations, and the teaching plan revealed that in fact 13 teaching and learning strategies were involved (Table 2). On the basis of the work of Rickinson (2001), who suggested that teacher role modelling, experiential learning, and social constructivist learning were important in environmental education, the researcher classified the 13 strategies as each contributing to one of these three pedagogies. The total number of the incidences of the strategies revealed that teacher role modelling in its various forms was the major pedagogy (56 percent of incidences). However, social constructivist learning (28 percent) and experiential learning (16 percent) were also important.

Table 2 **The incidences of 13 teaching and learning strategies, grouped according to the three pedagogies identified by Rickinson (2001)**

	TEACHER ROLE MODELLING	EXPERIENTIAL LEARNING	SOCIAL CONSTRUCTIVIST LEARNING
1. Teacher or school initiated/directed/modelled	51		
2. Scaffolding			16
3. Child centred/child initiated		5	
4. Negotiated learning			3
5. Teacher questioning	10		
6. Children discussing			17
7. Children's hands-on exploratory activities		14	
8. Teacher leading future planning	2		
9. Teacher connecting with other learning	3		
10. Child emotive response		1	
11. Co-operative learning			1
12. Teacher reading to children	3		
13. Teacher guiding thinking strategies	3		
Totals	**72**	**20**	**37**

What skills relevant to achieving action competence did students demonstrate during and after the teaching and learning?

Two skills relevant to achieving action competence, each with a range of criteria for success, were defined: *developing and using understandings*; and *participation skills*.

Developing and using understandings was an outcome from the teacher's learning intention that "the children will use knowledge and understanding of plants, containers, and the courtyard environment to inform decisions about changes to the courtyard". The five, non-cumulative criteria, and the number of children (out of 23) who achieved each criterion, were:

1. Can share and discuss ideas about our courtyard (20).
2. Can consider and discuss possible changes to our courtyard (15).
3. Can identify issues for us in the courtyard (8).
4. Can collect and process information related to the courtyard, plants and containers (13).
5. Can use the information to carry out practical solutions related to the courtyard (11).

Seven children completed all five criteria, and three children did not complete any criteria.

Participation skills was an outcome of the teacher's learning intention that "the children will demonstrate participation skills in being consultative, democratic, collaborative, and co-operative in order to identify issues and make changes related to the courtyard". The four cumulative criteria, and the number of children (out of 14) who achieved each criterion, were:

1. No action, individual or collective (5).
2. Some voluntary participation (3).

3. Most actions intentional (6).
4. Intentional actions, individual or collective (0).
5. Shared competent direction of actions (0).

The data suggest that, although a number of these children were able to take collective action where adults guide and direct the activities (criterion 3), none were able to participate spontaneously and collaboratively, directing their own actions (criterion 5).

What did teachers feel led to any changes in students' skills relevant to achieving action competence during and after the unit?

In the teacher's view, the factors that contributed the most the children's achievement of action competence were: her own personal commitment to the project; her directing and scaffolding of the learning through dialogue and provision of experiences; her continual efforts to provide conceptual connections to all of the children's other learning (and, in particular, the practical activities going on at school—"weeds", "chooks", "eggs", "the worm farm"); and the mutual emotional responses that resonated in the classroom (especially in small group learning).

However, the teacher felt that the action competence achieved in the unit was as much a result of the overall culture and ongoing environmental nature of the school programmes as the pedagogies she adopted in this particular unit.

Summary and implications

The fact that, according to the researcher's analysis, teacher role modelling was the dominant pedagogy used to achieve action competence in this case study is hardly surprising. These Year 1 children were just getting started at the school—they were in an induction class that in the wider school programme was being introduced to the school's Care Code, its Code of Behaviour, and its Virtues Programme. Rickinson (2001), in his description of teacher role modelling, includes a range of teacher-led or teacher-controlled strategies. In this case study, these manifested as strategies such as teacher initiation, teacher direction, defining parameters, assisting the making of connections, reading to the children, and continually highlighting and clarifying issues.

The last point (the need for the teacher to continually highlight and clarify the issues) is especially significant: the many practical activities in the unit (see Table 1) all related in some way or another to the overall theme—namely, changing "Our space". The teacher frequently restated the purpose of the unit and reinforced the connection of current learning to the theme in various ways. She constantly used professional judgement and formative learning and assessment practices to focus the children on the issue. As a result, the differentiation between what Jensen and Schnack (1997) termed an "action" (which the learner relates to solving some problem connected with the issue) and an "activity" (which the learner does not) was difficult. However, the key point is that the children's participation was focused on and related to the issue, either directly or vicariously (through the mediation of the teacher), and led to action in relation to the issue.

A final point on pedagogy: it is, of course, wrong to suggest that pedagogies such as teacher role modelling, experiential learning, and social constructivist learning do not overlap. For 5-year-olds, as with all children, it may be some unique combination of these more dominant pedagogies that results in the development of action competence in environmental education, rather than any one pedagogy on its own. Rather, these pedagogies are perhaps better seen as components or phases in one broad pedagogy that could be called formative teaching and learning (Clarke, Timperley, & Hattie, 2003).

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Appendix 3: Coast College—Case Study 3

The context of the study

This case study was set in a co-educational college in an expanding dormitory town, close to a small community shopping centre and a coastal sand beach. The college was established in the early 1950s, in spacious grounds with mostly exotic/non-native flora. Most of the classrooms were built in the older style, with a more modern library, canteen, Year 13 student centre, and administration buildings. The college draws its students from more than 18 different primary schools. Some students travel 45 minutes to get to school. The college has a philosophy of being a "community of learners" and has a growing international student roll. Classes follow a 6-day revolving timetable and the school is closed on Wednesday mornings for staff professional development. Demographic features are given in Table 1 below.

The students who took part in this study were of mixed ability, gender, and ethnicity from a Year 9 ESS (integrated English and social studies) class whose members were drawn from 10 contributing primary schools. ESS is taught only at Year 9 level and is intended, among other things, to improve the transition from primary to secondary. The ESS teacher is also the form teacher and interacts with the class each day for 1–2½ hours. Lessons in the environmental education unit were either 1 or 2 hours in duration.

Table 1 **Demographics of Coast College**

SCHOOL DEMOGRAPHICS				
School type	Full secondary college, state co-educational			
Roll size	975			
Decile rating	9			
Locality	"Suburban" community, regional			
Student ethnicity (%)	NZ European/ Pākehā	Māori	Pasifika	Other
	74.6	16.5	1.6	7.3
Fee-paying students	41			
Teaching staff	Full-time/part-time: 59 FTEs			

The environmental education unit

The framework for the environmental education unit delivered to the Year 9 students was based on the capabilities for action competence identified by the research team, and the pedagogies and teaching strategies that might lead to their development. The necessary components for developing action competence in this unit were identified as including:

- greater awareness by the children that they have a role in environmental action;
- thinking skills;
- the ability to explore issues in depth; and
- action that is embedded in, about, and for the environment.

The team considered which pedagogical approaches could lead to transformative learning for students. Those considered most appropriate for the planned unit included experiential learning (which includes involving students in meaningful experiences), enquiry learning (which involves identifying issues, thinking critically, and reflecting), and co-operative decision making that leads to taking action.

Strategies to support enquiry learning (to make informed decisions for solving problems), reflective practice (involving both students and the teacher analysing the state of learning and making strategic decisions for future implementation) and student-centred learning (where the learner is at the centre of the holistic learning experience) were considered appropriate. In addition, strategies that would enable affective-aware learning (expressed as teacher awareness of how learners are feeling about a situation) were engaged. These included discussions about the role of feelings, attitudes and values, and encouragement for the students to share with their teacher and peers their own emotional response to the issues they were investigating.

The environmental education unit was designed to fit with other units planned for the class during the year and initially focused on the general perception of New Zealand as a clean, green country. The title "Clean green New Zealand: yeah, right!" was chosen to challenge student attitudes and encourage critical thinking about how culture and identity are influenced—in this case, by static image. This approach was taken to ensure the unit fitted the requirements of the current Year 9 ESS programme and integrated aspects of the required skills (e.g., values and static image appreciation) outlined in the English and social studies curricula, as well as enabling students to learn the skills, attitudes, and values needed for the action component of the New Zealand EE *Guidelines*.

The amount of time available for the unit was an important consideration. The teacher intended students to revisit and further progress their action plans after Year 9 examinations at the end of the year. The implications of teaching an environmental education unit as a "stand alone" unit are discussed in a later section.

Teaching strategies were chosen to provide students with the opportunities to develop elements considered key to the development of student's action competence. These elements were:

- knowledge and understanding for decision making;
- participation;
- emotional engagement and response;
- critical thinking and reflection; and
- planning and taking action

The strategies to develop these elements were implemented and refined by the teacher during the unit, in response to student levels of engagement and learning needs. These strategies included

- providing a supportive environment for reflective 'brainstorms',
- facilitating co-operative and student-centred discussions, providing the information for building and practising research skills, and
- encouraging and supporting collaborative group work and the use of action planners.

These strategies (teacher approaches) supported the overarching teaching pedagogies of experiential, enquiry and co-operative learning.

Formal assessment was limited to the analysis of four student "products" during class. These were the individual student posters produced in Lesson 1 (assessing prior knowledge and attitudes), the Likert scale opinion continuum in Lesson 2 (formative assessment), and the final end-of-unit summative assessment during Lesson 13 of the "repeated" individual poster and Likert scale activities. Throughout the unit, the teacher kept a reflective journal in which she recorded her observations of student responses and behaviours.

Research design

A case study design (Bassey, 1999; Merriam, 1998) was used, to provide a process that enabled researchers to gain an in-depth understanding of the issue and to explore meaning from a number of angles (Merriam, 1998). Using a number of data sources and collection methods allowed triangulation of the findings, leading to improved validity and reliability. Conclusions on the case could then be drawn which, when situated in the context of the case, would permit the reader to decide on the generalisability of the findings to another context. Ethical approval for the research to be carried out by the environmental education researcher was obtained from Victoria University of Wellington and research consent was gained from the co-researching teacher, who in turn obtained consent from the principal of the college and parents of the students participating in the environmental education unit, before the data was collected.

The class of 27 Year 9 students (25 of whom were involved in the research) ranged in age from 13 to 14 years. Thirteen students were female, 14 were male. Twenty-two were New Zealand-born European, 3 were Māori, 1 Pasifika and 1 New Zealand Asian. The New Zealand-born female teacher was of New Zealand European descent and had 7 years' experience in teaching.

Data collection methods

The following data collection methods were used:

Written surveys

Student questionnaires. One-page anonymous questionnaires were conducted during class time by the teacher, immediately before starting the unit and again on the day that the unit was completed. Both surveys were analysed by the research co-ordinator.

The questions were designed primarily to ascertain what students thought actions for the environment might be, what actions they were taking and what their environmental concerns were, if any.

Likert scale activity. As part of the environmental education unit, students were introduced to survey methods and the Likert scale (used to explore people's opinions and values). Students anonymously completed a Likert scale in the second lesson of the unit and again in the last lesson of the unit. The scores were aggregated by the teacher and analysed by both co-researchers.

Interviews

Semi-structured interviews were used. Most interviews were audiotaped. Some observational notes were taken by the researcher during and immediately after the interviews. The taped interviews were transcribed into written form and analysed by the co-ordinator. Notes of the transcription were made available to the teacher as part of the action research process of informing participants on the progress of an "intervention". All interviews were carried out and analysed by the researcher.

Teacher interviews. Two interviews were held with the co-researching teacher. The first interview (face to face) took place 4 weeks before the unit began. The second (an evening telephone interview) was held one week after completion of the unit. The second interview was recorded in written note form.

Student interviews. Three focus group interviews were held with small groups of the 25 participating students from the teacher's Year 9 combined social studies and English class. These were carried out near the beginning of the unit, during the unit, and 6 weeks after the unit had been completed. Students were interviewed in small focus groups of 3–5, depending on who was present on the day and was prepared (and had parental consent) to be interviewed. The first set of interview questions was focused on establishing whether students considered the environmental education unit was being "taught" (or they were learning) differently from previous lessons, what the difference was, and how

they felt this learning could help them in other situations. The interview questions that were used 5 weeks into the 7-week unit focused on what actions students could take for the environment, how they would plan for this, and what skills they had learned to enable them to undertake such action. Students were also asked what actions for the environment they took at home, at school, and in the community, and a reflective question about positive action. Similar questions were asked again in the focus group interviews 6 weeks after the unit had been completed.

Written work and observations

Observations of student behaviour were recorded by the teacher during and immediately after some lessons.

Student work to be analysed was collected by the teacher and shown to the researcher. At the end of the unit the researcher and the teacher compared the results of written work done at the beginning to similar work from the end of the unit. In addition, the planning presentations made by student groups to their class were observed, noted, and photographed by the researcher.

The teacher's journal and unit-plan notes were read by the researcher. At the end of the unit the teacher provided a written summary of her experiences and impressions. The teacher accessed information about school policy documents and found that there were no policies relating to any environmental management or educational issues. Written comments made by the teacher's head of department during an observational visit to the class in the final weeks of the unit were made available to both the teacher and researcher.

Findings

Students' action competence before the unit

In the initial written student survey, six out of 23 students responded that they were currently taking action for the environment at school. Of these six, four stated that they put rubbish in the bin and two that they did "rubbish duty" (a duty carried out as part of the class contribution to picking up the school-wide litter). When asked why they got involved, two of the four respondents stated: "I had to", one wrote: "I don't like litter" and the other wrote: "so the school is tidy". It is unclear from the responses whether any of the actions were voluntary.

Students were also asked about their involvement in environmentally friendly activities at home. The responses are shown in Table 2.

Table 2 **Student involvement in environmentally friendly activities at home (n = 24)**

ENVIRONMENTALLY FRIENDLY ACTIVITIES AT HOME	
None—5	Composting—1
Recycling—10	Saving paper—1
Cleaning up—3	Picking -up dog poo—1
Rubbish pick-up—2	Planting—1

When the students were asked about their involvement in environmentally friendly activities in the community, only two considered they did anything in the community. Of the remaining 22 students, eight responded that they did nothing, and 14 did not answer the question, possibly also reflecting non-involvement.

Teacher's views before the unit

The views of the co-researching teacher were explored through an interview before the environmental education unit had been fully planned. The teacher expressed interest in being part of the research in order to be part of something that might make a difference for others, to be involved in something different herself, and to challenge both her own and other's teaching practices. She stated that the action part of environmental education (EE) appealed to her, commenting that "I like the fact that it is about student's input … and that [it is] empowering for students". She believed that "the usual style of teaching is not usually empowering —it is not really about being a good student [citizen], it is about exam achievement".

She believed the focus for student learning about the environment should be on "our impact on it, the sustainability of it, different cultural values of it, how we use it. Most important is the sustainability".

The teacher considered that during the unit her students should develop skills that could be transferred, such as co-operative learning and critical thinking so that they might question things, and by the end of the unit "be aware of how we impact on our environment" so that they would ask questions about recycling, waste, and other sustainability issues.

Observations and reflections during the unit

Students interviewed in small focus groups during the unit were asked whether they thought that this unit was different from their other lessons. Students referred to the way in which they were able to share ideas and have greater communication than in other classes. They felt that listening to their fellow students helped to build their own ideas. Students also noted that their learning in class had resulted in some changes in behaviour at home, related to recycling and re-using materials.

Pedagogies for action taking—the research questions

What skills relevant to achieving action competence did students possess before the unit?

Before the unit, some students in this class indicated that they were taking actions for the environment. As noted in Section 4 Limitations, a questionnaire administered to the students before the unit indicated that only 6 out of 23 students felt they were carrying out any environmentally friendly actions at school, 19 out of 24 were doing something environmentally friendly at home, and only 2 out of 22 thought they were doing anything in this way for the community.

What pedagogical approaches did teachers select before and during the unit, and why?

A mix of experiential, enquiry, and co-operative learning pedagogies were used throughout the EE unit. The teacher considered that some scaffolding of experiences would be needed to help the students move from the more traditional "receiver of information" to the more transformative learning mode. The lessons were planned to move from individual knowledge valuing through individual experiential reflection and attitude evaluation, while using research techniques and building confidence to enable students to engage in co-operative learning, planning, and the development of action competence skills.

This progression was demonstrated as follows. The unit started with a 2-hour session in which students were asked to do individual "brainstorms" on "New Zealand's environment", to produce a personal poster for themselves. The brainstorming session took nearly an hour. The teacher observed that students appeared fully engaged in the activity and seemed to enjoy what they were doing. The activity provided students with the opportunity to reflect on and value their own knowledge, ideas, and personal values. The range of answers reflected the varied prior experience of students, through home and the different primary schools they had come from. The information they provided enabled the teacher to consider how best to accommodate their different understandings of "the

environment". When this activity was repeated at the end of the unit, some interesting trends emerged from the analysis, which will be discussed later.

After this the class completed a Likert scale attitudinal activity. Students were asked to mark where they would place themselves on a scale from strongly agree to strongly disagree in response to the following statements:

- The environment is important.
- New Zealand has a clean, green, and healthy environment.
- New Zealanders look after their environment.
- I am responsible for the environment.
- I have plans to be involved with the environment.

This activity provided the opportunity for students to reflect on their personal values and attitudes. Working on the poster and completing this attitudinal scale gave them a deeper understanding of their own opinions. The teacher observed that all students were fully engaged and seemed interested in giving opinions.

In the next lesson the class was shown a range of global images, with starter questions. Students wrote their answers before analysing them in class discussion.

The three questions were:

- Where do you think this is?
- What is the picture showing?
- What do you think happened before this picture was taken?

The images shown were of pollution and environmental change. There was much discussion and good engagement—most of the students were very surprised to learn that the pictures showed the results of human actions, many being images of New Zealand. This session encouraged the students to share their ideas, realise that they needed to find out more about what lies behind an image, and understand that there is a need to research information.

Students were introduced to strategies for building their research capabilities through exploring written articles in the newspaper and watching a video titled "Lakes and Rivers" before using a values continuum on which to put the (imaginary) people using and misusing a lake. They were given guidance on how to create surveys. Class discussions were encouraged to let students experience a range of opinions and hear why others used resources differently, including through role play involving stakeholders.

A sequence of teaching and learning strategies were then followed to enable students to engage in and choose to plan for actual actions for the environment. A class brainstorming session resulted in students identifying a large number of national and local environmental issues that needed to be addressed, leading to the idea of the class or groups of students taking possible action to help solve them. During the resulting class discussion a variety of ideas were put forward and noted down by the teacher. The discussion then moved to the idea of groups taking action to help solve a chosen issue. Questions were asked about what sort of actions people could take and who was responsible for taking actions, with the teacher acting as facilitator while the class considered whether they wanted to take actions. The discussions led to students wanting to choose an issue themselves. Students were really keen to make a difference and started contributing ideas within their self-selected groups.

The enquiry learning process was used to help develop action, in the form of an action plan outline that was shown and explained to the students as a way of providing the steps a group could use to plan a successful group action. The students seemed well motivated and came up with a good range of ideas, such as planting around the school marae, setting up websites, and cleaning up polluted

lakes. Some groups needed facilitated discussion to help them choose an issue that they could actually do something about within the school area. Several groups chose very similar issues (litter and waste) to investigate. The implications of this were managed through teacher facilitation, enabling groups to plan for different actions to contribute to solving similar issues. The teacher's role as a facilitator and encourager was vitally important in preventing students setting themselves up to fail.

Enquiry learning was evident in the class as students identified an issue that concerned them, used the action planner to help them identify what research they needed to do, and moved through the planning process. Although a number of groups identified the litter problem around the school as something they were concerned about, each group chose a different plan of action to tackle the challenge of reducing or eliminating litter—some with teacher facilitation (for instance, asking the students how they would tackle the whole problem as opposed to part of the problem).

The strategies selected for this environmental education unit provided a scaffolded range of experiences in a safe environment so that students could learn to work co-operatively and collaboratively, leading to positive experiences in their decision making and planning. This enabled students to plan for and start to carry out "real" actions that would contribute to solving their chosen environmental problem. This form of experiential learning is essential if students are to move from the traditional transmissive "knowledge top-up" to the transformational learning described by Sterling (2001) that students need to be able to take responsibility for their own learning. When learners become engaged, empowered, and self-directed in their learning they are likely to achieve much more in terms of acquiring the knowledge and skills to assist their development of meaningful action competence.

What skills relevant to achieving action competence did students demonstrate during and after the teaching and learning?

This section discusses and provides evidence of the development of the five components of action competence.

Knowledge and understanding for decision making. Many responses to the final student survey questions indicated an increased awareness of their environment. Statements included: "I learnt more about the environment and what will happen if we don't do anything about it"; "I learnt that it is important not to litter and not just on the grounds—in the lakes and rivers"; and "… more about the environment and how to keep it clean". These comments reflected a general agreement by students in the final focus group interviews that it was important to care for our environment. That students had developed greater knowledge through self-directed learning was evident from statements such as: "we learnt that native trees are important and if they aren't cared for, they will all die off".

Planning and taking action. As noted earlier, students were involved in a limited amount of action for the environment at school, in the home, and in the community. At the end of the unit the students were able to identify a greater range of actions that could be taken and to detail actions that they were actually taking. The increase in action taking appeared to be greatest in the home, and was less marked at school or in the community. However, all the students outlined the actions they or their group had planned at school, ranging from creating and putting up posters to encourage litter reduction, designing websites about water use, making a video (to show others) about conserving water, planting native trees, and organising an environmental group, to creating a PowerPoint show to inform others. Some had already completed their action (for example, creating and putting up posters) while others were still progressing with their plan. In some cases, students developed specific skills in order to take action—as one Year 9 boy commented, "I went and learned to do computer stuff so I could make good posters for litter". Self-directed learning was demonstrated by two girls spending the whole weekend happily learning how to create websites so they could develop a page for the school intranet to educate students about litter and waste problems. Further student

comments included: “I learnt how to create and host a website over the Internet and how to turn information into a useful resource to help educate”; “how to plan what you are doing”; “group work which would help the environment”; “doing surveys and displaying results”; and “it’s taught me the skills to work in a group and be independent”.

Participation. Students demonstrated a high level of engagement and commitment during the unit. Successful class and individual brainstorming sessions led to an inclusive attitude towards student views. Students selected themselves into groups to work on particular issues and were seen to work in a strongly collaborative way. An independent observer (the teacher’s head of department) noted “how focused the class was”, how student learning was “characterised by purposeful meaningful learning activities”, and that “all students are actively engaged, the boys as engaged as the girls”. The observer noted how students were both encouraged and able to help others (for example, with IT skills they had that others lacked) and “this was done willingly”. The impact of this participation on some students was made clear when the teacher received an email from the mother of boy who before the unit was quiet in class, usually contributing very little. She said that her son was for the first time tal researching information locally to help plan his grou ts best suited for the local environment and had rung upport for his group’s issue.

Emotional bout fe f responsibility towards and actions emotional engagement and attitudes. In response to ment?” the results, as graphed in Figure 1, showed a sagreed and an increase in those who agreed they

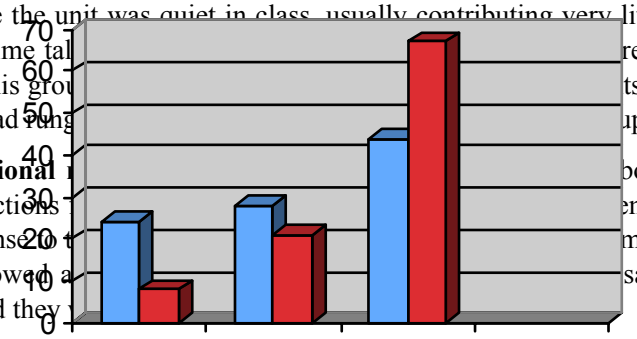
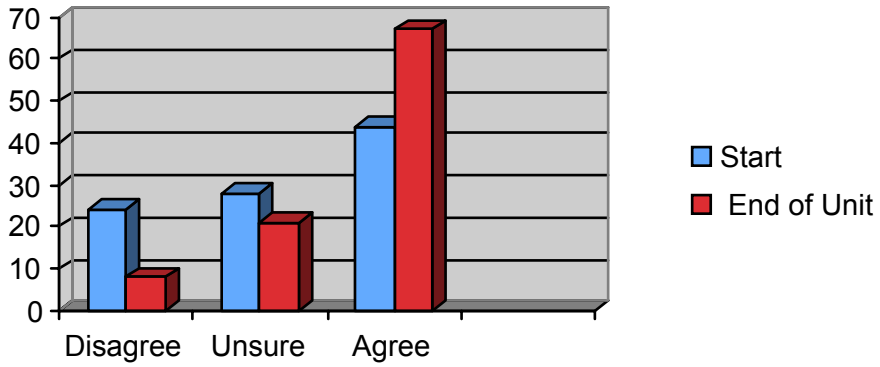
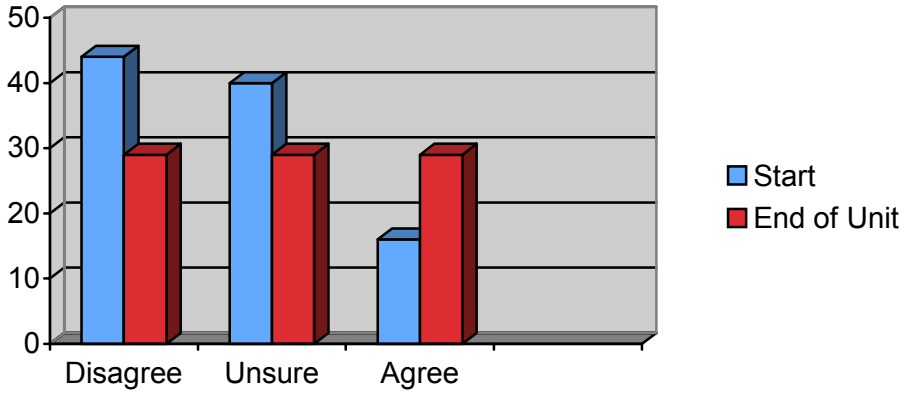


Figure 1 **Students’ perceptions of their responsibility towards the environment**



In response to the statement “I plan to be involved with the environment” the results (given in Figure 2 as percentages) also show a reduction in those who previously disagreed or were unsure, and an increase in those who said they planned to be involved.

Figure 2 **Student intention to be involved with the environment (not all students completed the scale as instructed, so that the total is less than 100%)**



These changes in some students' attitudes or emotional responses reflect the changes observed through the focus group interviews, that students became more willing to discuss and comment positively on their personal views, responsibility, and commitment to issues. A further example of personal commitment was shown by two girls who spent hours gathering information and help from the community to learn how to create a video on their topic. They continued with this beyond the end of the unit and worked on another aspect of their action plan in their own time. Personal commitments from other students were reflected in statements such as: "I will try to do more stuff at home like recycling and composting"; "how to make a difference, knowing that every little bit helps"; "it will help me to clean up New Zealand and preserve it for future generations"; and "to be open and honest about your opinions and carry issues out".

Critical thinking and reflection. Students demonstrated use of reflection when confronted with images of pollution in New Zealand. The teacher commented on how surprised and shocked students had been when they were told what some images were really showing and where they were from. The students appeared to realise they should not take images at face value. Later in the unit, two examples of student reflection were well demonstrated by the comments: "not a thing that I already knowed, but deep down inside everyone knows of this problem but chooses to ignore it" (Year 9 boy); and "that if you want something done, it's up to us. I have also learnt that we can all take action, no matter how small or big 'they' are" (Year 9 girl). When the personal poster brainstorming activity was repeated at the end of the unit, some interesting trends became apparent. The Year 9 boy who had thought he could "probably not" do more to look after the environment now stated three things that he could do: "not drop my rubbish, tell my friends to put their rubbish in the bin and tell my family". Most students showed more complex thinking in their responses, moving from simply saying "recycle" to "reduce, recycle, reuse", as well as adding "set up environmental groups and clean up" (Year 9 girl). One girl stated: "definitely, there is always more you can do to look after our environment" and another girl, from a family culture of caring for the environment, had a list of six actions, which included "conserve water, use public transport, educate people about the state of our environment and set up a group".

Summary

In this case study, three pedagogies were used to contribute to student development of action competence for use in the newly developed unit. These included enquiry, experiential, and co-operative pedagogies. The strategies within these pedagogies included brainstorming (both individual and class), with guiding questions so students could establish and evaluate their pre-existing knowledge. Class and group discussions, with teacher facilitation and questioning, provided opportunities for individuals to acknowledge values and express opinions in a safe environment.

Research skills were introduced, scaffolded by the teacher and practised by the students, and collaborative learning opportunities led to students self-selecting into groups to plan actions *for* the environment. Students used action planners to guide them through the complex process of identifying and researching their chosen local issue before planning actions that would help solve the problem.

There was evidence that these strategies increased students' interest in environmental problems and improved their collaborative, co-operative, and research skills, leading to their use of those skills in planned actions "for the environment". The teaching pedagogies also contributed to the increased emotional engagement and empowerment for action that most students demonstrated. For some students, this engagement and empowerment proved to be keys for ongoing action competence, which continued beyond the unit. These secondary students became empowered to take risks and

follow their own learning choices, even though the infrastructure and culture of the school reflected the traditional secondary school focus on assessment.

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Appendix 4: City School—Case Study 4

The context of the study

The demographics of the school involved in this case study are described in Table 1.

Table 1 **Demographics of City School**

SCHOOL DEMOGRAPHICS					
School type	Full primary, state school with special designated character				
Roll size	180				
Decile rating	6				
Locality	Central business district of large city				
Student ethnicity	NZ European/ Pākehā	Māori	Pasifika	Asian	Other
	144	16	7	3	10
Teaching staff	8 teachers (all full-time)				

The special character is described as:

- students directing and managing their learning;
- students are asked first what they need in order to learn;
- a learning community where everyone—families, staff, and businesses and community mentors—are partners;
- learning that takes place where it occurs naturally anywhere in the community, not limited by curriculum, place, time, style, or subject;
- students of all ages as part of a learning community without barriers, learning at their own level; and
- everyone being a learner and everyone being a teacher.

The school occupies the top three floors of a commercial building in the central business district of a large New Zealand city. There are two small outdoor areas, one with a small playground, on the second floor of the school (level 3 of the building). The total area of these outdoor spaces is approximately 300 m^2. There are no other outdoor areas—no sports fields or large outdoor, grassy or paved areas. Internal spaces are predominantly open planned, non-traditional classroom spaces. The school operates as a learning community, with learning groups organised in home bases (most with a mix of year levels spanning 3 years). The teaching staff are called by their first names. Their job title is "learning adviser", to distinguish between their role and that of the traditional teacher. The inner city location allows ready access to a plethora of facilities for learning experiences beyond the school base, including the central library, the museum, an art gallery, parks, gardens, and local businesses.

Ideas and pedagogies for EE unit

Action competence in the EE context refers to students' abilities to act with reference to environmental concerns, as active participants in environmental education. It includes the ability to identify problems, make decisions about solutions, and take action that develops the students'

competence to participate in future action. Development of students' action competence can be seen as promoting democratic and participative education that can be valuable across all aspects of schooling.

Jensen and Schnack (1997) describe successful action competence as meeting two criteria concerning action:

- students themselves need to be involved in deciding what to do; and
- what is done targets the solution of an actual problem or issue.

The development of action competence in students, therefore, includes a range of capabilities related to the criteria described above. These capabilities include the knowledge and understanding required for decision making, the ability to plan to take action, how students participate, their emotional connection and response, and the inclusion of critical and reflective thinking. Table 2 details key considerations for the learner and teacher with respect to each of these capabilities.

Table 2 **Teaching and learning aspects of action competence**

CAPABILITY	TEACHER	STUDENT
Knowledge and understanding for decision making. Knowledge could include technical, social, political, historical, and economic factors.	Needs to facilitate opportunities for students to gain new knowledge in a range of contexts and settings	Requires knowledge upon which to base soundly reasoned decisions
Planning and taking action—planning to take action in an informed manner	Needs to scaffold student development in planning, organisation, goal setting, time management, and other related skills	Requires skills to identify and solve problems, set goals, gather information, communicate, manage time and logistics, and take action (indirect or direct)
Participation is often described as needing to be voluntary (Hart, 1997). However, in New Zealand education is compulsory. This dualism requires creativity and flexibility to encourage students to want to participate	Provides learning experiences to engage and motivate learners Encourages student involvement across abilities	Requires skills in being consultative, democratic, collaborative, and co-operative Needs to develop a willingness and openness to becoming involved in own learning and taking responsibility
Emotional response is often required to become motivated to learn and engage with an issue. "Connecting with the environment is an important source of motivation and engagement, which helps [us to] create our own learning and become participative learners" (Proudman, 1992, p. 22)	Provides experiences "in and about" the environment, and opportunities for students to engage with a range of viewpoints and ways of resolving issues	Needs to understand own and others' attitudes and values towards issues in order to be able to decide upon the appropriate action to take and the nature and extent of their own personal responsibility and commitment
Critical thinking and reflection—time is needed to consider the impact of experience on current beliefs, knowledge, and understandings so that new thinking and learning can emerge (Proudman, 1992, p. 22). Sterling (2001) describes reflection as supporting critical collaborative enquiry, and as a mechanism for achieving systemic transformation	Places value on reflection as a process and allocates time for this within the programme Needs to scaffold students' learning processes so that they can analyse and evaluate information, experiences, and situations	Needs to be able to think critically about the causes of issues and what actions could be taken. Needs to reflect on own knowledge, actions, participation, attitudes, and values to make meaning

Particular strategies and approaches have been noted in the environmental education literature that support the implementation of education *for* the environment. Students' action potential and action competence are key aspects of education *for* the environment. Key strategies and approaches include student-centred pedagogies such as enquiry learning, experiential learning, discovery learning, role play, simulation, and clarification and analysis of values (Fien, 2001). The aim is to increase student control of their learning and develop co-operative and collaborative styles of learning (Wilson-Hill, 2003).

Within the specific context of this school, enquiry learning is a significant pedagogy utilised by the teacher. Therefore, the key foci established at the start of this project were the use of enquiry learning as a major teaching and learning approach, focusing student action competence capabilities on critical thinking, reflection, and questioning.

The environmental education unit

The environmental education unit chosen for this project was an enquiry based on "Seeing our city with new eyes". Before the unit began the teacher and students had discussed how they used the city as a resource and some of the barriers students had experienced. The students were responsive to the concept of a collaborative enquiry based on the city, and chose to accept the proposal. The aim of the enquiry was to build awareness of the city neighbourhood and its associated environmental resources, challenges, issues, and concerns. It was surmised that learning experiences that emotionally engaged students with the city would enable them to have a greater sense of ownership and belonging, and thus they would feel motivated to take action *for* the environment.

As an enquiry unit of work, the first stages of the enquiry were planned and described as an immersion phase, in which the teacher provided a range of learning experiences to engage and motivate the students with the some of the issues within the inner city. The key learning activities for this immersion phase are described in Table 3.

Table 3 **Learning experiences for immersion phase of teaching unit**

WEEK OF UNIT	TYPE OF ACTIVITY
1: Introduction to enquiry theme Immersion activities begin	**Discussion** led by teacher about why we will be doing a shared enquiry this term **Introduction** to main themes: Our city
	Oral, written, and visual language/art In groups or individually, students brainstorm ideas about how they perceive the city. Ideas to be shared and summarised on one display chart (recorded by teacher) Identify groups of ideas. Discussion about the ***affective*** aspects of the issues and how these influence where we go, what we do, etc. Students individually draw/sketch/paint how they perceive the city (choice of media)
	Students look at pictures and describe how they might be perceived by different people (e.g., a roast chicken considered by a vegetarian as opposed to a very hungry person) Students identify different alternatives and possibilities for solving a problem
	Revisit brainstorming from previous challenge. Next challenge: How I perceive myself in the city—a visual representation by most students. Work displayed in home base
	Class discussion on thinking, based on DeBono's key points re intelligence and thinking
2: Experiential learning	Three days if learning experiences in Hanmer Springs

Table continued next page

Learning experiences, continued

WEEK OF UNIT	TYPE OF ACTIVITY
3: Our city—my perception Student teacher starts	**My Ideal city** Students plan and design their ideal city
	Where I live (Part 1) Students reflect on their own neighbourhoods and describe them. They are then asked to think of one thing they would like to change about where they live that would improve the quality of their lives there
4: Personal enquiries on theme	**Where I live (Part 2)** Explain reasons behind choice. Share ideas and stories.
	10 minutes from school In small groups, we go out into city—10 minutes from school, in compass directions—and record what we see, hear, feel, etc. Where do we end up? Share results. What did we learn?
	Personal choice of enquiry focus Working independently or in small groups (chosen by students). Students select different topics for enquiry, under the theme "Seeing our city with new eyes"
5: Personal enquiries	Personal enquiries continue
6: Personal enquiries	Personal enquiries continue
7: The city as I see it	**Visual arts** Students have option of using crayon, dye, photography, or other media to show how they see city now
8: Measurement/ survey challenge	**Numeracy** Students choose an area/issue to investigate and go into the city in small groups to carry out their investigations
9: What is enquiry?	**Brainstorming**— as individuals, then as a class
	Scenarios: 1. Shipwrecked; 2. Survival Students choose a scenario, put themselves into it and role play how they will cope with this situation. The aim is for them to think beyond their current experience
10: Scenario	**Scenario: Carless city** Individual and/or small group activity. Students imagine and record how different the city would be without cars: • accessibility of resources and services, etc. • access to recreation and leisure activities Students are challenged to design a new vehicle that does not run on fossil fuels

During the course of this unit several things happened that affected the delivery and management of the enquiry, so that the direction and focus of the learning needed to be reviewed and redirected. The learning community at the school is very flexible and responds to students' interests and needs. As a result, spontaneous learning opportunities arise regularly. This impacted on the time the students had in which to focus on and engage in their EE inquiry. This factor affected students' learning and

reduced their opportunities for engaging in the enquiry. Furthermore, one criterion—the need to target the resolution of an issue, as opposed to the symptoms (Jensen and Schnack, 1997)—was missing.

For the next term, therefore, it was decided that the development of action competence capabilities (described in an action competence matrix designed as part of the research to explore the students' developing action competence) would continue to be part of the overall learning programme for the students, so that they could attempt to resolve an issue rather than just identify symptoms. This matrix is described more fully below.

Research design and data collection methods

The action competence capability matrix

Data were collected from a range of sources including student survey, teacher observation and judgement, researcher observation, and document analysis. A major tool developed as part of the research to gather data and triangulate the findings was an action competence capability matrix as a single tool for sorting and collating information from across the data sources.

This matrix identified 15 capabilities for action competence. These 15 capabilities were described across four levels, showing increasing competence in the capability from a level one to four. This matrix was used by the students, the teacher and the researcher as a survey, interview and observation form to assess action competence capabilities. A sample of the matrix is shown in Table 4 and the full refined matrix can be seen in Table 7 at the end of this case study.

Table 4 **Sample of the action competence matrix**

KNOWLEDGE			
I get information from one place only – it is the only place I go.	I get information from a couple of different places, mostly books and the Internet.	I get information from books and the Internet mostly.	I get information from lots of different places, people and resources.
PLANNING AND TAKING ACTION			
Action planning			
I don't plan at all.	Sometimes I plan things.	I plan quite often by myself and sometimes might get some ideas and help from others.	I always plan and share my ideas with others to help me make the best plan.
PARTICIPATION			
Working with others to achieve goals			
I prefer to work by myself all the time and I don't think others can help me.	Sometimes I work with others but if they can't help me I would rather work on my own.	I enjoy working with others and like to share things that I am good at to help the group achieve its goals.	I think I learn more in a group and enjoy working with others and take on any role to help the group achieve its goal.

The first draft of this matrix was developed for the initial interview with the focus students on 9 June 2005. At this time the matrix consisted of nine statements described across a continuum. After the initial surveys it was recognised that the matrix needed to be reviewed to include other aspects of action competence and to be reworded in student-friendly language. This refined matrix was used as

a student survey on 27 June, 5 July, and 29 August 2005. The final student survey took place on the 22 September 2005.

The focus group for observation, interviews and document analysis of work consisted of six students, who were selected at random. Three of the students were girls (all in Year 8) and three were boys (two in Year 8, one in Year 6).

The two in-class observations were conducted by the researcher, who listened and watched the focus group students and tracked their behaviours on the matrix. As the context of the tasks strongly influenced the opportunity to observe competencies, it is acknowledged that the two observations were extremely limited. The class teacher also used the matrix to assess the students' action competence capabilities, as a further triangulation of the student and researcher observations. This survey took place once, on 5 October 2005 at the conclusion of the research project.

Findings

The development of the action competence matrix was an attempt to gather information on student action competence from a range of perspectives including the students, the teacher, and the researcher, while maintaining consistency in how ideas were being considered. In order to show responses from each perspective, therefore, the results are presented in a number of formats. The results are a combination of qualitative information from teacher and student interviews and quantitative data derived from the surveys and observations, using the action competence matrix.

The quantitative data were obtained by scoring the four statements under each heading from left to right (see the sample matrix in Table 4). This then enabled a cumulative figure to be gained on all 15 aspects of action competence for all students. This cumulative figure was then averaged to give an overall level of action competence for the class. The matrix is a developing tool and its use was trialled with a small number of observations and a small number of survey responses only, so caution is needed in interpreting the results presented here.

Teacher's views on environmental education and action competence at the start of the unit

The interview with the teacher suggests a number of beliefs about environmental education and action competence. These beliefs included the notion of affective learning and emotional engagement in taking action, and enquiry learning as best practice. Linked to this affective aspect was the notion that the emotional engagement of the students would be a way to gauge whether action competence was happening—the teacher described it as "Gaining a sense from the students' vitality and interest" (interview, 6 May 2005).

The special character of the school influenced the way the teacher saw the environmental education unit being implemented. The character of the school was also highlighted as a potential barrier to the students achieving action competence, because of timetable changes supporting the spontaneity of student choices for learning.

Students' views at the start of the project

Students were asked at the start of the unit to identify their beliefs about enquiry learning (because this was the chosen pedagogy selected for this unit). Their comments indicate that they believe enquiry learning enables them to choose their own learning path, and to implement some change as a result of the learning.

> Work on something that you want to do. (Group interview, 10 June 2005)
>
> … and things that we would like to change and actually do it. (Student M, 9 June 2005)

Students indicated strong beliefs about the style of enquiry learning they engaged with at this school. These included the notion that learning should be "FUN" (group interview, 10 June 2005), and that it encompasses what is already known: "[enquiry learning is a] combination of what I have learnt previously" (Student M, 9 June 2005), and includes open-mindedness and thinking skills.

On the role of the teacher in successful enquiry learning, students highlighted:

- providing a starting point for learning;
- supporting planning and organisation of the learning;
- raising awareness of issues;
- providing scaffolding processes; and
- providing learning experiences.

The first data gathering point indicates that before beginning the teaching unit students ranked themselves in the upper half of the action competence matrix, with 74 percent of the responses indicating either a Level 3 or 4 capability (see Table 4 for an illustration of levels). This supports the students' comments about enquiry learning as a pedagogy to develop action competence capabilities.

Teacher's observations and reflections during the unit

During this interview the teacher identified that students were using the action competence capability of reflection more effectively than before the EE unit in learning experiences outside the environmental education unit. She noted that students were responding positively to the teaching strategy of scenarios and were using skills that contribute to the action competence capabilities. The teacher considered that within the scenario strategy students also needed to be encouraged to consider the conclusions they had reached through their own knowledge, against other sources of information that would support or challenge their conclusions.

> … they have used their own knowledge and ideas. For future scenarios we need to be scaffolding the students to use other sources of information to support their ideas. (Teacher interview, 5 July 2005)

This led the teacher to reflect on the level of direction she provided in the unit, and how this could sit within the framework of the special character of the school and meet the needs of the students. At this point she was considering her role in teaching EE, and how important it was to challenge the students' thinking and encourage further investigation and enquiry.

Students' views during the project

Two students were interviewed during the unit and provided further student insight on the purpose of enquiry. Their views suggest that the notion of choice is important to them and that to be successful you need to be skilled in managing yourself:

> You get to choose what you are learning…you can work at your own pace and you still get more of a free chance—opportunity to be able to choose … you need to be able to manage your time wisely … need to be able to work by yourself. (Student R, 29 August 2005)

They saw the role of the teacher as supporting and guiding learning, and helping with key resources such as people and equipment. These views are consistent with those of the group interviewed at the start of the project.

Researcher's observations

During the unit two observations of the target group of six students revealed that predominantly level one and two action competence capabilities were being utilised by the students. This is shown in Table 5.

Table 5 **Observations of student action competence capabilities (matrix rankings 1–4 equate to the four statements in the matrix, read from left to right)**

MATRIX RANKING	1	2	3	4	TOTAL
Number of competencies observed at each rank (27 June 2005)	1	10	6	3	20
As a percentage	5	50	30	15	100
Number of competencies observed at each rank (5 July 2005	9	7	2	0	18
As a percentage	50	39	11	0	100

The first observation on 27 June revealed that 45 percent of the action competence capabilities observed by the researcher were at either Level 3 or 4, while 55 percent of the action competence capabilities observed was at either Level 1 or 2. During the second observation on 5 July only 11 percent of the action competency capabilities observed were at Level 3, none were at Level 4 and nearly 90 percent of the capabilities observed were at either Level 1 or 2. These results appear to be at odds with the students' perceptions of their own action competence development, as determined through surveys. This raises questions for further investigation about the validity of the matrix as a research instrument, and differences in perception of ability between an independent observer and the students.

Teacher's views on the development of students' action competence

The teacher identified emotional engagement, the use of reflection beyond the environmental education unit, the impact of scenario as a strategy, and the special character of the school as key determinants in contributing to student action competence in the context of this research (see Table 6).

Table 6 **Teacher reflection in the final interview**

STUDENT ACTION COMPETENCE	REFLECTION STATEMENT
Emotional engagement	No "life" from students, focus from teacher: Students weren't engaged with the enquiry enough to develop their own questions to investigate seeing the city with new eyes—Teacher, 9.September 2005
Use of reflection	Reflection used with greater impact outside the enquiry: Reflection is meaningful and purposeful .From here we can improve our teaching [and] learning actions. All round, this context has improved their listening as well. Their improved interdependence skills are all round, not just from within the scenario—Teacher, 9.September 2005.
The use of scenarios as a strategy	The use of scenarios engendered a sense of "… something important was happening. First time I had seen them working together in this way" (Teacher, 9.September 2005). This showed students using skills—listening, sharing—that the teacher wasn't sure they had developed previously
Special character of the school	The special character of the school was more important or students than the enquiry: Spontaneous nature of the school learning environment was taking precedence and student interest over the unit—Teacher, 9.September 2005

Two new ideas were revealed in the concluding interview: the application of learning from scenarios to real life, and the concept of enquiry used at the school as a development within the special character of the school.

Students' concluding views

At the conclusion of the project the students completed a final survey and interview, indicating their perception of their action competence. The concepts they saw as important were:

- planning—"plan better when Teacher helps a lot, asks questions" (Student T, 22 September 2005);
- discussion and participation— "improves your thinking" (Student R, 22 September 2005);
- purpose of learning—"I always ask why—[I] want to know more" (Student V, 22 September 2005);
- having a positive outlook for change, thinking about how to make a difference;
- developing connections through experience—"hands on helps understanding" (Student R, 22 September 2005); and
- reflection—"reflect on what is wrong and improve" (Student R, 22 September 2005).

The results from the final student survey indicate that students ranked 83 percent of their action competence capabilities at Level 3 or 4. This is a 9 percent difference from the survey taken at the start of the teaching unit, and a 1 percent difference from the survey completed during the teaching unit, compared to these student rankings at the conclusion of the research project. In this final survey, 16 percent of the action competence capabilities identified by the students was at Level 2, while 1 percent was identified at Level 1.

Data triangulation

A comparison across all three data sources (students, teacher, and researcher) regarding action competence capability is shown in Table 7. The average was obtained from the total scores for each data source (students, teacher, and researcher) across the Levels 1, 2, 3 and 4 of the matrix being totalled and averaged.

Table 7 **Average action competence capability by student, researcher observation, and teacher**

KEY	AVERAGE ACTION COMPETENCE CAPABILITY
S1 = Student survey (9 June 2005)	2.9
S2 = Student survey (29 August 2005)	3.2
S3 = Student survey (22 September 2005)	3.2
O1 = Researcher observation (27 June 2005)	2.6
O2 = Researcher observation (5 July 2005)	1.6
T = Teacher survey (5 October 2005)	2.9

Using the action competence matrix, for any given survey there is an average action competence identified by that group. For example, the average action competence identified by the students at the start of the project was 2.9. For the remaining two surveys the average action competence they identified was 3.2. The matrix tool appears to indicate that the average capabilities identified by the researcher's observations are lower than both the teachers and the student's average perception of their action competence capability. As noted above, the validity of the matrix as a data gathering instrument needs further investigation before any conclusions can be drawn about these differences.

In particular, issues concerning a perceived hierarchy of behaviour in the statements need to be addressed, and trials need to be conducted with larger numbers of participants.

Pedagogies for action taking

Within the scope of this research project there are no clear results available with regard to pedagogies for action. No physical action was reported or observed as a part of this teaching unit. The teaching strategy students predominantly experienced was the use of scenarios/simulations.

Summary and implications

City School is an inner city school in a large city of New Zealand, with a designated special character that is best epitomised by 27 students, ranging from Years 5–8, who were directing and managing their own learning. Thirteen students had ethical approval to participate in the research and six students were surveyed and interviewed three times during the research and observed twice. The remaining seven students participated in semi-structured group interviews conducted at the start and end of the project.

A major tool developed as part of the research to address the research questions was an action competence capability matrix (Table 8). This matrix identified 15 capabilities for action competence.

What skills relevant to achieving action competence did students possess before the unit?

Six focus students completed a survey identifying their action competence capabilities. The results of this survey showed that the students identified a high level of action competence capabilities as described on the matrix. They identified capabilities across Levels 3 and 4 of the matrix, with some students identifying their capabilities at Level 2.

At the start of the project the teacher and the researcher planned an enquiry learning unit entitled "Seeing the city with new eyes". The key aspect of the unit affecting student performance was the concept of a whole-class enquiry, as opposed to the individual enquiries that the students usually engaged in. The decision to use whole-class enquiry was based on the co-operative and collaborative aspect of environmental education. The process included whole-class discussions, group and individual tasks to unpack students' prior knowledge and views of the city, the use of thinking tools such as questioning and brainstorming, and experiential learning in the city environment. Students were invited to consider a question or issue that they would like to investigate further. Students could choose to work individually or in small groups. The students selected a range of questions and issues and developed draft action plans. However, for a number of reasons these action plans were not implemented. The teacher tried to redirect the learning process and discussed with the students the next possible course of action. During this time the students worked co-operatively and collaboratively, using a range of strategies (based on experiential scenarios) that included problem solving and acting on solutions to make changes necessary for personal and collective survival (albeit in an imaginary context). The scenarios also required students to explore multiple perspectives of themes dealing with human rights, social justice, and sustainability.

What skills relevant to achieving action competence did students demonstrate during and after the teaching and learning?

The observations and surveys showed two different pictures. The students' surveys showed a slight increase in their action competence capabilities from the initial survey. However, the researcher's observations indicated that the action competence capabilities observed were predominantly at Level 1 and 2 of the matrix. The reflections of the teacher showed that students were using the capability of reflection more effectively in other learning tasks after the environmental education unit, and also noted slight improvements in co-operation and collaboration across the class.

There was a slight impact on student participation and reflection. The students identified that "managing yourself" and "having the teacher support you in the enquiry process" were important to carry out enquiry learning effectively.

What did the teacher feel led to any changes in student's skills relevant to achieving action competence during and after the unit?

The research explored the notions of student engagement and critical thinking and reflection. The teacher used the strategy of scenarios to engage the students. The results of this research suggest that this is a useful approach to encourage students' interests in exploring environmental issues. The findings of other research (e.g., Fien, 2001), however, suggest that it is important that scenarios be either followed by real experiences in the environment or run in conjunction with them. The students themselves described actual connection with the environment as an important factor in developing their understanding of issues. The teacher also felt strongly that critical and reflective thinking had a major role in supporting students' understanding of issues within the scenarios, and how the students solved problems, discussed issues, and made decisions in their groups. The students also worked co-operatively and collaboratively to meet the group goals within the scenarios.

A further implication is needed in order to better understand the impact of sustained periods of involvement in the teaching unit. For this group of students, the very flexible timetable of the school meant that the actual time spent each week on the EE enquiry was extremely limited. What this research highlights is how much impact the intermittent nature of the learning had on student's lack of demonstrated action competence.

The research also raises questions about how the students perceive their ability to take action on significant issues of sustainability in the urban environment. Supporting students to be confident in their ability, but also to accept the reality of what can be achieved within the bureaucratic complexity of a city, is an important facilitative role for the teacher. The research results suggest that supporting students to select manageable issues is important, especially when working to take action for the environment for the first time. As students' action competence grows, they may be better equipped to take action on some urban issues that lie outside the school doors.

Finally, this research acknowledges the limitations of data that were gathered over short time periods and across limited foci, so that the researcher, in fact, observed only five of the 15 action competence capabilities described in the matrix that used to gather data. While we believe the matrix to be a useful tool, better use during the research would have yielded more robust information from which to draw conclusions. It is hoped that the matrix will be further reviewed and developed to support teachers and students in achieving action competence for environmental education.

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Table 8 **The action competence capability matrix**

KNOWLEDGE			
I get information from one place only – it is the only place I go.	I get information from a couple of different places, mostly books and the Internet.	I get information from books and the Internet mostly.	I get information from lots of different places, people and resources.
PLANNING TO TAKE ACTION			
Action planning			
I don't plan at all.	Sometimes I plan things.	I plan quite often by myself and sometimes might get some ideas and help from others.	I always plan and share my ideas with others to help me make the best plan.
PARTICIPATION			
Working with others to achieve goals			
I prefer to work by myself all the time and I don't think others can help me.	Sometimes I work with others but if they can't help me I would rather work on my own.	I enjoy working with others and like to share things that I am good at to help the group achieve its goals.	I think I learn more in a group and enjoy working with others and take on any role to help the group achieve its goal.
Discussion and participation			
I don't find discussing my ideas helpful, but will discuss ideas if I have to.	I listen in a discussion, but don't usually say much. Listening to others can sometimes be helpful to me.	I like talking about ideas, but don't usually find others' ideas helpful in sorting out my own.	I like talking with others and find I can use their ideas to help me sort out my own.
EMOTIONAL RESPONSE			
Considering the views and perspectives of others			
I think everyone thinks like I do.	I know other people have different ideas from me, but it doesn't change what I think.	I know my own ideas and am interested in other people's views.	I can explain my view carefully and consider other ways that the same idea might be explained by others.
Purpose			
I'm not worried about knowing the purpose.	I often don't understand the purpose but I think I should.	I like to know the purpose behind things.	Things only make sense if I know the purpose of what we are going to do.
Positive world outlook			
I don't think I can make a difference	I think I can make a difference, but I don't know how to go about it.	I have some ideas on how to make a difference, but am not sure if they will work.	I know that I am able to make a difference and have ways to do this.
Connections to the environment			
Experiencing an issue in the environment doesn't help me to understand it. It doesn't motivate me to find out more.	Experiencing an issue in the environment sometimes helps me to understand it and sometimes I am motivated to find out more.	Experiencing an issue in the environment really helps me to understand it and sometimes I am motivated to find out more.	Experiencing an issue in the environment helps me to understand it and motivates me to find out more.
Relationship to the environment			
I don't think I am part of the environment and therefore I do not affect it.	I know that I am part of the environment, but I don't think I have any effect on it.	I know that I am part of the environment and sometimes I have an effect on it.	I know that I am part of the environment and know some ways to lessen my effect on it.
Attitude			
I know that the environment is an issue, but I don't care.	I know that the environment is an issue, and sometimes I care.	I know that the environment is an issue, and I often care.	I know that the environment is an issue, and I always care.

Table continued next page

Action competence capability matrix, continued

CRITICAL THINKING AND REFLECTION			
Reflection			
I don't like to reflect or think about what has happened.	I will reflect if I have to.	I use reflection because I have to, and find that it helps me to learn better.	I like to use reflection and can do it by myself. I know that it helps me.
Thinking innovatively and creatively			
Coming up with new ideas is a struggle for me. Nothing seems to help me come up with ideas.	I use other people's ideas. I find it hard to come up with new ideas on my own.	When some ideas are shared with me, I find it helps me to think up new ideas of my own.	I think up new ideas by myself and think of different ways to make things, present my ideas, and sort out information.
Problem Solving			
I find problem solving really hard and usually give up after one try.	I find problem solving hard, but am learning a way to help me solve problems.	I find problem solving quite easy, and I have one way of solving problems.	Problem solving is easy for me. I have several ways to go about sorting out problems, either by myself or with others.
Decision making			
I don't know how I make decisions.	Sometimes I think about my decisions, other times I just do stuff.	I have my own way of making decisions that others might not be able to work out.	I set criteria for making decisions that help me and make it clear to others what I am doing.
Open-mindedness			
Once I have an idea, or have made a decision or choice about something, I stick to it, even if I get new information.	I can change my ideas, decisions, and choices based on new information, but I don't usually do that.	Sometimes I can change my ideas, decisions, and choices when I get new information.	I change my ideas, decisions, and choices often when I get new information.

Appendix 5: Beach Head School—Case Study 5

The context of the study

Environmental education, a core philosophy for Beach Head School, is an overarching, multidisciplinary policy that drives all other curriculum areas. Beach Head School, which caters for 22 Years 1-6 students (see Table 1), is a sole-charge school situated in a small, rural, coastal community in close proximity to the beach and the local estuary. The locality provides a wonderful opportunity for the school to be immersed in environmental education.

Beach Head School has a dual principalship and one part-time principal-release teacher. Students identified as Māori comprise up to 50 percent of the school roll. Innovative environmental education programmes link the students' learning with the local cultural, Māori, and conservationist community. This linking enables students' learning to be closely tied to the values of their parents and of the wider community, which has a long history of acknowledgement of Māori perspectives.]

The school's open door policy, which actively encouraging parent and community participation in school programmes, is met with enthusiastic and positive commitment by the community. The attractive grounds are used outside school hours by the wider community. Beach Head School has a vision of further development that includes native trees, a walkway, and a large community garden to be developed in an adjoining paddock owned by the school.

The whole school was involved in the case study.

Table 1 **Demographics of Beach Head School**

SCHOOL DEMOGRAPHICS					
School type	Contributing primary (Years 1–6)				
Roll size	22				
Decile rating	4				
Locality	Rural				
Student ethnicity (%)	NZ European/ Pākehā	Māori	Pasifika	Asian	Other
	50	50	0	0	0
Teaching staff	Full-time/part-time:1.3 FTEs				

Framework

This research project aimed to involve classroom practitioners alongside researchers, both to inform them and to provide them with a platform for reflecting on their own personal practice within environmental education as well as in their teaching practice in general.

Wright (2003), among others, has noted that the development of a local curriculum encompassing a knowledge of local history and an appreciation of the local area is an inherent responsibility of small rural schools to ensure the sustainability of their communities. This "community as curriculum" approach has been recognised as building strong relationships between schools and communities. Researchers on rural education agree. Theobald and Nachtigal (1995), for example, see this knowledge as being crucial to the "re-creating of communities" to meet the "needs" of their learners. The term they use to describe this approach is "place-based education" (p. 134).

Place-based education has five essential characteristics. Woodhouse and Knapp define these characteristics as:

> - emerging from the particular attributes of a place—it is content specific
> - being inherently multidisciplinary
> - being experiential—action must be a component if ecological and cultural sustainability are to result
> - being reflective of an educational philosophy that is broader than 'learn to earn'
> - connecting place with self and community. (2000, p. 4)

In New Zealand, unlike some other western education systems, environmental education shares many of the characteristics of a place-based curriculum. Furthermore, a focus of environmental education in New Zealand has been the emphasis on action-based learning *in*, *about*, and *for* the environment. Without action competence, students will be unable to act *for* the environment (McLean, 2003). As a result, the teaching and learning approaches used in the unit of worked that formed this case study were based on transformative models that engaged learners in action based learning *for* the environment.

Pedagogical approaches

Pedagogical approaches leading to this transformative model of learning were explored and identified as:

- *Experiential learning*—an overarching concept of learning from one's own experiences;
- *Enquiry learning*—a process that involves identifying and solving problems through critical reflection, leading to understanding and informed decision making;
- *Reflective practice*—analysing the state of learning and making strategic decisions for further implementation;
- *Student-centred learning*—the learner is placed at the centre of the learning experience in a holistic and integrated learning environment; and
- *Affective-aware teaching*—the teacher is aware of not just the cognitive learning in the class but how individual and group learners are feeling about a situation.

The environmental education unit

This unit was part of a long-term school plan (LTP) that encompasses four main areas of environmental education—living landscape, healthy water, precious energy and ecological buildings, and zero waste. The LTP is expected to cover studies and individual topics over a 4-year period. The topics within the current environmental area are normally generated by children as they make decisions about their learning. Many of these topics were carried over from prior learning in previous years and involve decisions made by the children about their immediate or local environment.

As in most schools' curriculum, reasons for the choice of unit varied. The unit had to:

- fit into the major module of ecohousing;
- lead to action competence, so therefore:
  - be something all the children could be involved in from conception to finale;
  - be experiential and student centred;
- be manageable in a team teaching situation;
- involve the school's local environment (school grounds)—i.e., place-based curriculum;
- deal with an issue/problem identified by the children as requiring action (action competence); and
- be part of the Youth Enviroschools programme.

The bird unit will carry over into 2006, when the health of the estuary (in terms of local birds, water quality, and so on) will be investigated.

Pre-unit planning meeting

The planning meeting considered how the bird unit would fit in with the ecohousing/energy study that had had already been under way during the previous 18 months. An advantage of having environmental education as a core philosophy is that it allows time to complete studies in-depth in an integrated way, because it includes all areas of the curriculum over time and it also involves local curriculum.

Format of the unit

The lesson plan for the unit is given in Table 2.

Table 2 **Unit lesson plan**

LESSON	COMMENT
Lesson 1: Examining prior knowledge and experience]	Before the bird unit was introduced the children went back over the principles of ecohousing.
Lesson 2. Introducing the unit	The bird unit was introduced informally, with whole-class discussion
Lesson 3. What do we know about birds already?	Children often need to be made aware that they already have a great deal of knowledge about their world, and that this can be applied to new learning
Lesson 4: Key words and paragraphs	A number of the children had little by way of research skills, and had difficulty in finding pertinent information from printed sources. Participants at the planning meeting had identified gathering information as a research skill that was a prerequisite for informed decision making. They also saw it as necessary for planning and taking action
Lesson 5: Use of the action planner—where to next?	The action planner used in the unit was based on the planner in the Youth Enviroschools programme, but was adapted for the purpose of "What do we need to know?" rather than "What skills do we need?" Action planning allows children to be in control of decision making, and gives them the confidence to be able to make decisions
Lesson 6: Gathering data and determining the structure of bird presentations	The objectives for this lesson were to • introduce the PowerPoint software to small groups of Years 5–6 • introduce the scanner for scanning selected photos (Years 5–6) • recapture prior knowledge about poster design (Year 2+) • experiment with Word Art for title display (Year 2+) • begin to accumulate data about individual birds.
Lesson 7: Homing pigeons' visit	By arrangement, a community member brought in some pigeons for the children to observe, touch, and hold. A valuable experience for the junior children
.Lesson 8: Aviary visit and bird exhibition	School visit to the aviary at the Botanical Gardens in Dunedin. Children were given the opportunity to examine different kinds of birds' nests to see at first hand how the aviary staff made nesting boxes for the garden birds
Lesson 9: Making nests	Children had been asked to gather suitable material over the weekend for making a bird's nest. This was completed at school and culminated in the great nest-building competition

Table continued on next page

Unit lesson plan, continued

Lesson	Comment
Lesson 10: Bird feeders	This lesson evolved from the children's observations in the school environment when working on their gardens. The construction of edible gardens was a first priority in their initial survey in 2003 and is ongoing
Lesson 11: Gathering data and making presentations	The six children in Years 5–6 were taken through the PowerPoint programme again to explore slide design and layout. Younger children (Years 2–4) were given a teacher-directed lesson on poster design and shown how to move their components around until they were happy with the layout
Lesson 12: Conclusion of bird study and lead-up to construction of bird houses	Objectives of this lesson were to: • celebrate achievement of work to date • isolate those features important for bird house construction • explore different options for bird houses
Lesson 13 (team teacher): Relating eco-principles to bird house design	At this point the unit was related back to the earlier topic of ecohousing (which had been facilitated mainly by the team teacher). Objectives for the lesson included • reflecting on and identifying principles of ecohousing • considering which eco-building principles could be applied to bird nesting boxes of feeders (critical thinking) • identifying and listing ways of attracting more birds to the school
Lesson 14: Designing a nesting box/feeder	Earlier sessions were recapped after a story about an environmental problem set the scene
Lessons 15–16: Constructing the bird houses	The culmination of the bird unit took place over two sessions. Help from the community was requested in the newsletter and followed up by personal communication to those parents and community members who had indicated a willingness to be involved
Lesson 17: Reflection on design process	It became obvious during the second session of birdhouse construction that some groups were having difficulty. This involved a number of competencies and elements of action competence

Research design

Case study methodology was used, as this research investigates a contemporary phenomenon in a real-life context. Shulman (1996) refers to a case study as being an account that enables professionals to reflect on, and learn from, their experiences.

Data were collected by:

- researcher reflection (diary);
- teacher reflection (diary);
- pre- and post-module interviews with both teachers;
- researcher's observation of lessons involving both teachers;
- stimulated recall using video;
- photographs of children's work (planning, displays, etc); and
- concept maps and thinking activity to ascertain children's prior knowledge, and research and information skills.

Number of people involved and unit time frame

The researcher, three teachers (two of whom were research participants), and 22 children (the whole school, across all levels) were involved in this study. The unit took place over two terms, following on from the earlier topic of ecohousing.

Findings

Students' action competence before the unit

Beach Head School has a history of environmental education involvement over a number of years and the pupils have been involved in a number of actions for the environment. An initial survey using the Youth Enviroschools model was used in 2003. Working through the enviroschools process highlighted that the children already had a range of skills and experiences leading to action competence (for example, decision making, not just about the composition of their working groups, but also on what topics they would study).

Visiting pre-service teachers asked the children questions about environmental education and how they felt about it. Some of their answers were relevant to the investigation of developing action competence, and demonstrated the dimensions of their action competence before the unit began. In response to the question "What do you like about environmental education?" children invariably mentioned trips, visits from other schools, and planting days, but also said: "We can choose what we do!", "We not only get to work in our garden and take things home but we know how to make our own garden at home now!", and "If we really want to do something like make our grounds better". From these responses we can infer that the students were aware that they had an element of shared control over action taking—that is, that they, too, could determine the path that action would take, and that they had a role in decision making—one of the criteria for action competence. For example, when asked how they decided what they were going to do, children were very clear about the processes involved: "We share our own ideas" , "We get in groups and talk and look at what we were doing and what we were not doing—we do surveys"; "We have a vote or group talk and what most people say is what we do"; "Sometimes we make a plan on a piece of paper"; and "We get into groups and decide". Here the students were demonstrating not only their familiarity with the elements of participation through co-operation, collaboration, and consultation and democratic principles, but also the competencies of relating to others, participation, and contribution.

Teacher's views on environmental education for action before the unit

All three teachers taking part in the research had been involved in environmental education for a number of years. Environmental education is a core philosophy shared by all staff and transmitted not just to the parent community, but to the wider community as well. Staff used an experiential approach that allowed students to build on prior experiences. Before the research began staff had a good understanding of the pedagogical approaches that lead to the development of action competence in environmental education.

Specific teaching and learning approaches and strategies that were emphasised included critical thinking, reflective practice, transformational as opposed to transmissive learning, experiential learning, place–based learning, problem solving, situation improvement, and student-centred learning that generated emotional engagement.

Knowledge of these pedagogical approaches was apparent in the pre-unit interview. For example, teachers spoke about "exploring the immediate environment", "revisiting what has been done before", "marrying up what they [children] have learned about … and come up with some synthesis", "rather than just action in the environment and about the environment we'll actually do something", "children are going to be able to evaluate how successful they are", and "children then related it back to a problem they had identified."

The nature of the school meant that staff could also share an in-depth and intimate knowledge of the local children and their social environment, which would influence the types of pedagogies considered most effective. The evidence for this was in the post-unit interviews, where teachers stated that "we have such a good knowledge of those children … we can make good valid decisions." An intimate knowledge of students allows consideration of pedagogical methods to go beyond this subsidiary awareness of how individual learners or groups of learners are feeling about a situation. As McCaughtry, (2005, p. 385) points out "in this sense, "understanding students emotionally and socially represented an inextricable layer of her pedagogical content knowledge". A sole-charge school mirrors this intimate knowledge of students. This principle was taken into account when considering and developing teaching pedagogies in the units of work that formed the case study.

Observations and reflections during and after the unit

The researcher observed both teacher participants when taking particular lessons with students. Both teachers modelled the teaching pedagogies that had been proposed in earlier planning as being conducive to developing action competence and determining how the affective learning aspects of the unit were presented. As the researcher commented, "I watched them [students] looking at pictures (of bird houses) and it was really funny when they'd say, 'Oh, no bird would come into that! It doesn't look bird friendly!' even though the designs themselves were quite pretty".

The researcher noted on one occasion that two children seemed unable to agree on a design for their nesting box. Eventually the teacher had to intervene, but she did it in such a way that the children were empowered to reach a consensus themselves. This intervention by the teacher reinforced the collaborative and co-operative approach used at the school. The teacher said to them, "You have to come to some sort of middle ground where you are both happy, or you are going to have to split up and work with other people, or work on your own". The children sorted it out themselves.

In the post-module interview, one of the teachers highlighted collaboration and co-operation across age levels: "It's very powerful for [the 5-year-olds] to say their ideas and to have the older kids say 'That's a really good idea.' And to adopt it".

Children were encouraged to reflect on prior learning at specific points within the unit. This was made obvious in the section on describing the unit. However, it was also used as a conscious teaching technique at the beginning of each new section and particularly during team teaching. As one of the teachers commented, "The sequential programme of the unit worked well, even over two people". Children explained what they had been doing with the other teacher: "They think they are doing me a favour [in telling me], but they're actually revisiting what they've done … it's that scaffolding again!"

Evidence of teachers' reflections can be seen in the post-unit interview. One teacher commented, "… revisiting all those earlier intentions" when speaking about the bird unit and children's choice of making bird habitats. When looking at ways that weren't quite so successful, one teacher commented: "We had looked at getting a bird expert … some of our planning became unnecessary, or bypassed if you like, because other things happened … but that's another avenue we can explore next year when we look at our estuary and the water and its inhabitants". This comment shows that the unit is part of an ongoing programme that links previous learning with future learning. It also shows that teachers need to be reflective and flexible over what they have planned, and be prepared to make changes were necessary.

Near the end of the unit, just before constructing their bird houses, the children were also canvassed about their involvement. Comments such as "I really liked finding out about … going to the aviary … and using the slide show" featured in a number of samples. Further comments from children demonstrated how this unit would also affect their own lives: "We're going to plant more trees at home, especially ones my bird likes, like kowhai or some berry trees!" One of the teachers

commented: “They have become real little experts on their birds”. A lecturer who visited with several pre-service teachers later commented that her students “were so impressed with how the children were so knowledgeable about their own bird”.

After the first two sessions of actually building the birdhouses, a survey was given to all children to complete. The collated results showed that the level of satisfaction for all groups was clustered in the highest portion of satisfaction. One child commented, “I was away the first day and when I came back I could see what we still needed to do from our design. Because I wasn’t here they let me have the first turn with the electric drill.” Another comment came from a child in a group consisting of a boy and girl: “She was better at the weaving bit, so I got the stuff and helped hold it so she could weave in and out”. Further comments included: “We talked about it and were able to come up with a different way of fixing the holes” and “We can do it all ourselves now—we don’t need any more adult help!”

These comments showed that children were aware of taking responsibility for developing solutions and that, rather than waiting on assistance from someone else, their participation was important. This ability to solve problems is an important part of developing action competence. The comments also showed that children were aware of the need for the democratic procedures of discussion and agreement before further action can be taken. The reflective component allowed children to analyse their state of learning and to make strategic decisions about future action. The elements of planning and taking action inherent in action taking competence were important for identifying the design problems and solving them, and consultative action during group discussion that led to future planned participation.

This sequence demonstrates that children were developing action competent skills and were familiar with the concept of action *for* the environment explicated by McLean (2003) before this unit began. They were identifying a problem from their immediate environment and working towards a solution. This research study has highlighted the importance of using appropriate pedagogies that continue to model and assist students to become more action competent.

Pedagogies for action taking—answering the research questions

What skills relevant to achieving action competence did students possess before the unit?

The enviroschool process highlighted that children had a range of skills and experiences leading to action competence (for example, being involved in decision making, not just over the composition of their working groups, but also in what topics they would study). Students were demonstrating not only their familiarity with the elements of participation through co-operation, collaboration, consultation, and democratic principles, but also the competencies of relating to others, participation, and contribution.

What pedagogical approaches did teachers select before and during the unit, and why?

Particular pedagogies for action taking were identified by teachers in the pre-planning stage. These complemented the teaching strategies listed by McLean (2003, p. 7) for implementing action taking for the environment. The underpinning pedagogical approach allied to action taking and to the constructivist learning philosophy held by the participating teachers was experiential learning. For this reason, the unit included experiential activities such as the lesson with the homing pigeons, children’s observations of actual birds visiting the school grounds, the aviary visit, and the visit to the exhibition as well as the bird house building competition.

Thinking activities and research skills leading to the necessary knowledge that in turn allowed for effective decision making were specifically included early in the unit, for this purpose as well as to fulfil other curriculum needs identified by the teachers. When thinking becomes a goal of instruction, a great value is placed on learning activities that stimulate cognitive processes. These include the type of language that stimulates discussion and prompts the student to reflect. For

example, when students express a preference for one alternative over another, the thinking question would be: "What criteria are you using to make your choice?" A pause after a question is posed (either by teacher or student) is an effective measure to increase thoughtful responses as well as the number of responses.

Both the action planner and design planner from the Youth Enviroschools programme were used to direct children's thinking and subsequent decision making. Reflection of prior learning and the application of prior learning to new learning were also identified as part of action competence.

Outside school visits (the aviary and the museum exhibition), the visit of the pigeons, the bird house building competition, and the grand finale of constructing the bird houses/feeders, led to the emotional engagement of students with their learning. "It was good to see how they (the aviary staff) made the nesting boxes", said one child on seeing a drum being used for the kaka's nest. At the time of the visit to the aviary, children were observed counting bird numbers while at lunch, and juniors were observed playing various games involving role play of different bird movements such as hops, skips, and jumps. These incidental activities demonstrate that the children felt an emotional engagement with their own learning. Emotional engagement is an underlying requirement for children to be able to develop action competence.

Many New Zealand classrooms have teachers who use pedagogies such as experiential learning, problem solving, and enquiry-based learning, all of which could lead to the development of action competence. However, it is the interrelationship between experience, reflection, student-centred learning, and emotional engagement (Law, 2005), the context, the teacher and learner relationship, and the element of risk taking and challenge, that is a critical—and often unrecognised—aspect of environmental education. This may be one of the reasons why McLean (2003) found that education *for* the environment is not prevalent in many schools.

What skills relevant to achieving action competence did students demonstrate during and after the teaching and learning?

Self-chosen working groups gave children practice in learning socially, and many choices as to the best way for them to work in co-operative or collaborative groupings. All students were encouraged to participate, and contributions were shared and celebrated. Higher order thinking skills were evident, as well as practice in the elements of emotional response as opposed to emotional engagement. "That's a good idea! We should try that with our bird house" was said in reference to a suggestion of woven harakeke sides. The development of action competence requires this practice in shared decision making.

A key determinant of action competence is to involve children in a decision making process that can lead them to determining the path of their own learning. Some teachers fear this loss of control. This unit evolved from a decision made by children to incorporate homes and habitats into their "dream garden". Comments such as: "We plan it in the playground where we are going to put something" and "Way back, we decided we needed to put more art in our school grounds and we needed to do something about homes and habitats for animals—building bird houses" demonstrate this. Children's decision making was fostered in the unit through the use of self-chosen groups, as well as their own choice of bird to study, and was evident in their action planners and design planners. They did need to be reminded that they were the decision makers, by reference to their planners, or to combined charts drawn up through group interaction and contribution.

Decision making on its own, however, is not enough. Action competence assumes that there will be an action taken, and that this action will help to provide a solution to an identified problem, or improve a situation. Underpinning the development of action competence is a range of pedagogical approaches that are successful in promoting its development.

Summary and implications

Beach Head School is a sole-charge rural school in which environmental education is the overarching policy driving all curriculum areas. The school has several features representative of small schools. Its flexibility in terms of timetabling and finishing dates for modules, and its varied age range from Years 1—6 in the class are factors that allow for continuity of learning in a holistic way. Mentoring occurs between children of different age groups. The relationship between the teachers and the community is a very close one—the school is an integral part of the community. Staff share an intimate knowledge of the children and their social environment. Teachers have also developed trust in each other's ability to carry out an agreed plan.

The best practice approaches identified in this study include experiential learning (using experience, reflective practice, and emotionally engaged learning), enquiry learning, co-operative learning, and student-centred learning (which included decision making, problem solving, and affective-aware teaching).

To have relevance for students, the experiences need to be meaningful, they need to be based in the students' milieu, and the action taken needs to have an agreed purpose.

However, unless teachers are prepared to take the risk of handing control over to children (while providing support and guidance), they will not be able to fulfil the criteria for teaching *for* the environment. Unless they are involved as decision makers, children will not feel empowered to find solutions to work towards the resolution of environmental issues and demonstrate their action competence and action potential.

Rural communities everywhere have a proclivity for caring for their environment, and in many rural schools in New Zealand environmental education represents a strong component in the local curriculum. This supports the placed-based education approach to developing the action potential of students at Beach Head School. Working with, and within, the local natural environment heightens communities' perceptions of school as benefiting both children and the local area. It certainly has proved so at Beach Head School, winning back enthusiastic, ongoing support for the school from the wider community in recent times—due in part to the increase in the action competence skills of both students and teachers at the school.

As a result there has been an increase in the number of parents who just drop in to help on occasions. Wider community support is also evident in the closer relationship that has developed with the local rūnanga, who now feel they can call on the school (often unexpectedly) to help with welcome ceremonies to other schools visiting the local marae.

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