Social-ecological resilience through education for sustainability: A case study of community scale resilience

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Neus (Snowy) EVANS

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Signed on the author's behalf by:

_____ _____

Head of School **Date**

Statement on the Contribution of Others

Nature of Assistance	Contribution	Name, title and affiliation
Intellectual support	Proposal writing	Dr Hilary Whitehouse, School of Education, JCU Dr Margaret Gooch, School of Education, JCU
	Thesis writing	Dr Hilary Whitehouse, School of Education, JCU Dr Margaret Gooch, School of Education, JCU
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Declaration on Ethics

The research presented and reported in this thesis was conducted within the guidelines for research ethics outlined in the *National Statement on Ethics Conduct in Research Involving Human (*1999*)*, the *Joint NHMRC/AVCC Statement and Guidelines on Research Practice* (1997), the *James Cook University Policy on Experimentation Ethics*. *Standard Practices and Guidelines* (2001), and the *James Cook University Statement and Guidelines on Research Practice* (2001). The proposed research methodology received clearance from the James Cook University Experimentation Ethics Review Committee (approval number H2765).

…… ……

Neus (Snow) Evans Date

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Abstract

This doctoral research applies a social-ecological resilience lens to investigate how principals, teachers and students in four schools in Far North Queensland, Australia, organise and enact the principles and practices of education for sustainability. Resilience builds capacity to mitigate disruptions, self-organise, learn and adapt. Education for sustainability is an educational approach which promotes capacity for change towards sustainability. The premise of this thesis is that successful education for sustainability provides the skills, knowledge and understandings of students, staff and others in the school community to build capacity to manage change in ways that open rather than limit future options. The sustainability work that schools undertake is known to produce positive local-scale benefits. Such benefits may include school community-scale resilience. Yet to date no known research in Australia has addressed if and in what capacity school initiatives can and do enhance social resilience.

This study applies a case study approach to investigate social resilience through education for sustainability from a social-ecological perspective. Sources of data include individual interviews with principals and teachers, group interviews with students, document studies, archival records, sustainability reviews of each school, and a questionnaire administered to the wider teaching staff. Data analysis applies a four stage process to study each school's everyday management and teaching and learning practices from a social resilience perspective.

One tangible outcome of this study is the production of a proposed set of qualitative indicators of social-ecological resilience at school community level that align with the Australian Government's *Framework for Environmental Education for Sustainability* outlined in *Educating for a Sustainable Future: A National Environmental Education Statement for Australian Schools*, which is a nationally agreed description for best practice. The indicators combine understandings from the education for sustainability and social-ecological resilience fields to describe education for sustainability with intent

to build resilience. A second outcome of the study is a set of propositions for how education for sustainability can be enhanced to promote resilience.

This research suggests education for sustainability has capacity to foster social-ecological resilience and highlights a need to plan for resilience within education for sustainability. The study found many of the principles, practices and processes of implementing a whole-school approach to education for sustainability parallel research on social-ecological resilience. Schools can foster resilience by teaching and modelling practices which provide the skills, knowledge and understandings to build capacity to manage change in ways that enhance future opportunities. It appears schools that nurture resilience-enhancing attributes such as critical thinking, self-organisation, flexibility, creativity, diversity, and social capital building improve the school community's adaptive capacity.

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Part A

Theoretical Development of Resilience

Through

Education for Sustainability

Chapter 1. Contextualising the research

Introduction

This research was undertaken within the Cairns region of Tropical North Queensland in Australia. The Cairns region encompasses the coastal area from Tully, 150 kilometres south of Cairns, to Cape Tribulation, 140 kilometres to the north and to Ravenshoe, Herberton and Mareeba, 100 kilometres inland (*Figure 1.1*). Far North Queensland expands from Cardwell, 200 kilometres south of the City of Cairns, to the Torres Strait on the northernmost point of the country (*Figure 1.2*). Over the last twenty years Cairns has experienced unprecedented environmental changes, mostly due to increased urban development. A soaring human population has resulted in the transformation of landscapes from chiefly untouched verdant hillsides, country roads and cane paddocks to ad hoc, developer-driven commercial and domestic development which has not considered many of the region's ecological values and ecosystem functions (Cairns and Far North Environment Centre Inc [Cafnec], 2007). Ecologically unsustainable growth is contributing to declining environmental conditions which may compromise local options for future generations. One area of significant concern is changes in the water quality of waterways leading to the Great Barrier Reef. Over the past 150–200 years, runoff from land-based agricultural activities and urban development has caused a fourfold increase in the levels of anthropogenic pollutants entering Great Barrier Reef waters via catchments (Haynes, 2001). It is projected that by 2020 the Great Barrier Reef will suffer further significant biodiversity loss, partly due to coastal development and population growth as well as threats due to climate change (Intergovernmental Panel on Climate Change [IPCC], 2007).

Environmental changes are not unique to north Queensland. Stories of major sustainability threats brought about by urbanisation, over-consumption of natural resources, and adverse agricultural practices abound worldwide (see Cutter & Smith, 2001). One renowned example is the collapse of the Canadian cod fisheries in the early nineties due to over-fishing. Despite warnings, humans continue to deplete non-renewable resources, damage ecological systems – at times beyond repair, reduce social

stability, and increase the gap between rich and poor (Queensland Government Department of Education, Training and the Arts [DETA]2006b). Each time the Intergovernmental Panel on Climate Change (IPCC) produces an updated report they advise that previous reports underestimated the magnitude of change. Humanity's global footprint now exceeds Earth's capacity to regenerate by about 30 per cent (World Wildlife Fund [WWF], 2008). This is causing system instability of social and ecological systems.

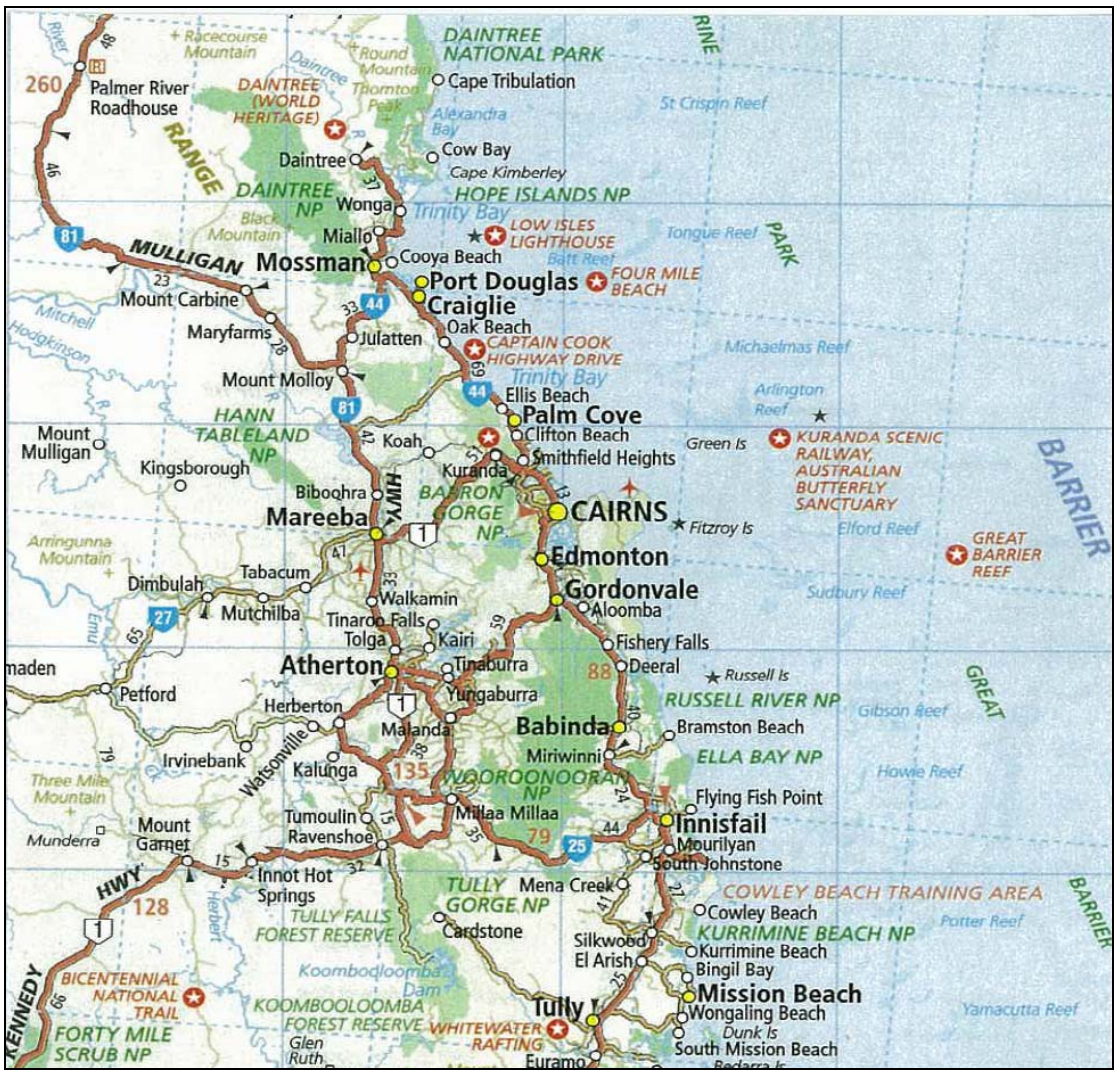

Figure 1.1. Map of Cairns region
(Explore Australia, 2008)

Education is heralded as a key strategy for mitigating unsustainable trends and working towards the creation of a sustainable future (Fien & Tilbury, 2002; DETA2006b; United Nations Economic and Social Council, 2008). According to the United Nations Commission on Environment and Development (1987), a sustainable world is one where ecological, social and economic needs are balanced to meet the needs of present generations without compromising the ability of future generations to meet their own needs. The United Nations declared the years 2005 to 2014 the Decade of Education for Sustainable Development with aims to integrate the principles, values, and practices of sustainable development into all aspects of education and learning (United Nations Educational Scientific and Cultural Organization [UNESCO], 2002b). Education for sustainability is conceived of as developing the skills, knowledge and values that promote sustainability through the application of transformational pedagogical approaches, and enabling students "to become active participants and decision-makers in the change process" (Tilbury & Wortman, 2004, p. 9). The approaches include envisioning, systemic thinking, critical (reflective) thinking, participation in decision making, and partnerships for change (Australian Research Institute in Education for Sustainability [ARIES], 2005b).

The theories and practices of education for sustainability are commendable, but other work is useful to further understanding, and merits consideration. Education for sustainability has been developed from an understanding of Earth systems as being in a state of equilibrium. Even though Earth has experienced many past periods of change, the planet's environment has been relatively stable for the last 10,000 years (Rockström et al.2009). The ideal of a sustainable society, with balanced ecological, social and economic systems, is built on a foundation of regular temperatures, readily available fresh water and biogeochemical flows (Rockström, et al., 2009). Researchers suggest increases in global disturbances such as climate change and abrupt ecological occurrences like earthquakes, cyclones and tsunamis indicate this period of stability is now under threat (Rockström, et al., 2009; Steffen et al., 2004). Earth systems are nearing a tipping point beyond which the planet will likely undergo very rapid, unpredictable and irreversible environmental changes (see Flannery, 2008; Resilience

Alliance, 2009) which may even be cataclysmic. These uncertainties present opportunities to reconsider the knowledges and skills needed to enable a truly sustainable society. According to James Lovelock (2009) the state of the planet is too far gone to consider mitigation. What we really need are adaptation strategies. Social-ecological resilience (SER) theory recognises the importance of adaptation (Folke, 2006; Folke et al.2002; Folke, Hahn, Olsson, & Norberg, 2005) and SER is central to this thesis.

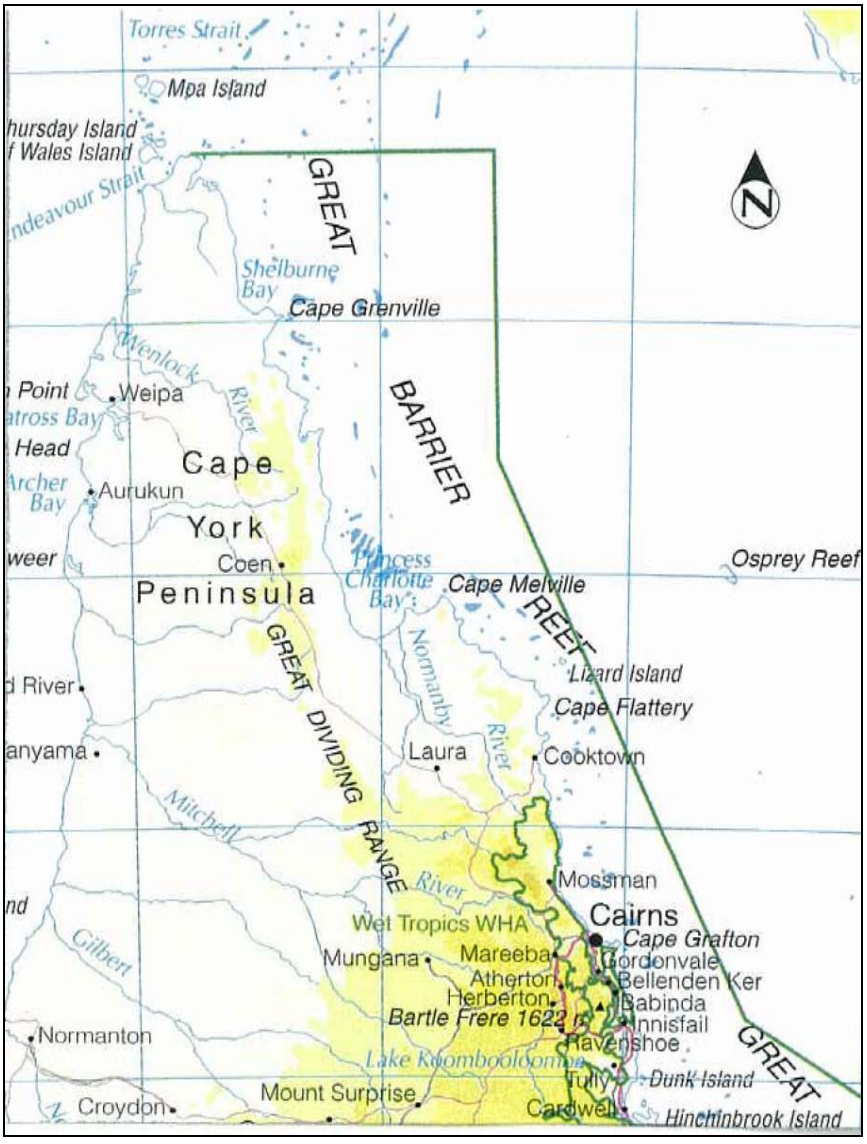

Figure 1.2. Map of Far North Queensland, Australia
(Jacaranda Primary Atlas, 2001)

Resilience is a cross-disciplinary concept which can be defined in many ways (Adger, 2000). This thesis draws from the ecological sciences to broadly explain resilience as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker, Holling, Carpenter, & Kinzig, 2004, Resilience section, para. 1). Specifically, I explore social resilience to environmental changes at the school community scale through a social-ecological framework. Adger (20002007) defines social resilience as the ability of communities to adapt to external social, political or environmental changes. Hopkins (2008) argues community-level resilience is evident when societies are able to respond adaptively (as opposed to collapsing) to adversity. The Centre for Community Enterprise (2000) maintains that a resilient community will take intentional action to enhance its adaptive capacity to respond proactively to change. This is because adaptive capacity enables social-ecological systems "to cope with novel situations without losing options for the future, and resilience is key to enhancing adaptive capacity" (Folke, et al., 2002, p. 7). I define a school community as the principal, teachers, students and any other people who participate in a school's daily business and operations. The social-ecological lens, which I explain further on in this chapter, provides a way to understand relationships between social and ecological systems.

I argue that if education for sustainability in schools is to be successful it must provide the skills, knowledge and understandings of students, staff and others in the school community to build capacity to manage change in ways that open rather than limit future options. To date, no published research has explored education for sustainability through a resilience understanding. This thesis investigates whether, and to what extent, education for sustainability in primary schools enhances resilience by fostering capacity for school community members to adapt to changing environmental conditions. I do this by investigating how principals, teachers and students in four Far North Queensland schools, known to prioritise education for sustainability, construct education for sustainability within their school settings. By construct I mean the ways these communities perceive, organise and enact the principles and practices of education for sustainability in their schools. The aim of the research is twofold. In the first stage I set

out to understand and interpret the principals', teachers' and students' perceptions, explanations, beliefs, worldviews and actions with regard to education for sustainability (Patton, 2002). In the second stage I examine the consequences of their constructions of education for sustainability from a social-ecological resilience perspective. In doing this I identify strategies to effect resilience at the school community level.

Resilience is an abstract and difficult-to-measure concept. I investigate how and to what extent the principles and practices of schooling in the four schools foster resilience by applying the Australian Government's *Framework for Environmental Education for Sustainability* outlined in *A National Environmental Education Statement for Australian Schools* (Australian Government Department of the Environment and Heritage [DEH], 2005). The framework is a nationally agreed description for best practice which is based on the belief that effective education for sustainability requires the involvement of the whole school. The framework deals with governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships, and school ethos. I describe the framework in detail in Chapter Three.

One outcome of the research is a proposed set of qualitative indicators which infer a whole-school approach to education for sustainability informed by social-ecological resilience. Indicators are information systems (Redefining Progress, 2006) and often take the form of a sign, symptom, omen, signal, tip, clue, grade, rank, data, pointer, dial, warning light, instrument, or measurement (Meadows, 1998). Qualitative indicators are sets of statements which provide descriptive information and are particularly useful for learning about a phenomenon about which little is known (Tilbury, Janousek, Elias, & Bacha, 2007). The qualitative indicators in this thesis are sets of statements which provide a rich description of the broad characteristics of resilience in school communities. They combine understandings from the education for sustainability and social-ecological resilience fields and attempt to describe education for sustainability practices which build resilience. I explain what qualitative indicators are and their application in this study in detail in Chapter Three. Directly below I introduce the concept of resilience from a social-ecological perspective before discussing the rationale

behind exploring resilience through education for sustainability. A more complete understanding of resilience and its application at school community level evolves throughout the thesis. The last section of the chapter describes the research questions and approaches, the significance of the study, and then outlines the layout for the remainder of the thesis.

1.1 Preface to a social-ecological resilience perspective

In modern western thinking and practice there is a habitual separation of environment and society which has led to a misguided belief that ecosystem response to human use is linear, predictable and controllable (Folke, et al., 2002). Recent climate change events, however, indicate that management approaches that treat ecological and social systems as separate entities are failing to provide public security, and essential goods and services (such as water, fresh air and oil) and that these approaches reduce the ability of social and ecological systems to respond to change (Folke, et al., 2002; Krasny & Tidball, 2009). A case in point is the flooding of New Orleans which occurred when human engineered river embankments burst following Hurricane Katrina in 2005.

An alternative approach is a social-ecological systems perspective, which considers people and ecosystems are complex, dynamic, fluid, context specific, and unpredictable (Adger, 2000; Marshall & Marshall, 2007). Based on complex systems theory, social-ecological systems theory emphasises an integrated view of social and ecological systems. Humans depend on the capacity of ecosystems to provide essential goods and services such as water and oxygen, while ecosystems' ability to provide these depends largely on people acting sustainably. Therefore, in considering community level resilience to environmental changes, "delineation between social and natural systems is artificial and arbitrary" (Berkes, Colding, & Folke, 2003b, p. 3). A social-ecological framework provides me with a way of understanding social and ecological systems as synergistic and interdependent because what happens in one inevitably affects the other.

One point to consider is the applicability of the ecological concept of resilience to the social sciences. That the concept of resilience from the ecological sciences is readily

transferred to the social sciences can be contested. One of the first papers exploring links between social and ecological systems was published by Folke, Pritchard, Berkes, Colding and Svedin (1998). The paper raised many issues that have since been explored. A revised 2007 copy of the paper (Folke, Pritchard, Berkes, Colding, & Svedin, 2007), found that nearly ten years later most of the research on societal development, sustainable development and social futures still treats ecological and social systems as separate. Adger (2000) explores potential links between social and ecological resilience in resource dependent communities. He concludes that the attributes germane to ecological resilience (the capacity to cope with surprises and change) are precisely the same ones which enable innovation, coping with change and social learning in social institutions. Folke et al. (2007) argue that confronting the challenges brought about by global change requires an integrated view of social-ecological systems. This is important when considering a school's capacity to provide the skills, knowledge and understanding of students, staff and other in the school community to build capacity to manage change.

Social-ecological systems have three defining characteristics: resilience, adaptability, and transformability. Resilience is a system's ability to keep functioning while experiencing change or disturbance. A resilient system is able to absorb (expected and unexpected) disturbances without significantly changing its structure, function and identity (Walker, Anderies, Kinzig, & Ryan, 2006). Loss of resilience can lead to irreversible changes, vulnerabilities and reduced functional capacity (Adger, 2007). Adaptability is the ability to adapt to changing circumstances. A resilient system is adaptable, and is therefore able to respond to feedbacks from other systems in ways that help the system adjust to changing circumstances. In social-ecological systems, adaptability refers to the capacity of humans to manage resilience (Walker, Anderies, et al., 2006). Transformability is the ability to change to something completely different when the current system is untenable (Walker, et al., 2004; Walker & Salt, 2006).

The characteristics of social-ecological systems (resilience, adaptability and transformability) are underpinned by scale which refers to other systems operating at different temporal and spatial levels. Walker et al. (2004) point out the social component

of a social-ecological system consists of groups of people organised at multiple levels with differing views about what is and is not desirable and/or acceptable. In a school, what a single student does may be affected by other students; the teacher; the whole year level including teachers and students; the whole school community including parents; and the whole social-ecological system in which the school is embedded, which includes the social, economic, political and ecological context in which the school is nested. On a larger scale what the school does is affected by the local community; the education department; state governance; federal governance and the larger social-ecological system in which all the systems are embedded. People at the school community level are affected by internal forces within their own level as well as external forces at levels above and below. While staff and students in a school may be willing to move forward with local climate change initiatives or actions to improve local ecological conditions, the effectiveness and durability of their actions may be tenuous without support from levels above such as Education Queensland or below such as local community members.

Resilience theory is attentive to the multifaceted nature of social-ecological systems because as well as enabling a system to overcome change or disturbance, resilience fosters capacity to mitigate perturbations, self-organise, learn and adapt in ways that are constructive (Folke, et al., 2002). When further change takes place, “resilient systems contain the experience and the diversity of options needed for renewal and redevelopment” (Walker et al.2002, p. 23). A system that lacks resilience is less able to respond, and is more vulnerable to undesirable changes.

1.2 Why investigate resilience through education for sustainability?

Resilience has been studied in many contexts such as leadership (Folke, et al., 2005), sustainable development (Folke, et al., 2002; Perrings, 2006), management (Berkes, et al., 2003b), ecological systems (Gunderson & Holling, 2002), social-ecological systems (Berkes, et al., 2003b; Folke, 2006) and social systems (Adger, 2000; Adger, Kelly, Winkels, Quang Huy, & Locke, 2002; Marshall, 2006), but apart from Fazey et al. (2007), Krasny and Tidball (2009), Tidball and Krasny (2007), and Krasny, Tidball and Sriskandarajah (2009), resilience within an education context has received little

attention. The concept of resilience adds a new dimension to education for sustainability and has the potential to enhance adaptive capacity. Resilience incorporates the concept of change and response to change into the definition of sustainability which existing literature seems to omit (Krasny & Tidball, 2009). Change, whether rapid or gradual, is a normal function in social-ecological systems and, therefore, critical to sustainability (Walker & Salt, 2006). In this thesis I explore how combining the understandings from resilience theory with education for sustainability knowledges and practices can enhance overall learning outcomes. To date we do not know whether and to what extent the theoretical and practical ideas of the resilience concept are included in current whole-school approaches to education for sustainability. This research is a first attempt to investigate this.

This research takes place during a period of global instability and transformation. Volatility of world economies and powers, threats of terrorism, war and ecological disasters dominate the news, and the uncertainties of peak oil and climate change loom. Since I started this research three years ago, the focus within the education for sustainability field has shifted from biodiversity to climate change. A resilient system has the capacity to adapt to new circumstances, learn and develop. I argue that school education plays an important role in equipping students with the capacity to manage change in ways that will open, rather than limit, future sustainability options. Administering schools in ways that enhance resilience can help school communities build capacity to manage unanticipated future events. Knowledge and understanding of resilience can empower us to make informed choices and actions. I suggest resilience based school management enables administrators to make choices that will foster teaching and learning for adaptive capacity. The relationship between resilience and education for sustainability is explored in more detail in Chapter Two.

1.3 Research questions

This study is guided by the following overarching research question:

- What is the role of education for sustainability in fostering social-ecological resilience within school communities?

I investigate how education for sustainability is constructed in each of the four schools from a social-ecological resilience perspective and I identify strategies to effect resilience at school community level. A social-ecological resilience lens enables me to consider whether the way school members think about, organise and enact education for sustainability enhances resilience. I intentionally kept the research question broad for two reasons. First, education for sustainability and social-ecological resilience are both extensive subjects that expand across various scales (local, regional, national and global). I wanted to keep a wide perspective which would enable me to make wide-ranging cross-scale connections. Second, I make sense of the world through a systemic perspective. Systems thinking takes a big picture view by identifying connections and relationships between parts rather than solving problems through a linear cause and effect paradigm (ARIES2005a; Sterling, 2004). Flood (2001) explains "valid knowledge and meaningful understanding comes from building up whole pictures of phenomenon, not by breaking them into parts" (p. 133). A systems view helped me develop deep understanding of my research area and how to generate change that can work with, rather than against the current education system.

The research question gave rise to a number of sub-questions which helped orientate the research method. These are:

- What are the characteristics of schools that prioritise education for sustainability and how are they similar or different to the characteristics of approaches described in the social-ecological resilience literature?
- In what ways are each school's construction of governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships, and school ethos, similar or different to those described in the literature on social-ecological resilience? What are the implications for the schools' ability to build resilience?
- If a school models actions and undertakes explicit teaching and learning for sustainability, does that promote the ability of the school community to think and act in ways that foster resilience?

- If a school has a well developed whole-school approach to education for sustainability, does that mean school members are better able to manage and respond (adapt) to environmental threats such as climate change?

1.4 Research background, methodology and complexities

This research forms part of a larger research project sponsored by the Australian Government's Marine and Tropical Sciences Research Facility (MTSRF) – *Project 4.9.7: Understanding social resilience and identification of social resilience indicators for management* (Marine and Tropical Sciences Research Facility [MTSRF], 2006). The project takes an integrated cross-disciplinary approach and involves researchers from the social and biophysical sciences across two universities and the CSIRO, the national government body for scientific research in Australia. The research team was contracted to develop a set of indicators of social resilience that are generally applicable to linked social and ecological systems in north Queensland. The indicators are meant to be useful for monitoring and reporting the general social resilience of north Queensland communities. As a doctoral candidate I had the freedom to direct my own research as long as the study was directly relevant to the aims of the team's project. As my professional background is in education and my previous research experience is in school-based education for sustainability, I decided to investigate resilience within an education for sustainability context at the school community level.

To conduct the research I took a constructivist approach from the qualitative standpoint. Qualitative research is the most suitable approach when researching an area where little or no research has been attempted. Qualitative methods allow a researcher to 'dig deep' by asking who, what, why, when and how questions to illuminate phenomena (Kayrooz & Trevitt, 2005). Qualitative research is inductive, emergent and shaped by the researcher's experiences (Creswell, 2007). Qualitative researchers assume that research is not a linear, orderly and pre-determined process. Unexpected events form part of the research process and should be welcomed as opportunities to learn (Clark, 2004). In this work, I employ a constructivist approach to research. I understand knowledge and meaning as emergent, fluid, multiple and subjective and I develop new knowledge and

new understanding through interactions and occurrences (Creswell, 2007). I make sense of occurrences through textual descriptions. Although I developed a study purpose and design early on in my research, the approach was flexible enough to take advantage of emergent conditions.

Constructivists understand that knowledge is constructed and reconstructed through personal experience. People perceive the world in their own way and create their own meanings from events (Burr, 2003). In Schwandt's (1998, p. 237) words "constructivism means that human beings do not find or discover knowledge so much as construct or make it" and constructivist researchers "invent concepts, models, and schemes to make sense of experience". Researchers with a constructivist epistemology understand studied realities to be "social products of the actors, of interactions, and institutions" (Flick, 2006, p. 78). Patton (2002, p. 96) explains the foundational question a constructivist researcher asks is "how have the people in this setting constructed reality? What are their reported perceptions, 'truths,' explanations, beliefs, and world-view?" These are the questions upon which I constructed my research and the way I conceptualised the resultant indicators.

Qualitative researchers study how phenomena are constructed in people's everyday activities (Silverman, 2009). As per Astleithner et al. (2004) I understand indicators as social constructs embedded in place and time. By exploring how education for sustainability is constructed in the everyday life of each of my four case study schools, I investigate whether the constructions mirror or hold resilience characteristics. I study the consequences of the constructions from a social-ecological resilience perspective. The indicators I develop offer a starting point to consider whether and how education for sustainability may facilitate resilience. From a positivist perspective, indicators are transferable. I do not suggest my indicators are transferable to schools in other areas of Australia or the world because I understand context and identity is fluid. Each school has multiple and individual constructions of education for sustainability. For example, the principal, teachers, students, documents, all project individual understandings of education for sustainability. A positivist approach would attempt to eliminate multiple

representations. I, on the other hand, examine what the constructions are and how they are constructed, and then consider the consequences for fostering resilience. In considering complexities of quantitative and qualitative research, my main concern in this thesis is that my qualitative approach is consistent.

1.5 Prelude to the case study approach and methods

This thesis is an exploratory multi-site case study based in four Far North Queensland schools located between Edmonton, south of Cairns, and Cape Tribulation to the north (Figure 1.3). I apply a combination of qualitative participatory and narrative methods within the case study approach to research practice at the intersection of education, sustainability and socio-ecological resilience thinking. I explain the methods in detail in Chapter Three. Yin (2003) argues that exploratory case studies are useful when there is little existing knowledge about the case, when the literature provides no conceptual framework or hypotheses and when context is important to understand the case. Stake (1995) believes exploratory case studies are useful to maximise learning when time is limited.

Figure 1.3. Location of case study schools
(Explore Australia, 2008)

For Denscombe (2007) a case study approach is most suitable when investigating complex situations where "to understand one thing it is necessary to understand many others and, crucially, how the various parts are linked" (p. 36). Schools are complex systems composed of many different people (who themselves are individual complex systems): teachers, students, parents, auxiliary staff, administrators, and people from many intersecting organisations, who are interconnected through similar yet individual interests in education (which is the whole). What a teacher understands education to be may be the same, similar or completely different to what parents, and/or students want or expect from education. Yet all participate in an interconnected manner within the education system. A case study approach offered me more opportunities than other more

superficial approaches “of going into sufficient detail to unravel the complexities” of each school’s situation (Denscombe, 2007, p. 36). This approach enabled me to investigate particular instances of education for sustainability through various methods, to elucidate whether their characteristics enhance and/or promote thinking, learning and acting in ways that foster resilience. Although there are many separate studies of social-ecological resilience (for example, Berkes, et al., 2003b; Gunderson & Holling, 2002; Walker & Salt, 2006) and education for sustainability (Australian Government Department of the Environment, Water, Heritage and the Arts [DEWHA]2008; Henderson & Tilbury, 2004; Tilbury, Coleman, & Garlick, 2005), this is the first Australian study that combines the two fields. Sustainability and resilience are both context-dependent. Applying an exploratory case study within a qualitative approach enabled me to build context as well as a database of interviews, questionnaires, documents, archival records and direct observations from each school.

Data collection methods for this research involved naturally-occurring and manufactured data (Silverman, 2007). Naturally-occurring data is produced by itself and is found “in the field” (Silverman, 2007, p. 37). This includes, for example, documents, websites, and observations. Manufactured data is specifically designed by researchers in order to answer a research question. Examples of manufactured data in this research include interviews with school principals, volunteer teachers, groups of students, school sustainability reviews, and teacher questionnaires. Data analysis involved four stages and several sub-processes at each stage. In the first stage I apply five levels of qualitative analysis to the field texts from each of my case study schools in order to organise and synthesise the voluminous data I collected, as well as to identify themes, sub-themes and patterns. Each level involved different methods of data manipulation as suggested by Miles and Huberman (1994), Strauss (1987), Dey (1993), and Creswell (2007), and includes putting information into different arrays, making a matrix of categories and placing the evidence within such categories, and putting information in chronological order.

The second stage of analysis involves building the field texts into four full narratives. Each narrative represents how education for sustainability is constructed in one particular case study school. Richardson (1990) explains that narrative is a mode of reasoning and a mode of representation. Narrative provides a method for organising an event/action or series of events/actions into a chronologically, holistic and meaningful episode (Chase, 2005; Czarniawska, 2004a; Polkinghorne, 1995). Narrative method offered me a way to organise, make sense of and present a voluminous and disorderly collection of data. More detail about the narrative method and its application in this research is provided in Chapter Three.

In the third stage of data analysis I apply a four-step process to analyse the narratives for characteristics of education for sustainability. This required reading the narratives through and noting each instance which reflected each of the characteristics of the Australian Government's (2005) *Framework for Environmental Education for Sustainability* (DEH2005). These are governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships, and school ethos. In the fourth and final stage of the analysis I derive and present a set of qualitative indicators which infer education for sustainability informed by social-ecological resilience theory. Stages One and Two analyse the field texts collected from each case separately, while stage three and four involve cross-case analysis to identify themes.

1.6 Significance of the study

So far in this chapter I have hinted at the significance of this study. If, as discussed above, we consider that (a) resilience provides adaptive capacity for change, (b) education for sustainability plays an important role in building capacity for sustainability, and (c) resilience is necessary for long-term sustainability, then a strong argument emerges for the importance of investigating whether, and to what extent, education for sustainability fosters resilience. To date no research in Australia, and only a few emergent studies elsewhere, have investigated resilience within the education context. Given resilience is considered essential for long-term sustainability (Adger,

2007; Folke, et al., 2002; Walker & Salt, 2006) and education is heralded as a major strategy for developing skills, knowledge and values to promote sustainability (Fien & Tilbury, 2002; DETA2006b; United Nations Economic and Social Council, 2008), it is important to investigate whether and to what extent education for sustainability fosters resilience.

This study has implications for individuals, groups, schools and programs concerned with education for sustainability. Environmental changes worldwide are causing instability of social-ecological systems and affecting their long-term sustainability. Education for sustainability is one way to engage and equip people for change towards sustainability (see ARIES2009). However, little is known about how people respond to change, or how society reorganises following change (Folke, et al., 2002). I argue that social-ecological resilience theory offers insights about change and response to change which can enhance current education for sustainability outcomes. The results of this study enhance current understandings of education for sustainability and contribute to the development of initiatives which teach people to take advantage of change in ways that enhance future options.

1.7 Organisation of the thesis

My research predominantly concerns two areas: education for sustainability, which combines understandings from the sustainability and education fields, and social-ecological resilience which has emerged from ecology. In Chapter Two I describe and develop understanding about the two sets of literature and pose possibilities for how the two combine to form new understandings. This sets the background for the findings that emerge from the research.

Chapter Three explains the methodology and methods. I explain why and how I apply a combination of participatory and narrative methods within a case study research approach to investigate ways that resilience can be enhanced or eroded in four Far North Queensland school communities that prioritise education for sustainability. I also

describe the process for the development of the qualitative indicators which I present and discuss in Chapter Five.

Chapter Four presents the stories of the four schools in my study in a narrative style. The stories were constructed by me in consultation with the research participant teachers and principals. Each story narrates one school's learning journey and is compiled from my field texts.

Chapter Five builds on the stories presented in Chapter Four to develop a framework of qualitative indicators based on the four narratives and supported by other data I collected. In line with this study's intent to explore the interrelationship between education for sustainability and social-ecological systems resilience in schools, I develop a set of indicators of education for sustainability informed by social-ecological resilience theory. I also discuss the findings that emerged through development of the indicators.

Chapter Six concludes the thesis. I engage in a general discussion of the findings, discuss the limitations of the thesis, and provide conclusions and reflections as well as possible avenues to further advances in learning.

Conclusion

There is now a multitude of evidence that the way we currently live is not sustainable. Regardless of increasing warnings from the scientific community we continue to put unsustainable stress on critical ecosystem resources such as clean water and fresh air, seemingly without consideration to the ability of ecosystems to continue to sustain future generations (Millenium Ecosystem Assessment, 2005). That the Earth is changing is also indisputable – icecaps are melting, temperatures are rising. However, scientists are not yet sure what the implications of the changes will be for future generations. What is known is that societies at all levels are going to have to respond to changes.

Education for sustainability has been put forth as one way to work towards establishing a sustainable future. The concept has developed considerably over the last thirty or forty

years. The ecologically-based resilience concept offers a new dimension to sustainability which can build capacity to respond to change. I do not suggest that education for sustainability needs to be replaced; rather that the integration of resilience thinking concepts into education for sustainability has the capacity to strengthen long-term outcomes. However, we do not know if or to what extent education for sustainability already incorporates resilience concepts.

In this first chapter I have positioned my research at the intersection of education for sustainability and social-ecological resilience to investigate whether the way education for sustainability is constructed in four schools (known to prioritise education for sustainability) fosters social-ecological resilience. I argue resilience is an important aspect of sustainability; therefore, there is a need to ensure resilience concepts are included in education for sustainability initiatives.

Chapter 2. Social-ecological systems, resilience and education for sustainability

Introduction

The concept of resilience can be applied in many different contexts because, as Carpenter and Brock (2008, Introduction section, para 2) point out, "Resilience is a broad, multifaceted, and loosely organised cluster of concepts, each one related to some aspect of the interplay of transformation and persistence". Resilience offers a means of thinking about and acting for sustainability because sustaining our ecological, social, and economic systems into the future involves adapting to new and unpredictable circumstances and challenges (Adger, 2007; Berkes, et al., 2003b). Because this thesis is about social-ecological resilience through education for sustainability in schools, the relevant literature extends across the ecological, sustainability and education disciplines. In this chapter I conflate various readings to provide a broad enough understanding to interpret the remainder of the research.

I begin the chapter by reviewing the broader concept of social-ecological systems, and then provide an explanation of the properties which promote resilience. In the next part of the chapter I review literature on sustainability, sustainable development and the relationship to resilience. This leads to a discussion on the history and development of environmental education and education for sustainability and how education may contribute to resilience and sustainability. In the final section I discuss emergent research linking resilience and education for sustainability, then consider and compare various approaches to education for sustainability which parallel social-ecological resilience theory and research.

2.1 Social-ecological systems

Disciplinary knowledges have traditionally considered people and ecosystems as separate entities. More recent understandings make it obvious the two are irretrievably linked. We depend on ecosystems to meet basic needs such as water, oxygen and fresh food, and ecosystems' ability to provide these goods depends on humans acting

sustainably. History provides many instances where ecosystems have ceased to provide goods and services due to the unsustainable actions of humans (see for example, Diamond, 2005). For example, the poisoning of waterways in China due to overuse of chemical fertilisers has made some of the country's water systems untenable for human use (The Worldwatch Institute, 2006). In Australia, broad-scale land clearing and introduction of foreign species to terrestrial and aquatic systems has destroyed native systems and severely incapacitated ecosystem health (Low, 2001). In Far North Queensland, local ecosystems appear to still be relatively healthy (Wet Tropics Management Authority, 2007). Adopting a social-ecological system perspective can help prevent regime shifts (rapid changes which occur when a system crosses a threshold and adopts a profoundly different structure, function and feedback loops) (Kinzig et al.2006; Walker & Salt, 2006).

Social-ecological systems theory is predicated on a complex systems view of the world. A complex system is one that has multiple interconnected parts which interact to operate as a whole. A human is a complex system because the body contains many interconnected parts such as the brain, heart and lungs which interrelate to function as a whole person. From a systems viewpoint, the world is a large complex structure that contains many interacting complex subsystems such as social, economic and ecological systems (Clayton & Radcliffe, 1996). Each subsystem is a whole nested within larger systems of various scales, whose specific structure derives from the interactions and interdependence of its parts (Capra, 1983). The Great Barrier Reef is a complex ecological system, nested within a region, state, country, world and universe, whose health and sustainability depends on its interactions with other systems such as humans (sustainable or unsustainable human actions), weather and climate systems. There are many different types of complex systems. My interest in this research lies with complex adaptive systems which include social-ecological systems. Social-ecological systems can be explained by a number of descriptive characteristics. These are: complex adaptive systems, the adaptive cycle, scales and panarchy, and resilience (Walker, Gunderson et al.2006). I explain each of these in turn.

Complex adaptive systems

Complex adaptive systems are particular types of complex systems. A system can be considered complex when it contains many different interconnected parts. A complex adaptive system is additionally dynamic, unpredictable, non-linear, flexible and self-organising. A way to understand this is by comparing an engine and a person. A mechanical system such as an engine can be very complex because it has many different types of parts that connect to each other; however, the parts act and respond in a linear and predictable manner which does not evolve over time. So, A leads to B which then may lead to either C or D. If there is a functional breakdown and B does not lead to C or D then the engine is not able to find alternative pathways and stops working. A person, on the other hand, is a different matter. While we can speculate how a person may act in a certain situation, self-organisation enables independent thoughts and actions which make people unpredictable.

A school community is a complex adaptive social-ecological system. A school system is comprised of a community of people, themselves complex adaptive systems, who interact daily or regularly in order to educate children from pre-school to Year Twelve. This includes the whole school community comprised of teachers, students, parents, as well as the whole social-ecological system in which the school is embedded and consists of the social, economic, political and ecological context in which the school is nested. Although each school community is individual, all are dynamic and respond in non-linear and unpredictable ways to change in response to feedback loops.

Feedback loops are secondary effects which magnify primary effects. Change in one part of the system produces a string of effects that eventually loop back to once again affect the original part. For instance, scientists predict feedback loops from Antarctic ice melt will exacerbate climate change because water absorbs more of the sun's heat than ice. The increased water temperature caused by the extra absorption of the sun's energy will make Arctic waters even warmer, and in turn melt more ice and further increase the amount of water absorbing the sun's energy (Homer-Dixon, 2006). When more radiation is absorbed into the Earth's system rather than reflected away from the Earth, this further contributes to global warming.

Strength of feedbacks is important. Tight feedbacks allow early identification of thresholds; loose feedbacks lead to delayed signals. According to Walker and Salt (2006) globalisation is causing delayed feedbacks. For example, people in the developed world receive weak feedback signals regarding the consequences of their consumption of developing world products. Understanding change in complex systems is fundamental to understanding life on Earth because all living things are embedded within life cycles which navigate through different phases. The adaptive cycle (Figure 2.1) is a popular metaphor for understanding change through a series of recurring cycles and can be applied to complex adaptive systems (Holling & Gunderson, 2002).

Adaptive cycle

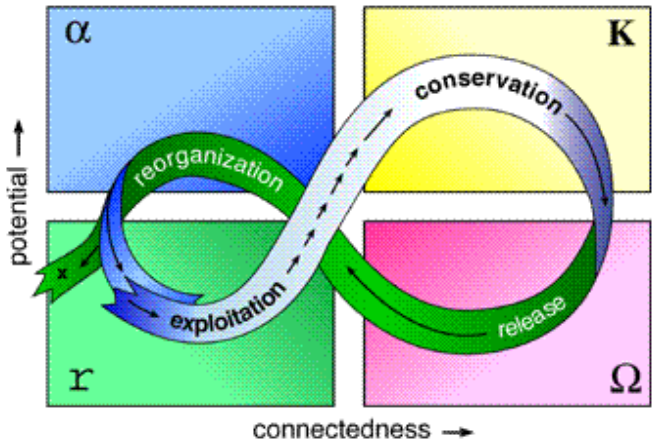

Figure 2.1. Model of the adaptive cycle
(Holling & Gunderson, 2002)

The adaptive cycle explains system behaviour over time and comprises four recurring stages: r (rapid growth), k (conservation), omega (release) and alpha (reorganisation). Time flow and resilience fluctuate in the adaptive cycle. The arrows in Figure 2.1 show variations in time flow in the cycle. Short arrows during the fore loop indicate slow change while long arrows indicate fast change. The Y axis represents stored potential of accumulated resources and the X axis represents the degree of connectedness among controlling variables (Holling & Gunderson, 2002; Walker & Salt, 2006). Systems with low levels of connectedness are readily affected by outside forces. Phases in the adaptive

cycle are discreet and have many possible variations. For example, the rapid growth phase usually leads to a conservation stage but can also move directly to a release phase. While the conservation phase usually proceeds a release phase, it can shift back to a growth phase (Holling & Gunderson, 2002; Walker & Salt, 2006).

The r phase is a period of rapid growth and gain when new opportunities and resources are ‘up for grabs’. Systems with adaptive capacity prosper during this phase which is characterised by short time frames, high environmental variation and uncertainty (Holling & Gunderson, 2002; Walker & Salt, 2006). I consider an ecological example of the r phase is the current rapidly melting ice caps in Antarctica. A social example of the r phase is when entrepreneurs grasp opportunities to start up or expand businesses. We have all heard about people that have become millionaires on the back of a property boom. Managers who take up adaptive management approaches do well in the exploitation stage because they are able to influence or manage resilience.

Transition from the r phase to the k phase is incremental. The k phase, known as the conservation phase, is a capital building phase marked by slow accumulation during longer time frames. Opportunities for growth slowly diminish and, although competition is still high, emphasis shifts from exploitation to conservation and opportunities for specialisation. Innovations are excluded and in an ecosystem, dominant species predominate by the end of the k phase. Capital is built through accumulating biomass and nutrients. In social systems, capital accumulation focuses on skills, increased knowledge, greater and more stable networks and higher levels of trust (Holling & Gunderson, 2002; Walker & Salt, 2006).

Transition from the conservation to omega phase can be unexpected, occur very fast, and is caused by disturbance that exceeds the resilience of a system. The omega phase is known as the release phase which can also be seen as a period of “creative destruction” (Schumpeter, as cited in Holling & Gunderson, 2002, p. 34). Collapse releases resources for new growth. Uncertainty is prevalent during this phase. System disturbance leads to the release of accumulated resources which clears the path for creative opportunities to emerge (Holling & Gunderson, 2002; Walker & Salt, 2006). An ecological example of

the omega phase is a forest fire which releases new growth. A social example is the death of Franco (Spanish Head of State from 1947 to 1975) in 1975 which lead to the collapse of his authoritarian regime and the establishment of a democratic government. Contemporary examples are provided by scientists such as Tim Flannery (2008), who publicly warn that our climate system is nearing a threshold which, if crossed, will result in very rapid, uncontrollable and undesirable changes to our planetary systems.

Transition from the omega to the alpha phase, also known as the reorganisation phase, is quick. The alpha phase is a period of renewal, reorganisation and optimism. Anything is possible and novelty can flourish as opportunities arise for innovation, experimentation and restructuring. However, there are no guarantees. This period can lead to a return to a 'business as usual' cycle if new opportunities are not grasped. In ecological systems, the alpha stage is evident when dormant seeds germinate after a forest fire (Holling & Gunderson, 2002; Walker & Salt, 2006). An example of the alpha phase in a social system is when a person re-evaluates future choices after a traumatic event. A current example of the alpha phase is the state of global financial markets. While the financial situation is causing many difficulties for people around the world, it does provide an opportunity to restructure to create more robust systems. If this opportunity is ignored the financial system will return to business as usual.

The alpha phase is important to the concept of resilience. If renewal or reorganisation options are not taken up, then the system fails to build resilience. If the original system was deficient or untenable to start with and emerging opportunities for change are not taken up then the system can repeat another undesired cycle. The current ecological state of the planet provides a way of understanding this point. Two options for managing the climate emergency and peak oil crises are (a) we do nothing and live with the consequences – whatever these may be, or (b) we take actions to mitigate the impacts, learn and develop from the experience, and as a consequence, build resilience.

Scales and panarchy

Central to understanding adaptive cycles is the concept of scale and that of panarchy. Complex systems cannot be understood in isolation because they do not consist of only

one kind of cycle at one level of scale, but exist within a range of hierarchical, spatial and temporal scales linked to influencing systems operating at different scales (Walker, et al., 2002; Walker, Gunderson, et al., 2006). Scale refers to system changes brought about by a combination of internal and external influences on that system from other systems operating at the same and/or different levels. Panarchy refers to the links across the scales (Gunderson & Holling, 2002). The term originated from the Greek god Pan "to capture an image of unpredictable change and upon notions of hierarchies across scales to represent structures that sustain experiments, test results and allow adaptive evolution" (Holling, Gunderson, & Ludwig, 2002, p. 5). Understanding cross-scale influences (panarchy) is important for gaining insights into how a system works because the resilience of a system can often depend on influences at scales above and below (Walker, et al., 2004).

A common mistake is to attempt to solve problems by focusing solely on the particular scale of interest (Walker & Salt, 2006). As mentioned in Chapter One, schools may be considered to be unique and independent units; but, in reality, all schools are intricately linked to other systems of varying scales. What schools do and how they do what they do is heavily directed by education department policy and regulations at scales above, and by the local community characteristics, needs and desires at the scale below. Schools are social systems nested within other social systems (local community and institutional systems), ecological systems (local, national and global ecological systems), economical systems (state and federal government education fiscal policies) and political systems (educational policies from state and federal education departments and ministries). What happens at state, national and international levels feeds back to school communities. For example, at the moment the implementation of education for sustainability is only compulsory in New South Wales schools. However, if other Australian state and territory education departments mandate education for sustainability then every school will need to engage with the social, economic, political and ecological elements of education for sustainability.

A school may act on climate change issues by, for instance, modelling actions as well as explicit teaching and learning that promotes student thinking and actions that foster resilience. This may take place at the scale of an individual student, a group of students, a class of students and their teacher, several classrooms, the whole school, or the whole social-ecological system. The level of achievement, however, is influenced (although not determined) by other scales. If education policies support climate change education, the education department may release funds and support that enable schools to implement effective initiatives. If the local school community supports school-based climate change initiatives, they may support the school by providing physical and monetary help which will help achieve better outcomes.

Resilience

Resilience is a dimension of the adaptive cycle which expands and contracts throughout the cycle (see Figure 2.2). Resilience shrinks as the cycle moves towards the conservation stage and expands with movement towards the release and reorganisation stages (Holling & Gunderson, 2002).

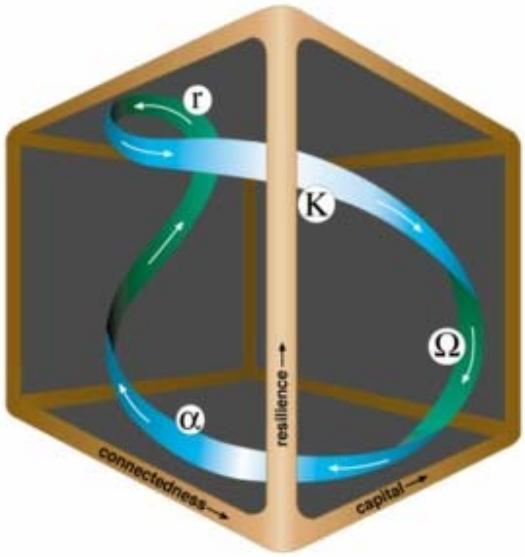

Figure 2.2. Model of the adaptive cycle with the resilience element added (Gunderson & Holling, 2002).

The resilience concept was originally published by Holling in 1973, in the *Annual Review of Ecology and Systematics*. The concept has subsequently been applied to social systems, ecological systems and more recently, social-ecological systems. Resilience is informed by complex systems theory – an interdisciplinary problem-solving approach which provides a multidimensional understanding of the world based on relationships, feedbacks and integration (Walker & Salt, 2006). A resilient system is able to withstand (expected or unexpected) change and still retain the same basic structure and features while simultaneously adapting to changing circumstances. In cases where adaptation is not possible, a resilient system is able to transform to another way of being (Carpenter, Walker, Anderies, & Abel, 2001). Such a transformation is enabled through a number of characteristics discussed in the next section.

Social systems have inherited what Sterling (2004) calls a 'thinking legacy' based on fragmented, analytic and linear thinking. Traditional problem solving methods assume change is linear and simplify issues by breaking them down into separate components and analysing each in isolation. The assumption is that "if we know everything about the parts, we will understand the whole" (Hjorth & Bagheri, 2006, p. 2). Problems emerge because "We don't always see the connections between things, how 'this' relates to 'that', or recognise that there might be other consequences to our actions than those we intended" (Sterling, 2004, p. 80). Sterling (2004) argues that when faced with rapid, complex and uncertain change, traditional thinking approaches are inadequate. Interactions which can provide deeper understanding and more effective solutions can be missed. Resilience thinking provides a more comprehensive approach by recognising that (a) Earth systems are interconnected, complex and adaptive and (b) change is irregular (Walker & Salt, 2006).

One important aspect of resilience so far not considered in this thesis is maladaptive resilience. Walker and Salt (2006) forward that resilience in and of itself is not necessarily desirable. A system can be trapped in a highly resilient state which, at the same time, is very undesirable. Examples include salinized landscapes such as the Murray-Darling Basin in Australia, depleted fisheries like the Canadian Atlantic

fisheries and political systems such as the communist regimes in Russia and China. In these cases systems are sustainable but maladaptive (Gunderson & Holling, 2002). The systems are sufficiently resilient to resist external influences and efforts which may enable transition to a more desirable state.

Resilient social-ecological systems are sustainable in the face of change (Krasny & Tidball, 2009). Loss of resilience leads to vulnerability. When systems are vulnerable, small changes can have big, and possibly devastating, impacts (Folke, et al., 2002; Hjorth & Bagheri, 2006). People often attempt to maintain stability by purposely either avoiding or controlling change. However, because change is inherent in all social-ecological systems, these traditional approaches may actually erode resilience and long-term sustainability (Folke, et al., 2002; Walker & Salt, 2006). A more effective approach is to manage with intent for resilience by learning to manage change. The concept of resilience embraces change as opportunity for innovation, creativity and renewal (Folke, et al., 2002). Managing with a resilience intent supports and enables social-ecological systems to adapt. Adaptability enhances long-term system sustainability because more resilient systems can absorb larger shocks before shifting to a different state (Folke, et al., 2002). Managing for resilience increases the likelihood of sustaining development in a constantly changing world where surprise and instability are likely (Folke, et al., 2002).

Scholars are working on extending current understanding of resilience dynamics (see for example, Walker & Salt, 2006; Walker et al., 2006; the Resilience Alliance, 2009). Knowledge of resilience is important because it can enhance adaptation skills. Although this work is still developing, there are a number of emergent properties of resilient systems relevant to this research which I now discuss.

2.2 Resilience properties

Diversity

Diversity concerns variety in species, people, and institutions existing within a social-ecological system (Walker & Salt, 2006). Diversity is important because it can provide

multifarious responses to problems and enhance future options. In social-ecological systems it is theorised there are two types of diversity: functional diversity and response diversity. Functional diversity enhances performance and leads to productivity; response diversity increases adaptive capacity and builds resilience (Walker, Gunderson, et al., 2006; Walker & Salt, 2006). A system has high functional diversity if members belonging to the system can perform different functions (Walker & Salt, 2006). In an ecological system with high functional diversity, one group of species fixes nitrogen, another breaks down waste, and yet another controls population. A social system with high functional diversity is supported by people who can contribute a variety of skills and experiences (Walker et al., 2006).

Response diversity refers to variability in responses. Response diversity is enhanced when members of a system can contribute a diverse number of solutions to overcome disturbance (Elmpvist et al.2003; Walker, Gunderson, et al., 2006). Elmqvist et al. (2003) study the role of response diversity in terrestrial and aquatic ecosystems affected by disturbance and human-induced environmental change. They find a diverse group of abundant species which can provide a wide variety of responses to disturbance will absorb disturbance events and increase resilience. Systems with high response diversity accumulate a repertoire of skills, history and experiences, which build adaptive capacity (Folke, et al., 2002). In a social context, diverse memories can provide response diversity. Individual memories provide accumulated experiences and history which enhance self-organisation and resilience (Berkes, Colding & Folke, 2003). In a school, a group of experienced teachers faced with adversity possess a diverse set of teaching memories and experiences that together can overcome problems.

Self-organisation

Self-organisation is the degree to which a system can re-organise after disturbance (Elmpvist, et al., 2003; Folke, et al., 2002). Self-organising systems have high levels of adaptive capacity and are able to reconfigure themselves when disturbed without significantly affecting the system's structure or function (Folke, et al., 2005). When a system has low resilience, self-organisation is difficult, or impossible. The more resilient a system, the higher level of self-organisation and the less the intervention required.

Adaptability

Resilient social-ecological systems are adaptable (Gunderson & Holling, 2002). Adaptability can be anticipatory or reactive and enables social-ecological systems to cope with novel situations (Folke, et al., 2002; Smit, Burton, Klein, & Wandel, 2000; Smit & Wandel, 2006). From a social perspective, the degree to which a group of people takes preventative adaptive action can be taken as an indication of their capacity to be resilient (Nelson, Adger, Brown, 2007).

Adaptation by itself, according to Fazey et al. (2007), does not necessarily promote resilience. They distinguish between two types of adaptation: adaptation by buffering and adaptation which addresses the root cause of the problem. Adaptation by buffering works against building resilience because "it tends to disconnect people from their environment and reduces opportunities for learning about the consequences of their activities. It also tends to result in the reinforcement of problems" (Fazey et al., 2007, p. 379). One example of adaptation by buffering is installing more air conditioners to manage the impact of rising temperatures due to climate change. This response is maladaptive because it does not stop temperatures rising and increases longer-term energy consumption. Positive adaptation, on the other hand, would find solutions to reduce temperatures long-term, for instance, by building designs that encourage airflow.

Schools can increase local level resilience and help communities prepare for uncertain futures by building anticipatory adaptive capacity. This requires flexible school management and learning systems that promote broad awareness, recognition and knowledge of sustainability and its implications (Fazey, et al., 2007). In light of current information on climate change, schools may decide to take anticipatory adaptation measures to strengthen and help their local communities cope more effectively with environmental changes. Initiatives can include actions which lower the community's ecological footprint and/or create alternatives. For example, composting, recycling, installing compact fluorescent light bulbs, sourcing local products, and encouraging school members to walk and cycle to school rather than drive. Being adaptable means that we can reorganise the way we think and do things in accord with new information.

A resilient system has the adaptive capacity to intentionally move thresholds or steer the system away from or towards a threshold (Walker & Salt, 2006). Thresholds are crossing points, like doorways, often unseen and unexpected, that can significantly change the future (Walker & Salt, 2006). When a threshold is crossed the whole system shifts to a new way of being. This is known as a regime shift (Kinzig, et al., 2006). Thresholds are not always avoidable. If this is the case, a resilient system is adaptable enough to take advantage of new situations brought about by disturbance. Once a threshold is crossed, a resilient system is able to recover from the shock and adapt to new, possibly completely different, circumstances by transforming its structure and way of functioning (Folke, 2006; Smit & Wandel, 2006). Communities acting on climate change are building resilience when they actively help steer their system away from the climate change threshold. This means those communities will be able to tolerate more disturbance before being subjected to crossing a threshold.

Transformability

Transformability is the capacity to create a new system when the existing ecological, economic, political or social system becomes untenable (Folke, et al., 2005; Walker, et al., 2004; Walker & Salt, 2006). Transformation changes the original structure and function of a system so that new possibilities are introduced or allowed to emerge (Walker, et al., 2004). A resilient system faced with a threshold change is able to reorganise and renew itself in creative ways (Gunderson & Holling, 2002). A person who changes vocation because the current position is undesirable or untenable demonstrates resilience through transformability because he/she has the capacity to transform when the current system is unsustainable (Marshall & Marshall, 2007). In a social sense, transformability reflects a community's capacity to create new opportunities and reorganise itself (Wolfenden et al.2007). A community reliant on coal mining revenues, when the coal industry is shut down, will be able to create other investment and job opportunities. Schools may influence a community's capacity for transformation by helping students develop the kinds of skills and knowledge necessary for managing threshold changes.

Social capital

Social capital is another cross disciplinary and multidimensional term that does not have a universally agreed upon definition (Grootaert & Van Bastelaer, 2002; Lin, Cook, & Burt, 2001). Social capital theory was first introduced at the beginning of the 20th century but only began to gain recognition later on through the work of Bourdieu (1986), Coleman (1988) and Putnam (1995; 2000). Social capital can be understood as a set of shared social norms, networks and trust within a society's institutions, relationships and customs which facilitate collaboration and thereby increase productive output (Putnam, Leonardi, & Nanetti, 1993; World Bank, 2009). If we consider resilience as one possible and productive outcome, we can begin to investigate the ways in which social capital processes and characteristics can enable adaptation. The following paragraphs describe characteristics that pertain to social capital.

Social norms

A social norms is defined as a set of unwritten but commonly understood principles about a community's valued forms of behaviour which act as a type of social control (Onyx & Bullen, 2000; Productivity Commission, 2003). Individuals apply social norms to their own behaviour to fit in with community expectations (Pretty, 2003; Pretty & Ward, 2001). Social norms are specific to communities (Productivity Commission, 2003), but generally facilitate communication and make exchanges between strangers possible (Hechter & Opp, 2001). In schools, social norms are formal and informal. Formal norms are school and classroom behaviour management plans/rules which outline expected student behaviour and consequences. Informal norms are general sets of unwritten expectations which teachers regard as proper and correct at school. The formal and informal sets of school norms may be reproduced to support learning and prepare students for successful participation outside school.

Networks

Networks are important for social capital (Productivity Commission, 2003). Networks are both formal and informal community interactions and are essential because social capital is accumulated through collective action (Black, 2008). Strong, diverse, flexible

and inclusive networks based on trust produce productive social organisations (Flora, 1995; Uphoff & Wijayaratna, 2000). Networks can be either vertical or horizontal (Putnam, et al., 1993). Vertical networks are “patron-client” (Putnam, Leonardi & Nanetti, p. 174) type of relations which are convened out of necessity. Typically, members of vertical networks have unequal status and power relationships. Examples are relationships between police officers and community members or teachers and students. Horizontal networks are voluntary and comprise people with equal status and power which Putnam, Leonardi and Nanetti (1993) call “networks of civic engagement” (p. 173). Examples of horizontal networks are volunteer and neighbourhood associations such as the RSPCA, Neighbourhood Watch, and sporting clubs.

In schools, networks can take many forms and serve a range of purposes (Black, 2008). Jackson and Burns (2005) suggest four broad network types:

(a) Geographically based and relatively permanent networks of schools that work together to benefit local young people;
(b) Strategic and temporary organisational networks of schools that come together for a specific time and purpose;
(c) Rational and relatively permanent specialist networks which involve people bound by shared specialist or subject-related goals; and
(d) Informal and idiosyncratic networks which are casual and created to provide reciprocal support or knowledge-sharing.

Schools are nested within both horizontal and vertical networks within wider communities and regions and are subject to operating within an organisational structure with multiple levels. My experience is that school networks work well when trust develops between network members.

Trust

Trust is an important social capital component as trust facilitates collaboration and productive activity (Halpern, 2005; Pretty & Ward, 2001). Lack of trust in others makes

cooperation and functioning within our every day communities and networks difficult. Trust involves willingness to take risks in a social context based on a sense of confidence that the trusted person will respond in an equally supportive way and that they will not try to harm us in return (Hoy, Gage, & Tarter, 2006; Onyx & Bullen, 2000). Trust is evident when people are willing to take social risks such as trusting that people will act according to their word and that their actions will be mindful of others' welfare, social norms and rules (Black & Hughes, 2001; Leonard & Onyx, 2004). Trust is not instantaneous and takes time to build, usually as a result of regular displays of honest and cooperative actions. Trust is easily broken (Tschannen-Moran & Hoy, 2000). According to Pretty and Ward (2001) there are two types of trust: the trust we have in people we know; and the trust we have in those we do not know, but which arises from our confidence in a known social structure. Both are necessary for building networks to enhance resilience.

Trust in school education is initially an example of trust of a known social structure in that parents entrust their children to schools every day, having faith the school system will teach, guide, counsel and protect their children (Tschannen-Moran & Hoy, 2000). Trust is important in education because much of what students learn is based on verbal and written statements from teachers which learners are expected to believe without extensive proof (Tooth, 2005). Trusting relationships are essential for principals wanting to create deep change (Sebring & Bryk, 2000; Zimmerman, 2006) and are necessary to develop a supportive school culture (see Goddard, Tschannen-Moran, & Hoy, 2001; Hoy, et al., 2006). Trust is also linked to improved student achievements (Leonard & Onyx, 2004; Putnam, 2000). Research by Sebring and Bryk (2000) finds schools that share high levels of trust among all members achieve higher academic outcomes than schools where teachers and principals do not trust each other.

Social ties

In schools, social capital operates in two forms known as "bonding ties" and "bridging ties" (Leonard & Onyx, 2004; Putnam, 2000). Bonding social capital is personified by strong, close and localised ties, norms and trust and can be exclusive in nature.

Examples are religious groups, ethnic social groups, local community groups. Ties in bridging social capital are weaker but broader because the bond extends to more people. School members do have bonding groups. Teachers form strong bonding relationships with other like-minded teachers. The relationships are characterised by reciprocity and trust, resulting in sharing of work loads and more fruitful experiences. Bridging social capital in schools is evident in large, loose networks that extend outward to include students, parents, community members and other people involved in school education. Conditions in bridging social capital need to be more explicitly set out than in bonding social capital. Hence the need in schools for explicitly set out behaviour rules.

Social capital facilitates managing for resilience towards long-term sustainability. Components such as trust, networks, and memories of shared experiences and/or past events – known as social memory (Folke, Colding & Berkes, 2003) – build connections which increase resilience and hence adaptive capacity for sustainability (Folke, 2006; Folke, Colding, & Berkes, 2003; Folke, et al., 2005; Wolfenden, et al., 2007). Diverse community networks and partnerships tend to create greater opportunities for members to share ideas and adopt new practices which can lead people to develop and prosper (Wolfenden et al, 2007). During times of rapid change when events can be chaotic, informal social networks can also provide space for novelty and innovation and further enhance flexibility (Folke, et al., 2005). Stresses are distributed and more easily absorbed and overcome (Wolfenden, et al., 2007). So, what is the role of memory?

Memory

Memory includes written and oral accounts and stories of events. Memory is an important element of resilience because it provides a portfolio of past experiences of change and adaptation which can be used to inform present and future actions (Folke, et al., 2003; Kofinas & Chapin III, 2009). According to Folke (2002) and Folke, Colding and Berkes (2003) social-ecological systems that lack a diversity of memories are more vulnerable to change and surprise and can have lower adaptive capacity. Memory captures accumulated history, experiences and understanding of change and adaptation of a system (Berkes & Folke, 1992; Folke, et al., 2005; Hahn, Schultz, Folke, & Olsson, 2008). In the context of climate change, memory provides a history of past climate

events and social responses to the events, including successful adaptations (Berkes, Colding, & Folke, 2003a).

Berkes, Colding and Folke (2003) identify three types of memories in social-ecological systems. These are ecological, social and institutional. Ecological memory is described as "the composition and distribution of organisms and their interactions in space and time, and includes the life-history experience with environmental fluctuations" (Berkes, Colding & Folke, 2003, p. 363). Of interest to this thesis are social and institutional memories. Social memory incorporates a diverse set of individual personal memories from people with different and overlapping roles. A collective social memory is drawn from an array of diverse backgrounds, practices, knowledges, cultural values, and worldviews. Institutional memory refers to the accumulation of a diverse set of institutional management practices. The combination of social and institutional memories provides potential for building resilience (Folke, et al., 2003).

School systems contain a combination of social, ecological and institutional memories. The memories can lie within documents, teachers, administrators and/or local community members. A resilience-building approach incorporating creativity enables the memories to be released and applied to inform current and future trajectories.

Creativity

Creativity is the ability to find innovative solutions to problems (Berkes, et al., 2003a). Creativity is a characteristic of resilient social systems and can help build adaptive capacity (Folke, et al., 2005). The ability to provide creative responses prior to or following change leads to renewal, reorganisation and/or transformation because the creative process generates new ideas and concepts. When people are creative they are forced to think rather than passively comply. One way to increase anticipatory adaptive capacity is to think creatively about the future and map out possible scenarios within particular contexts (Gooch & Warburton, 2009). Creative teams can mobilise social capital and social memory to initiate new forms of governance systems with the capacity to manage dynamic systems and landscapes (Folke, et al., 2005).

It can be argued creativity enables communities to reach higher levels of long-term resilience. In the emergency management context, Maguire and Hagan (2007) explain how a severe disaster may cause disarray in a community and leave survivors too fearful or disorganised to attend school. A more resilient community may provide support for teachers and students so normal functioning can resume quickly. A creative community may learn from the experience and teach its members how to better prepare for future disasters so that higher levels of post-disaster resilience are attained. Thus, a community that not only responds, but learns from adverse experiences reaches a higher level of functioning which leads to heightened resilience (Kimhi & Shamai, 2004).

To this point I have discussed current understandings of change and resilience to change from a social-ecological perspective. I now widen the discussion to the broader concepts of sustainability and sustainable development. The following section provides context for the last part of the chapter where I discuss the relationships between resilience, sustainability and education.

2.3 Sustainability, sustainable development and resilience

Sustainability is a contextual, contested, extensive and developing term (Fien & Tilbury, 2002) which can mean "all things to all people" (Summers, Corney, & Childs, 2003, p. 328). Economists refer to sustainable economies in the context of economic prosperity; scientists apply sustainability to earth and social systems and to relationships between the two. My own interpretation of sustainability combines understandings from the social and ecological sciences. I construe sustainability as a continuous social process which embodies the four interrelated social, ecological, economic and political domains in ways that open options for future generations. This involves present generations thinking and acting in ways that prioritise the interests and wellbeing of future societies, rather than current generations only.

The term sustainable development is also contested and critiqued for being ambiguous (Fien & Tilbury, 2002; Gadotti, 2008; Kates, Parris, & Leiserowitz, 2005) and "widely abused" (Hjorth & Bagheri, 2006). Sustainable development was first defined in the

1987 Brundtland Report as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (United Nations Commission on Environment and Development [UNCED], 1987). Twenty years later, interpretations maintain the integrity of the original definition. Adger (2007) interprets the goal of sustainable development is to “promote use of the environment and resources to meet the needs of present societies without compromising the future” (p. 79). As I see it, development is an unavoidable part of life and sustainability is the opportunity to make choices which enable us to live within the Earth’s current ecological, social and economic carrying capacity.

A problem emerges if we consider humans have already exceeded Earth’s current ecological carrying capacity. Steffen et al. (2004) and Rockström et al. (2009) argue human activities have pushed ecological Earth systems, such as climate and biodiversity, beyond safe levels for humanity. The consequences will likely lead to unacceptable global scale environmental change and detrimental and catastrophic effects for large parts of the world. The implications override the possibility of ecological sustainable development. The concept of sustainable development has inadvertently resulted in worldwide improvements in economic and social wellbeing to the detriment of ecological systems. Further loss of ecosystems is unsustainable for humanity because the continuation of human society depends on ecosystem services and goods such as clean air and water (Folke, et al., 2002). Sustainable development approaches aim to achieve an improved quality of life for all while maintaining flourishing social, ecological and economic systems (Folke, et al., 2002; Sustainable Measures, 2005; Tilbury & Cooke, 2005).

The representation of sustainable development as a balance between social, ecological and economic systems is critiqued as too simplistic by some scholars. Sustainability involves more than just understanding systemic links (Tilbury & Cooke, 2005). In reality, the many definitions and assumptions of sustainability reflect “a variety of contesting ideologies and an ongoing political debate about the nature of sustainable futures” (Fien & Tilbury, 2002, p. 2). The result is competing sectors of society which

“project their interests, hopes, and aspirations onto the banner of sustainable development (Kates, et al., 2005). Kyburz-Graber, Hofer and Wolfensberger (2006) assert that this framing of sustainability as a balance between social, ecological and economic systems “evokes a picture of harmony, equality and justice” which, given human nature, is unachievable. In reality, “issues of environmental stress do not do us the favour of being resolvable by just balancing the social, economic and ecological dimensions of the problem” (p. 110). Holling, Berkes and Folke (1998) conclude sustainable development is failing because we simply do not know how to do it. Sustainable development, they argue is little more than a “veneer of environmental respectability on the process of continuing unsustainable practice” (p. 349). Other authors argue that what sustainable development requires is critical analysis of current systems and transformative actions (Kyburz-Graber, et al., 2006; Tilbury & Cooke, 2005). What is clear is that, as Wals and van der Leij (2009) point out, after talking about sustainability and sustainable development for the last couple of decades, there is still no one clear way to understand or interpret the concept.

Hjorth and Bagheri (2006) propose sustainable development practices are failing because approaches have typically followed reductionist methods that assume problems are limited and can be defined. Reductionist thinking, they argue is not useful for working towards sustainable development because matters of sustainability deal with complex, unpredictable and undefinable adaptive systems. What is needed are cross-disciplinary holistic approaches that recognise rationality is bounded, certainty and predictability limited, causality indeterminable and change evolutionary. Wals and van der Leij (2009) agree, commenting that “a routine problem-solving approach falls short, as transitions towards a sustainable world require more than attempts to reduce the world around us into manageable and solvable problems” (p. 17). Wals and van der Leij (2009) support a systemic and reflective approach which incorporates change and uncertainty. Hjorth and Bagheri (2006) argue any possibility for achieving sustainable development requires replacing linear and mechanistic thinking with a non-linear and organic thinking they call systems thinking.

Systems thinking, also known as systemic thinking, is prevalent in the literature. According to Fien and Tilbury (2002) a systems approach recognises the interconnectedness and interdependence of all aspects of constituted human and non-human nature. Sterling (2003) finds traditional scientific approaches too simplistic for addressing sustainable development and argues systemic thinking provides a viable alternative to reductionist and objectivist thinking. Focusing on process, dynamics and wholes is a more realistic reflection of how Earth's systems function, insofar as humans are able to understand them.

Resilience offers an alternative means for thinking about and acting for sustainable development. Sustaining present ecological, social, and economic systems into the future involves adapting to new and unpredictable circumstances and challenges (Adger, 2007; Berkes, et al., 2003b). Resilience can be considered an essential property of a sustainable system (Adger, 2007). A system with low resilience has limited sustainability because it may not be able to persist long before being forced to cross a threshold. Human abuse of ecosystems results in loss of ecological resilience, making ecological systems vulnerable to thresholds which can lead to irreversible and detrimental changes. The less resilient the system is, the greater the risk of irreversible change (Perrings, 2006). The concept of resilience considers sustainability in terms of a system's capacity to absorb stress and shocks without fundamentally changing the structure and function of the system (Brock, Maler, & Perrings, 2002). Adger (2007) argues building resilience is imperative to successful sustainable development. Resilient societies are able to use landscapes and resources without compromising the provision of services for future generations as resilient systems have the tools to cope, adapt or reorganise in response to change.

Social, ecological and economic systems are also dynamic processes in which periodic change is triggered by events from within and across scales (Janssen, 2002). Use of the adaptive cycle model (Figure 2.1) helps interpret the dynamics of change (Holling & Gunderson, 2002). The sustainability of a system at any time depends on the properties of the system at any stage of the cycle. Small-scale change can trigger changes in larger-scale systems and occurrences at larger scales will influence systems at the small scales

(Holling, Gunderson, & Peterson, 2002). As the systems move through the four phases of the adaptive cycle (exploitation, conservation, destruction and renewal) resilience expands and contracts. The level of resilience determines how vulnerable the social, ecological and economic components of a system are to unexpected disturbances and surprises. Low levels of resilience can push the system over a threshold (Holling & Gunderson, 2002).

From a resilience perspective achieving sustainable development is not simply about lowering our ecological footprint or increasing quality of life. Equally important is to build adaptive capacity to manage and overcome external shocks and challenges in ways that increase rather than reduce future options. Walker and Salt (2006) propose the best way to build adaptive capacity is to increase knowledge about social-ecological change processes. To ignore or resist change increases vulnerability, foregoes emerging opportunities and limits options. One way to increase knowledge is through formal education.

Explicit teaching and learning about resilience will develop knowledge about how complex systems continually adapt through cycles of change. Walker and Salt (2006) argue ignorance and misunderstanding play a crucial role in the decline of global resource bases. Knowledge about thresholds, cycles and scales will help humans satisfy current resource demands without necessarily compromising the needs of future generations. Understanding cycles will provide insights into a system's levels of resilience which can inform management. As Walker and Salt (2006, p. 95) explain:

> By understanding adaptive cycles you gain insight into how and why a system changes; develop a capacity to manage for a system's resilience; and, most importantly, learn where and when various kinds of management interventions will, and will not, work.

Education for sustainability, and environmental education before that, directly aims to build capacity towards sustainable development by equipping all members of society with the "knowledge, skills, values, capacity and motivation to respond to the complex sustainability issues they encounter in their personal and working lives" (ARIES2009).

The next section provides an overview of the history of environmental education and education for sustainability, before discussing links to resilience.

2.4 From environmental education to education for sustainability

In 1972 delegates at the United Nations Conference on the Human Environment in Stockholm, which was attended by scientists such as Rachel Carson (1962) and Garrett Hardin (1968), formally recognised the potential of environmental education for addressing ecological problems. In the 1960s attention was drawn to growth of global environmental problems such as exhaustion of natural resources, the escalating contamination of air, land and water; and exponential growth in human population. The 1972 conference paved the way for the first formal environmental education framework in 1976, known as *The Belgrade Charter* which defined the objectives of environmental education as raising awareness, increasing knowledge, changing attitudes, teaching skills, improving the ability to evaluate, and encouraging participation. In 1977 the *Tbilisi Conference*, the world's first intergovernmental conference on environmental education, resulted in the *Tbilisi Declaration* that set out a framework, principles and guidelines for defining the purpose of environmental education.

Environmental education was conceived as a means to solve environmental problems. The emphasis was on raising awareness, individual knowledge and ecological actions towards conservation on the now contested premise that increased knowledge leads to positive environmental action (Armstrong & Grant, 2004; Armstrong, Sharpley, & Malcolm, 2004; Gralton, Sinclair, & Purnell, 2004). In schools, environmental education was delivered through science and geography curricula by teachers who "translated scholarly scientific material into subject matter to be taught and learned" (Gough, 2008, p. 34). As environmental education evolved, however, understanding about the inadequacy of the approach began to emerge. Pedagogical approaches focusing on raising knowledge and awareness as a means for initiating pro-environmental action were proving ineffective. At the same time, on an international level the language of sustainable development and sustainability began to emerge (Gough, 2007). The 1987 Brundtland Report, titled *Our Common Future*, was the first formal introduction of the

idea of sustainable development and recognition of the interdependence of ecological, economic and social systems.

At the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, one outcome was *Agenda 21*, a blueprint for sustainable development. Chapter 36 focuses on reorienting education towards sustainable development, increasing public awareness, and promoting training (United Nations, 1992). The term "education for sustainable development" was introduced in this document. As set out in Chapter 36, education for sustainable development has four main elements: improving basic education, reorienting existing education, increasing public awareness, and developing specific training programs. The term "education for sustainable development" is often used interchangeably with "education for sustainability", "learning for sustainability", "education for a sustainable future", "sustainability education", and "environmental education for sustainability" (Tilbury & Cooke, 2005). In Australia we generally use the term "education for sustainability" (EfS) (ARIES2009) and "environmental education for sustainability (EEfS) (see DEH2005).

Additional moves to formally advance education for sustainability came about at the 1997 International Conference on Environment and Society: Education and Public Awareness for Sustainability in Thessaloniki, Greece. The conference refocussed implementation of Chapter 36 of *Agenda 21* to reorient education towards education for sustainability, and resulted in *The Declaration of Thessaloniki* (International Conference on Environment and Society: Education and Public Awareness for Sustainability, 1997). The document is an agreement between government, intergovernmental, non-government organisations (NGOs) and civil society representatives from eighty-three countries, on the future of education for sustainability.

In 2002 the World Summit on Sustainable Development in Johannesburg, South Africa, resulted in the *Johannesburg Declaration on Sustainable Development* (The World Summit on Sustainable Development, 2002) and the *Plan of Implementation of the World Summit on Sustainable Development* (World Summit on Sustainable

Development, 2002). These two initiatives build on previous declarations. Resolution 54/254 in the *Plan of Implementation* was to implement a United Nations Decade of Education for Sustainable Development (UNDESD), from 2005 to 2014. The United Nations Educational, Scientific and Cultural Organization (UNESCO) was designated to lead the Decade. The DESD aims to "integrate the principles, values, and practices of sustainable development into all aspects of education and learning, in order to address the social, economic, cultural and environmental problems we face in the 21st century" (UNESCO2009).

In 2009, participants from over 150 countries attended the UNESCO *World Conference on Education for Sustainable Development – Moving into the Second Half of the UN Decade*, in Bonn. The conference marked the half-way point of the DESD and resulted in the *Bonn Declaration*. The declaration was written to reflect the debates and proposed implementation guidelines for the second half of the DESD (UNESCO World Conference on Education for Sustainable Development, 2009). Two other significant documents emergent from the UNESCO World Conference are the *Mid-DESD Review: Key Findings and Ways Forward* (Wals, 2009a) and the *Review of Contexts and Structures Education for Sustainable Development 2009* (Wals, 2009b). The documents provide a review of the DESD at the half way point and reveal a great deal about meanings and interrelationships between environmental education and education for sustainable development. It seems education for sustainability remains contested worldwide. Countries apply a variety of names such as environmental education, education for sustainability and environmental education for sustainable development. Interpretations vary as well. Some countries adopt a pedagogical orientation to education for sustainability which emphasises learning, participation and capacity building. Others apply a more instrumental approach which emphasises changing people's behaviour.

Countries with a strong history in environmental education seem to interpret education for sustainability as building on the elements and understandings of environmental education (Tilbury, 1995; Wals, 2009b). I propose that whereas environmental education focused on enhancing student knowledge, education for sustainability aims to build

capacity for sustainability. By contrast to earlier concepts of environmental education, education for sustainability aims to amalgamate ecological systems with economical, social and political sustainability (Fien, 2001; Tilbury, 1995). Fien (2001) states that:

> Education for sustainability involves approaches to teaching and learning that integrate goals for conservation, social justice, appropriate development and democracy into a vision and a mission of personal and social change. It seeks to develop the kinds of civic virtues and skills that can empower all citizens and through them our social institutions, to play leading roles in the transition to sustainability (p. 1).

To build capacity for sustainability, people are encouraged to take up sustainability as an integral part of their personal values framework. In the schools sector, teachers take on concepts of education for sustainability to enhance student capacity to meet "the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations Commission on Environment and Development [UNCED], 1987). More recently, education for sustainability has developed into a systems pedagogical approach which inextricably links all the sustainability systems together with critical and participatory skills (Fien, 2001; Fien, 2004; Tilbury & Cooke, 2005; Wals & van der Leij, 2009).

The Australian Research Institute in Education for Sustainability's (ARIES) report on *Frameworks for Sustainability* (Tilbury & Cooke, 2005) defines education for sustainability as:

> A new approach to Environmental Education. This new approach attempts to move beyond Education *in* and *about* the environment approaches to focus on equipping learners with the necessary skills to be able to take positive action to address a range of sustainability issues. Learning for sustainability motivates, equips and involves both individuals and institutions in reflecting on how they currently live and work. This assists them in making informed decisions and creating ways to work towards a more sustainable world.
>
> Learning *for* sustainability aims to go beyond individual behaviour change or single actions often associated with education for the

> environment. It seeks to implement systemic change within the community, institutions, government and industry (p. 4).

The recent publication by ARIES, *Education for Sustainability: The Role of Education in Engaging and Equipping People for Change* (2009) explains:

> Creating a sustainable community requires that individuals and organisations have the knowledge, skills, values, capacity and motivation to respond to the complex sustainability issues they encounter in their personal and working lives … Education for Sustainability goes beyond providing information about the environment. It is seen as a process which motivates and engages people in creating sustainable futures. It is not only a process which builds competence but also a change strategy which will assist people and organisations to move towards sustainability (pp. 3–4).

The report describes the components of education for sustainability as: envisioning a better future, critical thinking and reflection, participation, [creating] partnerships for change, and systemic thinking. These can be thought of as tools to enable capacity building.

The reality of education for sustainability practice in the school sector, however, is very different. Although teachers report liking the concept of education for sustainability, implementation is often marginalised and positioned as a low priority, left to a few very dedicated teachers, or employed as an add-on to an already overcrowded curriculum (Cutter, 2002; Robottom, Malone, & Walker, 2000; Tilbury, et al., 2005; Tilbury & Cooke, 2005). This situation is researched by Henderson and Tilbury (2004) in *Whole-School Approaches to Sustainability: An International Review of Sustainable School Programs*, by Tilbury, Coleman and Garlick (2005) in a *National Review of Environmental Education and its Contribution to Sustainability in Australia*, by Eames, Cowie and Bolstad (2008) in the New Zealand school context, by Robottom, Malone and Walker (2000) in five Australian Schools, and by Cutter (2002) in Queensland primary schools.

Sustainability researchers call for extensive changes to school systems (see for example, Fien, 2001; Henderson & Tilbury, 2004; Tilbury, et al., 2005; Tilbury & Cooke, 2005;

UNESCO, 1997, 2002a). In Australia, while many schools have taken up education for sustainability, Tilbury and Cooke's (2005) research finds too many still follow older approaches based on awareness raising, transmission of key messages and behaviour change goals rather than new approaches focussing on capacity building and learning-based change. Fien (2001) argues education needs to be redirected from reproducing the status quo to a process of social and environmental change which more authentically represents the principles and practices of education for sustainability. So, in what way might a social-ecological resilience approach contribute to concepts of education for sustainability? This question is discussed in Section 2.6 of this chapter, following a review of the history of environmental education in Australia.

2.4.1 The Australian context

In Australia environmental education in the school sector has an unstable history dating back to the 1970s (Tilbury, et al., 2005). Currently, in all states and territories apart from New South Wales, education for sustainability is a non-compulsory curriculum offering which has struggled to establish and maintain a profile among a long list of other competing educational demands (Greenwall Gough, 1997; Tilbury, et al., 2005). In 1980 Linke conducted a nationwide survey on the uptake of environmental education at primary, secondary and tertiary education levels. His results show a limited amount of environmental education was being taught, mostly through the subjects of Science and Studies of Society and Environment (SOSE) (Linke, 1980). Some twenty years later other studies found environmental education teaching and learning practices have not changed (Curriculum Corporation, 2003; Cutter, 2002; Robottom, et al., 2000). In 2000 Robottom, Malone and Walker published a case study report of five schools and concluded environmental education was most likely to be incorporated into SOSE areas and more than likely becomes the responsibility of a few very dedicated teachers. Cutter's (2002) research in Queensland schools found environmental education is problematic in terms of implementation, pedagogy and teacher knowledge and again reiterated Robottom et al.'s (2000) findings.

Over the last ten years the Australian Government has provided leadership and support for schools by investing in a number of national policies and initiatives. The first, *Today*

Shapes Tomorrow: Environmental Education for a Sustainable Future – A Discussion Paper (DEH1999) promoted discussion for future development of environmental education in Australia. The document was closely followed by *Environmental Education for a Sustainable Future: A National Action Plan* (DEH2000). The intent was to provide a national framework for enhanced coordination and "to promote best practice and professional development in the field and to enhance existing efforts by environmental education providers" (p. 1). *The National Action Plan* (2000) was the catalyst for the development of a number of initiatives such as the *Australian Sustainable Schools Initiative* (AuSSi) and establishment of the *Australian Research Institute in Education for Sustainability* (ARIES) at Macquarie University, New South Wales.

Five years later, in 2005, the Australian Government released *Educating for a Sustainable Future: A National Environmental Education Statement for Australian Schools* (DEH2005). The document provides a nationally agreed description of the nature and purpose of environmental education for schools which includes a vision and framework for implementation. I apply this framework in this research. *Educating for a Sustainable Future: A National Environmental Education Statement for Australian Schools* makes a noticeable shift in language from environmental education to environmental education for sustainability. The next Australian Government release followed the inauguration of the United Nations Decade of Education for Sustainable Development 2005–2014, and was called *Caring for Our Future: The Australian Government Strategy for the United Nations Decade of Education for Sustainable Development, 2005-2014* (DEH2007). The document sets out the Australian Government's 10-year vision, goal and strategy to promote sustainable development through education and training. The discussion recognises progression in language from environmental education to education for sustainability and then education for sustainable development. The most recent national initiative is *Living Sustainably: The Australian Government's National Action Plan for Education for Sustainability* (DEWHA2009). This plan supersedes the 2000 *National Action Plan* and aims to represent Australia's participation in the United Nations Decade of Education for

Sustainable Development. Sustainability education in the *National Action Plan* is referred to as education for sustainability.

Concurrent with national initiatives, the Queensland Government Department of Education, Training and the Arts (DETA) has developed a way forward for the expansion of what has become known in Queensland as environmental education for sustainability in the state education system. The *National Environmental Education Statement for Australian Schools* led the way for the development of the *Queensland Environmentally Sustainable Schools Initiative* (QESSI) in 2006 (DETA2006a). QESSI aims to establish a network of environmentally sustainable schools. Also in 2006 the Education for Sustainability Working Group of the Ministerial Advisory Committee for Educational Renewal (MACER) released *Education for Sustainable Futures: Schooling for the Smart State* (DETA2006b). The report sets out the principles for building sustainability into the Queensland school education system, including a set of 13 recommendations.

Another explicit inclusion of education for sustainability in Queensland education policy is Outcome SC2 in *Destination 2010*, which is the action plan for the school improvement and accountability framework set out by Education Queensland. Outcome SC2 states that schools will "Implement strategies and actions, in partnership with the community and within the school, to reduce the school's ecological footprint" (Education Queensland, 2008, p. 6). The most recent document, the *Statement on Sustainability for All Queensland Schools 'enough for all forever'* (Queensland Government Department of Education and Training, 2008), is intended to serve as a guide for schools across all three school systems in the state: state, Catholic and independent. The one-page document summarises a set of values, principles and approaches that support education for sustainability in schools.

2.5 Education for sustainability and social-ecological resilience

Research linking social-ecological resilience and education is in the early stages of development. A review of the literature reveals Krasny, Sriskandarajah, Sterling et al.

(2008) explored the application of resilience theory to education for sustainable development in a panel discussion session at the *Resilience 2008 International Science and Policy Conference* in Stockholm. Krasny and Tidball have published a chapter in Wals (2007) *Social Learning: Towards a Sustainable World*, and an article in the *Journal of Environmental Education Research* (2009) exploring relationships between urban environmental education and social-ecological resilience. The authors have two more papers pending review for the journals *Ecology and Society* and *Environmental Education Research*. Krasny, Lundholm and Plummer are editing a book due to be published in December 2010 called *Resilience in Social-Ecological Systems: The Role of Learning and Education*. The book explores social-ecological resilience, sustainability and environmental education. In a separate context, Fazey et al. (2007) published an article in the journal *Frontiers in Ecology and the Environment*, which considers the enhancement of adaptive capacity through education. In the section that follows I synthesise existent literature and make connections to other education for sustainability theory and research which parallels social-ecological resilience theory and practice.

Krasny et al. (2009) attribute lack of research in social-ecological resilience and education to theoretical contradictions between the two fields. They argue that education is content-driven, top-down and deterministic and that "a top-down transfer of information for predetermined outcomes … is antithetical to systems notions of unpredictability, emergence, and interactions" (p. 2). For Krasny et al. (2009) participatory educational approaches, such as action competence (Jensen & Schnack, 1997) and inquiry learning, are more constructive because student outcomes are not prescribed in advance "but rather emerge from the interactions of the participants with their social and bio-physical environment" (p. 2). This is because:

> Participatory approaches to education seek not so much to control the direction of student learning but rather to create situations where, through ongoing interactions with the social and ecological elements of the larger system, students develop the capacity to play a meaningful role in shaping their own future and that of their larger community (p. 2).

Krasny et al. (2008) observe changes in theoretical and practical approaches to environmental education over the last forty years. They note environmental education has progressed from conceptions of "humans as separate from nature to a concept of integrated socio-ecological systems, and from traditional instructional methods to those emphasizing networking, social learning, and participation" (para 1). My own examination of the literature indicates the premises and language of resilience filters through publications on education for sustainability. Whereas approaches in environmental education focus on teaching students about and in the environment (Cutter, 2002), the theories and practices of education for sustainability promote resilience thinking concepts such as adaptive capacity, creativity, understanding and managing complexity, and systemic thinking (see Henderson & Tilbury, 2004; Tilbury & Cooke, 2005). The latest published document by ARIES (2009) called *Education for Sustainability: The role of education in engaging and equipping people for change*, argues that education for sustainability facilitates change by "building capacity in individuals and organisations for transformational change" and by "emphasising creative, critical and innovative approaches" (p. 3).

From my review of the literature on environmental education, education for sustainability and sustainable development, I identify a number of approaches designed to build student capacity to take action for sustainability which parallel social-ecological resilience theory and research. These are: action competence by Jensen and Schnack (1997), Gestaltungskompetenz by de Haan (2006), civic ecology education by Krasny and Tidball (2007, in press), and systemic approaches (Tilbury, et al., 2005).

Action competence (Jensen & Schnack, 1997; Mogensen & Schnack, 2010) is an environmental education approach which aims to build students' capacity to take self-directed intentional action to target solutions to real-life environmental problems. Jensen and Schnack (1997) consider the aim of environmental education is to "make students capable of envisioning alternative ways of development and to be able to participate in acting according to these objectives" (p. 164). Traditional environmental education fails to achieve this aim because teaching and learning focuses on activities and

investigations where (a) outcomes are pre-determined and (b) do not address the cause or solution to the problem. Education approaches that typically aim to change student behaviour through behaviour-modifying teaching (teaching students to lower resource consumption by switching lights off), activities (such as sorting waste and composting) and investigations may increase student knowledge but do not target solutions (for instance, measuring the physical, chemical and biological levels of a polluted system). Jensen and Schnack (1997) argue that although these sorts of activities may be valuable to increase knowledge and motivate students, they do not "build up students' abilities to act – their action competence – with reference to environmental concerns" (p. 163).

Similar ideas to action competence are promoted through the concept of "Gestaltungskompetenz" (de Haan, 2006). Loosely translated as 'shaping competence' or 'participation skills' (de Haan, 2007) and means:

> Having the specific capacity to act and solve problems […] to modify and shape the future of society […] having the skills, competencies and knowledge to enact changes in economic, ecological and social behaviour without such changes always being merely a reaction to pre-existing problems. Gestaltungskompetenz makes possible an open future that can be actively shaped and in which various options exist (de Haan, 2006, p. 22)

"Gestaltungskompetenz" promotes capacity to deal with uncertainty and future prognosis, interdisciplinary work and learning, competence in cross-scale linkages such as local to regional to national and global scales, participatory skills, planning and implementation skills, empathy, compassion and solidarity, motivation to make changes for sustainability, and critical and reflective skills.

Civic ecology education is described by Tidball and Krasny (2009) as youth programs where learning is situated in community-scale environmental stewardship projects, such as gardening and habitat restoration, which have ecological and social outcomes. One example of a civic ecology education program is Cornell Garden Mosaics (www.gardenmosaics.org). Youth spend time in local community gardens with elder community gardeners, learn about plants, gardening and cultures, and then use what they

learn to conduct action projects to improve the gardens and communities (Krasny & Tidball, 2008). Tidball and Krasny (2009) explain education programs situated in civic ecology practice become part of a "virtuous feedback loop". Youth and adult stewardship actions contribute to natural capital by creating green spaces, and social capital by providing opportunities for members to socialise, build trust and participate in community life. In turn, participation produces ecosystem services such as fresh fruit and vegetables. Krasny and Tidball (in press) view civic ecology education as:

> An approach to ESD [education for sustainability] that (a) integrates ecological and cultural diversity, diverse ways of knowing, and civic participation; and (b) builds on positive activities occurring in urban and other communities, and thus presents an alternative to environmental education programmes focusing solely on pollution and other negative issues (p. 3).

A systems approach to education for sustainability is another way to significantly impact "what we learn, how we learn and what we learn for" (Tilbury, et al., 2005, p. 15). Systems approaches depart from conventional educational methods in that systemic thinking "encourages us to see the world in a wider, more holistic way, recognising that issues and relationships are much more like a connected web" (Sterling, 2004, p. 84). Systems approaches are useful in education for sustainability because systemic thinking helps consider relationships. In Sterling's (2004) words:

> It [systemic thinking] helps us consider how issues and possible solutions relate to others in our community – whether they are our neighbours, communities, distant environments or future generations – and to better understand the connections and interdependence between human and natural systems (pp. 84–85).

Education for sustainability programs built on systems understandings recognise change must be systemic. A school cannot become sustainable unless the whole school, all individuals, structures and management systems, participate. Systemic educational approaches explicitly teach the skills associated with thinking in an inclusive, integrative, systemic and holistic manner (Tilbury, et al., 2005). One example of a systems approach to education for sustainability is the *Australian Sustainable Schools*

Initiative (AuSSI) that takes a whole-school approach to managing resources and social and financial issues (DEWHA2008).

When we manage for resilience we build adaptive capacity to respond to change in a world of rapid transformations (Gunderson & Holling, 2002). The approaches to education for sustainability I describe above attempt to build student capacity and share many of the features written about in the literature on social-ecological resilience. Given that resilience and adaptive capacity are difficult to measure, how can we know whether education for sustainability is promoting resilience? Folke et al. (2002) address links between resilience and sustainable development in a paper written for the 2002 World Summit on Sustainable Development. Although the authors write from a natural resource management policy perspective, the paper offers insights applicable to education contexts. In the section below I synthesise Folke et al.'s (2002) work together with the literature on action competence, Gestaltungskompetenz, civic ecology education, and systemic thinking to try to elucidate to what extent education *for* sustainability approaches promote resilience. Table 2.1 provides a summary of links between the approaches.

Table 2.1. Comparison of Folke et al.'s (2002) sustainability policy recommendations and education for sustainability approaches

Sustainability policy recommendations	**Gestaltungskompetenz**	**Civic ecology**	**Action competence**	**Systems thinking**
Interconnections between ecological, social and economic systems	Interdisciplinary problem solving recognises environmental issues have social, economic and technological implications	Learning in community-scale environmental stewardship projects has social, environmental and economic outcomes – creates green spaces, builds trust and friendships, saves money on fresh fruit and vegetables	Students collaborate with peers, community members and organisations to solve an environmental issue	Students experience cross-scale interactions between ecological, social and economic systems through working towards improved environmental outcomes
Open, collaborative, and flexible relationships that nurture learning for adaptive capacity	Students run projects in collaboration with non-school partners	Relationships between youth and community elders nurture learning for adaptive capacity by combining different knowledges and actions	Students collaboratively develop cross-scale knowledge, critical thinking, vision and creativity to find solutions	Teachers, administration, students, parents and other community members and organisations, cooperate to achieve an environmental outcome
(a) indicators of resilience and key variables, (b) focus on all forms of diversity – biological, landscape, social and economic, (c) ecosystem friendly technology, (d) incentives to encourage learning and build social-ecological knowledge into institutional structures in multi-level governance, (e) participatory adaptive management processes	Diversity in teaching and learning practices enhances adaptive capacity by exposing students to multiple approaches. Innovative participatory approaches to solve sustainability issues	Community participates in adaptive management processes through sharing community gardens	Students learn to manage adaptively by collaborating in authentic problem solving	Community participatory adaptive management enhances adaptive capacity by providing diverse forms of knowledge, practices, participatory learning and action. Innovative school structures encourage learning and help build social-ecological knowledge into the education system.

Folke et al. (2002) make three policy recommendations for sustainable development from a social-ecological resilience perspective. If we consider sustainable development requires the creation and maintenance of options for prosperous social and economic development and that social-ecological resilience is necessary for creating and maintaining options, then:

- All policies should be formulated with explicit inclusion of interconnections between ecological, social and economic systems. This includes clear recognition of ecological thresholds, uncertainty and surprise.
- Institutions should be open, collaborative, and flexible and nurture learning for adaptive capacity.
- Incorporating resilience into sustainable development requires that policy frameworks encourage (a) formulation of indicators of resilience and key variables, (b) focus on all forms of diversity – biological, landscape, social and economic, (c) ecosystem friendly technology, (d) incentives to encourage learning and build social-ecological knowledge into institutional structures in multi-level governance, (e) participatory adaptive management processes.

The ideas are similar to three propositions de Hann (2006) identifies as essential for successful implementation of education for sustainable development. These are interdisciplinary knowledge, participatory learning, and innovative structures. Problems of ecology and sustainability need to be resolved through a multi-level interdisciplinary approach because issues such as climate change have social, economic and technological implications. For students to develop a holistic understanding of sustainability problems and implications there needs to be (a) interdisciplinary collaboration across various levels among teachers, the school community, and government and non-government organisations, and (b) diverse forms of teaching and learning approaches. Although learning frameworks such as de Bono's "thinking hats" (1987) and Gardner's "multiple intelligences" (1999) recognise learning is constructed in diverse ways, it can be argued the Australian education system still relies heavily on linguistic methods. A teaching and learning monoculture excludes some students and their contributions. Exclusion diminishes response options and affects capacity for resilience by limiting participation

– if students are not enabled to understand and make links then they will not be able to actively participate in society. One way to help students make links is by creating innovative participatory approaches to solve sustainability issues. This includes involving different community members and residents, businesses and organisations. Such collaboration can build school community-level resilience by enabling students to run projects in collaboration with non-school partners.

Krasny and Tidball (2009) agree systems that incorporate ecological diversity, diverse forms of knowledge, multiple levels of organisation (including community participation and adaptive learning) are likely to be more resilient. Their research with young people who work alongside elders in community gardens to grow vegetables, herbs, trees and flowering plants, finds the experiences promote community-level resilience by producing ecological, social and economic outcomes. Community gardens integrate traditional knowledge with multi-cultural and global understanding, youth development, ecological and cultural diversity, civic participation, and diverse ways of knowing about nature, community participation, and adaptive learning.

Action competence (Jensen & Schnack, 1997; Mogensen & Schnack, 2010) embodies resilience characteristics by developing student capacity to act. Students are required to take self-directed environmental actions which target solutions to real-life problems. Contributing to environmental solutions necessitates that students collaborate with peers, community members and organisations to solve an environmental issue. Students learn to act adaptively through participation in real life environmental issues. Teaching and learning in action competence is open and flexible to allow students to collaboratively develop cross-scale knowledge, critical thinking, vision and creativity to find solutions. The action component has the potential to enhance social and ecological resilience. Students develop networks, self-organisation skills, and adaptive learning and enhance their understanding of environmental problems.

Systems approaches to education for sustainability include resilience building characteristics by developing cross-scale systemic thinking and action. Students learn

complex problems usually cannot be solved through mechanistic approaches. When students are exposed to a systems-based education for sustainability approach, they experience cross-scale interactions between ecological, social and economic systems. Teachers, administration, students, parents and other community members and organisations, cooperate to achieve a sustainable outcome. Collaboration can enhance community-scale social resilience because members become more active in the community. A systemic approach enhances adaptive capacity by including diverse forms of knowledge, practices, participatory learning and action and innovative school structures.

Conclusion

This chapter has provided context for the remainder of the thesis by explaining connections between social-ecological resilience, sustainability and education. The first part of the chapter reviewed current literature and understanding of social-ecological systems and resilience. The middle section considered the concepts of sustainability, sustainable development and discussed links to resilience. In the last part I provided an overview of the history and development of education for sustainability and discussed emergent literature on education and resilience.

Adger (2007) regards resilience is essential for long term sustainability because sustainable systems are considered to be resilient. Although research linking social-ecological resilience and education is in the infancy stages, emergent studies indicate education for sustainability initiatives can and do promote community-scale resilience. Education for sustainability has evolved from the earlier concept of environmental education. The major difference is environmental education focused on knowledge acquisition while education for sustainability aspires to build capacity towards sustainability. If we consider that resilience is necessary for development to be truly sustainable, then a case can be built for resilience-building attributes to be explicitly embedded into education for sustainability programs.

Chapter 3. Research methodology, design and methods

Introduction

Method and methodology are distinct concepts. Methodology explains why we take a particular approach and is the connecting thread between the research questions/s, the method/s and data (Clough & Nutbrown, 2007). Methods are the strategies applied for conducting research (Berg, 2007). In qualitative research, methodology is a theoretical conceptualisation that preconfigures method, which Clough and Nutbrown (2007) describe as "a driving force that travels in the researcher's backpack throughout the time of the study" (p. 19). The researcher's views will dominate the way the research is conducted and will determine, for example, whether the researcher is an active participant or an observer (Clough & Nutbrown, 2007; Evans & Gruba, 2002).

In Chapters One and Two I explained the purpose of this research, introduced the theoretical foundations that guide my research and reviewed relevant literature to provide context for the research. This chapter expands on the foundations of the research and describes the specific approach and methods I take. In planning and thinking about this research, I considered a number of approaches. In this chapter I explain how and why I came to decide on a qualitative case study approach that applies a narrative technique and produces a set of qualitative indicators. I describe the theory and application of the methods through which I chose to conduct and explain the research, provide contextual details of the four case study schools, and explain how I analyse the data.

3.1 Research approach and design

The research approach is the "strategy, plan of action or design" which informs selection of methods, determines the information gathered and how the information is interpreted (Kayrooz & Trevitt, 2005, p. 116). Research approaches can be quantitative, qualitative or both, and are shaped by the researcher's ontological and epistemological foundations, past experiences and knowledge (Creswell, 2007). Choices are always subjective and "what we end up thinking and doing may be only a fraction of the possibilities that could

conceivably be open to us" (Clark, 2004, p. 28). Quantitative and qualitative researchers have different ways of conceptualising research problems (Holliday, 2007). Quantitative research attempts to predict and control variables; qualitative research applies variables as a way to understand the problem (Holliday, 2007; Kayrooz & Trevitt, 2005). The research approach must suit the purpose of the investigation (Creswell, 2007).

This research could have been carried out through a quantitative, qualitative or mixed methods approach. I chose a qualitative approach for two reasons. Because research into resilience and education for sustainability is in its embryonic stage, my interest lies with developing meaning and understanding rather than precise numerical descriptions (Morgan, 1997). Quantitative research processes work top-down in a deductive style, and use numbers and measures to evaluate conditions without necessarily considering the nuances of context (Berg, 2007). A quantitative approach might have explored how sustainability initiatives affect social-ecological resilience in school communities by developing and testing a hypothesis derived from the resilience literature. Qualitative methods are helpful for developing a deeper understanding of situations (Barrett, Hart, Nolan, & Sammel, 2005). I chose a qualitative approach in order to gain in-depth understanding of the relationship between sustainability and resilience in the context of four primary schools. I do this, not by testing a hypothesis, but by employing inquiry methods to co-construct understanding with research participants (Creswell, 2007). In environmental education research over the last fifteen years, focus has shifted from quantitative to qualitative approaches (Hart & Nolan, 1999; Scott, 2009). Sustainability deals with people and specific places and is sensitive to contextual circumstances. It is reasonable to argue that a qualitative methodology which focuses on understanding through dialogue in place is the most suitable approach to this particular research topic.

Creswell (2007) and Eisner (1991) provide a comprehensive list of features of qualitative research that apply to my research. Creswell (2007) argues qualitative research is most suitable when a social issue without measurable variables needs to be explored; when we need to understand the context to develop a more complete understanding of an issue which is best investigated by talking with people embedded in

the field; when we want to follow up quantitative research to help explain causal theories; or when we want to develop theories because existing theories are partial or inadequate and cannot or do not capture the complexity of the problem. For Eisner (1991) a qualitative approach is most appropriate when research is “field focused” and “nonmanipulative” (that is, when situations are studied as they really are); the researcher is also the interpreter making sense of the situation; the research is interpretive and the researcher critically evaluates situations and not merely reports or describes them; the writing is qualitative in nature and reveals “expressive language” and “presence of voice” through use of metaphors and first person; the research pays “attention to particulars” to demonstrate the uniqueness of the case; and the researcher employs “multiple forms of evidence” to argue the case.

Most published research on social-ecological resilience emanates from the ecological sciences. While some researchers such as Adger (2000, 2007) and Marshall (2006) have focused on the social domain, there is still limited understanding of social resilience within social-ecological systems (Marshall, 2006). Resilience building through school-based education for sustainability is a social process within a social-ecological system. In my experience, education for sustainability in schools is often driven by very dedicated teachers in response to local conditions. Each school is embedded in a community with its own particular social, economic, financial, environmental and political circumstances. These individuals convince others in the school to implement sustainability initiatives relevant to local issues and interests. A situational multi-site case study has the potential to advance understanding of connections between education for sustainability and resilience within particular school contexts because the approach allows for in-depth collection of data from multiple sources of information (Creswell, 2007).

3.1.1 The case for case study

Case study is a disciplined inquiry approach driven by strong underlying rationale and direction (Yin, 2003) and is concerned with illuminating meaning through inductive investigation (Glatthorn & Joyner, 2005). Case study is most useful when we want to provide in-depth descriptions of a specific situation, organisation, individual or event

(Glatthorn & Joyner, 2005) or highlight processes (Denscombe, 2007). Case study is my preferred way of doing research as I have previous experience with qualitative case study research (Evans, 2006) and enjoy being embedded in and sorting through the wide variety of information a case study provides. I decided to take an inductive approach which uses an embedded multiple-case study (Yin, 2003) to investigate the particular to enlighten the general (Denscombe, 2007). This has allowed me to investigate, narrate and analyse how education for sustainability is constructed in four school communities.

Denzin and Lincoln (2008) argue research processes are shaped by paradigm-specific ontological, epistemological and methodological foundations. This research is an exploratory case study situated within an interpretive/constructivist paradigm. Interpretivism and constructivism are closely related philosophical paradigms which, according to Howe (2003), "amount to the same thing" (p. 81) because they share the same epistemology. Under an interpretivist/constructivist epistemology knowledge is actively constructed and individually interpreted. In this research I co-construct knowledge and understanding about social-ecological resilience through education for sustainability with the participant school principals, teachers and students which I then re-interpret through narratives.

Constructivists assume a relative ontology, a subjectivist epistemology, and a naturalistic methodology (Denzin & Lincoln, 2008). Under these assumptions reality is considered multiple, varied and subjective and knowledge is constructed via social interaction through an inductive approach in a natural setting (Creswell, 2007; Denzin & Lincoln, 2008; Lincoln, 1990). I presuppose that each school community in my research has its own reality that is embedded within the context of their community, region, state and country. While all four school communities share commonalities at regional, state and national level, the demographics and dynamics of each school's local community shapes its particular decisions about teaching and learning approaches. An exploratory case study approach provides the flexibility to investigate and interpret these contextual differences.

Carrying out in-depth research in schools is difficult due to the very busy nature of schooling. Although none of the schools I approached were averse to my research, some were hesitant due to work demands already placed on them. The case study approach provided me with a way to inductively gather detailed information from participant schools because I was able to collect multiple and varied sources of field texts using different methods. As part of the case study approach I decided to create a narrative for each school, and then analyse these to develop the indicators.

3.1.2 The case for narrative

Definitions of narrative vary. Some authors, such as Barthes (cited in Riessman, 2008, p. 4 and Czarniawska, 2004a, p. 1), consider any type of communication (visual, spoken, fixed or moving gestures) as narrative. Other definitions are more constrictive and define narrative as, for instance, a text that is thematically organised by plots (Polkinghorne, 1995). For Barthes any type of communication tells a story and can therefore be considered a narrative, whereas for Polkinghorne narrative is a specific type of genre. In this work, I define narrative, after Czarniawska (2004a) and Chase (2005), as a spoken or written text that provides a way of organising and understanding an event/action or series of events/actions which are chronologically connected and presented in a holistic format that includes contextual details. Consequently, narrative provides a way to see the consequences of actions and events over time (Chase, 2005). Narratives can be fiction or non-fiction, but must follow a number of sequential past events, (usually bounded into a beginning, middle and end format) and have a plot which unites and justifies the narrative (Riessman, 2008). Obviously, the research narratives presented in my work are non-fictional, though I have constructed these from the data I collected.

In research, narrative is a qualitative approach that can be applied to the collection, sorting and/or analysis of field texts – which are data collected from the field. Although a neat and concise explanation for narrative research is not available, two common themes that link all narrative research are story telling (Polkinghorne, 1995) and retrospective sequential schemas (Chase, 2005; Riessman, 2008). All narratives connect and impose order and meaning on what may otherwise be “random and disconnected” information (Salmon, in Riessman, 2008, p. 5). As stories, narratives provide a holistic

reporting method because apart from describing past events, narratives incorporate the nuanced emotions, thoughts and interpretations of those who experience the events (Chase, 2005).

Narrative is a characteristic of human thought processes. People typically think in, and apply story formats to understand and explain experiences (Clough, 2002; Cortazzi, 1993; Polkinghorne, 1995; Riessman, 2008). My own understanding of the world was mediated by my childhood stories. I have childhood memories of sitting around the dinner table and asking my grandmother, who had a reputation for storytelling, to tell me one. The stories varied according to her mood – sometimes they were fairy tales and other times they were stories of her childhood, adolescence, adulthood and the war. Some twenty-five years later I witnessed my children also apply stories to construe understanding as they cried out to their Pop, who was a practised story-teller, to tell them a story. Narratives play an important part in adult formal learning. At university we had a lecturer who used to tell us stories about his classroom experiences. I remember him asking "Have I told you the story about …" and we would all eagerly sit up with expectant expressions.

I became interested in using narrative because unlike other approaches which highlight commonalities in data, narrative exposes the unique traits of a particular case study (Chase, 2005; Polkinghorne, 1995). Very early on I understood narrative to be a powerful method to present data because "narrative does not simply represent historical events and empirical facts; it also encodes these facts into a mode or structure of expression that not only conveys information but also produces meaning" (Sandlos, 1998, p. 6). I apply narrative (after Riessman, 2008 and Polkinghorne, 1995) as a means to arrange, interpret and present the large and disorderly amount of field texts collected at each case study site. I create, through narrative, a unique and holistic account of how education for sustainability is constructed and enacted at each of the four schools in my study. Interpreting a wide and variable set of field data through a narrative structure enabled me to bring all the information together in a holistic and coherent way. My stories attempt to construct each school's education for sustainability experience for the

years since each school began implementation to the end of 2008. In Riessman's words, I tell "a story about stories" (p. 6) because I think of all my field texts as sets of stories which I collected. After I constructed the four school narratives from field data, I analysed these to construct a set of indicators of education for sustainability informed by social-ecological resilience theory.

3.1.3 The case for indicators

Indicators are communication tools that provide information which is not immediately apparent and which reflects the condition of a system (Hoernig & Seasons, 2005; Redefining Progress, 2006; Redefining Progress and Earth Day Network, 2002). Redefining Progress (2006), an American clearinghouse for information and communication, provides a useful definition of indicators as "the mechanism for getting feedback about a system that might otherwise be too big and complex to understand" (p. 4). An indicator most people are familiar with is the GDP (Gross Domestic Product) which is treated as a measure of a country's national economic activity. Most of us, in our day-to-day lives, would not be aware of the country's economic activity status. However, we can understand that the rise and fall of the GDP reflects national economic activity. We learn to equate low GDP with a downturn in the economy and high GDP with better economic conditions. Indicators help us to understand the world and make sense of changing conditions (Redefining Progress, 2006). In making the obscure obvious and in providing a sense of a larger-scale view, indicators can help determine the condition of a system, or to monitor and assess the impact of a program, policy or action. Indicators provide useful information about existing circumstances, based on past and present trends and conditions, and are used to enhance decision making or focus on target areas (Beratan, Kabala, Loveless, Martin, & Spyke, 2004; Gahin & Paterson, 2001; Office of Sustainability and the Environment, 2008; Redefining Progress and Earth Day Network, 2002; Tilbury, et al., 2007).

Indicators can be tools of change, learning and propaganda (Meadows, 1998). An emergent problem is that because there are many different types of indicators used across different fields and contexts, there is a lack of universal consensus on what an indicator looks like (Tilbury & Janousek, 2006; Tilbury, et al., 2007). Quantitative

indicators, also known as objective (Meadows, 1998; Pepperdine, 2000) or mechanistic indicators (Stirling, as cited in Tilbury & Janousek, 2006), may present as a set of easily verifiable numbers, while qualitative indicators, also called subjective (Meadows, 1998; Pepperdine, 2000) or holistic indicators (Stirling, as cited in Tilbury & Janousek, 2006), can appear in the form of a set of statements, checklists and/or questions which are not as easy to measure. Quantitative indicators are generally considered more reliable and valuable (Meadows, 1998) because they are easier to measure, compare and record (Stirling, as cited in Tilbury & Janousek, 2006). Qualitative indicators reflect personal attitudes, beliefs and feelings which Pepperdine (2000) argues are necessary to measure the 'reality' that people live in as well as to counter a general societal emphasis on objective measures. Quantitative indicators alone are not comprehensive enough to be used exclusively (Meadows, 1998) as they do not necessarily provide detailed insights into social conditions.

In the literature on sustainability there is a general assumption indicators should be based on measurable goals which are quantifiable (Bell & Morse, 2003). Problems arise when what the indicator indicates is vague, contested and complex, as is the case with education for sustainability (Reid, Nikel, & Scott, 2006) and resilience. A more realistic method to develop education for sustainability indicators is to adopt an approach that promotes "reflection on practice, rather than simply hitting targets, so that the shape of our ESD [education for sustainability] emerges through practice, throughout the education system." (Vare, 2006, p. 2). From a social-ecological perspective, quantitative indicators alone do not provide a realistic representation of conditions. A more comprehensive account requires a balance of quantitative and qualitative indicators (Pepperdine, 2000).

In this study, I apply an inductive approach to develop a set of qualitative statements of education for sustainability that are informed by social-ecological resilience theory. I call these qualitative indicators. The indicators emerge directly from my case study research and present a tangible outcome from my research. To develop the indicators I take the theories from the resilience and education for sustainability fields and apply

them to examine the attributes of the schools in my study. I take the position that knowledge is never complete. Therefore, the indicators I develop are not a complete work, set for all time and all situations. These indicators are tentative because they have not been subjected to testing and evaluation, but are a set of researched propositions which attempt to open up discussion about how we might further develop the very valuable education for sustainability work which has been done in schools. These provide a baseline for further research which can refine these into operational and testable indicators.

Indicators are not ends in themselves (Redefining Progress, 2006). To be useful, indicators need to be linked to a specific purpose. According to Redefining Progress (2006), there are three main purposes for developing indicators: for public education, to provide background information for major policy changes, and for performance evaluation. In this study the indicators are a set of variables, developed as indicators of performance within schools that prioritise education for sustainability. The indicators are designed to assist with critical appraisal and continuous improvement of education for sustainability.

Part of the requirement of this doctoral study, as mentioned in Chapter One, was that I produce indicators. Combining narrative with indicators provided me with a way to produce indicators that give voice to the schools' lived experiences. The narratives tell each school's story. Interpretation of narratives, however, can be subjective. I understood the indicators as being a means to make each school's story obvious - a way to make the obscure obvious.

3.2 Study schools

My choice of case study schools and participants was purposive. The four schools represent different contexts, approaches to and stages of implementing sustainability education. At the time of the research period, 2006–2009, Hollindale and Whanilla State Schools (pseudonyms) were deeply embedded in implementing education for sustainability. Reliwarra and Fontana State Schools (pseudonyms) had been

implementing education for sustainability initiatives for less time but had achieved considerable outcomes in a short period and were very keen to make greater progress. The investigation of four similar and contrasting cases adds understanding, validity and reliability to the findings because it allows investigation of the research problem in different circumstances (Miles & Huberman, 1994; Yin, 2003).

The procedure for selecting schools to participate in the study begun by identifying schools that engage with education for sustainability in the Cairns district of Far North Queensland. I determined this by reviewing schools in the Cairns district through the literature and on the internet, and by talking to people I know. I chose four schools from a selection of some possible 30 local primary and secondary schools due to their demonstrated commitment to fostering education for sustainability. All four schools were members of the Queensland Environmentally Sustainable Schools Initiative (QESSI), had developed School Environmental Management Plans (SEMP), and regularly showcased their education for sustainability work and achievements in the "Post ed" section of *The Cairns Post*, the regional Far North Queensland newspaper. A detailed context of each school is supplied in Chapter 4. To provide enough background for this chapter, I describe each school briefly in the following pages.

3.2.1 Whanilla State School

Whanilla State School (pseudonym) is situated about 100 kilometres north of Cairns in a semi-rural area. The school is located 300 metres from the beach against the backdrop of the World Heritage-listed Daintree Rainforest. The student population is around 120 and ranges from kindergarten to Year Seven. The local population are mostly blue collar workers or sugar cane farmers (Australian Bureau of Statistics [ABS], 2008). The school employs six permanent full-time teaching staff and a number of part-time teachers. I interviewed the principal (pseudonym Elizabeth) and the education for sustainability co-ordinator (pseudonym Kieran), who teaches at the school full time.

Whanilla State School (SS) has been implementing education for sustainability since 2004. The approach involves the whole school in managing water, waste, energy and biodiversity issues on a daily basis. Class teachers implement at least one sustainability

based unit of work per year to develop student knowledge. The school is widely known for focusing teaching and learning around the principles and practices of education for sustainability.

3.2.2 Fontana State School

Fontana State School (pseudonym) is located in an established part of Cairns, under the slopes of a partly developed mountainous range, about 10 kilometres from the city centre. The school has a student population of about 670 students with classes spread from kindergarten to Year Seven. Students originate from a mostly professional or small business background with middle to high socio-economic status (ABS2008). Fontana State School (SS) employs some 70 staff, which includes teaching and non-teaching positions such as administration and grounds persons. I interviewed the principal (pseudonym Lyn) and the key education for sustainability teacher (pseudonym Kim), who teaches at the school three days per week.

Kim began implementing education for sustainability at Fontana SS with her class in 2000 by building sustainable gardens. Since 2002 other classes in the school have been implementing other initiatives connected to biodiversity, water, energy and waste. Each year level implements one sustainability unit of work per year. The school is best known for its waste recycling initiative, which has won a state award.

3.2.3 Hollindale State School

Hollindale State School (pseudonym) is located on the southern corridor of the Cairns Local Government Area. The area around the school was once a rural community, but is now the largest suburb on the outskirts of Cairns. Hollindale is about 15 kilometres from the centre of Cairns, and has a mixture of land uses and activities, including residential, commercial and recreational. The area houses an established population of around 8200 with middle to low socio-economic status (ABS2008), and has a reputation for providing a cheap buyer and rental market. Hollindale State School (SS) supports around 950 students from kindergarten to Year Seven. I interviewed the principal (pseudonym Robert), and five teachers, including two key teachers (pseudonyms Denise and Esther)

and three teachers who engage with the school's education for sustainability initiatives (pseudonyms Melanie, Katherine, and Mary).

Denise and Esther lead Hollindale SS's education for sustainability initiatives. Denise has always implemented education for sustainability in her own class, but began to lead a whole-school approach in 2003. Each classroom teacher implements one sustainability-based unit of work per year and contributes to managing some aspect of the school's waste, water, energy and biodiversity. The school is well known in Cairns for its leadership in sustainability.

3.2.4 Reliwarra State College

Reliwarra State College (pseudonym) is located in an affluent socio-economic area of Cairns, about 10 kilometres north-west from the centre. Reliwarra is the fastest growth area in Cairns and has a reputation for having higher than average house prices. Reliwarra State College (SC) caters for around 1300 students from kindergarten to Year Twelve. The school is under the slopes of a fast-developing valley and employs about 120 staff. Most families attending the school work in professional, semi-professional or small business jobs. I interviewed the principal (pseudonym David), the associate principal (pseudonym Ann) and the education for sustainability coordinator (pseudonym Mel).

Mel began implementing a whole-school approach to education for sustainability at Reliwarra SC in 2004. The whole school participates by undertaking one sustainability-based unit of work each year and actively helping to manage the school's energy, waste, water and biodiversity. Mel is working hard to imbed education for sustainability into the school's curriculum, operations, teaching and learning, physical surroundings and relationships with the local community.

3.3 Conduct of study

My case study explores whether education for sustainability initiatives foster social-ecological resilience in four school communities. Data were collected through interviews

with principals, teachers and students, document studies, sustainability reviews, teacher questionnaires administered to the wider teaching staff, and reading archival records collected at each school through "analytical generalization" (Yin, 2003, p. 37). An overview of the information I collected at each school is provided in Table 3.1 and described in the next section. The case study design was inductive and flexible. While I developed a basic conceptual framework and strategies for answering my research question early on, the research design was flexible enough to adjust to emerging developments. I planned to hold interviews with principals, active teachers, and students, but the teacher questionnaire that went to all teachers was a late addition which emerged as my understanding about my research progressed. This is common among qualitative researchers. Miles and Huberman (1994, p. 17) explain:

> The [qualitative] researcher has an idea of the parts of the phenomenon that are not well understood and knows where to look for these things – in which settings, among which actors. And the researcher usually has some initial ideas about how to gather the information. At the outset, then, we usually have at least a rudimentary conceptual framework, a set of general research questions, some notions about sampling, and some initial data-gathering devices.

Methods are defined as specific techniques to collect evidence to answer the research question (Glatthorn & Joyner, 2005; Patton, 2002). My choice of research methods was shaped by my constructivist worldviews. Typically constructivists make sense of the research world through, for example, qualitative interviews (Crabtree et al. in Morgan, p. 139), which involve holding loosely structured in-depth conversations with participants.

Data collection and data gathering are generic terms used to describe the process of collecting information and/or evidence to answer the research question. Critics argue the terms imply data is out in the research field waiting to be objectively collected by researchers (see Clandinin & Connelly, 1994; Massey, 2005; Whatmore, 2005) similar to the way squirrels collect and accrue acorns in the autumn (to use an analogy):

> Taken at face value, the business of data 'collection' that abounds in introductory texts on research methods bears an uncanny resemblance to the activity of squirrels in the autumn, gathering up acorns and hoarding them as treasured stores of winter food. Whether interviewing actors in

> situ, manipulating the digital population of census returns, or trawling documentary archives for traces of past lives, data collection mimics this squirrel-acorn relationship as you scurry about after nuggets of 'evidence' just waiting to be picked up, brought home and feasted on a later date (Whatmore, 2005, p. 89).

An alternative understanding is that data is inductive, generated and shaped by the researcher and research participants (see Creswell, 2007). Clandinin and Connelly (1996) call data "field texts" because they argue that data are actually "texts created by participants and researchers to represent aspects of field experience" (p. 419). I consider my field texts as information which builds a story about each school's sustainability journey. Each particular school story has been co-constructed through the sharing of information between the participants and me, as the researcher. Implementation of education for sustainability initiatives within a school can shift along with other changes and/or disruptions such as staff turnover and policy modifications. Employing a variety of methods within a case study approach allowed me to capture the fluidity and complexity of each school's situation. While research method choices are subjective, a combination of methods strengthened my case study because each method represents a particular source of knowledge about the practice of education for sustainability within the relevant school (Riessman, 2008). Directly below I describe the elements of my data collection.

3.3.1 Interviews

The interview method is the preferred approach to ascertain other people's perceptions (Glatthorn & Joyner, 2005; Patton, 2002). Interviews can be with an individual or a group, take place face to face, over the internet or the telephone (Fontana & Frey, 2005). Interviews in qualitative research are a collaborative effort between two or more people, based on the assumption that other people's perspectives are valuable and lead to a negotiated understanding of the situation being investigated (Fontana & Frey, 2005; Patton, 2002). One-on-one and pair interviews with principals and teachers, and student group interviews were my principal strategies for initial data collection. The interviews were conducted with key teachers, principals and students about their environmental education for sustainability experiences, thoughts and beliefs. Interviews helped me

understand how education for sustainability was constructed in each site and provided a snapshot of the overall organisation of programs in each case study school.

The three major types of interview styles are structured, semi-structured and un-structured, although the structured interview is sometimes considered a quantitative rather than qualitative method (Bryman, 2001). The major difference is the level of flexibility. Structured interviews allow no digression from the interview schedule, unstructured interviews have no formal schedule at all and semi-structured interviews lie somewhere in the middle (Berg, 2007). I used a semi-structured style design and followed a flexible interview guide to provide "topics or subject areas within which the interviewer is free to explore, probe, and ask questions that will elucidate and illuminate that particular subject" (Patton, 2002, p. 343). A flexible interview schedule ensured that I pursued similar lines of inquiry in each interview while simultaneously allowing the interviewees to express individual perspectives in their own way (Lankshear & Knobel, 2004; Patton, 2002). The semi-structured technique allowed me to co-construct knowledge with participants and gather understanding of education for sustainability practice in each school because I was able to reword, add and/or delete individual questions to suit the interview context.

A drawback of the semi-structured interview technique is they are time consuming. Organising, carrying out, transcribing and analysing interviews is a lengthy processes (Bryman, 2001). Flexibility in interview structure and content can result in salient questions being inadvertently omitted. One may also find that one has substantially different responses from different perspectives to the same question (Patton, 2002). While there is no way to shorten the interview process, I looked upon it as an illuminating experience which allowed me to "walk a mile in my participants' heads" (Patton, 2002, p. 417). I realise at times I gathered conflicting accounts from participants and, in retrospect, I sometimes wished that I had asked different questions. I compensated by collecting field texts from different sources such as sustainability reviews and observations. In the end, it was the diversity of responses and the totality of the field texts from each particular school that formed the narratives presented in

Chapter Four. I did not get “hung-up” on the variations but rather viewed them as an opportunity to expand my understanding. One way to avoid some of these problems is to hold multiple interviews rather than just one. Riessman (2008) recommends the multiple-conversation approach because follow-up conversations allow the researcher to develop deeper understandings by querying, clarifying and developing new conversations from prior discussions. Unfortunately, school personnel are constrained by tight time limitations and in most cases principals and teachers only had enough time to give me one interview. I conducted a total of fifteen adult interviews, comprising of five interviews with principals and ten interviews with key teachers. All interviews were conducted on-site and lasted from thirty minutes to two hours, with the average lasting forty-five minutes (see Table 3.1). In keeping with ethics requirements, each participant was issued with an “information for participants” statement, outlining the nature and requirements of the research, and a consent form prior to commencement of the interviews.

3.3.2 Student group interviews

A group interview is one held with a small number of people on a specific research topic (Minichiello, Aroni, & Hays, 2008; Patton, 2002). Group interviews are useful for research that aims to understand and provide explanations of particular issues or occurrences (Hennink & Diamond, 1999). Social interaction between group members can be a useful mechanism for extending knowledge and understanding (Minichiello, et al., 2008). Student group interviews added to the collection of field texts most substantially. I conducted a total of eight student group interviews, involving a total of 30 students. Two student group interviews were conducted at each of the four schools. All details, such as ages and year levels, are provided in Table 3.1. In synergy with the rest of the research I applied a systems perspective to the student group discussions taking into account that groups are embedded in and influenced by structures and relationships (Agazarian & Gantt, 2005). Children can be difficult for adults to interview due to status imbalance (Eder & Fingerson, 2001). I was aware of the power relations between me as the researcher and the student participants. These relations were affected by the school setting, and student role expectations and boundaries.

The greatest strength of group interviews is the capacity to produce a large amount of data on a particular topic in a relatively short time. Comments from one group member serve to trigger further remarks from other members which then advance understanding of the topic (see Berg, 2007; Frey & Fontana, 1993; Krueger, 1994; Krueger & Casey, 2000; Morgan, 1997; Salkind, 2003; Stewart & Shamdasani, 1990). The flip side is, however, that if participants are hesitant to share information they may defer to more assertive or dominant group members (Krueger, 1994). Weaknesses include logistical factors such as finding a convenient time and place to conduct the interview (Crabtree, Yanoshik, Miller, & O'Connor, 1993; Hennessy & Heary, 2005). Researcher inexperience (Berg, 2007; Frey & Fontana, 1993; Salkind, 2003) can influence participants' replies to questions by providing cues about desirable (and undesired) responses (Morgan, 1997; Stewart & Shamdasani, 1990). A tendency towards conformity and polarisation in groups is always a matter to be considered. For some individuals the group environment will affect what they say and how they say it (Frey & Fontana, 1993; Morgan, 1997; Sussman, Burton, Dent, Stacy, & Flay, 1991). Confidentiality is also a concern as everything said is shared among all participants.

Nevertheless, group interviews provide a powerful and safe method for discovering how children think about school programs and learning opportunities (Krueger, 1994; Krueger & Casey, 2000; Stewart & Shamdasani, 1990). Interviewing children in small groups can simulate a real-life conversation (a social format children are familiar with), and can encourage freedom of expression. By contrast, individual interviews can induce children to supply what they think the interviewer will perceive to be the right answer (see Graue & Walsh, 1995; Hennessy & Heary, 2005). Zwiers and Morrissette (1999) argue that in a group situation children's ideas are "contaminated" (p.146) by other participants' opinions. This is not unique to children; adults too are susceptible to interpersonal influences (Graue & Walsh, 1995). Graue and Walsh (1995) dismiss worry about children influencing each other's answers during group interviews. Children, they believe, are found to be much more relaxed when interviewed in groups and provide higher quality responses.

In conducting interviews with groups of young people, age variation, gender differences and social cohesion are important considerations (Hennessy & Heary, 2005; Krueger, 1994). Krueger and Casey (2000) recommend keeping the age of the group to within two school years and organising groups that are not pre-established. My student group samples were purposeful, chosen from each school site in consultation with teachers. I was interested in working with students who engaged with sustainability education and were active participants in classroom and/or school activities. I thought these children would provide richer insights due to their interest and experiences. My groups were composed of girls and boys of similar age. The youngest student was nine years old and was in Year Four, the oldest was thirteen years old and was in Year Eight. In all cases the participant students knew each other. Very structured group interviews, where the researcher has an inflexible agenda, can interrupt group dynamics (Crabtree, et al., 1993). Krueger (1994) and Krueger and Casey (2000) suggests groups with young people be limited to a maximum of 60 minutes to avoid restlessness or off-task behaviour. The duration of interviews varied according to the dynamics of each group. The shortest group lasted 40 minutes and the longest 60 minutes. Questions were open-ended to encourage students to explain their thoughts and experiences and to discourage yes/no answers.

Organisation of the interview content was more difficult to plan. I wanted a tight content structure because I was working with primary school students accustomed to structure. Loosely structured student groups may have been unproductive in terms of generating rich responses. On the other hand, I felt it important to adapt to the particular school context. I prepared a flexible interview schedule that included a combination of brainstorming activities, visual stimulus material, and open-ended questions. Student group interviews were conducted after I had collected other data so I had contextual background for the student interviews. I adapted my approach to fit in with each school's particular circumstances. I found the best technique was to ask students to tell me about their experiences with sustainability at their school.

Primary school students can have short attention spans and be easily distracted. I was interested in gaining in-depth understanding of young people's perceptions. I aimed for four students per group, however, due to absenteeism and other commitments, the number of students in the groups varied from a minimum of three to a maximum of five (see Table 3.1). In preparation I read widely on researching children's experiences (for example, Greene & Hogan, 2005; Lewis & Lindsay, 2000), and on conducting different types of interviews with children and young people (for instance, Brooker, 2001; Krueger & Casey, 2000) and thought deeply about the structure, content and procedure I should follow. I made decisions based on the literature, my own teaching background, advice from my supervisors and prior knowledge from the research schools' settings. Group interviews can involve diverse group tasks such as brainstorming, discussing issues and problem solving (Kitzinger & Barbour, 1999; Westcott & Littleton, 2005). I decided to combine three activities in order to make the sessions more stimulating and maintain student interest. The three activities included using stimulus materials such as photos and flashcards, asking students to recall and discuss environmental changes they had experienced during their lifetimes, as well as brainstorming and discussing strategies for lessening negative impacts. I structured the sessions around the topic of environmental changes because, as outlined in Chapter One, the Cairns region has been experiencing transformational environmental changes over the last twenty years. I found all students were readily able to identify and talk about local changes. I applied my judgement within each context as to how to conduct the session. This meant I covered the same content as per the schedule in each interview session, but I varied delivery according to the dynamics of each group. Parents and students were informed about the study prior to interviews via a parent/guardian letter and a student letter. Signed consent was sought from parents/guardians. All group interview sessions were conducted at the schools, on school grounds and in school time, in a location of which the students approved, such as under a tree in the playground.

Good preparation and sufficient time between group interviews allowed me to recognise that some students silenced others because they were more assertive. I was then able to plan to open up opportunities for the meeker students who made equally important and

interesting contributions. Nevertheless, at times I felt somewhat ineffective because school structures and the power relationships between students and adults, and between students themselves, are deeply entrenched. I am aware that students deferred to me as a knowledgeable person in my capacity as an adult researcher from the university.

Table 3.1. School interview details

	Reliwarra SC	**Hollindale SS**	**Fontana SS**	**Whanilla SS**
Principals and Teachers	Principal and associate principal (47 minutes) EfS coordinator and middle school science teacher (1 hour and 16 minutes)	Principal (41 minutes) EfS coordinator and year 6 teacher (50 minutes) Key teacher and school librarian (45 minutes) Year 1 teacher (31 minutes) Year 5 teacher (27 minutes) Year 6 teacher (46 minutes)	Principal (45 minutes) EfS coordinator and year 4 teacher (45 minutes)	Principal (1 hour and 39 minutes) EfS coordinator and year 4/5 teacher (2 hours)
Students	One group with four students (1 hour) 2 x Year 8 (13 years old) 2 x Year 9 (14 years old) One group with four students (43 minutes) all in Year 6 (11 years old)	One group with four students (1 hour and 4 minutes) 4 x Year 5 (10 years old) One group with three students (26 minutes) 2 x Year 6 (11 years old) 1 x Year 7 (12 years old)	One group with four students (1 hour) 2 x Year 7 (12 years old) 1 x Year 6 (11 years old) 1 x Year 5 (10 years old) One group with three students (38 minutes) 2 x Year 6 (11 years old) 1 x Year 5 (10 years old)	One group with four students (56 minutes) 3 x Year 6 (11 years old 1 x Year 7 (12 years old) One group with five students (1 hour) 1 x Year 3 (8 years old) 3 x Year 5 (10 years old) 1 x Year 6 (11 years old)

3.3.3 Using sustainability reviews

A sustainability review is also known as an environmental audit or an environmental review (Envirowise, 2008). This audit examines a range of features on a site to determine the place's level of sustainability at a particular point in time and is useful as a first step towards developing future sustainable pathways (Envirowise, 2008). My sustainability review is an original design I developed because I could not find a generic

one suitable for my study. I conducted two sustainability reviews, one with the teachers I interviewed and another with the student groups, as semi-structured interview style exercises with teacher and student interview participants, directly following the interviews. The sustainability reviews were designed to add to other field texts to construct a detailed picture of environmental education for sustainability in each school, as well as confirm data or highlight inconsistencies. To design the teachers' sustainability review I drew heavily upon:

- A National Environmental Education Statement for Australian Schools' (NEES) *Framework for Environmental Education for Sustainability* (DEH2005), which recommends seven characteristics of effective education for sustainability (governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships, and school ethos). Details are described further on in the chapter,
- Catholic Earthcare Australia's *An Environmental Audit: Towards Environmental Futures* (Catholic Earthcare Australia, 2007), and
- Sustainable Schools NSW's *Checklist Towards Becoming a Sustainable School* (New South Wales Government - Sustainable Schools NSW, n.d-a).

For the students' sustainability reviews I downloaded the *Simple Environmental Review* from the Eco-Schools website (Eco-Schools, n.d) and adapted it to suit my circumstances. Although these audits could have been run as a checklist exercise, I felt that talking through the review rather than handing teachers and students the document to complete was a more viable approach that would allow me to probe, clarify and extend salient emergent points.

In addition to the sustainability reviews, I administered pen-and-paper questionnaires to the wider teaching staff in my case study schools. The purpose of the questionnaires was to gather data on how other teachers were thinking, feeling and acting with regards to the sustainability initiatives implemented in their schools. I explain these in detail below.

3.3.4 Questionnaire

A questionnaire is a data gathering technique for people's opinions, attitudes and/or feelings in response to questions asked by the researcher, and can be presented in various formats such as pen-and-paper, face-to-face or electronic (Denscombe, 2007). The underlying assumption is that the targeted sample are willing and able to provide truthful responses (Burns, 2000). Two types of sampling techniques can be used for questionnaires: probability and non-probability sampling. Probability sampling is random. The research sample is selected without knowing whether the sample is representative of the overall population being studied. Non-probability sampling involves purposeful selection of the sample (Denscombe, 2007) and is the most suitable approach when the researcher has background knowledge of the research context (the people and events) and the sample is selected with a specific purpose in mind (Denscombe, 2007). My questionnaire targeted all teachers working in my research participant schools. Details are provided in Table 3.2. The non-probability sampling technique was appropriate because my questionnaire was grounded in the "discovery" approach to research (Glaser & Strauss, 1967) where the researcher, rather than have a predetermined plan to test a hypothesis, opens up the research to "discover" multiple perspectives.

Gathering information from other teaching staff provided a wider picture of education for sustainability at each school. Pen-and-paper questionnaires have advantages and disadvantages. The advantages are they are convenient, and provide large amounts of information for relatively small amounts of money, materials and time. Confidentiality can be assured and data is generally easier to analyse and categorise as wording of the questions are identical for all participants (Bryman, 2001; Burns, 2000; Denscombe, 2007; Kayrooz & Trevitt, 2005). The most salient disadvantages include poor response rates; the information obtained can be superficial; the researcher is not able to extend questions and/or verify or check answers; the wording, structure or composition of the questionnaire can limit and shape answers; and questions can be misinterpreted (Bryman, 2001; Burns, 2000; Denscombe, 2007).

To minimise the disadvantages, questionnaires were prepared as a package consisting of a cover page providing an overview of the research purpose, the stages and the required task; the questionnaire; and a stamped, self-addressed envelope. The questionnaire itself consisted of one open question which focused on the central issue of my investigation. The question was: "What do you perceive the impacts of your school's environmental education initiatives are?" The question was printed at the top of an A4 page in bold print and respondents were provided with the rest of the page and overleaf to reply. Teachers could answer the question in a writing style of their choice, for example, dot points or story format. I used an open question style to capture the richness and complexity (Denscombe, 2007) of thoughts on education for sustainability in each school. The distribution of questionnaires was negotiated with each school principal. At Reliwarra State College, the principal invited me to attend a staff meeting to brief the teachers on the research and hand out the questionnaire. At Fontana State School, the principal invited me to talk to teachers during a lunch break in the staff room. The Fontana State School principal also posted information about the questionnaire on the school's internal computer network system, on the staff room information board and placed a questionnaire package in each teacher's pigeon hole. At Hollindale State School and Whanilla State Schools, the principals distributed the questionnaires at a staff meeting.

Regardless of a concerted attempt to overcome questionnaire disadvantages, I certainly still experienced at least one shortcoming - this being extremely low response rates from staff at Hollindale SS (3%) and Fontana SS (4%) (see Table 3.2). Asking why this occurred raises a number of questions and possibilities. In many schools across Australia, education for sustainability has struggled to establish and maintain a profile among a long list of other competing educational demands (Greenwall Gough, 1997; Tilbury & Cooke, 2005). Although research indicates teachers acknowledge the importance of teaching and learning sustainability education (see for example, Cutter, 2002), implementation is often marginalised and positioned as a low priority, left to a few very dedicated teachers, or employed as an add-on to an already overcrowded curriculum (Cutter, 2002; Robottom, et al., 2000; Tilbury, et al., 2005; Tilbury & Cooke,

2005). The staff from the schools I researched identified their school take a whole-school approach to education for sustainability. However, the low rate of responses from staff at Hollindale SS and Fontana SS raises the possibility that in these two schools, at least, education for sustainability is still driven by a few committed teachers.

3.3.5 Document study

Documentary evidence texts come from a wide variety of sources and serve to confirm or contradict data gathered through other means (Salkind, 2003; Yin, 2003). The documentary evidence in this research contributed to the total evidence to build a story about each particular school. Choosing documents to include as part of the research evidence can be a problematic task when schools produce large volumes of documents for administrative purposes. I collected as much relevant documentary evidence from each school as I was able. This includes public and private photographs of the school sites, school environmental management plans (SEMPs), school news letters, websites, reports and grant submissions, media outputs by the schools – such as articles in "The PostEd", a section of *The Cairns Post* newspaper dedicated to promoting school activities. A complete list of relevant documentary evidence I collected from each school is found in Table 3.3.

Table 3.2. Teacher questionnaire details

School	**Number of questionnaires distributed to teaching staff**	**Number of questionnaires returned**	**Percent %**
Reliwarra SC	62	19	30%
Hollindale SS	61	2	3%
Whanilla SS	6	6	100%
Fontana SS	47	2	4%

3.4 Analysis of information and evidence

Data analysis tells us the “how”, “why” and “what” of research inquiry by providing a means to interpret, explain and understand phenomena (Dey, 1993, p. 30). Qualitative data conveys meaningful information in a form other than numbers (for example, interview transcripts, documents and field notes) and is analysed through conceptualisation rather than through statistics and mathematics (Dey, 1993). My data analysis examined how each school constructs education for sustainability through a four stage process. Figure 3.1 provides an overview of the steps of the analysis process.

In the first stage I applied five levels of qualitative analysis (explained below) to the field texts collected at each school to order, organise, synthesise and identify themes and patterns. In the second stage, I built these data into a series of full narratives on how education for sustainability is constructed in each school. In the third stage, I analysed the narratives (explained below). The fourth and final stage involved developing a set of qualitative indicators of education for sustainability informed by social-ecological resilience theory and education for sustainability literature. Stages One and Two involved working with the field texts collected at each school on a case-by-case basis. Stages Three and Four involved cross-case analysis. Employing the various levels of analysis enabled me to develop a comprehensive understanding of how education for sustainability is constructed in each school, enabled me to write in-depth and informed narratives and develop indicators.

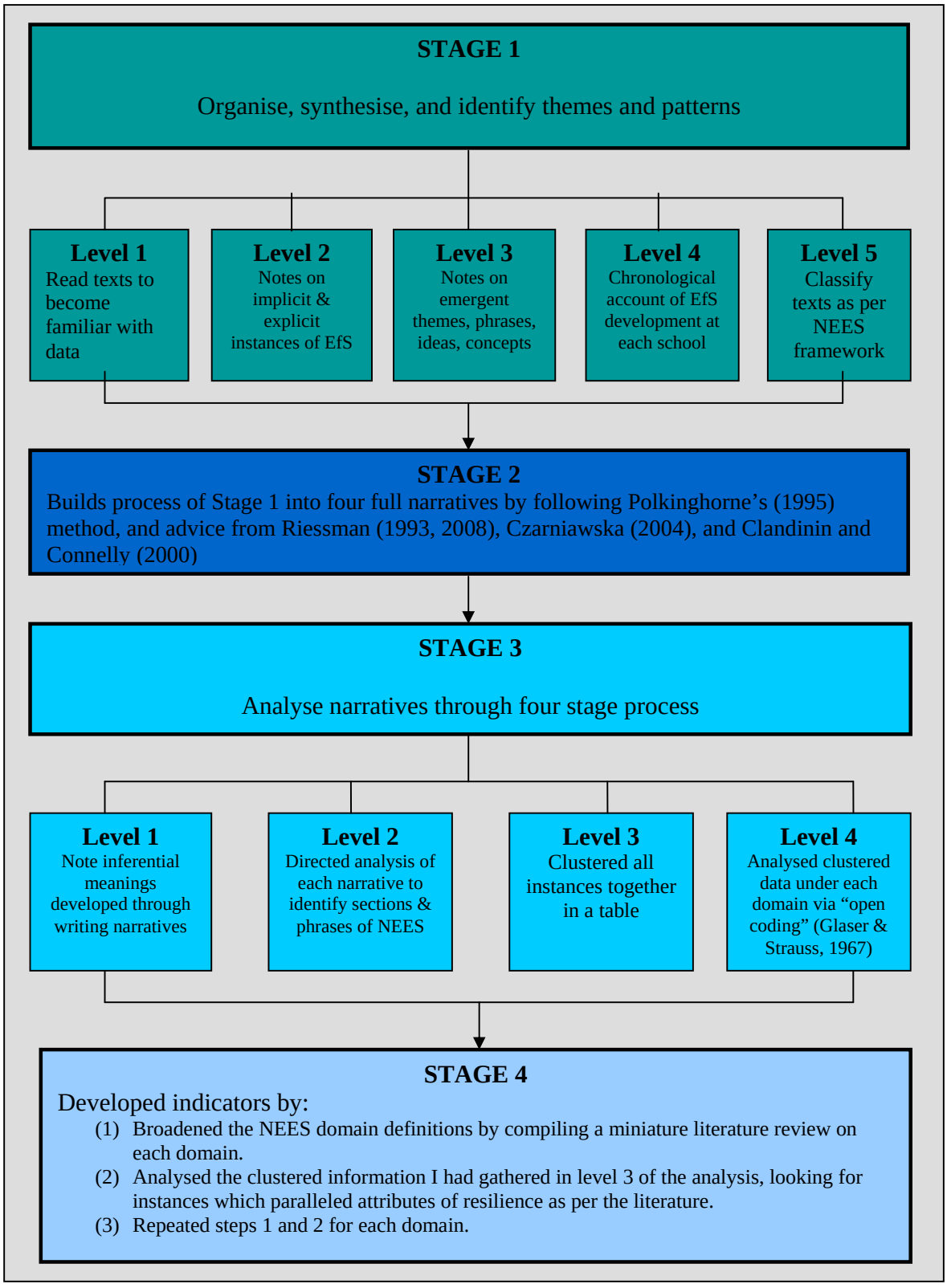

Figure 3.1. Steps in the data analysis process

Research participants exert influence over field texts because they create their stories and answers to questions with preconceived ideas about the research and required information (Riessman, 2008). I am aware that, although I tried to be as objective as possible, preconceptions about potential research results shaped my listening and questioning during interviews, transcription and writing of the narratives (Riessman, 2008). To avoid unidimensional and biased field texts I applied data triangulation and member checking methods (Creswell, 2007). Data triangulation occurs when different sources of data are collected to study a phenomenon (Patton, 2002). When evidence is collected from multiple sources, data is regarded as more valid and reliable because findings can be cross-checked and corroborated. According to Creswell (2007) research can be considered valid when findings are agreed on by both the researcher and the participants. One way to ensure validation is by member checking, a process which involves participant review and input into study findings. In attempting to make my school narratives valid and trustworthy representations, I sent the narratives to the adult research participants and invited them to make changes, comments or suggestions. Out of the four participant schools, Whanilla SS was the only one I received a response from. The Principal and education for sustainability coordinator read and annotated desired changes. I complied with the requests and sent it back to them for confirmation.

My analysis followed qualitative analytical techniques set out by Miles and Huberman (1994), Strauss (1993), Dey (2002), Creswell (2007), and Silverman (2005) as I found these the most helpful. My research analysis was guided by the question "How is education for sustainability constructed in this school?" The aim was to examine each school's everyday management, teaching and learning from a social-ecological perspective. Each level of analysis built on understandings already grounded and helped me develop a more in-depth and sophisticated overall analysis. All levels required 'active' reading which involves sitting up, pen in hand, and interacting with the information by annotating, and highlighting instances that helped answer "Who? What? When? Where? Why? questions within the context of the overall direction of the study" (Dey, 1993, p. 83). Below I explain the data analysis procedure I applied.

3.4.1 Stage One – Sorting through the field texts

To begin, I organised hard copies of all field texts I had collected into piles that corresponded to each individual school so that I could analyse each school independently. The analysis of the field texts for each school then proceeded as follows:

1. I carefully scrutinised the field texts. This required inspecting and reading through all the texts to get a feel for the discourses and nuances of the school.

2. I inspected and re-read the texts a second time. This time I made notes in the margins referring to implicit and explicit instances of text that highlighted constructions of education for sustainability at the school.

3. I inspected and re-read all the texts a third time. This time I made notes in the margins about themes, phrases, ideas or concepts that emerged directly from the field texts and were related to the analysis question.

4. I inspected and re-read all the texts a fourth time, and constructed a chronological account of the development of education for sustainability within the school.

5. Finally, I inspected and re-read all the texts a fifth time. This time I classified texts as per the *Framework for Environmental Education for Sustainability* (DEH2005), set out below. This consisted of reading and re-reading each text and noting down each instance that corresponded with sections of the framework. I then cut and pasted each into a table.

Below I explain the Australian Government's (2005) *Framework for Environmental Education for Sustainability.*

3.4.1.1 The Australian Government's *Framework for Environmental Education for Sustainability*

The document released by the Australian Government in 2005 called *Educating for a Sustainable Future: A National Environmental Education Statement for Australian Schools* (DEH2005) provides a nationally agreed description, vision and framework for the development of education for sustainability in the school sector called *A Framework*

for Environmental Education for Sustainability. The document is intended for use by teachers, schools and their communities, education systems and curriculum writers, and aims to affirm success, indicate "good" practice and inspire school communities to take action. I apply the framework to guide my study because it is representative of a whole-school approach to education for sustainability which includes a school ethos, governance, physical surrounds, resource management, teaching and learning, curriculum organisation, and networks and partnerships. Figure 3.2 provides a visual representation of the framework. Directly below Figure 3.2 I explain each domain of the framework as per the explanation provided in the document.

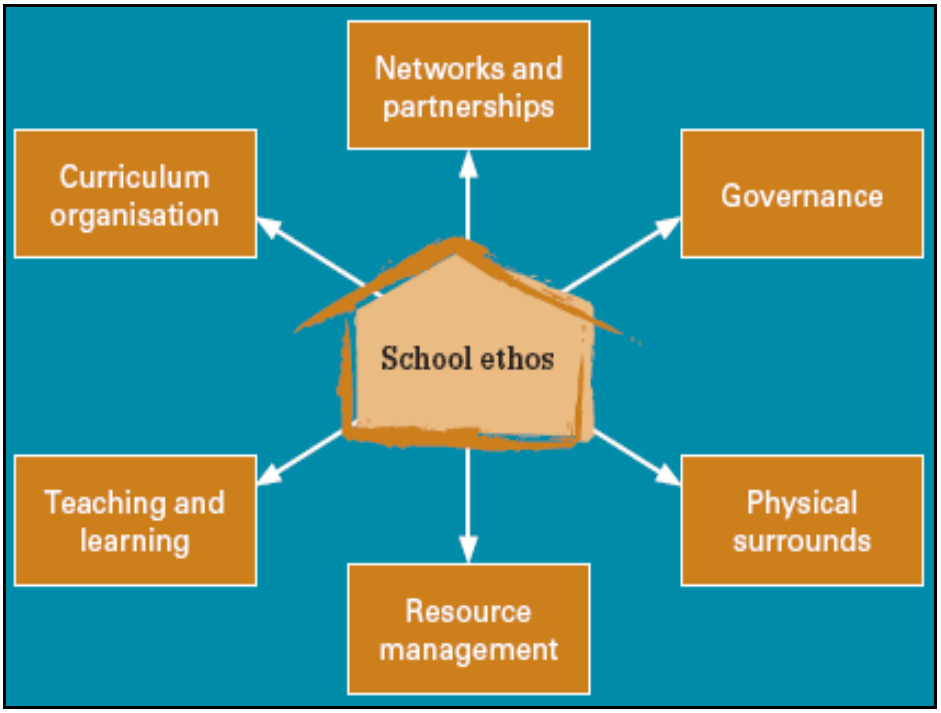

Figure 3.2. A Framework for Environmental Education for Sustainability (DEH2005, p. 7)

School ethos

For environmental education for sustainability to be truly effective it needs to be a core feature of the school ethos. The school ethos is the value structure that underpins all domains of teaching and learning and management at a school, and includes a shared vision, goals and objectives. The school ethos is best determined through discussions, dialogue and reflections involving school community members. According to the

Framework for Environmental Education for Sustainability (DEH2005), the school ethos may be explicitly written in policy documents, but is most apparent in the interrelationships between school staff, students and parents.

Governance

Governance refers to school leadership and management structures. Typically, Australian schools are governed by a principal, who has overall responsibility for the school. While schools usually have school councils these bodies are advisory only. In larger schools the principal is supported by a team of administrators including a deputy principal. In smaller schools the principal usually balances administration duties with a shared teaching load. High quality and effective governance is adaptive and is evident where decision making is distributed across the school community, including students and parents.

Physical surrounds

Physical surrounds are the physical areas on and around the school grounds and include buildings and landscapes. Schools are encouraged to transform (a) school grounds into examples of working sustainable landscapes through habitat creation and restoration, food production, mulching, landscaping, litter reduction, and creation of learnscapes; and (b) school buildings to incorporate energy-efficient elements. According to the *Framework for Environmental Education for Sustainability* (DEH2005), increasing the diversity and vegetation of the school grounds enhances the image of the school and maximises potential student educational and environmental experiences.

Resource management

In the *Framework for Environmental Education for Sustainability* (DEH2005), resource management refers to the ways schools manage resources such as energy, water, and waste. Schools are said to become more sustainable if they commit to identifying, conserving and improving the environmental and heritage values of their school site, as well as by reducing their ecological footprint – which can be understood as a measure of human demand on the planet's ecological resources. Environmental education for sustainability aims to help schools reduce waste, minimise energy and water

consumption, increase recycling, encourage biodiversity in the school grounds, conserve the heritage value of the site, apply sound purchasing practices and ensure canteen products are environmentally appropriate. It is preferable that sustainable resource management becomes integral to the school's daily operational practices.

Teaching and learning

Effective teaching and learning with an environmental education for sustainability perspective enables students to better understand the world around them. Students can contribute to creating a sustainable future by becoming reflective and deep thinkers, ethical and responsible citizens, and connected and autonomous learners. Ideally, teaching and learning is active, self-directed and empowering.

Curriculum organisation

Curriculum organisation involves planning and organising the curriculum content within the context of each school. Effective environmental education for sustainability requires a whole-school focus, not just structured learning activities. A valuable environmental education for sustainability curriculum provides the knowledge and understandings, skills, attitudes, values and opportunities for participation and action.

Networks and partnerships

Networks and partnerships facilitate education for sustainability work and help students make links between school and their lives outside school. Partnerships can be formal or informal and include collaborative action with the local and broader community. Schools form partnerships with other educational institutions, local councils, businesses, industry, and community groups.

3.4.2 Stage Two – Writing the narratives

Stage Two of the analysis consisted of writing the narratives. Difficulties with narrative methods arise because no prescribed procedures exist (Czarniawska, 2004b; Riessman, 1993). Clough (2002) believes it is impossible to offer prescription for narrative research. Clandinin and Connelly (2000) consider "anything goes" as long as "it works and is convincing for the audience" (p. 154). To write the narratives I followed Polkinghorne's (1995) guidelines for developing narratives (explained below), and

referred to Riessman (1993, 2008), Czarniawska (2004a), Clandinin and Connelly (2000), and Clough (2002) who provides specific examples of narratives in research. Directly below I describe Polkinghorne's (1995) method for writing narratives with reference to the writing of my own narratives.

3.4.2.1 Polkinghorne's guidelines for developing a narrative

Polkinghorne's (1995) narrative analysis method is largely preoccupied with the writing of the stories themselves. The stories are written by organising field texts into a logical developmental order by applying a plot to produce stories. The stories give order and meaningfulness to what can sometimes be very illogical and disparate field texts. Unlike other qualitative data analysis methods that pull data apart, Polkinghorne's (1995) narrative analysis synthesises field texts and configures them to make a whole. The stories reveal the uniqueness of each individual case and provide understanding of the case's idiosyncrasy and particular complexity. Polkinghorne's (1995) guidelines, based on Dollard's (1935) work, state that in creating narratives, the author needs to consider and incorporate the cultural setting, the protagonist/s and other people that interact with the protagonist/s, the interaction between the protagonist/s and the setting, the historical continuity of the characters, a bounded temporal period (beginning, middle and end), and story plausibility and comprehensibility. I explain these below.

Cultural setting

The cultural setting includes the values, social rules, meaning systems, and language of the storied place to explain happenings and actions. All schools develop specific cultural settings which staff members are expected to embody, thus a narrative includes the cultural features to help explain particular happenings and actions.

Embodied nature of the protagonist/s

This can include physical and cognitive characteristics. These provide context for actions because people's actions and reactions are affected and restricted by personal characteristics. For example, Polkinghorne (1995) explains the physical and cognitive development of a three-year old and a 73-year old are very different, which obviously impacts on the way they act and react. In my narratives the key teachers and principals are the protagonists.

Significant other people

Narratives require an explanation of the relationships between the protagonists and other people which affect their actions and goals. The significant other people in my narratives include students, parents and community members who participate in the schools' initiatives. What a teacher can or cannot do is affected by the principal and, in part at least, by the expectations and demands of the parents and/or guardians and the local community.

Understanding the protagonist

Narratives must develop understanding of the central character by uncovering her/his personal meanings, understandings, worldviews, plans, purposes, motivations and interests. Polkinghorne (1995, p. 17) tells us the protagonist is not "merely a pawn buffeted by the setting, but an actor who alters the scene". This is particularly relevant to key teachers in my case study schools because the education for sustainability actions they take are very intentional. In my narratives I develop an understanding of the key teachers' motivations for implementing education for sustainability.

Historical continuity of the characters

Development of the characters needs to be embedded within the context of their own life history. The decisions and actions we take are embedded in and affected by historical factors such as where we come from, and how we learnt about and experienced life while growing up. This is relevant in my case studies because research indicates childhood personal histories play a significant part in the development of adult environmental actions (see Hart & Nolan, 1999; Jacobson, McDuff, & Monroe, 2006).

Bounded temporal period

This refers to a story containing a clear beginning, middle and end which advances the plot. The beginning outlines the initial situation and explains how everything began. The middle details how things developed. Finally, the end sets out the outcome (Flick, 2006). My narratives are historical but end in 2009 due to the demands and restrictions of a PhD study.

Story plausibility and comprehensibility

A narrative provides a plot that unifies all the disparate field texts into a story that provides a meaningful, believable, intelligible, and holistic explanation of occurrences. The story is a reconstruction of a series of events and actions that produce a particular situation. Polkinghorne's (1995) explanation of outcomes is very specific. For example, the achievement of a high reading score, overcoming performance fears, and overcoming an addiction to drugs (p. 18). However, to my mind, outcomes are negotiable and the outcomes of my narratives are more general than Polkinghorne's. I do not target one specific item; rather, the outcome is an understanding of how education for sustainability is constructed and played out in each school. My stories narrate these constructions. I give a more detailed explanation of how I developed my narratives below.

There are many ways to represent field texts. The particular way I have constructed my narratives is based on my preconceptions as well as my constructivist epistemological and ontological understandings. In keeping with Czarniawska (2004b), writing narratives from field texts is a matter of recontextualising the texts in a manner that is interesting, credible and respectful. Problems with narrative arise due to difficulties in differentiating between fiction and fact. This is due, first, to a lack of structural differences between fictional and factual narratives (Czarniawska, 2004a) and second, it is due to the fact that narrative is retrospective and often people's recollections and/or versions of the same past events can and do vary. Narratives are not "out there" waiting to be collected, but are socially and actively constructed stories (Polkinghorne, 1995; Riessman, 1993, 2008). Research participants influence field texts because they create their stories and answers to questions with preconceived ideas about the research and the required information (Riessman, 2008).

The process for writing the narratives was not linear. Each narrative required writing and rewriting a number of times and involved applying my intuition about what felt, looked and sounded lucid and fluent. Each rewrite helped me to develop new nuances and refine the story. On one side of my computer I had Polkinghorne's guidelines to guide my

narrative construction; on the other side was the chronological account of the development of education for sustainability I previously prepared for each school. Problems I encountered in writing the narratives were not simply technical ones. I asked myself, as per Riessman (1993), should I include silences, false starts, emphases, nonlexicals like ‘uhm’, discourse markers like ‘y’know’. Riessman (1993) emphasises that choices of what to include and how to arrange and display the text have serious implications for how a reader will understand the narrative.

3.4.3 Stage Three – Analysing the narratives

Stage Three involved:

1. Writing down inferential meanings I developed through the process of writing the narratives about the characteristics and construction of education for sustainability in each school.

2. Directed content analysis (Krippendorff, 2004) of each narrative to identify sections and phrases related to governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships and school ethos as per the Australian Government’s *Framework for Environmental Education for Sustainability*. The process involved reading and re-reading each narrative and jotting down instances in the margins that related to each domain until I was certain I had exhausted all the narratives for examples of each domain.

3. Clustering all the instances together in a table.

4. Analysing the clustered information under each domain by applying a method known as “open coding” (Glaser & Strauss, 1967). This required reading and re-reading the information under each domain while simultaneously writing down inferential meanings I derived. This cross-case analysis allowed me to identify themes from the narratives which were similar and different in meaning. I repeated this step a number of times.

3.4.4 Stage Four – Developing the indicators

The last stage of analysis involved the development of indicator domains and indicator variables. Together, these formed the qualitative indicators, which I describe as statements that provide rich descriptions of the characteristics of resilience in schools. The indicators include subjective measures and are shaped in response to the data collected from the participant schools as well as the literature on education for sustainability and social-ecological resilience. To develop the indicator variables I applied knowledge and understanding from the *Framework for Environmental Education for Sustainability* (DEH2005) and drew on literature about indicators (for example, Meadows, 1998; The Victorian Community Indicators Project Team [VCIP], 2006; Tilbury, et al., 2007). To develop the indicator variables I relied on the analysis derived during Stage Three to identify themes which were similar and different in meaning to resilience, the literature and my own understanding of social-ecological resilience.

My indicator framework consists of a set of qualitative statements written around each school's ethos, governance, physical surrounds, resource management, teaching and learning, curriculum organisation, and networks and partnerships domains of *A Framework for Environmental Education for Sustainability* (DEH2005). I derive the indicators direct from my narratives which are based on my field texts. The indicators are not framed from a measurement approach, but are designed from a communication and explanation perspective. The process for developing the indicators was shaped by consultation with people involved with research in the sustainability and education for sustainability field, data collection from the participant schools and relevant literature. The process for developing the indicators is set out below.

1. I broadened the definitions provided in the *Framework for Environmental Education for Sustainability* for school ethos, governance, physical surrounds, resource management, teaching and learning, curriculum organisation, and networks and partnerships by searching the literature and compiling a miniature literature review on each domain. For the governance domain I searched all literature related to school leadership, governance and/or management. This

allowed me to formulate a broad understanding of what school governance is or is not according to past and recent research.

2. I analysed the clustered information I had gathered in level 3 of the analysis, looking for instances which possessed attributes of resilience as per the literature. For example, I looked for elements of diversity, transformability, self-organisation, and social capital. This step, which was informed by the analysis process to date, led me to define the research emergent category codes which formed my indicators. In this way the variables emerged directly from the inferential meanings I got from each narrative which was based on the field texts I collected from each school.

3. I repeated the above steps for each of the domains in the *Framework for Environmental Education for Sustainability* (DEH2005).

I am aware that the themes are constructs and that they vary between the narratives. Some themes appeared strongly in one narrative, and less strongly in others, or were missing altogether from one of the narratives. The process of developing the indicators required me to apply judgement to identify the most important and representative themes for my research. The themes emerged from directed content analysis of the narratives using the *Framework for Environmental Education for Sustainability* (DEH2005). The indicator domains and variables are presented in Chapter Five, together with the qualitative indicators which are constructed from the domains and variables.

Conclusion

In this chapter I have explained the approaches and methods through which I have collected and interpreted my field texts as well as provided the necessary background for reading Chapters Four and Five. I chose qualitative research because the approach suits the purpose of my study. The case study approach allowed me to collect large amounts of information about the practice of education for sustainability and resilience in school education. Interpreting the field texts via narrative enabled me to organise and make sense of them and, simultaneously, to provide context and research participant voice.

The narratives provide the background for development of indicators of resilience through education for sustainability. The indicators are a tangible method for interpreting and presenting results from my research. The indicators are a set of propositions which aim to open further discussion about the scarcely researched phenomena of education for sustainability, resilience and school education; this is why they can be called variables. The next chapter presents the narratives and Chapter Five presents the indicator framework emergent from my research.

Table 3.3. Field texts collected at each school

School	Interviews	Documentation	Sustainability Review	Teacher Questionnaire	Archival records
Reliwarra SC	1 x joint interview with the principal and associate principal 1 x interview with key teacher 2 x student group interviews	School Environmental Management Plan (SEMP) 2007 and 2008 Annual School Reports and curriculum units of work Sustainable Living Challenge Award submission 2007 and 2008 end of year school sustainability report Assortment of school newsletters Litter Free Lunchbox brochure Photographs of school and sustainability related events School website *The Cairns Post* "PostEd" articles	Conducted with key teacher. Audio recorded and notes taken.	Distributed to teachers.	Field notes I took during and directly after school visits. Eg., Appearance of school grounds. School demographics through Education Queensland and school websites. School community context demographics through Cairns City Council, Australian Bureau of Statistics websites.
Hollindale SS	1 x interview with principal 1 x interview with key teacher 1 x interview with second key teacher 1 x interview with Year 1 teacher 1 x interview with Year 4 teacher 1 x interview with Year 6 teacher 2 x student group interviews	2007 and 2008 Annual School Reports and curriculum units of work 2005, 2006, and 2007 Reef Guardian Reports Reef Guardian School awards submission Future Leaders Eco-Challenge 2007 submission Sea and Sustainability 2008 Calendar 2005, 2006 and 2008 Reef Guardian Action Plan Photographs of school and sustainability related events *The Cairns Post* "PostEd" articles The school website	Conducted with key teacher. Audio recorded and notes taken.	Distributed to teachers.	Field notes I took during and directly after school visits. Eg., Appearance of school grounds. School demographics through Education Queensland and school websites. School community context demographics through Cairns City Council, Australian Bureau of Statistics websites.

Fontana SS	1 x interview with principal 1 x interview with key teacher 2 x student group interviews	2007 and 2008 Annual School Reports and curriculum units of work Comalco Green & Healthy Schools award submission 2007 School Environmental Management Achievements Report 2008 overview of achievements Media release from the Comalco Green & Healthy schools award Photographs of school and sustainability related events School website	Conducted with key teacher. Audio recorded and notes taken.	Distributed to teachers	Field notes I took during and directly after school visits. Eg., Appearance of school grounds. School demographics through Education Queensland and school websites. School community context demographics through Cairns City Council, Australian Bureau of Statistics websites.
Whanilla SS	1 x interview with the key teacher 2 x joint interviews with the principal and key teacher 2 x student group interviews	Education Queensland Show Case Awards submission 2005 Reef Guardian Action Plan and Report 2006 School Sustainability Action Plan 2007 School Sustainability Action Plan and Annual Reef Guardian Report 2007 and 2008 Green & Healthy Schools Assessment Booklet Curriculum units of work 2008 *Women's Weekly* Award submission Telstra Environment Awards submission Photographs of school and sustainability related events School website	Conducted with principal and key teacher. Audio recorded and notes taken.	Distributed to teachers.	Field notes I took during and directly after school visits. Eg., Appearance of school grounds. School demographics through Education Queensland and school websites. School community context demographics through Cairns City Council, Australian Bureau of Statistics websites.

Chapter 4. School Narratives

Introduction

Over the time I have been researching education for sustainability in schools, I have had the opportunity to meet and speak with a large number of informed, hard working and talented people from schools, universities and Education Queensland. I have found schools have a diversity of reasons for engaging with education for sustainability. Nearly always, education for sustainability begins with one or two passionate teachers and an enabling school principal. Embedding education for sustainability into schools is a progressive and inductive process. My research data indicates most schools do not sit down with a meta-plan. Rather, the process is much more subtle, organic and emergent. This is certainly the case at Whanilla, Fontana, Hollindale and Reliwarra schools (pseudonyms) which are the focus of this thesis.

This chapter tells the stories of each of the four schools' experiences of implementing and running education for sustainability programs/initiatives. Each story captures how the school constructs education for sustainability based on the data I collected via interviews, document analysis, sustainability reviews, observation and questionnaires. Each narrative is written by me as the narrator as a way of presenting the data collected from each school. To reflect a constructivist approach and to make the story flow, the narrator and participant voices in the narratives are combined rather than set out on separate lines. I begin the section on each school by providing context which explains the setting, characteristics and history of the school. Each school narrative follows a similar structure: The introduction section tells how education for sustainability began at the school and how the initiatives have been enabled. The next section explains the implementation process, including each school's experiences with education for sustainability. All narratives end with a segment explaining the progress the school has made after five years of implementation. Each narrative is followed by a précis. The précis is based on inferential meanings I inferred about the characteristics and construction of education for sustainability at each school and lays the foundation for further analysis that arrives at qualitative indicators in Chapter Five.

4.1 School Narratives

4.1.1 Whanilla State School

Context

Whanilla is situated about 100 kilometres north of Cairns in a semi-rural area. The school is located 300 metres from the beach, in the middle of Whanilla township which is situated between two World Heritage listed areas – the Great Barrier Reef on one side and the Wet Tropics Rainforest on the other. The student population is around 120 from Preparatory (or kindergarten) to Year Seven. The local population mostly consists of blue collar workers or sugar cane farmers. The predominant economic activity in the area is sugar cane. The school employs six permanent full-time teaching staff and some part-time teachers. Students are grouped into five mixed age classes: Preparatory–Year One, Year Two–Three, Year Three–Four–Five, Year Four–Five–Six, and Year Six–Seven.

Whanilla SS has been implementing education for sustainability since 2004 and is locally known for focusing administration and teaching and learning around the principles and practices of education for sustainability. The initiatives are led by Kieran, one of the full-time teachers and enabled by Elizabeth, the principal. The approach involves the whole school in the implementation of curriculum, practical "hands-on" management of waste, water, energy and biodiversity, and extra curricular activities. Class teachers implement at least one sustainability-based unit of work per year to develop student knowledge and lead their class to take action to manage a particular aspect of the school's waste, water, energy and biodiversity.

Since 2004, Kieran has led the school to plant over 6000 trees, rehabilitate a dilapidated wetlands system adjoining the school (see Figures 4.1 to 4.5), implement a school-wide solid waste management and recycling system that includes a worm farm (see Figure 4.6), build vegetable and other gardens of endemic species (see Figure 4.7), create frog habitats, a wildlife corridor and a mini wetland in school grounds (see Figures 4.8 to 4.10), reduce school waste, electrical power and water consumption by 50%.

Whanilla SS's story

Kieran was inspired to initiate education for sustainability at Whanilla SS for personal and professional reasons. Kieran has been teaching at Whanilla SS and living in the surrounding area for 14 years. During this time he has developed a sense of place, a feeling of reciprocity with the landscape, and a concern about the degradation of ecological systems. Kieran exclaims "It was just a pity to see such a beautiful waterway system being destroyed, in the sense that it just became a dumping ground for people to dump their rubbish from their back yard. The council were concreting all the creeks so they would get better drainage. You know, you have a look around and you think, 'geeze, these little patches have brought so much life, it'd be nice to do something, something better'."

Professionally, Kieran wanted to meet curriculum demands in a locally relevant manner. Kieran's students use local creeks for recreational purposes and have established a connection with and knowledge of these creek systems. Kieran wanted to inspire students to develop a sentiment of stewardship and develop critical thinking and active citizenships skills. "If you look at the generation we live with, it's the most disposable. I'm horrified by the way we're going. Instead of repairing your TVs when they break down, now people go 'Oh, I want plasma'. It doesn't matter if it's not broken, get rid of it anyway. Most of us don't think in the slightest about it. We just do it because that's what your parents do, that's what you've always done. We started thinking 'Well, if we can get at the things students do all the time, address the rubbish they produce, and those sorts of things, then we'll have a real effect'. I want them [students] to make informed decisions. If their informed decision is that they're going to go and throw their pet fish in the creek, generate lots of rubbish, burn plastic in the back yard – they've made that decision knowing what the consequences are."

Principals are ambitious for their schools to have a positive reputation. Elizabeth is a teaching principal who teaches the Preparatory–Year One class three days per week and does administrative work the other two days. Elizabeth has been teaching for 15 years, and has been at Whanilla for 11 years. Of these, she has been principal for 7 years. Elizabeth describes herself as an enabler. "I always say I'm the enabler. I just enable education for sustainability to happen. I'm not a boss, I'm a leader. And sometimes I lead from the front and sometimes I'm just part of the pack that goes along. We work in

a team and we all create the objectives and goals together. I'll do whatever needs to be done. If there's a grant that needs to be written. If you need more money in your budget we'll do something creative to get money." When Kieran began to talk to Elizabeth about education for sustainability, Elizabeth recognised a myriad of opportunities and potential for the school. Elizabeth explains, "We wanted a corporate image for the school. We had this reputation, you know, all the ratbags come here … and we said 'we need a corporate image for us too. We need something that sets us apart'. And so when we were doing this, we said 'well, this is a good corporate image for the school as well … If we start doing well, then we get a good reputation, we get a good image'."

Elizabeth realised, early on in 2004, that implementing education for sustainability required time. She provided Kieran with one day per week, free of teaching, to establish and embed education for sustainability into all areas of the school. This includes school operations, curriculum design, teaching and learning, physical surrounds and relationships with the local school community. Assigning Kieran one day free of teaching per week required Elizabeth to creatively rearrange the school's set budget lines and funded positions as well as to make a personal time sacrifice. Education Queensland, the government body responsible for administering public education in Queensland, allocates staff to schools according to student enrolment numbers. As a teaching principal, Elizabeth is allocated three days of classroom teaching and two days of school administration duties per week. Elizabeth gave Kieran one of her allocated administration days and created the position of curriculum coordinator. "I go back to the classroom to free up time that I would have spent administering, to give Kieran time to do what he wants to do, what he needs to do, to run our program. Because I would have no experience of the wetlands or building the ponds that they're building out here, or all that sort of stuff, which Kieran can do". Elizabeth still needs to complete her principal administration duties using one less allocated administration day. The consequences are evident in that Elizabeth says: "I pay for it at 11 o'clock at night".

An emergent, inductive and flexible approach has enabled Whanilla SS to achieve continuous progress to become a model for what a sustainable school can be. In 2004 Kieran and Elizabeth began with a vision about how they wanted to act, but did not have a fully mapped out plan. Kieran planned for all initiatives to be action orientated because he considers active hands-on learning is more effective than passive learning.

“It’s the things you’ve done, rather than the things you’ve been told about, that stay with you for a long time. We do things students think is fun. They enjoy it [education for sustainability], which is the way I want them to see it. As we went on the picture got clearer and clearer. We saw what we wanted to do. One project just leads into another. We sort of amble along, take a few directional changes here and there [as required]. We keep following our noses. As things go wrong or go right. This determines where we go next. You can’t beat your head against a brick wall. If things aren’t going well in a direction, we’ll pick another direction. When you meet a barrier you think ‘We’ll drop that and we’ll go off in this direction’. We know we’re trying to reduce resource use. We know we’re trying to reduce water consumption. And we know we want to retain habitat.”

Embedding sustainability is a long-term process. Early on, Kieran realised that he alone could not effect school-wide progress toward sustainability. Despite Kieran’s best efforts, passion and commitment, he quickly became overburdened by an extensive workload. “Originally, I tried to do all of it [education for sustainability] through my own class. It really doesn’t work. I was trying to do energy efficiency, waste efficiency, habitat reconstruction, wetlands development and pull the local community into the school. It started to spin me out. After a while it kept me awake at night. There were problems all over the place.” Implementing systemic change towards sustainability was further complicated because the changes could not yet be articulated to staff. Elizabeth explains “everything was abstract and nobody knew what was going on”. Kieran and Elizabeth then recognised that without properly structuring and staffing the process to provide teacher agency, education for sustainability could not be sustained.

The following year (2005) Kieran and Elizabeth employed a change management approach to embed school-wide change for sustainability. Change management is one way to effect significant organisational change in an orderly and systematic manner. The method can be useful for transitioning from a current to a desired future state. So, what does this mean for Whanilla SS? Change management was implemented at management and ground level. At the management level, Elizabeth worked to integrate education for sustainability values and understandings into the school’s ethos and governance. To start, Elizabeth and Kieran very carefully articulated what education for sustainability looks and feels like at Whanilla SS. Elizabeth explains “We sat down with

the teachers and said ‘when we look in your classroom we will see this, when we walk around the school we will see kids doing this’.” Elizabeth ensures Kieran is available throughout the year to mentor teachers conceptual and practical issues.

On the ground, Kieran worked to integrate education for sustainability into the school curriculum, teaching and learning, physical surrounds, and resource management. All teachers participate in continuous in-house professional development and have gradually built up knowledge and understanding about the values, principles, practices and approaches to teaching education for sustainability. Teachers are required to implement at least one sustainability-based unit of work per year of their choice. The curriculum is supported through links to daily formal and informal school operations. Each class is required to manage one aspect of the school’s water, waste, energy and biodiversity throughout the year. Although each area is discrete, the requirements are integrated for ease of management and to help students make links between theoretical and practical components of education for sustainability. For instance, in 2007 the Preparatory–Year One class learnt about biodynamic farming and established and maintained the vegetable patch following biodynamic guidelines. The Year One–Two class learnt about water and maintained water issues within the school. The Year Three–Four class undertook a unit on waste and recycling and maintained the school’s waste management program which included sorting litter, recyclable and organic matter as well as educating other classes to sort their rubbish. The Year Four–Five–Six class did a unit on energy and also assumed responsibility for monitoring the school’s energy use. This included regularly recording school energy use and advising ways to decrease consumption. One way students did this was by checking to ensure that all classes turned lights and air conditioners off when the classroom was vacated. The Year Six–Seven class learnt about biodiversity and ecosystems in class and then built a frog pond, a mini wetland in the school grounds, and maintained a wetland area behind the school.

Significant barriers emerged early on in 2005. These included a lack of money, the perennial problem of time, resistance by some staff, and being positioned as “greenies” by local community members. Schools in Queensland are not allocated funding for sustainability initiatives. Kieran and Elizabeth quickly realised “You can't do anything without money. Tiny projects end up costing a fair bit. Like the recycling bins – you want to get the bins, you want to fill the worm farm. Just the infrastructure that goes

with it and the materials that are required all add up." Elizabeth and Kieran have overcome a lack of systemic funding for sustainability initiatives by developing and refining their expertise in completing grant submissions. A partnership approach with various organisations and individuals has resulted in enormous success. From 2005 to 2007 Kieran and Elizabeth secured five grants to the approximate value of $61,000. Grants are competitive and enormously time consuming to write. Kieran says "To write a good grant it takes me – because they want all sorts of stuff, including signed permissions if it's off property – it takes me two weeks to write, usually". Although Kieran was allocated one day per week to work on the school's education for sustainability initiatives, he would often spend a second day, on the weekend, to writing grant submissions or prepare work.

During 2006, Elizabeth and Kieran discovered resistant colleagues caused problems in the school. One case was a teacher who was transferred into the school at the beginning of the 2006 school year. Kieran explains this teacher "used to come and say 'Oh sustainability sucks' when she walked into the staff room." Elizabeth tried to accommodate and encourage the teacher to engage with the school's directions. "I tried being nice and supportive, [I said] Kieran can help you, he's got an environmental science background. You pick your topic and we can have planning days. Because the teachers here get a planning day a term, out of the classroom and they can work with Kieran if it's an environmental topic, they can have a Wednesday to work with him as well. So there's all that support and we've got money [for planning]." When the teacher continued to resist, Elizabeth felt compelled to take a more heavy handed approach. "At the end of the day when they go 'No, No, No' I go 'Well, this is the way we're doing it at Whanilla. This has been decided by the P&C [Parent and Citizens Association], this has been decided by the staff. The staff is more than one person. You're just going to have to do it'. And they have to."

Kieran felt the effect of this teacher's resistance in a small school was that, "It stopped us going forward". Kieran had spent the 2005 year working with the Year Six–Seven students to design, plan and organise the rehabilitation of a wetlands system behind the school. In 2006 Kieran changed year level and the new teacher taught the Year Six–Seven class. "It was really disappointing because I really wanted [the older students] to keep going with the wetlands. They had designed it. They had seen it built. They'd

planted it and I was really hoping they would continue on and turn it into a sort of Learnscape. But, it sort of got a bit lost because I was with the Three–Fours. I really wanted these things to go on but they just stopped." The result was, after a year-long struggle, the teacher transferred to another school.

A not-so-obvious barrier Kieran and Elizabeth face is being positioned as "greenies". A "greenie" is an, often pejorative, Australian vernacular term given to a person who prioritises the protection of the biosphere from human misuse. In Australian media and society "greenies" are often linked to irresponsible and radical environmental activism. Kieran explains his position with regards to the local community. "One of the barriers I tread very warily against is not being seen too green, not being seen as an ultra conservationist. If you're a radical in any field, if you're radically right-wing [for example], you can alienate a lot of people as well. So you've got to maintain your connection with the community you're working with. If they see you as being like them, but a little bit more over there [points left], they're accepting of that. But, if they see you as not being like them … I take a much more pragmatic, much more practical approach. Farmers have to make a living, they can only do what they have the resources to do. I'm sure a lot of farmers would like to treat their land a lot better than they do. But if you're being screwed to the ground and getting minimal price for your product, you haven't (a) got any spare money, and (b) you've got to maximize the returns from your land." Feedback from one Whanilla SS teacher in mid-2008 indicates the school has, "Put a positive spin on sustainability in a community that has perceived environmentalists as greenie trouble makers and an intrusion into their rights."

Elizabeth finds herself labelled as a "greenie" amongst fellow principals from the region. "Well they think we're a bunch of tree huggers. We joke about it and I know they mean it in the kindest jest, but we had a presentation the other day where someone gave us a whole lot of photocopies and [a principal colleague] said, 'Oh Elizabeth, you've got to go and hug a few trees for all of us, because look at all the photocopies". Elizabeth reports she is unaffected by colleague attitudes. "I don't care because it's what works for Whanilla. And it fits right. If I was at a different school with a different community, I might have to approach things differently. So I appreciate that there are different schools taking different paths."

One initiative which has required perseverance throughout the years is a school-wide solid waste management system. This system consists of three bins: one for recyclable waste, one for landfill waste, and a third for organic waste to feed the worm farm. Students are required to distribute rubbish into the appropriate bin. Separation of waste was difficult to establish. Kieran explains “We tried to get the kids to cut down their rubbish and get rubbish sorted. But it really didn’t work very well, and in the end we were really wondering whether it pays to do this sort of stuff. The rubbish is a really labour intensive and a difficult issue. If you talk to any school that undertakes environmental actions, they’ll all tell you rubbish is a major pain in the neck. The kids don’t sort it properly, and reducing the amount of waste that comes in is quite difficult.” Nevertheless, Kieran persevered because he believes children’s actions can become more sustainable.

The school has trialled various methods of managing lunch waste. During 2007 the Year Three–Four class took sole responsibility for implementing the system for the whole year. In 2008 each class was allocated a term to manage the bins. Kieran found the separation system works best if one class takes full responsibility. The Year Three–Four class that managed the waste bins in 2007 demonstrated initiative and creativity by, for example, allocating students to guard the bins during breaks. They called themselves “bin guards” and were rostered. The bin guards ensured that waste was thrown into the correct bin and paid students ED2 (ED is short for Enviro Dollars – Whanilla SS fictional money) each time they placed recyclable waste in the recycle bin. In one of our meetings in 2008 Kieran reported the “bin guard” idea worked very well and he was considering offering to pay students (in Enviro Dollars) to take up “bin guard” positions. School staff encourage students to minimise the amount of rubbish bought in to the school by paying students ED2 for having zero rubbish lunch boxes.

With perseverance the waste separation program does work, although Kieran declares “It has its ups and downs. It works but there’s always a pretty high percentage of contamination. It certainly keeps the amount of rubbish to landfill down though”. Additionally, the school reduces paper waste by using overhead projectors rather than photocopies (every classroom is now fitted with an overhead projector), using both sides of any paper, shredding paper and feeding it to the worm farm.

By 2007 Whanilla SS had built a reputation as being a school that models sustainability principles and practices in all aspects of the school, including the school ethos, governance, curriculum, teaching and learning, physical surrounds, resource management and relationships with the community. Teachers now choose to transfer to the school because they want to be involved in education for sustainability. Elizabeth states "We've got a new teacher coming and she's chosen to come here rather than another school in the district, because this is the way we do things at Whanilla. She's had a look at our website. She's involved with a school in Cairns and seen Kieran and the kids at a workshop. She knows what we do and she's really keen. When she had a choice of schools up here, she said 'I want to go to Whanilla and I want to do what Whanilla's doing'. So that's really good, because it means already we've got someone coming who wants to take on projects and wants to be involved." In mid-2008 this new teacher reported that "As a new teacher it has been refreshing to have the children show and teach me about all the initiatives. It is clear that [students] have been integral in the planning and implementation of these initiatives. My previous experience in schools has been fighting staff and students to take on tasks. Here children display real ownership and are proud of their efforts".

Two enabling personal attributes Elizabeth shares with her staff are support and trust. Kieran says that, "Having a supportive principal makes a huge difference. She's never put up a barricade. She's always asked 'How can we do it?' [She is] Always looking for ways of facilitating what we're trying to do rather than say 'No, no, that's too expensive, that's too messy.' She asks 'What are we going to do?' The great thing about Elizabeth is she trusts us and she'll say, 'Okay, you can do this. Don't kill anyone, and don't poison anyone'. Elizabeth trusts me. I go to Elizabeth and let her know what I'm doing. But every time I go to Mitre 10, I don't say 'I'm going to buy another bag of cement, is that alright with you?' If your principal trusts you to do your stuff, you think, 'oh yeah', and you try to live up to it".

Elizabeth's approach is to trust her staff. She says her attitude is that, "I will trust you until you do something otherwise. I expect everyone to be honest and do the right thing. There's nothing here that's kept a secret. Even as far as the stationery cupboard. I was having a chat with another principal last week. Their stationery cupboard is closed with a padlock on it and only the admin assistant has the key … Everyone [here] has a master

key to the school, whether you're the cleaner or you're a teacher or you're the head of curriculum or you're me … So that means you can walk into my office and everything is here. And I just trust that there's no reason why anyone would need to walk into my office – unless there is something here that you need." Trust extends to the Whanilla SS community. Elizabeth noted the school's Parents and Citizens Committee (P&C), "Give us $1000 [every year], no questions asked. We don't have to ask their approval to do things ... the P&C just go 'There are no questions asked, we know you're doing sustainability. We know you use the money wisely. Just give us the receipts'."

Whanilla SS can be considered a working exemplar for school-based education for sustainability. School management and organisation centres around education for sustainability. Each class has a designated and negotiable project. There is emerging anecdotal evidence students are internalising (at least to some extent) some of the practices Kieran initiated. Over the years there has been an increase in the number of students and teachers bringing litter-free lunches to school. As many as 80% of lunch boxes can be litter free. Teachers said the zero rubbish lunch initiative prompted her to think more carefully about the materials she used to pack her lunch. One student mentions: "We buy big tubs of yoghurt now. We just put them [the yoghurt] into containers and just take them to school instead of buying all the small ones [tubs of yoghurt] and creating heaps of rubbish". Certainly, the adult staff is thinking differently. In the words of a classroom teacher, "As a staff, people are changing their attitudes in the way they think [about sustainability issues]".

Kieran remarks, "Personally, the work we have been doing on sustainability has made me look at many of the environmental issues that are now global in their causes and solutions. I am becoming increasingly aware of the high probability that we are on the cusp of a great change in human history. You can see the groundswell of concern over global warming growing. Rather than frightening, the potential for change and global cooperation is exciting and offers the potential for a new direction in human thinking and behaviour. Bring it on! We need to be positive about the future and embrace the changes to come. However, I can't deny there is some probability that human greed and ideology could interfere with this rosy outcome, so there is a need for individuals to be proactive and drive these changes". One teacher reported the school-based education for sustainability initiatives led her to change home practices. Another explained the

school's waste management initiative made her "more aware of the different classifications when recycling, reusing and sorting rubbish items." Another teacher commented that winning the awards, "Gives us all a warm, proud feeling at school and in the community".

I spoke with nine of Whanilla SS's students about climate change. All attributed climate change to anthropogenic causes, identified possible consequences, and were able to suggest actions they can take at individual and community level to mitigate effects. One said, "We can still do what we do at this school – recycle and stuff. Because we're not turning out as much rubbish as other places". Other individual and community-level actions students identified included: turn off air-conditioners, plant more trees, drive more fuel efficient and smaller cars, and participate in community sustainability activities such as Clean Up Australia Day.

The school canteen participates by recycling wherever possible. Although the tuckshop is a source of rubbish associated with packaging due to the nature of takeaway food, Elizabeth explains, "The canteen convener has had a big focus on recycled products. She's done lots and lots of research about what to use and how to be economical, to keep with the philosophy of the school. [The canteen convener] said it's no good being an environmental school and then handing out lots of styrofoam cups and plastics." The canteen convener also runs the vegetable patch and uses the vegetables that the school grows for school lunches.

Whanilla SS has created a number of relational partnerships with local organisations and individual residents from whom the school can solicit support on an 'as needs basis'. The local council were instrumental in helping the school rehabilitate the wetlands area. Kieran explains, "We would have been lost without the Council helping us with the swamp to start with. That was a big project. A lot of machinery I didn't know about and they organised all that. They got us up and going. [The Council has] got environmental officers and they come and talk to you and work with you on what you're doing. They're just really good because they deal with all this sand country and try to plant appropriate species." A number of local residents have expertise or interests in sustainability who volunteer time. One local retiree who has a personal interest in bird watching volunteers one morning per week to take a group of students bird

watching. Students keep log books on the bird species identified so changes can be identified over periods of time. Further a field, in 2007, Year Six–Seven students involved in the construction of the mini wetland consulted water feature designers and wetland ecologists from the United Kingdom and other states in Australia via email. Also in 2007, a group of students from Yokohama University, in Japan, visited Whanilla SS to witness the school's work and talk to staff and students.

After much hard work, experimentation, and dedication, education for sustainability has become integral to Whanilla SS's philosophy and practice. Education for sustainability has transformed the school's physical, ecological, educational, social and economic landscape and achieved measurable improved outcomes in water and electricity consumption and waste production. The school has won some 14 local and state-level awards in recognition of their education for sustainability achievements. Elizabeth has changed the school's official profile. Future principals recruited to the school will be required to maintain the initiatives. Elizabeth explains, "It's part of the community and who we are. And so it needs to be self sustaining." From the beginning of 2009 Kieran has renounced his dedicated education for sustainability day. He now manages the maintenance of the initiatives within his normal teaching workload.

Précis

This narrative tells how education for sustainability was implemented and is constructed in one small rural school now locally considered a working exemplar of school-based education for sustainability. In following the Australian Government's (2005) *Framework for Environmental Education for Sustainability*, I identified themes which form the basis for developing a set of emergent indicators in Chapter Five.

Themes immediately apparent are trust, flexibility, altruism, tenacity, principal support and transformative learning. Elizabeth and Kieran consider trust is very enabling. Many relationships at Whanilla SS are based on trust. This includes relationships between Elizabeth and her staff, as well as the Parents and Citizens Association (P&C) and Elizabeth and Kieran. Elizabeth promotes trust by (a) extending trust to all staff members and expects her trust be honoured, (b) modelling trust by, for example, giving all staff members a master key and extending sincere and open relationships. Kieran is

enabled by Elizabeth's trust and feels a personal responsibility to "live up to it [Elizabeth's trust]".

Elizabeth demonstrates a flexible and altruistic leadership style in her dealings with staff and approaches to administration. Elizabeth rearranges the school budget and staff positions to enable implementation of education for sustainability and applies flexible approaches to managing staff. Altruism is evident when Elizabeth willingly sacrifices her personal time to enable Kieran to implement education for sustainability. Elizabeth allocates one of her administration days to Kieran, then works outside her allocated work hours to ensure all administration work is still completed. Tenacity is manifest in Elizabeth and Kieran's willingness to persevere when faced with adversity. Support is obvious when Elizabeth takes actions to enable Kieran to implement education for sustainability. Elizabeth actively supports Kieran by providing time and money and by working with Kieran to, for example, help him write grant applications.

Emergent in Whanilla SS's narrative is learning that has transformed the community's physical and social landscape as well as teacher and student professional and personal practices. I call this transformative learning. Members of Whanilla SS are actively involved in lowering the school's ecological footprint by sustainably managing resources such as energy, water and waste and have transformed the local landscape by creating native and vegetable gardens, wetlands and frog ponds. Teaching and learning aims to develop student critical thinking and Elizabeth and Kieran understand the importance of increasing teacher knowledge about education for sustainability. The curriculum integrates education for sustainability at every year level and teaching and learning includes academic and hands-on work that explicitly addresses local sustainability issues. Teaching and learning activities are causal, consequential and contextual rather than isolated. Kieran has created diverse cross-scale partnerships and networks with local, state, or national agencies, businesses or individuals who help the school with their sustainability endeavours. Elizabeth has embedded the values, beliefs and practices education for sustainability into the school's culture and identity.

Plate 4.1. Tree planting around Whanilla SS (March 2005)

Plate 4.2. Whanilla SS tree planting area two years later (March 2007

Plate 4.3. Wetlands area prior to rehabilitation in 2004

Plate 4.4. Wetlands area behind Whanilla SS after being dug out

Plate 4.5. Rehabilitated wetlands area behind Whanilla SS in 2007

Plate 4.6. Whanilla SS's worm farm

Plate 4.7. Students building the vegetable garden at Whanilla SS

Plate 4.8. Constructing first stage of the mini wetlands at Whanilla SS

Plate 4.9. Constructing final stage of the mini wetlands at Whanilla SS

Plate 4.10. Completed mini wetlands at Whanilla SS

4.1.2 Fontana State School

Context

Fontana SS is situated under the slopes of a partly developed mountainous range, approximately 10 km from the centre of Cairns in a middle-to-high socioeconomic area. The school has a student population of around 670, with parents from a mostly professional or small business background, and 70 staff which includes teaching and non-teaching positions such as administration and grounds persons. Fontana SS was originally established in 1923 with one classroom. In 2009 the student population is dispersed across 27 classrooms. Over the past five years, Fontana SS has experienced rapid growth resulting in a restructure and a major expansion of school facilities. During 2007/08 construction works were in progress for over 12 months and caused excessive disruption and noise levels. Outdoor play areas were restricted to less than 60% of the available area prior to the works and some students relocated classrooms up to three times during the period.

Education for sustainability at Fontana SS is led by Kim, who has been a primary school teacher for 20 years. Kim has been teaching at Fontana SS since 2000. From 2000 to 2006, Kim struggled to implement education for sustainability because the principal at the time did not support the initiatives. In 2006 Lyn took over as principal. Lyn supported education for sustainability and enabled Kim to lead the school to develop new initiatives. Since 2006 the approach to education for sustainability has involved the whole school in the implementation of curriculum and practical "hands-on" management of school-based sustainability issues.

Fontana SS's Story

Fontana SS's education for sustainability program emanated from Kim's personal interest in gardening and previous teaching experiences. Kim explains when she joined Fontana SS in 2000 she began "doing little gardens here and there" with her class. Kim's momentum grew as a result of people admiring the gardens and she submitted a proposal to the school principal to build school-wide gardens as a way of engaging with education for sustainability. The principal rejected Kim's proposition and resisted any further initiatives by demanding Kim justify any small amounts of money she spent on establishing school gardens. Kim, nevertheless, persevered and by 2002, another two teachers jointly worked with her to establish what became a school-wide beautification

program and a recycling program. The beautification program consisted of designing and constructing new native, vegetable and herb gardens. The whole-school recycling program, which won a state award in 2006, began with recycling drink containers then progressed to recycling cans, bottles and all plastics via a variety of bins designed to cater for different waste grades.

In 2002 Kim registered Fontana SS in the Comalco Green and Healthy Schools Program, which was a curriculum-based program that encouraged schools to tackle a range of local social and ecological sustainability issues at school level. Fontana SS has won five Comalco Green and Healthy school awards – in 2002, 2004, 2006 and 2007. In 2004 Kim and six other teachers formed a sustainability committee and Kim officially became the coordinator. In 2006 Kim volunteered Fontana SS in the Queensland Environmental Sustainable Schools Initiative (QESSI) local alliance. QESSI is an initiative that supports schools to become environmentally sustainable by integrating existing education for sustainability activities. Also in 2006 the previous school principal retired and was replaced by Lyn who took a new view towards supporting education for sustainability. Kim says the change in administration enabled her to lead the school to develop "an inspiring, bigger and better vision to make a greater sustainable future come to life."

When Lyn first began as principal at Fontana SS she was immediately interested in Kim's concept of education for sustainability and was inspired by Kim's enthusiasm. Lyn has a diverse employment history in education, having held different teaching and administration positions around Queensland. In Lyn's experience "all sorts of great things can happen if you've got the person who's willing to drive it". Lyn committed to support Kim early on in her principal position because Lyn instantly recognised education for sustainability promised potential to enrich student outcomes and enhance the school's profile. Principal support has been enabling for Kim. In Kim's experience, implementing education for sustainability is most effective "if the people who help make the decisions and bring groups together back you. If nobody at that level [administration] is in there it's very difficult to be able to move on". Lyn explains she supports Kim by "breaking down the barriers [to implementing education for sustainability]. It's hard to get things going because teachers are extremely busy and very tired at times. So, asking Kim 'how can I support?' One way – and it's only a tiny

way – is a little bit of release time to be able to manage things." Lyn also helps Kim negotiate and manage positive relationships with other school staff by openly supporting Kim at staff meetings and school assemblies.

Systemic education for sustainability approaches are known to be effective. Prior to 2006, education for sustainability at Fontana SS involved disconnected activities driven by individual teachers. Principal support enabled Kim to reorganise education for sustainability within the school. The approach includes the whole school's curriculum, organisation of teaching and learning, physical surrounds, resource management, school ethos, networks and partnerships with the whole school community including staff, students and parents and local organisations, and an annual allocated education for sustainability budget from the school's overall budget and from the P&C.

Kim implemented the Comalco Green and Healthy Schools Program and QESSI initiatives as frameworks to initiate a range of on-ground projects involving the whole school. The Comalco Green and Healthy Schools Program guided Kim to address school biodiversity and waste through school grounds beautification and waste recycling. The QESSI framework assisted the school address energy and water issues. The on-ground work is underpinned by a coordinated whole-school approach to the education for sustainability curriculum. Each class undertakes one education for sustainability curriculum unit every year based on water, waste, biodiversity or energy. The curriculum work is important because the theory guides the practical aspects students develop and work on. Money is instrumental to enable education for sustainability because Kim explains, "if a budget is not allocated then we have to always ask for money to do things. But where is the money going to come from if it's not allocated?"

One of Fontana SS's most significant initiatives is the waste management system Kim has developed. The effort won the school a state waste management award in 2006. At Fontana SS, waste management is guided by a philosophy of reduce, reuse and recycle and involves the whole school in actively sorting waste into biodegradable, glass, plastics and paper bins. On Fridays allocated students collect, audit, sort and clean the bins. Kim found a whole-school recycling program is difficult to run successfully, mostly because of continuous time, energy and manpower constraints. It proved difficult to get all members of a school community the size of Fontana SS to learn and

commit to separate organic, plastic, paper and glass waste into different bins. Students I interviewed felt recycling is important because it helps conserve resources, but raised concerns that "sometimes people put the wrong things in the bin and it's not very nice if you clean it out - like at the end of the week. Because if someone has put like a not finished sandwich in there and then it goes all yuk and we have to pick it up and put it in the [correct] bin". All school members need continuous reminding about which rubbish to throw into which bin. Time is required each week to sort and dispatch the waste before cleaning the bins ready for use again. Waste has differing destinations: Organic waste to the compost heap or worm farms; paper is shredded and thrown into the worm farms; plastics and glass to the waste transfer station bins. To add to the complications, the Cairns Regional Council does not collect recyclable materials from schools, so schools wishing to recycle waste materials collected by Cairns Regional Council from domestic situations, must organise and transport their separated waste to the waste transfer station.

One of the major barriers to the success of the waste management system was teacher resistance. Some teachers resented the intrusion into their teaching time. In 2007, Kim organised each class to be responsible for the recycle bins for two weeks twice a year. "They would go out on Friday, collect all the bins from the classrooms, all the bins from around the school, and then sort each bin and count how many recycled items and how many non-recycled item were in the bins. So, then we would get up on Parade and say, for example, 'The year two resources class had 39 recycled items, but there were 10 in there that were incorrect. These are some of the things that you are not supposed to put in'. And we would give out awards and prizes for the class that got the most [waste correctly] recycled. [Students] had to clean the bins and then put the bins back in the classroom. [sorting the waste each Friday] would take around two hours and it was a really hard job to do and was really stressful for staff because your kids are dispersed, so if you've got any [children with] behaviour problems it was a problem … There was a lot of [negative] staff feedback at the end of the year about 'Why do we have to go and clean bins now?' So it became that some people were really keen and others said 'This is just ridiculous'."

At the end of 2007 the school sustainability committee decided to revise the recycling program and devise a more efficient system. Kim recalls, "we talked to all the staff and

we voted on choice. We felt that if we're going to [recycle] we need to do it as a staff and it has to be a majority. If not, unfortunately, you can't keep pushing something if there's not the choice. You have to give people choice rather than stress already overworked people - being pushed to do something else.' Professionally and personally, I think it would be awful if it doesn't occur, but that's my focus and I think you need to think about each teacher, whether they think it's [education for sustainability] an important part of the future or not. It was incredibly important to me that we put it to vote because if you haven't got support it's not just a matter of putting stuff out and saying 'ok, you've got to do it'. If I'm sitting in a group of fifty [staff] and forty don't want to do it, then the likelihood of the program succeeding is highly unlikely". Lyn points out, "Teachers have to be able to see how this can happen – be integrated into what we're already doing. There are so many things that have been put on to schools now. [Responsibility for recycling] can be quite overwhelming for a classroom teacher when they've got so many other things as it is." Kim brought the recycling issue to the staff meeting and found "About three quarters of the staff were to go for it". Kim then designed a draft implementation plan and circulated the draft to teachers for feedback. The plan was implemented on a trial basis for one term, then further revised and modified.

Systems can be difficult to shift. Waste management systems in schools have remained much the same for many years. Kim's work is an example of one individual's attempt to leverage community resources to, in Kim's words "make a change in this school [community]". Administration issues further clouded the success of the waste management system. Emergent problems included finding and organising reliable people to place the wheelie bins on the roadside and then collect and lock the empty bins up, and bins that disappeared from the roadside. Kim realised that for waste recycling to be sustainable long term, the initiative needed to be integrated into the school system. One way Kim has done this is by organising the waste management running costs to be incorporated into the school's grounds and facilities budget. Another way is by continuous revision of the operation and progress of the program.

I asked Kim and Lyn about other barriers to implementing education for sustainability. Both identified barriers at Fontana SS that are related to practical issues such as shortage of money, time and energy, as well as having a large school community

population. Shortage of money, time and energy are consistently problematic. When funding for education for sustainability has been available, Kim has been very productive. In Kim's words, "When you get money you can organise release time to sort, organise, maintain and evaluate [initiatives]". However, teacher release requires a delicate balance because, as Lyn points out, "Releasing Kim from her class too much is a problem because of the negative consequences for her class – the kids miss her, the parents [complain]. So, we have to make sure it's [release time] not too much, but that it's enough as well." Kim adds, "You need to have the person who's replacing you to be able to carry on the class. If you're having a few difficulties with the class the more time you have out of the class – it can create a variety of upheavals."

Designing effective lines of communication in large organisations can be challenging. Fontana SS has a combined student and staff population of around 750. Kim says, "When you've got 670 kids and some 70 staff members – that's a massive group of people and you've got to keep communication as open as possible. A lot of people come and go in schools and it's hard to keep up with everything that's going on. You get new enrolments and parent groups. So, when you've got new people you need time and energy to dedicate to a new group. The people that want to be involved need to know how to get involved and need to learn the procedures." Kim also found having too many people involved in the organisation of education for sustainability was counterproductive. "By about 2004 or 2005, there were too many people in the group [the sustainability committee]. It was too hard to meet and it just became another meeting." Kim found a more effective system was to have two coordinators who organised the initiatives and people who wished to be involved. In Kim's experience education for sustainability is most effective when a flexible approach is taken and when people are able to work in small groups. Kim explains education for sustainability is context based because "It depends on what works [at the time], what staff's here [at any given time], and what parents you've got on board at the time. If something doesn't work, [you need to think about] are we going to do this again [and] how are we going to do it better?".

An education for sustainability school ethos at Fontana SS has emerged through ethics of care and responsibility. For Kim, education for sustainability "is about teaching this generation how to educate the last generation and the next one about how to care for the

environment. It's about caring with regards to sustainably using what we have. There are a lot of people that care a lot about the things that go on way after three o'clock. [For example] There are people in this school that come in to water the gardens during the school holidays". Lyn asserts, "We often say to the kids 'care about yourself, care about each other, care about our school and care about the environment.' One other thing we're also on about is responsibility. So rather than complain 'what can we do?' lets make sure that what we're doing here [at school] for a start is sustainable." My conversation with seven students highlighted values of care and responsibility are flowing through. When I showed the students a picture of a dilapidated landscape and asked them how they would feel if they lived near the place, one student responded "you'd feel like – if you were near it – you'd feel like you were responsible for it". The student council incorporates education for sustainability in the council's statement of goals and continuously works to improve the school's energy and water efficiency initiatives. The student council initiated and carried out installation of energy efficient light bulbs and water saving devices. They also survey classroom energy use.

One way schools can influence local sustainability is by involving the local community in its activities. At Fontana SS, the whole school community is involved, including school staff (teachers, grounds person, tuckshop convener and clearers), students, parents and local community members. Informal networks and partnerships with parents and local community members have provided practical help in, for example, the building and maintenance of school gardens. Local organisations have donated materials and time. One example is the local nursery which has donated plants, gardening materials and advice. Fontana SS's central location and reputation as school innovators in implementing education for sustainability has attracted local government and non-government organisations such as Conservation Volunteers and the local council. All networks and partnerships have been informal, but have provided Fontana SS opportunities to achieve greater outcomes than they would have on their own. The Parents and Citizens Organisation (P&C) provide money, parents provide hands-on help with gardens, the tuckshop convener runs the compost bin, the student council drives student lead initiatives.

When I last spoke to Kim in early 2009, she reported her focus for the year was maintenance, reflection, revision and improvement of the school's established education

for sustainability initiatives. Fontana SS has worked hard to introduce initiatives in energy, water, biodiversity and waste over the years from 2002 to 2009. Lyn planned to work on effecting school management change aimed at enhancing an ethos consistent with the philosophy of education for sustainability. At the time of talking, the plans were in the infancy stage and Lyn could not articulate them, but did explain the overall aim was to enable teachers higher levels of autonomy. In Lyn's words, "What we're developing are some structures where teachers can make their own decisions. Everything doesn't have to come back through the principal or the deputy principal because we trust that teachers are professionals and they can get together and work out what's needed". Every year Fontana SS participates in annual federal, state and local events such as Clean Up Australia Day and National Tree Day. Kim intends to continue this level of participation.

Précis

Themes emergent from the Fontana SS narrative are community participation, strategic budgetary reorganisation, strong and open lines of communication, flexibility, tenacity, and principal support. The local community is integral to Fontana SS's successful implementation of education for sustainability. Kim has worked systematically to reorganise budgets to imbed education for sustainability and has prioritised open and clear communication. Both Kim and Lyn apply a flexible approach and tenacity to implement new initiatives to shift resistant structures. Kim found Lyn's support instrumental to affecting school level change.

Emergent in Fontana SS's narrative is the role community participation can play in transforming a school. Local community members and organisations are actively involved, either indirectly by providing resources such as money, materials and advice, and/or directly by extending practical "hands-on" help such as building and maintaining gardens. The discernible outdoor innovations are reinforced through classroom units of work ranging from Preparatory to Year Seven which address the theoretical components of the initiatives. Children also learn how to lower their ecological footprint by addressing energy, waste, water and biodiversity issues within the school.

Interestingly, Fontana SS encounters many of the same barriers as those faced by Whanilla SS. Although Fontana and Whanilla SS have different contextual

circumstances, both need to overcome a shortage of funds and time. Both schools also identify that money is an enabler.

Plate 4.11. Recycling bins at Fontana SS

Plate 4.12. Shadehouses at Fontana SS

4.1.3 Hollindale State School

Context

Hollindale State School (SS) supports a student population of about 800 from middle-to-low income families and caters for Preparatory to Year Seven. The suburb of Hollindale (SS) is about 12 kilometres from the centre of Cairns, has an established population of around 9000 people and a mixture of land uses including residential, commercial and recreational. The suburb has a reputation for providing cheap buyer and rental housing. The neighbourhood directly surrounding Hollindale SS is comprised of a combination of old weatherboard Queenslander and modern Besa block-style homes and commercial establishments, one remnant cane field directly across the road from the school, and a seasonal creek which has been concreted to provide more efficient drainage of water from the mountains directly behind the school.

Education for Sustainability at Hollindale SS is led by Denise, an active environmentalist who has been teaching at Hollindale SS for 22 years, and is supported by Esther, the teacher librarian, who has been at the school for 25 years. Denise is renowned in the school community for being passionate about environmental sustainability and is an inspiration for many teachers wishing to take up education for sustainability. As Melanie, a Year Five teacher, exclaimed “when you’ve got people like Denise, when you’re teaching with her, you just kind of do it [education for sustainability]”. Katherine, who teaches year one, comments,“Denise seems to be the lady. Denise and Esther, and so it’s just through their leading [that Katherine took up education for sustainability]. They seem to get everyone rounded up. They’re great leaders in this area”. Esther is an early adopter of education for sustainability. Esther explains she does not consider herself a “wild environmentalist” but believes “it’s important that we look after all sorts of things we have in our environment. I’m passionate about education and about educating the young today for the future”. Denise and Esther have an excellent working relationship which is supported by a long history of teaching at the same school. Esther discloses “over the last few years I’ve collaborated with SOSE areas and Denise’s looked after the science area. We’ve worked well together to bring sustainability to the forefront [of the school community].”

Denise, Esther and the school’s sustainability committee are supported by Robert, Hollindale SS’s principal since 2003, who is also a member of the sustainability

committee. The sustainability committee is comprised of about eight people with teacher representatives from Years Two to Six and administration staff. Meetings are semi-formal and take place every three to four weeks.

Hollindale SS's Story

According to Robert, education for sustainability has always featured in Hollindale SS's teaching and learning practice. Robert has a personal interest in education for sustainability and considers it is an important part of schooling. When he first began as principal in 2003 he soon noticed "there were little isolated pockets of interest [in education for sustainability]". Teachers with a personal interest in education for sustainability implemented units of work based on sustainability issues and carried out "hands on" work to complement the class work. Robert recognised education for sustainability learning would be more effective if a whole-school approach were developed which, in Robert's words, "[could] pull those pockets together into a program area with a central focus". Robert encouraged the staff to join The Green and Healthy Schools Program as a way of moving towards a whole-school approach to education for sustainability. The Green and Healthy Schools Program, which is no longer available, was a Queensland State curriculum-based program which encouraged schools to adopt a holistic approach to teach school communities how to live sustainably.

Robert's vision for a holistic approach to education for sustainability began to unfurl when Denise took on the role of education for sustainability coordinator in 2003 and formed an education for sustainability committee. Since then the school has been involved in the Green and Healthy Schools Program (2003), The Reef Guardian Schools Program (2004) (a Queensland education for sustainability program based on systems theory), and the Queensland Environmentally Sustainable Schools Initiative (QESSI) (2006). The Green and Healthy Schools and Reef Guardian Schools Programs provided frameworks to lead a whole school management approach to address local waste, energy, water, biodiversity and social sustainability issues. Later on QESSI helped support and enhance the initiatives by providing pathways to establish local enabling networks. The whole school, including staff, students, parents, local business and government agencies, became participants in the school's initiatives through classroom-based curriculum units of work, projects such as construction and maintenance of native

gardens (see Figure 4.15), events such as Arbor Day and Clean Up Australia Day, and special interest and extra curricular groups like the student council, Energy Efficient Group and Science Club. At the beginning of each year the sustainability committee develops an action plan for the year in the areas of curriculum, resource management, on-ground projects and community education. The action plan is revised at the end of the year and a report written up. One very successful initiative was to "green" the school tuckshop which is run by parents and volunteers. The tuckshop convener participated in a number of workshops run by staff from the Reef Guardian School's Program. As a result, the tuckshop developed a policy of "minimal plastic". Denise explains this means that "[at the tuckshop] you don't get things wrapped in Glad Wrap or anything like that. It's all in greaseproof paper and paper bags. For a long time [the tuckshop] has been as plastic free as possible. They also store food in Tupperware type containers rather than covering foodstuff with Glad Wrap".

Robert, Denise and Esther developed a sophisticated understanding about the complex interplay of concepts related to education for sustainability, which lead to the elaboration of a whole-school integrated approach. Denise explains that in the beginning education for sustainability outcomes were separated and met through the science and/or studies of society and the environment (SOSE) strands. As Denise, Esther and Robert's understanding progressed they developed a more systemic view. They began to see that, as Denise says, "it's a bit hard to categorise and separate things" because Esther adds, "Sustainability doesn't stand alone, it's part of integrated elements within society, so it needs to be part of the integrated curriculum that we have".

Education for sustainability entails a vision for society that is ecologically, economically, socially and politically sustainable. Once Denise, Esther and Robert understood this, they set out to purposely interlink their ecological tenet to the school's long standing social and political processes. This included valuing, caring and working towards improving the local ecological and social environment through a student-led democratic process. Examples of student-led democratic processes include student leadership programs, student council, student mentors, and active and informed citizenship awards. The approach has lead to student leadership in education for sustainability, for example, in 2006 Hollindale SS students hosted a Reef Guardians Youth Forum on sustainability to which all Far North Queensland Reef Guardian

schools were invited. In 2008 Hollindale students participated in the 2020 Schools Summit – an Australian Government initiative set up to gather school community opinions on Australia's future development.

Curriculum work can be a useful mechanism for informing practical "hands-on" work. At Hollindale SS all classes undertake at least one education for sustainability-based unit of work per year. For example, in 2008 Year One students studied rainforest ecosystems, Year Two, Australian animals, and Year Seven, river systems. Students are involved in the management of the school's water, waste, energy and biodiversity through taking actions to reduce human impact. Water management focuses on saving and anti-pollution practices in everyday activities, for instance, all taps are fitted with water saving devices and in 2008 the school applied for a grant to install water tanks. Waste management focuses on reducing and reusing, for example, in 2008 the student council ran a 'swap shop' on designated days during the year which facilitated students swapping unwanted toys, books and games of similar value with each other. Energy management centres on developing energy efficient habits such as switching off lights, fans and air-conditioners when vacating rooms. Biodiversity management works on improving local ecological biodiversity by, for example, planting and maintaining the native trail. Students can also engage with community education which aims to educate and encourage the wider community to take on sustainable practices through, for instance, school participation in community events, publications in the school newsletter and local newspapers, and presentations to the wider community.

Successful education for sustainability is known to depend on a few passionately committed teachers. In recognition of the need to ensure education for sustainability became a permanent and progressive feature in the school, in 2007 the sustainability committee worked to develop a dedicated program area with an allocated budget line and ongoing teacher training. The program area was called "sustainable environments" and was allocated annual funding from the school's budget. Robert explains, "Any program that sits around key staff rather than a program that's core [is in danger of disappearing], so we've tried to make our program core so that it doesn't hinge around one particular person. If that person leaves the core will remain. Sustainable environments gets a budget line and funding amount each year and the sustainability committee have to write an Annual Operations Plan [which sets out details of how the

sustainability committee will pursue the outcomes it sets] so it's on par with the school's literacy and numeracy system… I think education for sustainability is very important and is core business here. By assigning it a program area, the equivalent of maths or English or science, and giving it a brand name like sustainable environments, it gives it that credibility and stays in the eyes of everybody. It's what we do every day. It's our core business. We teach kids to write and read and speak and numerate and we also teach them to behave – sustainability is about behaviour".

Since 2003 Denise, Esther and Robert have overcome a number of barriers to implementing education for sustainability. These include lack of resources such as money and time, teacher professional development, and systemic impediments which marginalise education for sustainability perspectives from the core business of schooling. All three mentioned that lack of money and time is the main day-to-day barrier. Robert says, "We've got our direction, we know where we want to go and what we want to do, but resourcing is proving to be difficult because it's another thing. Resources would be the biggest [barrier] – money, people. We're all very time poor at the moment. Resourcing would be the key to allow staff training or staff networks – building networks". Denise explains, "It would be lovely to have some money to not only purchase solid things but also maybe to have TRS [teacher release time] days so teachers could work with small groups of students to finish off the native trails, to take them to the Reef Guardian Day. This all costs TRS days and at $350 it's a lot of money to keep finding for school budgets. So I think the biggest handicap is money and then teacher time". When funding has been available Denise and Esther have found it very enabling. During 2006 and 2007 Denise and Esther received a small amount of funding through the QESSI initiative. Esther explains that it was very useful in terms of their professional development because, "We got to meet with other schools and do workshops. It was really helpful to talk and get ideas. You got to see what other people were doing. It helped affirm what we were doing and thinking".

Professional development is an important part of any change movement. Denise, Esther and Robert found lack of staff professional development in education for sustainability exacerbated teacher resistance and slowed progress. When Esther spoke to other teachers she found, "Some teachers feel that sometimes we can present too much information and it seems overwhelming and too hard. There are also teachers who teach

education for sustainability so that students develop the knowledge but not necessarily the action part". The three leaders understood professional development was one way to help staff develop understanding of the principles and concepts of education for sustainability. Against the perennial constraint of lack of money, Robert was able to juggle budgets to find money to release teachers from teaching duties for professional development opportunities.

Schools can be leaders of social change at community level by modelling and helping the community move towards sustainability. As part of the change process at Hollindale SS, Denise wanted to install water tanks and solar panels to existent buildings and ensure any new buildings were designed to reduce environmental impacts. Systemic barriers prevented Hollindale SS from taking education for sustainability to this higher level. Systemic barriers are those imposed by inflexible laws, regulations and policies. Education Queensland released money for water tanks or solar panels during 2007 and 2008, however, this was via grant schemes which were very competitive and time consuming to write. As late as 2008 and regardless of requests by the school to Education Queensland, new buildings constructed at Hollindale SS continued to lack any measures to reduce environmental impacts.

Students initiated changes which aimed to reduce Hollindale SS's ecological footprint. Since 2003, the student council have arranged to install water saving devices on all taps, dual flush toilet cisterns and energy saving light bulbs. Some of the teachers I spoke to reported students were leaders of social change in their homes. Melanie, a Year Four teacher, said, "parents come in and say things like 'do you know so and so is not letting me buy such and such washing power any more because it's not biodegradable'". Katherine, a Year Two teacher, reported, "A lot of parents come in and say 'the kids are educating me'. The kids were going home and telling parents what they could and couldn't put in the recycle bin. I spoke with seven students. Some reported they have instigated changes in their homes. One 10-year-old boy told me he set out to reduce energy consumption at home by turning the television off at the power point rather than leaving it on standby. Another boy, 11 years old, explained he instigated composting and washing the car on the grass instead of the driveway. Katherine also reports her personal at-home practices changed as a direct consequence of engaging with the school's initiatives, "I know I think about things now – recycling properly. I'm more

careful than I was before. I have a new perspective on how important it is... [I am now] very pedantic about all of that – rinsing the tins, rinsing out the milk bottle, taking off the lids – all of that, I never used to bother".

Partnerships and networks enable education for sustainability. Because Robert understood this he worked to encourage contacts between the school and the local community. Robert explains, "[Education for sustainability] is something that's very difficult to do by yourself, it's expensive, it can be very high risk – and a lot of people are not willing to take that professional type of risk. So, when we form networks and partnerships that risk is spread and you're in it with mutual support and all the benefits of a positive relationship". Robert, Denise and Esther actively sought and built relationships for sustainability with parents, local businesses and community groups, government and non-government agencies such as Volunteers Australia. The relationships are informal but very valuable for establishing sustainability initiatives because, as Robert says, "Parents will come into the school if we've got a project on, if we ask for help to assist us with jobs. [For example] some have machinery, on their way past they'll whip in and dig piles of dirt for us". From a teaching perspective, Melanie explains that relationships provide "access to a lot of resources, like lots of places to go to and a lot of agencies offer people to talk to the kids. I find it makes life a lot easier if you can tap into that expertise".

The story of education for sustainability at Hollindale SS over five years is one of converting scattered initiatives into a whole-school coordinated process. Denise and Esther's tenacity and dedication, together with Robert's support, has led Hollindale SS to implement an impressive number of initiatives which have won the school extensive recognition. Into the future, the sustainability committee plan to expand understanding of sustainability. Esther explains, "When we think sustainability, we think environmentally, but there are other types of sustainability as well – financial, etc, etc. So, I think that's an avenue that I would like to explore to help others understand that sustainability is not just environment because the environment has impacts on all of those other things as well. So, there's a bigger picture, even bigger than the picture that we've got, so expanding that big picture is a way to go." Denise and Esther also plan to get involved with the Green Schools Connect Program which is a partnership between Conservation Volunteers Australia, the Vodafone Australia Foundation and schools that

helps schools implement sustainability projects. Last, the sustainability committee aim to involve more people in the committee, including the grounds-person and a larger representation from the school's administration team.

Précis

The narrative told here centres around dispersed education for sustainability initiatives that were pulled together into a holistic process. The transparent theme is strategically imbedded sustainability. Denise, Esther and Robert planned and coordinated to embed education for sustainability into their school community. To do this they addressed curriculum organisation, networks and partnerships, physical surrounds, budgetary reorganisation, and teacher training. All sectors of the school community participate in education for sustainability, including teachers, administrators, students, and parents. Students have been enabled to develop sustainability skills and understandings through integration of ecological, social and political initiatives.

Similarities between Hollindale, Fontana and Whanilla SS emerge if we consider the types of barriers each school encountered, the role local community plays in implementing initiatives, the importance of supportive principals. Hollindale SS's story also provides a glimpse into how restrictive systemic barriers can be. While school staff can negotiate locally based barriers such as lack of time and money, systemic barriers are more difficult to overcome because they are imposed by systems operating at levels out of our control.

Plate 4.13. White paper recycling at Hollindale SS

Plate 4.14. Fitting water saving devices at Hollindale SS

Plate 4.15. Native garden at Hollindale SS

4.1.4 Reliwarra State College

Context

Reliwarra is located about 10 kilometres north-west from the centre of Cairns along a hinterland mountain range, and has a population of around 7000 people from a mainly high socio-economic status. Reliwarra State College is situated in the middle of Reliwarra and currently supports about 1200 students from Preparatory to Year Ten. Reliwarra State School (SS), as it was formerly known, was originally established in 1932 as a primary school to cater for students from Preparatory to Year Seven. In 1994 Reliwarra SS was relocated from its former site due to an expanding population. In 2004 Reliwarra SS was approved to extend learning to Year Nine. Then, in 2007 Reliwarra SS was reclassified as a Preparatory to Year Twelve (P–12) school and renamed Reliwarra State College (SC). The college now has two campuses – Prep to Year Six (P-6) and Year Seven–Twelve, and is separated into three learning phases – primary, middle and high school. The primary school teaches from Preparatory to Year Six, middle school from Year Seven–Nine, and the high school from Year Ten–Twelve.

At the time of writing this narrative, the school was in the process of expanding into the senior years of schooling (Years Ten–Twelve).

Learning at Reliwarra SC is underpinned by a whole-school vision statement: "Learning in our valley, thinking beyond the hills". This whole-school philosophy leads the way for students to take local actions that have global impacts. The high school section of the college is also guided by four learning tracks – environmental education, sports science, technology education, and technology and creative arts. The college has one overall principal, two associate principals and two deputy principals. The two deputy principals oversee the Preparatory to Year Six section of the school and the two associate principals the Year Seven to Year Twelve. I interviewed David, the overall principal, Ann, the acting middle-school principal (Years Seven to Nine) and Mel, the education for sustainability coordinator who is Head of Department Middle School, and teaches maths and science.

Since 2004 Mel has led Reliwarra SC to embed education for sustainability into the curriculum at each year level, revegetate the park and creek adjacent to the school grounds (see Figure 4.18), recycle waste paper (see Figure 4.16), recycle printer and copier cartridges and organic waste, establish worm farms (see Figure 4.19) and a compost heap, build school gardens, set up a student-led radio station to promote education for sustainability called RSC FM "Your Conservation Station", establish energy, water and waste monitoring programs, install water and energy saving devices such as triphosphate light bulbs, and promote reduction of waste through litter free lunch boxes.

Reliwarra SC's Story

Reliwarra SC students were traditionally exposed to education for sustainability through isolated activities. In 1994, the year the school was relocated to the current school site, teachers and students established a rainforest plot on the school grounds, and for many years some classes grew giant pumpkins to enter in the annual Giant Pumpkin Competition in the Cairns Show. The organisation of education for sustainability began to change in 2004 when Mel took up a permanent teaching position. Mel explains she did not plan to take up education for sustainability. "It wasn't something I looked at specifically to grow within the school. It's something that I personally have always looked at, it's an interest of mine, and it was something that I'd always done with my

kids. I found that when I had an opportunity to do it with the classes I actually just did it. Once I started doing it with classes, I recognised there was an opportunity to actually build this into it [school practices and curriculum]. I have a very strong interest in curriculum, so I thought that would be a way to actually expose students to it [education for sustainability] at each year level." Mel continues, "It was always done piecemeal in schools. There was never any continuity. It was always something that, when you spoke to teachers, was an extra. It was things that were tagged on, it was a lunch time or afternoon activity and it was never actually part of the curriculum. So, for me it was being able to look at it from a curriculum perspective and say 'How can we actually embed this into the curriculum so that it doesn't become an extra and that the children build on the knowledge each year as they're going through school?'"

Mel began to effect an education for sustainability change process at Reliwarra SC by committing the school to the Reef Guardian Schools Program (RGSP) in 2004 and the Queensland Environmentally Sustainable Schools Initiative (QESSI) at the beginning of 2005. The RGSP and QESSI frameworks enabled Mel to create systems to more sustainably manage school-ground waste, water, energy and biodiversity at (school) policy and ground level. During 2004 and 2005 Mel initiated composting, worm farming, energy monitoring and litter free lunches with students from Preparatory to Year Seven. Mel trained and organised for a group of Year Five students to take responsibility for maintaining the worm farm, one Year Six class for recycling white paper, a group of Year Seven students to monitor, graph and report energy consumption. In 2006, Mel applied the QESSI and RGSP frameworks to develop a School Environmental Management Plan (SEMP), to guide implementation of formal action plans for the management of waste, water, energy and biodiversity within the school, and education for sustainability curriculum into all year levels. Mel explains she created the SEMP with the Year Seven class she taught in 2006, "I had my year 7s do it with me. We did it together. I did the visioning with a group of staff, I put it together and then the actual action plan came from the students. We had the four areas (waste, water, energy and biodiversity) and the kids came up with the first lot of identified needs, the actions, and the timeframes. Now I revise that every year."

During 2006 the new middle school was built and curriculum planning for the middle years of learning (Years Seven–Nine) began. Mel recognised the middle school

provided her with an opportunity to implement education for sustainability from the ground up to create an authentic, holistic, and embedded whole-school approach that could become part of Reliwarra SC's identity and culture. High schools in Queensland are obligated to teach nine compulsory key learning areas and offer a number of elective subjects of their choice. In Cairns, high schools offer subjects across all elective learning areas, but tend to specialise in a particular area such as information technology, the arts or science. Mel's vision was for Reliwarra SC to offer a suite of specialist education for sustainability elective subjects. Mel formally presented her ideas to David. As Mel explains, "I would like to see electives running in environments – sustainable education and sustainability. It's identifying what we can offer students that's different from other high schools. So, Smithfield High School is an ICT type area of excellence, and Cairns High is a dance, drama, and arts area of excellence. Environmental education can be something that we can focus on. We can make links with the community and academically with JCU [James Cook University] and market that. If kids want to go into the environmental area then this is the school that you come to for that". David explains he immediately understood developing a focus in sustainable environments would provide the school with an individual and marketable identity. David explains he felt compelled to support Mel because "she was living and breathing [sustainability], she was so enthusiastic [that] you could not stifle that enthusiasm. Her enthusiasm rubs off on other people".

The QESSI framework focuses strongly on the establishment of networks and partnerships for sustainability. In recognition of the opportunities that networks and partnerships provide for student learning, in 2005 Mel applied the QESSI structure to seek local community connections. The first was an informal partnership with the Cairns Regional Council to rehabilitate a dilapidated riparian and park area adjacent to Reliwarra SC. The project included clearing weeds and exotic trees and in 2008 it culminated with Year Six students and Cairns Regional Council officers jointly planting the area with 1500 native local trees (see Figure 4.18). Since 2005 Reliwarra SC has developed relationships with the Great Barrier Reef Marine Park Authority, the Cairns and Far North Environment Centre, and the Australian Conservation Volunteers. Mel continues to focus on establishing networks and partnerships because, in her words "[partnerships] will help us grow what we can offer the kids. [Community linked] projects provide exceptional learning opportunities for our students right across all year

levels. We are going to get the expertise from partnerships and relationships within the community, that's also where we are going to start getting our monetary support to get projects up and running. So, this includes business partnerships, academic partnerships – whether it be with other schools, JCU, Griffith University".

In 2007, the first year of middle school operation, Mel took the position of Acting Head of Department – Middle School. The position provided her with the opportunity to explicitly write education for sustainability into the middle school curriculum. Mel reflects, "I came at it [education for sustainability] from a curriculum perspective in schools. It's been good because we're growing year level by year level, so we have the opportunity to actually write it into our curriculum as we're going through. My idea was to have it like a spiralling curriculum – so it's ongoing and each of the year levels has that sustainability focus in one unit through the years. So, at least one term they've got exposure. Then it doesn't become a chore for the teachers as well, it's not 'Oh no here's another extra thing that they're asking me to do'. It just becomes a part of what they do."

Integration of education for sustainability at Reliwarra SC appears seamless; however, David, Ann and Mel identified a number of barriers. Similar to other schools, there is lack of money, time, understanding of the principles and practices of education for sustainability among the school community (school staff, students and parents), and there are also systemic impediments. With regards to resources Mel points out, "Resourcing is a big hurdle – physical resources and personnel. Funding to be able to do it [education for sustainability] is the biggest hurdle because it's not there. Then you have to go out and source it for yourself through the student council, Parents and Citizens Association or wherever. And it's not a priority in schools [which makes the funding hard to get]. They see it as really wonderful that the kids are learning about what's going on but it's not actually seen as a priority at the moment. There are grants, but the amount of rigmarole there is with that! I don't have the time to write grants, or the knowledge – nobody here on staff does. It's almost like – it's too hard and we don't have the time to do what they want us to do - like getting three quotes and getting it all costed out and all that sort of thing. It's like a Catch 22 [situation]. The money's there [in grants], but getting access to that money is the difficult thing. It comes back to [lack of] time, money and expertise. It's also personnel as well. For example, we need a new

shadehouse. The shadecloth needs to all be replaced, it needs new posts put in it, it needs a new watering system. All of these sorts of things come back to dollars and the personnel to put it all in."

I asked David, Ann and Mel how they managed the barriers. "Funding wise" David said "we go to different sources. Our P&C is really good, they support us no end. But there are other funding bodies available. Creative timetabling from Ann, if we need to release a teacher to do something. You can release people and try and give them some prime time to do it, rather than them do it on a weekend. The most valuable asset are the teachers that have got real drive. So you've got to try and support them, resource wise – financially, physically." Ann says they "ensure we find alternative ways, because we're never going to find enough money for everything we want to put in place and we're never going to have enough time. So, the most important thing is finding different ways to do it." One way to broaden community understanding of education for sustainability is through education. David provided opportunities for Mel to speak to school and community members by, he explains, "Making sure we make time available at staff meetings, parent meetings and other meetings, to talk about what she wants to do. So it's out there, so people start to think about it. So, they can ask questions and they're fairly clear on where we're going".

Limited teacher understanding of the principles and practices of education for sustainability was another significant barrier. In Mel's words, "Convincing teachers that it's not an extra, was the biggest one [barrier]. We got around that by embedding it in the curriculum." The problem recurred in the middle school during 2008. Mel says, "Because we're just developing it here in the middle school at the moment, there's still a little bit of a – I guess it's not that they [teachers] don't want to teach it – it's that they can't see how it can be incorporated into their particular subject area. So it's educating them how we can actually connect the curriculum and if we're doing global warming, for instance, we can actually structure our maths so that the maths is being done with that focus, so we're looking at data and statistics and graphing and that sort of thing. So it's just getting that idea across to staff in a particular area that they can support what's going on in sustainability education in another area".

Beyond the common barriers of money, time and teacher knowledge, parental resistance was a unique issue at Reliwarra SC. This was the case with litter free lunches which

involved students bringing lunches in plastic re-usable containers rather than throwaway wrap materials. Mel reports, “We tried to promote litter free lunches as an ongoing thing each day to try to reduce our litter, but we’ve had to put it on the back burner [because] that’s one area that really gets parents’ backs up. Parents said, ‘Well, if I want to give my child pre-packaged food and have a lunch box full of 25 pieces of litter, that’s my prerogative and you butt out’.” David adds, “I had complaints about ‘How much I used to wrap my lunch up’ and ‘How do we get it here?’ and ‘we spent more time trying to get a lunch ready than we’ve ever spent’. There were lots of issues about that. So I guess we do have that battle when the teachers and the kids are trying to do something, and the parents are saying ‘No, too hard’.” David considers the school’s capacity to contribute to a more sustainable community is limited by the community’s willingness and/or unwillingness to take actions beyond their comfort zones. In David’s words, “I would have to say, just as a Reliwarra community, people are aware of environmental issues, but there’s not that drive to say ‘Let’s turn off the air-conditioning. Let’s get rid of the fridges out of the school to save power’. So they want it all, but they don’t want to give anything away for it.” David believes parents are not necessarily aware of the contribution education for sustainability can make to building a more sustainable future. ”Over the last two years [2007–2008], I have probably had one parent, I think, that has come to me and said ‘Do you do anything with environmental studies?’ They don’t come here saying, ‘I’m looking for a school that supports environmental studies’. But I think it’s something that’s going to grow”.

At the end of five years, Mel has integrated education for sustainability across the primary and middle school curriculum and developed systems to manage school level waste, water, energy and biodiversity in the primary campus. Mel is working to develop similar management systems in the middle and high school campus. At the end of 2008 Mel was working to develop a waste management system for the tuckshop, including recycling and composting organic waste. She was also negotiating with Conservation Volunteers Australia to establish a management plan to rehabilitate a dilapidated area behind the school into a learning space.

Schools can be leaders in community social change by displaying initiative. In the future, Mel hopes Reliwarra SC will lead community learning in sustainability. Mel explains, “This [school] is the hub of the Reliwarra area, so [I envision] providing

learning opportunities for the community within our facilities. It may be three or five years down the track, but we will be able to offer some community environmental education. We can do sessions on ‘how to compost’, ‘how to worm farm’. For the immediate future, Mel plans to continue to establish relationships and networks with the local community. One way Mel intends to do this is by showcasing and sharing the work the school does by, for instance, running a school market stall with home grown produce once a week outside the school or the local shopping centre. The aim, in Mel’s words, is “Getting out and showing people that as a school we are doing things”.

Précis

This narrative highlights the ways in which one individual can shift systems to influence learning in education for sustainability through curriculum development and management of water, energy, waste, and biodiversity. Emergent themes are curriculum, community partnerships, and tenacity. Curriculum underpins education for sustainability learning and resource management at Reliwarra SC. Students learn to understand sustainability through classroom-based units of work and then apply their learning to manage school resources. The school has intentionally sought partnerships with outside agencies to extend learning beyond the capacity of the school. The work would not have been possible without the incredible tenacity and dedication Mel has applied.

Similar to Denise, Esther and Robert at Hollindale SS, Mel strategically wrote sustainability into Reliwarra SC’s curriculum. The curriculum is progressive so students build on previous knowledge as they move through the school years. Reliwarra SC faced many of the same barriers as the other schools in this study. Relevant also is the role of the school principal in enabling key teachers. Despite a lack of resources, David and Ann looked to provide money and time for Mel whenever possible. This story provides another opportunity to think about systemic barriers. Although progressive schools may wish to model sustainability through physical structures such as rainwater tanks and sustainable buildings, their capacity is limited by systems out of their control.

Plate 4.16. White paper sorting at Reliwarra SC

Plate 4.17. Recycled paper fashion parade at Reliwarra SC

Plate 4.18. Revegetated area adjacent to Reliwarra SC

Plate 4.19. Worm juice farming at Reliwarra SC

Plate 4.20. Reliwarra SC shadehouse

Conclusion

It is curious these four distinct schools, each implementing education for sustainability in their own way, have experienced many of the same barriers. Two similarities in the schools' approaches are flexibility and tenacity. Flexibility enabled readjustment when plans failed to proceed in a predictable manner. Tenacity made it possible for these teachers to persevere in the face of adversity. One other common feature in the four stories is explicit embedding of education for sustainability into the school's system. Each school did this in their own way. Whanilla SS changed the school's public profile with Education Queensland, Fontana and Hollindale SSs reorganised school budgets, Reliwarra SC wrote a progressive education for sustainability curriculum. Each aimed to make education for sustainability permanent in their school.

Part B

Applying Understanding of Resilience

Through

Education for Sustainability

Chapter 5. Presentation and Discussion of the Indicators

Introduction

In this thesis I define indicators as communication tools that provide information about the condition of systems over time that may not be immediately apparent (Hoernig & Seasons, 2005; Redefining Progress, 2006; Redefining Progress and Earth Day Network, 2002). The use of indicators is becoming acceptable in education for sustainability practice. Although education generally has used indicators for many years (Reid, et al., 2006) it is only recently that practitioners of education for sustainability have began to pay attention to just how indicators can be useful. The use of indicators in the global education for sustainability context arises from a recognised need to monitor and evaluate changes and impacts of the United Nations Decade of Education for Sustainable Development (2005–2014). Developing a set of global indicators is not possible due to the contextual nature of sustainability, but published reports do provide a guide for indicator development. These include the *Asia-Pacific Guidelines for the Development of National ESD Indicators* (Tilbury, et al., 2007); and the *Development of a National Approach to Monitoring, Assessment and Reporting on the Decade of Education for Sustainable Development* (Tilbury & Janousek, 2006).

The qualitative indicators developed through this research infer social-ecological resilience (as discussed in Chapter Two) and are designed to assist decision makers such as principals, teachers, curriculum and policy writers, and environmental managers to make choices about the provision of education for sustainability. The intent is to induce, secure and enhance adaptive capacity. The qualitative indicators emergent from this research are not specific, easily measured, identified and tested elements of practice (developing such indicators was beyond the scope of this research). Each indicator emerges from a communication and explanatory perspective. As discussed in Chapter Three, these qualitative indicators are sets of research-informed statements which have emerged directly from four case study schools that prioritise education for sustainability. Developing specific and testable indicators was not the aim of this research. This chapter builds on the introduction to indicators set out in Chapter Three to identify and explain the rationale for a suite of qualitative indicators derived from the research. I begin by explaining the indicator development process, then outline the indicators in a table format. Section 5.2 explains the domains and presents a rationale

for the indicator statements. The rationale explains the reasoning behind the production of each indicator. The last section of the chapter addresses the understanding I have developed through the process of developing the indicators.

5.1 Development of the indicator framework

To develop the indicators I drew on understandings from the UNESCO framework for developing indicators, the *Asia-Pacific Guidelines for the Development of National ESD Indicators* (Tilbury, et al., 2007), and the *National Environmental Education Statement for Australian Schools' Framework for Education for Sustainability* (DEH2005). The indicator framework I developed is represented in Table. 5.1. The framework is divided into seven domains and sets of statements. The 'domain' column reflects the Australian Government's (2005) *Framework for Environmental Education for Sustainability* (DEH2005) explained in Chapter Three. The indicator statements represent a set of variables which describe the domain. The domain and statements combined make up the qualitative indicators which describe education for sustainability practices that build resilience as per existing literature.

The intent of this study was to apply a social-ecological resilience lens to investigate how principals, teachers and students in four Far North Queensland schools organise and enact the principles and practices of education for sustainability. The set of qualitative indicators makes more concrete what may otherwise be seen as vague concepts. The indicators were identified by investigating everyday education practice in four schools known to prioritise education for sustainability. As part of the process, I build a theoretical case for why these practices can be used as indicators of social-ecological resilience.

Indicators are not an end in themselves but a means to an end. They are valuable for gathering information about key aspects of sustainability in specific contexts (Pinter, Parris and Kates, as cited in Pinter, Hardi, & Bartelmus, 2005, p. 2). In this study indicators are applied to assist understanding of resilience enhancing practice, to advance education for sustainability theory and action, and to support decision making. The process for developing the indicators was shaped by consultation with people who work in the sustainability, education and resilience fields, by data collection and

analysis from the participant schools and by a comprehensive review of relevant literature.

Table 5.1 provides an overview of the domains and the statements. The domain column (taken directly from the Australian Government's (2005) *Framework for Environmental Education for sustainability*) lists the various sections that make up a whole-school approach to education for sustainability. The 'indicator statements' column names the variable statements that I identify as having emerged directly from my school-based research. Each set of indicator statements is assigned a corresponding domain to represent the characteristics that enhance resilience, as identified through the data analysis procedure. Each indicator statement illuminates an aspect of a whole-school approach to education for sustainability, which when employed across a school can build adaptive capacity and enhance aspects of resilience as described in the reviewed literature on resilience in Chapter Two. Section 5.2, directly following Table 5.1, explains how each indicator is characteristic of adaptive capacity and resilience. Each section has the same structure. First, I introduce the domain and provide an overview and brief literature review of the relevant features. Then, I present and discuss the emergent variable statements which are the qualitative indicators, comprised of the domains and corresponding variables. The last section of the chapter (Section 5.3) is a discussion of the contribution to knowledge and understanding I have derived through developing the indicators.

Table 5.1. Identified qualitative indicators of resilience through education for sustainability

Domain	**Indicator statements**
School ethos	The school ethos displays: *The school's meta-values and culture values and encourages higher order learning, diversity, trust and understanding and managing change*
Governance	School governance demonstrates: *Cross-scale flexibility and adaptability* *Creativity* *Democracy* *Altruism* *Tenacity and recursiveness* *Trust* *Active principal support*
Physical surrounds	Physical surrounds shows evidence of: *Landscape diversity (including dominance of local native plants)* *Minimal litter, control of invasive weeds and pest animals* *Sustainable technologies*
Resource management	Resource management is addressed through: *Locally based whole school environmental management plan (SEMP)* *Adaptive management*
Teaching and learning	Teaching and learning demonstrates: *Creativity* *Self-organisation* *Higher order thinking skills* *Flexibility*
Curriculum organisation	Curriculum organisation is: *Flexible* *Local, problem and futures based* *Culturally inclusive* *Integrated*
Networks and partnerships	Networks and partnerships are: *Cross-scale, diverse and flexible*

5.2 The emergent qualitative indicators

5.2.1 School ethos domain

According to the *Framework for Environmental Education for Sustainability* (DEH2005), the school ethos is the value structure of the school and includes a whole-school shared vision, goals and objectives. Education for sustainability is held to be more effective if it is established as a core feature of the school ethos. School visions have implications for how the school is organised and the roles school members assume. A school's ethos is difficult to quantify because it is not immediately obvious. Rather, a school's ethos:

> is best observed in how administrators, teachers, students and parents interrelate; in how the school presents itself and responds to the community; in programs offered to students; and how the school embodies the principles of citizenship in the way it operates as a learning community (DEH2005, p. 7).

So, how is ethos related to resilience? There is no literature which addresses ethos and resilience. I draw on my understandings of education for sustainability and resilience to make some propositions.

If we consider that schools can enhance community resilience by teaching and modelling adaptability, then a school's ethos will work to optimise future options for the local community. I propose the shared vision, values, goals and objectives will foster learning, diversity, change and trust. My experience in schools has taught me many students are disengaged from learning. Yet enthusiasm for learning is an important feature of resilient social-ecological systems. Diversity is important because resilience relies on the capacity to respond in different ways (Walker & Salt, 2006). Schools are social systems under intense (and seemingly unending) political and community pressures and expectations. I assume it can seem easier for school leaders to manage homogeneous rather than diverse school populations. Harnessing the ability to change is important because when a system's resilience is challenged, the capacity for change may determine future actions. Trust matters because trust facilitates collaboration and productive activity (Halpern, 2005; Pretty & Ward, 2001). Lack of trust makes building a whole-school ethos for education for sustainability difficult.

Discussion of the school ethos indicator statement

The school's meta-values and culture value and encourage higher-order learning, diversity, trust and understanding and managing change

I describe a school's meta-values and culture as the principles that permeate the school and guide governance and teaching and learning. Because this research is novel I have not been able to find literature to support this statement. However, I draw on Krasny et al. (2009) who argue that enhancing resilience requires a reorientation from behaviourist to participatory educational approaches. Behaviourist approaches are content-driven, top down, deterministic, and "antithetical to systems notions of unpredictability, emergence, and interactions" (Krasny, et al., 2009, p. 1). Participatory approaches, on the other hand, aim to build capacity through emergent learning experiences. I propose behaviourist teaching approaches, such as direct instruction and drill and practice (McInerney & McInerney, 2002), can work against developing higher-order thinking, diversity, and understanding and managing change because the focus is on memorising what the teacher considers is a right answer rather than on developing independent and complex thought. Students engage in higher-order learning when they go beyond memorising the right answer to developing more complex thoughts to hypothesise and/or develop a conclusion or interpretation (Education Queensland, 2002).

The four schools in this study apply higher order thinking to engage students in solving local ecological sustainability issues. At Whanilla SS, students assessed the dilapidated wetland area behind the school, designed possible alternatives, then planned and implemented a sustainable and award-winning ecological solution. Similar processes at Reliwarra SC also led to the rehabilitation of a local waterway. Higher-order thinking skills are also necessary to successfully manage complex non-linear change and require analysis, synthesis and evaluation. Schools can teach students how to manage complex change by guiding students to critically analyse, synthesise and evaluate. Such exercises also build trust between participants. Trust in school communities is built over time through the process of relationship building between the principal, teachers, students and parents (Bryk & Schneider, 2002). I propose schools can encourage trust by actively engaging in complex change processes and activities that explicitly build relationships.

I suggest a school that encourages diversity recognises and values difference in, for example, culture, ways of understanding knowledge and learning. Sustainability has social, ecological, economic and political goals (Fien, 2001). Hollindale SS's ethos is underpinned by social and political processes necessary for sustainability, by active and informed citizenship and by valuing, caring and working towards improved local ecological and social environments. Through a student-led democratic process, Year Seven students hold yearly forums to directly address local social and ecological issues. Students have hosted, attended and presented at forums such as the 2006 Reef Guardian Youth Forum and the 2020 Schools Summit held in 2008. Nevertheless, my analysis of the data indicates Hollindale SS's approach fails to explicitly address cultural diversity in knowledge production. A review of the unit plans indicates knowledge and understanding is presented from a western perspective. The schools in this study remain embedded in the dominant consumerist culture. A cross-cultural perspective would enable students to more critically examine contrasting cultural sustainability approaches with the aim of exposing students to ideas about sustainability from the perspective of other cultures (Polistina, n.d.).

5.2.2 Governance domain

Governance can be understood in terms of the practices through which societies are governed (Meadowcroft, 2007). The United Nations Economic and Social Commission for Asia and the Pacific (2010) describes governance as the process of decision making and the processes by which decisions are implemented and is inclusive of both formal and informal structures. The definition is supported by Lemos and Agrawal (2006) who argue that governance "[i]ncludes the actions of the state and, in addition, encompasses actors such as communities, businesses, and NGOs" (p. 298). Lemos and Agrawal (2006) further argue the concept of governance has been shaped by debates about what "good governance" involves. In schools, governance is a broad concept which takes place within the context of laws, regulations, administrative instructions, government-issued directives, school community groups (such as Parents and Citizens Associations) and individuals (like parents, carers and teachers) (UNESCOn.d). The principal leads the school and oversees and manages the school and daily activities. I examine the attributes of governance in the four case study schools within an education for

sustainability context to identify how certain aspects parallel resilience theory and research. The emergent indicators in this section reflect the process.

Governance is central to effective education for sustainability because strong support from school governance teams of a whole-school approach can ensure "physical and human resources are used in economical, environmental and socially sustainable ways" (DETA2006b, p. 10). According to the Australian Government's (2005) *National Environmental Education Statement for Australian Schools* good governance occurs "where decision making is distributed across the school community and involves students in an appropriate way" (p. 11). The *Report to the Queensland Minister for Education and Training and Minister for the Arts on Education for Sustainability in Queensland Schools* (DETA2006b) considers "good" governance "is vital for strong networks that contribute to social cohesion and for partnerships that embed a commitment to education for sustainability within the whole school" (p. 10).

In the context of resilience, governance is defined as "the structures and processes by which societies share power" (Lebel et al.2006, p. 120). Resilience scholars consider good governance enhances the ability to effectively manage social-ecological systems. Traditional governance approaches are hierarchical based on top-down command and control theory – otherwise known as linear causal thinking – and assumes an ability to predict the way systems will respond. By contrast, a resilience approach emphasises most systems are, in fact, unpredictable. Therefore, we can learn to manage with and for change by focussing on building the capacity of systems to cope with "whatever the future brings" (Anderies, Walker, & Kinzig, 2006; Walker, et al., 2002). Lebel et al. (2006) study the politics of governance to consider how certain attributes enhance capacity to manage resilience. They find "good" governance is participatory, polycentric, accountable, just, multi-layered and deliberates through debate, dissent, mediation and negotiation. Participation and deliberation builds trust and shared understanding. A polycentric and multilayered organisational structure improves response capacity as results and consequences of actions are more readily obvious.

Local knowledge is more efficient in informing local action than a single centralised system (Lebel, et al., 2006). Centralised systems have weaker feedback systems and slower response rates. Management that is both accountable and just ensures benefits

and risks are equitably distributed. This maximises opportunities for the whole system to adapt and to be adaptive, rather than a selective portion. Although these understandings were developed in the context of governance within natural resource management, I propose many of the principles are similarly applicable to school governance. Indicators relating to governance can provide information for school administrators and/or managers interested in enhancing local-scale resilience.

Discussion of the governance indicator statements

School governance demonstrates cross-scale flexibility and adaptability

Resilience scholars argue flexible organisational structures are better adapted for long-term survival than rigid systems (Folke, et al., 2002). This is because flexible institutions are better able to deal with uncertainty and surprise, promote learning through experimentation and innovation, and more ably support cross-scale institutional linkages (Huitric et al.2009; Simonsen, 2007). Flexible institutional arrangements also involve multiple polycentric and cross-level horizontal institutional and organisational linkages with other social groups, government agencies, and non-governmental organisations (Folke, et al., 2005).

Relevant here is leadership. Flexible leadership is adaptable and tailored to specific places and situations (Folke, et al., 2005). Dunphy (cited in Dunphy, Griffiths, & Benn, 2007, pp. 298-299) identifies flexibility and adaptability as one of twelve important characteristics for leaders to develop when wanting to enact change. Flexible leaders are able to apply different leadership strategies as the situation requires; for example, they can be directive or non-directive (Fullan, 2001; Waters, Marzano, & McNulty, 2003). Marzano, Waters and McNulty (2005) conducted a meta-analysis of research on school leadership spanning 35 years and found that flexible leaders adapt their leadership styles to the needs of specific situations, are directive or non-directive as the situation warrants, encourage people to express diverse and contrary opinions and are comfortable making large changes to how things are done.

In this study, flexible governance was demonstrated by a willingness to juggle competing school priorities to enable action as well as to adapt and incorporate change derived from feedback and reflection into school processes. Elizabeth (principal,

Whanilla SS) applies different approaches to engage teachers in education for sustainability. When Elizabeth first negotiated with a resistant teacher she applied a non-directive style. Elizabeth explained, “I tried being nice and supportive, and [saying] Kieran can help you … You can pick your topic and we can have planning days”. When the teacher continued to resist school directional change, Elizabeth felt compelled to employ a directive style: “At the end of the day when teachers say ‘No, no, no’. I’m compelled to say ‘Well this is the way we’re doing it at Whanilla. This has been decided by the P&C, this has been decided by the staff. The staff is more than one person. You’re just going to have to do it’. And they have to.”

Flexibility and diversity increases system resilience (Newman & Dale, 2005). When managers apply experimental methods to deliberately seek out and reapply feedbacks to inform further planning, each action is viewed as an opportunity for learning and adaptation (Berkes & Folke, 1998; Folke, et al., 2005). Elizabeth demonstrates a resilience management approach at school level through her willingness to ‘learn by doing’ (Berkes & Folke, 1998). Elizabeth and Kieran were unable to map out linear pathways for education for sustainability at Whanilla SS because outcomes were emergent and unpredictable. Elizabeth said in the beginning they “just kept trying things”. Elizabeth and Kieran learnt from feedbacks and then shaped future actions. This flexible and iterative approach enabled both Kieran and Elizabeth to lead and develop their education for sustainability vision by adapting to and shaping circumstances as required.

Further demonstration of flexibility and adaptability is evident by principals’ willingness to juggle school budget systems, and teaching and administration positions to help teachers implement education for sustainability. In the resilience field this is known as innovation (Walker & Salt, 2006). Innovation is when leaders enable change by offering help to those who are keen to enact change. In each of the four schools researched, principals supported their staffs’ innovations by practical means, including releasing teachers from classroom duties to work on education for sustainability programs. At Whanilla SS, Elizabeth (principal) allocated Kieran one of her administration days and created the position of curriculum coordinator to “give Kieran time to do what he wants to do, what he needs to do to run our program”. At Hollindale SS, Robert (principal) and the key teachers created a reportable school program area

with a budget line, which they called “Sustainable Environments”. Robert directly supports teachers who wish to advance education for sustainability, for example, by: “get[ting] younger people to shadow the more experienced teachers. They self nominate to varying degrees and we sort of generate and encourage that interest. Some of our new teachers, the youngest ones, are showing a lot of interest and we’re encouraging them by giving them professional development opportunities or funding them to attend various things alongside the more experienced program managers and that sort of thing.

School governance demonstrates creativity

Creativity is the ability to improvise and innovate in response to change (Aguirre, 2006; Maguire & Hagan, 2007). Creativity increases our array of possibilities by enabling us to find innovative ways of thinking about and doing things which ultimately leads to improved capacity to respond to change (Kimhi & Shamai, 2004). Creative social-ecological systems have higher levels of functioning and adaptive capacity, and are less vulnerable to change and surprise (Folke, 2002). When faced with adverse conditions, creative social-ecological systems are more likely to emerge with higher levels of learning than less resilient systems (Maguire & Hagan, 2007). Consider Strathewen, a rural town with a population of 200, north of Melbourne, Australia. The Black Saturday Bush Fires on 7 February 2009 destroyed the town and killed 27 community members. Stathewen Primary School, completely devastated in the bush fires, was operational four days later. In an ABC Radio interview on 4 February 2010 (Armstrong, 2010) the principal of Strathewen Primary School reported on Monday, 9 February 2009, community members held a meeting to consider and plan a future pathway. On Tuesday, 10 February 2009, volunteers, community members, and students and parents from local schools worked to set up alternative classrooms, and on Wednesday, 11 February 2009, the school was reopened in an alternative location.

Creative thinking is an explicit skill that leaders are expected to possess (Law & Glover, 2001). The principals in my study demonstrate creativity through their capacity and readiness to explore new possibilities. All principals demonstrated a willingness to improvise and innovate new ways of thinking and acting within their schools. One way the principals did this was by rearranging internal school systems. David (principal, Reliwarra SC) applied what he called “creative timetabling” to provide Mel (education for sustainability coordinator) non-teaching time to develop and implement her ideas.

Elizabeth (principal, Whanilla SS) demonstrated creativity by doing "whatever needs to be done. If there's a grant that needs to be written, if you need more money in your budget, we'll do something creative to get money". Lyn (principal, Fontana SS) helped Kim find time to coordinate the school's initiatives by rearranging timetables, classroom staffing and budgets. Ann (associate principal, Reliwarra SC) was open to "finding different ways to do it", saying "this is most important when thinking about how to enable teachers to implement education for sustainability".

In schools, curriculum underpins learning. Education for sustainability is most effective when implemented across the curriculum. According to the Australian Government's *National Environmental Education Statement* (DEH2005) curriculum planning is best undertaken within each school's context. Curriculum innovation is another means by which principals in this study display creativity. All principals enabled the rearrangement of the curriculum to ensure all teachers implemented a minimum of one education for sustainability unit of work each year. At Reliwarra SC, Mel (education for sustainability coordinator) is working to make sure the education for sustainability curriculum is progressive across year levels so students build on prior knowledge. At Hollindale SS, Robert (principal) creatively integrated education for sustainability into the school's core learning areas by, he said, "assigning it a program area, the equivalent of maths or english or science, and giving it a brand name like sustainable environments".

School governance demonstrates democracy

Democratic governance is characterised by horizontal social structures with distributed power, strong participation, sense of ownership, and accumulated social capital (Buckley, 2002). A consistent finding from studies on effective school governance is that leadership is distributed across the whole school community (Mulford, 2003). Short and Greer's (2002) research finds distributive leadership is effective for building school community self-esteem and capacity. The *National Environmental Education Statement* (DEH2005) holds that distributive leadership is good practice. In a resilience context, democratic governance is often described as adaptive co-management. Folke et al. (2005, p. 448) describe adaptive co-management systems are "flexible community-based systems of resource management tailored to specific places and situations, and they are supported by and work with various organizations at different levels". Such

democratic place-based governance systems combine the dynamic characteristics of adaptive management and the distributive leadership characteristics of democratic management (Folke, et al., 2005). Adaptive co-management requires people, working at and across different scales, to collaboratively work together in a commonly agreed-on direction.

The four schools in this study demonstrate the characteristics of healthy democratic governance through (a) strong and supportive leadership, (b) partnerships with school and local community members and businesses, government and non-government agencies, (c) self-organising school community members. In the schools democratic leadership takes the form of disseminated leadership and willingness on the part of the principals to accept other viewpoints from their staff and incorporate these views into practice. Elizabeth (principal, Whanilla SS) displays democratic leadership in her approach to school decision-making processes, making decisions on school direction and curriculum by consensus. Elizabeth explains "we work in a team and we all create the objectives and goals together." Elizabeth does not see her school's organisational structure as hierarchical, but rather as a horizontal team arrangement. She says, "I'm not a boss, I'm a leader. And sometimes I lead from the front and sometimes I'm just part of the pack that goes along". In her approach, Elizabeth clearly distinguishes between organic leadership and directive positional power structures.

Lyn (principal, Fontana SS) thinks teachers should contribute to school decision-making processes and is purposefully developing democratic decision-making structures for teachers to "make their own decisions". Lyn asks her staff how they wish to proceed on education for sustainability matters. While Kim (education for sustainability coordinator) leads and coordinates education for sustainability activities, the initiatives she implements are decided upon by the sustainability committee who regularly invite school community members to contribute to decision making. Students at Fontana SS are asked to play a substantive role in this decision making process through the student council body which is required to set an agenda for action at the beginning of each year and follow it through.

Students, teachers and parents at Hollindale SS influence education for sustainability through the student council, the Sustainability Committee and the Parents and Citizens

Association. Decisions then flow through the school. The student council and Sustainability Committee both set objectives at the beginning of each year and report on outcomes at the end of the year in a formal report. The end-of-year report is a record of the whole year's education for sustainability activities and outcomes. The report also provides the basis for the following year's action plan.

Data show all four principals incorporate adaptive management and comanagement principles and practices and apply a continuous, iterative learning process of planning, implementing, monitoring and reviewing. Fabricius, Folke, Cundill et al. (2007) list six characteristics of adaptive comanagement. These are leadership and vision, knowledge networks, the existence or development of multiple institutions, links between culture and management, the existence of enabling policies, and high levels of motivation in all people involved. All six characteristics emerged in this study to a greater or lesser degree.

Capable leaders have strong leadership skills and vision, organise people to work towards an agreed future, and use opportunities to precipitate change (Fabricius, et al., 2007; Folke, et al., 2005). When Elizabeth began her position as principal at Whanilla SS, she planned to elevate the reputation of the school, but was unsure how to do this. When Elizabeth began to learn about education for sustainability she immediately recognised its potential as a means for improving the school's status and profile. Elizabeth then set about developing a whole-school vision around education for sustainability principles and persistently organised the school community to work towards this.

School governance demonstrates altruism

Altruism is a pro-social behaviour, defined as selfless concern for other people's needs and welfare (Vaughan & Hogg, 2008). Altruism is evident when people take deliberate and unselfish actions to help others without expectation of personal gain (Kanungo & Mendonca, 1996; Vaughan & Hogg, 2008). The Altruistic Personality and Prosocial Behavior Institute (n.d) identify a behaviour as altruistic when actions are directed towards helping another, involve a high risk or sacrifice, where the altruist expects no external reward in return, and the sacrifice is voluntary. A number of studies have explored links between altruism and ecological protection (Popp, 2001), ecologically

beneficial actions such as recycling (Hopper & McCarl Nielsen, 1991), children's perceptions about global warming (Cai, Zhao, & Carey, 2009), and environmental volunteering (Randle & Dolnicar, 2006). All four studies found altruism is linked to a willingness to take actions for the environment.

Clayton and Radcliffe (1996) consider altruism among current populations to be minimal because people have chosen to maximise consumption at the expense of future generations. I argue that a link can be made between the work carried out by the very dedicated principals and teachers in this study and an unselfish concern for the welfare of present and future generations. The participants in this study demonstrate altruism by their willingness to make personal sacrifices that will directly benefit the school community. Elizabeth gives Kieran one of her allocated administration days per week to enable him to implement education for sustainability, and then works outside her allocated hours to complete her administration load. Ann (principal, Hollindale SS) works to relieve Kim's (education for sustainability coordinator) workload to ensure Kim does not "burn herself out". Mel (education for sustainability coordinator, Reliwarra SC) is motivated to enact and teach sustainability by an altruistic concern for future generations. In her words:

> [a]fter I had my own children, I started to think about the future, and that's when you start thinking 'what am I going to leave them? What am I going to leave my children's children?' And that's when I started to think about what we're doing and our footprint here on earth.

School governance demonstrates tenacity and recursiveness

Tenacity is the ability to persist in the face of adversity (Goldberg, 1995). Recursiveness is learning from errors and applying the learning to inform further action (Goldberg, 1995). I propose from a social-ecological resilience perspective, tenacity and recursiveness are important to responding positively to adversity in schools as well as in communities. When communities are faced with disasters, such as Hurricane Katrina in New Orleans in 2005 or Cyclone Larry which devastated the Innisfail community in Far North Queensland in 2006, tenacity enables the communities to persevere to overcome hardships. A recent Australian study by Drysdale, Goode and Gurr (2009) into successful school leadership identifies tenacity is an important personal characteristic for those wishing to enact change.

Tenacity is demonstrated by school community willingness to persevere with implementing education for sustainability with very modest support from regulating bureaucracies working at levels above the school scale. The interview data indicate that when faced with barriers to implementing education for sustainability, the dedicated teachers and principals in this study have remained optimistic and searched for alternative pathways to implement the sustainability initiatives. Participant teachers and principals have applied a recursive learning approach by reflecting on mistakes before moving forward again, always staying committed to working for sustainability. David's (principal, Reliwarra SC) words exemplify the tenacity and recursiveness all study participants applied when he says:

> If at first you don't succeed, try, try and try again …Try another strategy, take another road, get to the same destination but go a different route.

School governance demonstrates trust

Short and Greer (2002) and Tschannen-Moran's (2009) research finds participatory and polycentric governance styles engender trust building. Hierarchical management approaches where the principal reserves veto power over teacher decisions diminishes trust (Short & Greer, 2002). According to Short and Greer (2002) trust is most evident in schools where principals are:

> In the trenches working along with everyone else, who were never afraid of getting their hands dirty. They would do everything anyone else did and then go even further. These were the principals who, through personal behaviour and example, inspired trust from all. They trusted others and earned reciprocal trust. (p. 64).

It is argued by Folke (2006) and Walker and Salt (2006) that trust is critical in building and maintaining adaptive capacity in social systems. Resilience relies on the capacity of people to respond to change cohesively. Trust between people is a requirement if cohesive work is to be effective. Trust enables meaningful transfer and, it can be argued, exchange of knowledge and learning (Tschannen-Moran, 2009). Trust is critical in complex social-ecological systems because "relationships form the basis for all communication, motivation and action" (Blann, Light, & Musumeci, 2003, p. 228). The establishment of trusting relationships requires fair, open and honest transactions and communication between people (Blann, et al., 2003).

Trust in schools is important because schools are entrusted with the care and teaching of children and democracy, as well as reproducing desirable norms that society values such as respect and tolerance (Tschannen-Moran & Hoy, 2000). Recent case studies by Day (2009) and Drysdale et al. (2009) of successful schools in Australia and the United Kingdom identify high levels of trust as important among school community members. According to Tschannen-Moran (2009) school leaders play a significant role in establishing school-level trust. Short and Greer (2002) state "The principal is the key to building a trusting environment. Trust begins with the principal" (p. 63). Their (2002) research on school leadership finds principals of schools with high trust cultures actively participate with teachers in undertaking new initiatives, are non judgemental, and model high-trust attitudes towards all staff. Five important components of school level trust are benevolence, predictability, competence, honesty, and openness (Hoy, et al., 2006; Tschannen-Moran & Hoy, 2000). Benevolence is teacher-held confidence that principals act in good faith and will protect their teachers' best interests. Predictability refers to consistent principal and teacher action. When action is consistent, teachers and principals feel they can rely on each other. Competence is exemplified by principals and teachers performing to acceptable competent standards, however these are communally decided. It is difficult to build professional trust when teachers feel colleagues lack the ability to carry out their job competently. Honesty is displayed when principals and teachers are sincere, fair and open. Honest principals and teachers will not distort the truth or shift responsibility and will meet their commitments. Openness refers to principals and teachers sharing relevant information (Tschannen-Moran & Hoy, 2000).

All four principals in this study agreed trust is important. Richard (principal, Reliwarra SC) aptly explains, "Schools are built on trust". Parents entrust children to schools for around three quarters of the year in the faith schools will "teach, guide, counsel and protect" them (Tschannen-Moran & Hoy, 2000, p. 547). Trust is demonstrated by every principal in this study in their willingness to employ professional trust within each school community. Elizabeth (principal, Whanilla SS) overtly displays symbolic trust by providing staff with a master key which provides open access to all school areas. Elizabeth also actively fosters trust by working alongside teachers in school activities and sharing decision making. Robert (principal, Hollindale SS) says in his interview that trust is particularly important to enable education for sustainability. In Robert's

words, “We need that professional trust, without that you can’t do it [...] If you don’t trust your teachers it doesn’t work.” At Fontana SS, Lyn (principal) modelled trust from the beginning of her principalship. Although Lyn initially had limited knowledge and understanding of education for sustainability, she trusted Kim to lead the school into the sustainability initiatives. Lyn absorbs responsibilities but points out:

> Everything doesn’t have to come back through the principal or the deputy principal because I think that we trust that [teachers] are professionals and that [they] can get together and work out what’s needed.

Lyn’s approach to developing trust is consistent with the understanding of Bryk and Schneider (cited in Tschannen-Moran, 2009, p. 229), who point out:

> To foster trust, school policies must demonstrate an expectation of trustworthy behaviour on the part of teachers and other staff, thereby creating decision-making structures and granting discretion in instructional decisions that rely on teachers’ expertise and commitment to students.

School governance demonstrates active principal support

Change is always difficult because it requires breaking a cycle of habit (Westley, Zimmerman, & Patton, 2007). In schools, principal support is critical to the success of educational change (Fullan, 2003; Hallinger & Heck, 1996; Hargreaves & Fink, 2006). The same has been found with education for sustainability (see Gough, 2004; Larri, 2004). My experience researching education for sustainability in Far North Queensland schools leads me to the conclusion that principal support (or lack of) is a key characteristic that can enable or hinder the success of initiatives. I struggled to understand the full impact of principal support until I realised systemic change requires mobilisation of power, resources and established structures held by the status quo (Westley, et al., 2007). Since successful implementation of education for sustainability requires systemic change, the principal is the only person at school level who has the power/authority to unlock resources and remake the distribution of resources within established educational structures. This research led me to realise there are different ways principals can support teachers wishing to implement education for sustainability. Some types of principal support are more enabling than others. I further categorise principal support as active or passive in order to more fully investigate the phenomenon.

Active principal support is demonstrated by a willingness to take concrete actions that directly help teachers implement education for sustainability. Two examples are providing money or publicly speaking up for education for sustainability. Passive support, on the other hand, is inert and less helpful for the teacher innovator. A principal who extends passive support consents to education for sustainability, but does not take concrete actions to help the teacher. Westley et al. (2007, p. 95) tell us, “Innovation is fuelled first by the energy, time and skills of people, but also needs financial capital and, ultimately, enough authority to penetrate the established structures”. The teachers in this study are prepared to invest energy, time and skills; however, without active principal support to release financial capital and infiltrate the ‘business as usual’ model of educational bureaucracy, implementation of education for sustainability remains difficult.

I propose active principal support contributes to building school community level resilience. Principals who provide active support access multi-scale resources that are difficult for teachers to reach. All four principals in this study manipulate school budget lines to provide money to help teachers implement education for sustainability. Robert (principal, Hollindale SS) draws on his contacts to, as he says “strengthen the road [for teachers] and widen networks”. Lyn (principal, Fontana SS) actively and publicly supports education for sustainability. David (principal, Reliwarra SC) provides Mel (education for sustainability coordinator) opportunities to network with people from different influence circles by, for example, enabling Mel to attend workshops and conferences.

Active principal support is similar to the techniques applied by adaptive management. Westley (2002) explains adaptive managers capitalise on the “energy and movement of others” (p. 354). The adaptive manager is able to recognise and take advantage of emergent opportunities. All four principals recognised potential in education for sustainability and, each in their own way, have capitalised on the energy and movement of teacher innovators to benefit their school communities. Adaptive managers form relationships within and across scales. These relationships create a complex, adaptive system and act as a response network to provide social resources for dealing with crises and surprises (Westley, 2002). The four schools in this research have forged multiple cross-scale networks and partnerships. Data from the interviews and questionnaires

indicate benefits include enhanced social capital, learning and knowledge, extending to opportunities which may have otherwise not been available. Data indicate this lead to improved school community-level adaptive capacity.

5.2.3 Physical surrounds domain

Physical surrounds include the buildings and outdoor areas in and around the school. According to the Australian Government's *National Environmental Education Statement* (2005), beautifying school grounds (a) adds aesthetic value by improving the appearance of the school grounds, (b) enhances student educational experiences by, for example, creating hands-on teaching and learning resources such as learnscapes, and (c) enhances community-level cultural and social capital through member participation in activities such as landscaping and habitat creation. Schools can be places that promote, legitimise and drive community-level sustainability which, in turn, can enhance social-ecological resilience.

Schools are distinctive institutions, usually located on well travelled main roads in the centre of a suburb or town. I propose a school that houses visible sustainable technologies and landscape principles exposes the local community to alternative ways to respond to threats such as peak oil, climate change, biodiversity loss and changes to water quality. According to the Queensland Oil Vulnerability Taskforce Report (2007) diminishing global supplies of oil pose a substantial threat to Queensland's sustainable future. New sources of energy supply make us less vulnerable to peak oil. I suggest schools can encourage community-level acceptance of and transformation to more sustainable energy and land use through modelling the uptake of initiatives such as solar panels that promote lower energy use, productive vegetable and fruit gardens which provide local food sources, and native vegetation which encourages diversity of local species. Over time, local communities can begin to understand how alternative forms of energy and land use are beneficial.

Discussion of the physical surrounds indicator statements

The school's physical surrounds show evidence of landscape diversity (including dominance of local native plants).

I define landscape diversity after Urban, O'Neill and Shugart (1987, p. 119), to mean a "mosaic of heterogeneous land forms, vegetation types, and land uses". In this research

I focus on land uses within and around the school sites. Hopkins (2008) recounts it is only in the past forty years that widespread and cheap oil has "afforded us the luxury of being able to design totally useless landscapes" (p. 196). Before this, townscapes were scattered with productive landscapes bearing fruits, nuts and vegetables. Hopkins (2008) argues modern landscapes designed for aesthetic rather than practical values are dysfunctional and erode resilience because they limit local options and leave communities vulnerable to imposed outside forces. Resilient communities have their own resources to rely on during times of instability (Hopkins, 2008). One way schools can enhance resilience through education for sustainability is by producing productive heterogenous landscapes in and around the school grounds for the benefit of the school and local community.

Landscape heterogeneity is linked to increased species diversity (see for example, studies by Benton, Vickery, & Wilson, 2003; Oliver, Roy, Hill, Brereton, & Thomas, in press; Weibull, Bengtsson, & Nohlgren, 2000). School garden programs are linked to enhanced environmental awareness, science, english and nutrition learning, mathematical problem solving, development of social skills, and student behaviour (Ozer, 2007; Pranis, 2010). Productive school gardens can be seen to enhance local-scale resilience by teaching students how to grow different varieties of foods. Students can learn how to be self-sufficient enough to provide essential food needs in the case of need. In these case study schools, landscape diversity is exemplified by such initiatives as frog ponds, native and vegetable gardens, wildlife corridors, learnscapes, painted murals, and different varieties of trees. All four schools have attempted to develop landscape diversity within and around the school grounds. Whanilla SS has restored the swamp behind the school, planted 6000 trees, created frog and bird breeding habitats, built native and vegetable gardens, created learnscapes, designed and constructed a mini wetlands habitat, painted murals depicting the school's artistic representation of sustainability. Fontana SS has built a variety of extensive native and vegetable gardens. Reliwarra SC has rehabilitated an adjoining area to the school that has a seasonal creek running through and built native and vegetable gardens around the school. Hollindale SS has built native gardens around the school and painted murals representing the school's portrayal of sustainability. Whanilla SS and Fontana SS reported increased native species diversity after creating native habitats. Kieran (education for sustainability coordinator, Whanilla SS) recorded diversity in bird species, while Kim

(education for sustainability coordinator, Fontana SS) witnessed diversity and increased quantities of frog species.

I asked the participant teachers what students were learning through education for sustainability initiatives related to landscape diversity. All teachers responded that while they could not quantify the direct impact of the work they had done around the school on student actions, written assessment work such as assignments and tests indicated raised student awareness of sustainability issues and impacts. One example is student awareness of riparian zones at Reliwarra SC as a result of revegetating the seasonal creek adjacent to the school. My interviews with students support teacher statements and indicate these students have learnt that landscape heterogeneity is important for promoting species diversity. At Whanilla SS, students have been keeping logs of bird and animal species sighted in and around the school since before the landscape rehabilitation commenced. All students interviewed talked about all the different species they now see at school.

The school's physical surrounds contain minimal litter, invasive weeds and pest animals

The Queensland Government Department of Environment and Resource Management (DERM) (2010) defines litter as any domestic or commercial waste or material a person considers is refuse, debris or rubbish. This can be almost any material that is disposed of incorrectly. Common examples are drink bottles, food wraps, and cigarette butts. According to the Australian Government's *National Environmental Education Statement* (2005) the extent to which a school can reduce waste to landfill is an indicator of sustainability. It is a common experience that litter in schools is problematic. Students generate litter through lunches and drinks packaged in plastics and non-recyclable materials. Data from my case studies indicate one way schools can reduce waste to landfill is by implementing a waste management system which classifies, separates, organises and reuses recyclable waste. Whanilla SS and Fontana SS reduced the amount of rubbish sent to landfill by 50 per cent. They did this by encouraging litter free lunches, sorting school litter and recycling organic, plastic and paper waste. Treatment of waste is an important concept in community-scale resilience. Hopkins (2008) differentiates between centralised and local recycling and how these affect resilience:

> A community might, for example, campaign for plastics recycling, where all of its industrial and domestic plastic waste is collected for recycling. While almost certainly being better for the environment as a whole, it adds almost no resilience to the community. Perhaps a better solution (alongside the obvious one of producing less plastic waste), would be to develop other uses for waste plastics requiring minimal processing, perhaps producing tightly compressed building blocks or an insulating product for local use. Simply collecting it and sending it away doesn't leave the community in a stronger position, nor is it more able to respond creatively to change or shock (pp. 54-55).

I argue here that Whanilla and Fontana SS's waste management initiatives enhance local-level resilience because students are learning how to minimise waste by composting and recycling items which were previously thrown or sent away.

Invasive weeds and pest animals can be problematic for schools wishing to enhance school-ground biodiversity because both act to diminish diversity. Invasive weeds and pest animals are introduced species that adversely affect biodiversity and/or threaten native breeds (World Wildlife Fund Australia [WWF], n.d). According to WWF (n.d), only land clearing is a more serious threat to Australia's biodiversity than invasive weeds and pest animals. Invasive weeds displace native plant species and significantly contribute to land degradation and (DEWHA2009). Pest animals threaten native species by, for example, destroying native plants that provide food and shelter for native animals, and competing for water and food (Queensland Government Department of Employment Economic Development and Innovation, 2008). All four schools in this study recounted experiencing problems with weeds and pest species. Each school set targets to increase school-based biodiversity in their School Environmental Management Plans, but did not document weed and pest management plans. I asked teachers how they managed weeds and pests. All stated they apply mulch to reduce weed growth. Kieran (education for sustainability coordinator, Whanilla SS) takes his class out to weed and introduced a reward system for students who volunteer to weed during their break times. Denise (education for sustainability coordinator, Hollindale SS) implemented a class roster system for weeding. Mel (education for sustainability coordinator, Reliwarra SC) has no formal weeding regime in place. The grounds-keeper maintains the gardens and sprays the weeds. At Fontana SS, Kim (education for sustainability coordinator), her class and volunteer parents weed the gardens. The various approaches suggest weeds are managed ad hoc. I propose lack of formal weed

and pest management plans works against resilience building because there is no formal whole-school agreement to rely on if key teachers leave.

The school's physical surrounds show evidence of sustainable technologies

Sustainable technologies are products and processes which maximise resource and energy efficiency and minimise environmental impacts (The University of Sydney Laboratory for Sustainable Technology, 2010). Schools directly impact the environment through the resources they use and the pollution, greenhouse emissions and waste they produce (Centre for Ecoliteracy, 2010). In school grounds, sustainable technologies can include solar panels, water tanks, skylights and bores. I argue schools that model sustainable technologies can have a greater impact on resilience. This is because learning about sustainable technologies without hands-on access centres around abstract knowledge acquisition. If, on the other hand, the sustainable technologies are in the school, students can see how they work and be participants in the daily operations of the technologies. I surmise participation in the day-to-day discourses of the sustainable technologies is more likely to enhance resilience than passive knowledge acquisition. Sustainable technologies in my study schools vary. Whanilla SS have bores around the school for watering gardens and a water tank attached to one of the buildings. Fontana SS have one bore, one building with solar panels and a water tank. Reliwarra SC and Hollindale SS have no sustainable technologies but were both inquiring about installing some water tanks.

5.2.4 Resource management domain

Resource management refers to the management of water, waste, energy, and biodiversity. Resource management is a central concept to sustainability as many of the planet's problems are a direct result of unsustainable resource management practices. I propose school-based sustainable resource management (a) directly works for sustainability by reducing the school's ecological footprint, and (b) teaches students how to live more sustainably. The Australian Government's *National Environmental Education Statement* (2005) states schools can reduce their ecological footprint by reducing water and waste, minimising energy and water consumption, recycling, encouraging biodiversity in the school grounds, conserving the heritage value of the site, applying sound purchasing practices and ensuring canteen products are environmentally appropriate. However, resilience is more than engaging in activities

that reduce people's ecological footprint on Earth. A resilient community also has the skills to manage resources in ways that make the community stronger and more self-sufficient (Hopkins, 2008). Whole-school resource management can be a model for developing community-scale resource self-sufficiency – particularly, Hopkins (2008) reminds us, if the practices leave the community "in a stronger position to respond creatively to change or shock" (p. 55). One way to plan for this is through a School Environmental Management Plan (SEMP) which applies resilience understandings to the management of resources. This can include, for example, thinking through and articulating how resources will be managed locally. Another way is by adopting an adaptive management approach to resource management. Both these approaches are articulated as indicator statements and are explained further below.

One foreseeable problem with implementing a resilience-enhancing resource management plan is the nested nature of resilience. A school might wish to lower their ecological footprint by generating their own electricity and/or water. However, what a school is or is not able to do is influenced by the hierarchical nature of government policy and funding. A school wishing to buy solar panels to generate electricity or wind turbines to pump their own water, may be enabled to do so through the creation of government policy which supports sustainability initiatives. However, without funds the school is not able to action the policy. A school's resource management plan may improve sustainability but do little to enhance resilience if the school community is not able to create, test, and adapt resources that enhance self-reliance and adaptive capacity.

Discussion of the resource management indicator statements

Resource management is addressed through a locally based whole-school environmental management plan (SEMP)

A School Environmental Management Plan (SEMP) is a formal document which explains a school's intentions with regards to (a) education for sustainability, and (b) management of water, energy, waste, and biodiversity. For maximum impact SEMPs involve the whole school community (New South Wales Government - Sustainable Schools NSW, n.d-b). The Queensland Government's Department of Education and Training (2010b) states a SEMP includes curriculum resources as well as management plans for water, waste, energy, biodiversity, community partnerships and whole-school

governance. SEMPs are fairly new to Queensland. From my review of the literature there is a lack of information on SEMPS. The New South Wales Government provides a website which contains a section on SEMPs (see www.sustainableschools.nsw.edu.au). In Queensland, The Queensland Environmentally Sustainable Schools Alliance (QESSI) helps schools implement SEMPs and provides support for key staff (see http://www.southwestnrm.org.au/education/downloads/WHAT-IS-QESSI.pdf). At the time of finishing this thesis in mid-2010, a new website called *Queensland Sustainable Schools* was in the process of being constructed by the Queensland Government Department of Education and Training (see www.sustainableschools.qld.edu.au/). The aim of the website is to "support schools, their partners and the community in realising a positive environmental vision for their school" (Para 1). A feature of the website is an online tool designed to help school communities measure, monitor and reduce their ecological footprint. Beginning in 2010, schools are also able to seek assistance through the Earth Smart Science Program, a Queensland Government education for sustainability initiative. Earth Smart Science aims to reduce schools' ecological footprints through development and implementation of SEMPs. All Queensland schools are required to participate in Earth Smart Science by 2012 (see Queensland Government Department of Education and Training, 2010a).

SEMPS are useful for integrating sustainability into the school's teaching, learning and management; however, I argue that to enhance resilience, management of resources needs to be based locally. In following Hopkins (2008), a community that can produce and recycle its own resources is more resilient because it is less reliant on outside agencies. In the case of an unexpected event these communities are more likely to be able to maintain their normal function and structure. The four schools in this study have SEMPs which address management of water, energy, waste and biodiversity issues within their school grounds, although not specifically with a local focus. This is likely to be because resilience adds a new perspective to education for sustainability to which teachers have not been exposed. To include resilience-enhancing practices, schools need to revise the SEMPs to include a focus on, for example, local recycling and purchasing practices.

The Queensland Government's Department of Education and Training calls for schools to lower their ecological footprint and suggests SEMPS are a useful tool through which

to do this (Queensland Government Department of Education and Training, 2010c, 2010d). I suggest that although strategies that aim to reduce humanity's ecological footprint on Earth are valuable for their capacity to maintain and even improve ecological systems, they do not necessarily enhance resilience. A school's SEMP might address energy efficiency by, for instance, promoting energy efficiency strategies such as switching lights and air-conditioners off when vacating rooms, and retrofitting lighting. While these sorts of strategies are valuable for their capacity to (a) teach the school community to take actions for sustainability, and (b) cut emissions, they do little to build local-scale resilience. Hopkins (2008) argues that cutting emissions without building resilience is ineffective. In line with Hopkins (2008), resilience-enhancing energy reduction strategies will investigate alternatives that leave the community in a stronger position by, for example, localising energy production and thereby reducing the community's reliance on outside systems.

Resource management is addressed through adaptive management

Adaptive management emanates from the natural resource management field and is underpinned by a "learning while doing" philosophy (Lee, 1999, Conceptual soundness: learning by experimenting section, para. 11). Traditional management approaches wait until "enough is known" (Lee, 1999, Conceptual soundness: learning by experimenting section, para. 11) before taking any action, are based on top-down, command and control theory – otherwise known as linear causal thinking, and a presumed ability to predict the way systems will respond (Anderies, Walker & Kinzig, 2006). Adaptive management differs from traditional management practices in that they employ an iterative process which emphasises the importance of feedback and learning to inform and shape future pathways (Berkes & Folke, 1998). I propose adaptive management of ecological resources in a learning institution such as a school is useful for reinforcing the importance of learning, flexibility and adaptability.

The principals and the education for sustainability coordinators in this study demonstrate adaptive management principles. All four principals take a flexible management approach which enables them to support the education for sustainability coordinators. All considered feedback and learning derived from the education for sustainability initiatives was useful for informing future plans. The key teachers applied an adaptive management approach to manage resources. The waste management

systems at Whanilla SS and Fontana SS were developed through constant trial and error over a couple of years. Kim (Fontana SS) and Kieran (Whanilla SS) reported they implemented a continuous, iterative learning process of planning, implementing, monitoring and reviewing.

One last point about adaptive management I wish to make concerns SEMPS. I argue that under adaptive management practice SEMPS should be dynamic documents that are constantly reviewed and amended. A static SEMP that is written and filed away will quickly become outdated and ineffective for managing inevitable environmental change. Complex social and ecological systems require adaptive management techniques that facilitate continuous adaptation informed through feedback. A continuously updated and dynamic SEMP can be a valuable up-to-date management resource.

5.2.5 Teaching and learning domain

Effective teaching and successful learning for a sustainable future requires an approach that integrates

> goals for conservation, social justice, appropriate development and democracy into a vision and mission of personal and social change. It [education for sustainability] seeks to develop the kinds of civic virtues and skills that can empower all citizens and through them our social institutions, to play leading roles in the transition to sustainability (Fien, 2001, p. 1).

Education for sustainability advocates a participatory and active teaching approach to help students (a) develop a better understanding of the world and their place in it, and (b) provide opportunities for students to develop the skills, capacity and motivation to actively work towards a sustainable future (DEWHA2009; DEH2005). Effective teaching and learning for sustainability involves active, hands-on learning which educates students to take action for sustainability and, I add, resilience. Students learn to see and connect major concepts and general principles. I argue that incorporating resilience into the education for sustainability framework enables students to develop adaptive capacity to manage unpredictable future scenarios. Learning that is isolated does not help students see and connect actions to local, regional, state and global contexts.

According to the *National Environmental Education Statement* (DEH2005), effective teaching and successful learning produces students that are reflective and deep thinkers, ethical and responsible citizens, connected and autonomous learners. A reflexive and deep thinker makes sense of and understands the complexities of environmental concepts and the interdependence of ideas underpinning sustainability. Ethical and responsible citizens are empathetic and able to make ethical decisions about sustainability issues, events and actions. Connected learners are engaged, interested and enthusiastic about exploring the world around them and are able to work with others. Autonomous learners are self-directed and motivated with a continuous interest in learning about the environment.

Learning for resilience is similar to the principles and understandings of learning for sustainability and active adaptive management (Fazey, et al., 2007). A system's resilience is dependent on its adaptive capacity, which can be understood as the system's ability to reorganise and/or renew itself when faced with adversity or the ability to appropriately manage change (Tompkins & Adger, 2004; Walker & Salt, 2006). Schools can enhance student adaptive capacity (and through them the local community) by applying contemporary, research-led teaching practices and teaching the skills necessary to develop students' capability to manage change (Fazey, et al., 2007). For example, teaching metacognitive skills like practising different ways of thinking in a range of contexts (which enables students to be successful learners) rather than teaching and expecting students to remember disconnected facts. Research indicates knowledge that is organised around and connected to contexts supports understanding and transfer (Bransford, Brown, & Cocking, 2000) – characteristics that support adaptive capacity.

Current Australian education systems teach students to manage change that is simple, gradual and incremental (Westley, et al., 2007). However, the learning is only partially complete because, in reality, change is more likely to be multifaceted, chaotic and erratic. Take, for example, current events due to climate change which are rapidly altering the shape and state of the Earth. By itself climate change may not be so difficult to manage. However, combined with a history of unsustainable practices (which have depleted the condition of our earth and amount of resources), a crisis in global fiscal markets, and loss of biodiversity, the problem becomes much more complex. The

development of adaptive capacity, therefore, requires the teaching of skills such as: learning to prepare for the unexpected; to be proactive lifelong learners; to treat problems rather than symptoms; to be flexible and open to new ideas and other people's perspectives; to take advantage of opportunities for renewal and reorganisation; to be creative and adaptable rather than technical and practiced; and to understand that social and ecological processes are inextricably interconnected (Fazey, et al., 2007; Folke, 2006; Folke & Rockström, 2009).

Folke, Colding and Berkes (2003), prominent resilience thinkers, identify four critical characteristics of learning for resilience relevant for schools. To prepare young people to become active citizens in an uncertain world, schools need to teach students to learn to live with change and uncertainty; to nurture diversity for reorganisation and renewal; to combine different types of knowledge for learning; and to create opportunity for self-organisation toward social-ecological sustainability. Schools can help build local resilience by teaching students the appropriate knowledge and skills as well as by leading the community to take up actions which have ecological, economical and social impacts (Fazey, et al., 2007).

Resilience-enhancing education for sustainability combines knowledge and skills from both sustainability and resilience understandings. Students learn the necessary scientific knowledge to understand the physical functioning of the world – for example, cycles of change from the ecology field and systems theories from physics. Students also learn how to adeptly manage change in ways that enhance rather than reduce future options. One way to do this is by teaching students that knowledge is always incomplete (Fazey, et al., 2007) and by helping them develop the skills to become proactive lifelong learners. Resources are important too. Schools can provide resources to help students learn to manage unexpected change. This includes causative and consequential teaching and learning; teaching students to solve problems creatively rather than technically, in other words to 'think outside the square'; to be adaptable rather than inflexible by teaching students that there are multiple ways of understanding and doing any one thing; and by making links in knowledge across systems and scales explicit for students. Last are practical skills which help build resilience. This includes the participation and action component that often takes place outside the classroom and can include, for example, taking part in special community, state or national events, using the

community to investigate practical and real-life situations (DEH2005). It is important that students are involved throughout the process, from planning to implementation.

Discussion of the teaching and learning indicator statements

Teaching and learning demonstrates creativity

Creativity is a characteristic of resilient systems (see Chapter 2, Section 2.3) and an important aspect of preparing students for a complex future. Creativity can help build adaptive capacity by providing new perspectives which enable novel possibilities to arise (Homer-Dixon, 2006). Westley et al. (2007) tell us that without creativity systems become stifled and rigid:

> Unless we release the resources of time, energy, money and skill locked up in our routines and our institutions on a regular basis, it is hard to create anything new or to look at things from a different perspective. Without those new perspectives, and the continuous infusion of novelty and innovation in our lives, our organisations and our systems, there is a slow but definite loss of resilience, and an increase in rigidity (p. 68).

Data gathered from the schools in this research reveal schools can harness creativity at various levels and through different methods. At the classroom level, teachers can encourage creative thinking through open ended activities and problems that allow students space to think through and apply novel solutions. At a whole-school student level, student councils can provide new perspectives. At a different level again, school decision makers can encourage and support innovative and enthusiastic teachers who provide new ideas and energy to the school. Kieran (education for sustainability coordinator, Whanilla SS) and Mel (education for sustainability coordinator, Reliwarra SC) have encouraged creative thinking in their classrooms through real life problem solving. Kieran and Mel led their students to investigate problems of unsustainability in and around their school grounds, researched solutions and designed and implemented sustainable alternatives. Mel, together with her class, produced Reliwarra SC's SEMP. Student councils at Hollindale SS and Fontana SS led the school to implement sustainable energy and water alternatives by replacing incandescent light bulbs with energy saving ones and installing water saving devices on taps and urinals. All four schools are fostering student and teacher creativity by supporting teachers interested in education for sustainability.

I surmised from my study of the four schools that creative people are able to transfer and apply knowledge from one field to another. Kieran (education for sustainability coordinator, Whanilla SS) applied his university studies in terrestrial ecology to implement education for sustainability at Whanilla SS. Mel (education for sustainability coordinator, Reliwarra SC), Kim (education for sustainability coordinator, Fontana SS) and Denise (education for sustainability coordinator, Hollindale SS) each applied their own personal interests to lead their schools. The students in the student councils transferred the knowledge learnt in the classroom to sustainability initiatives in their respective schools.

Teaching and learning demonstrates self-organisation

Self-organisation is a feature of resilience as resilient systems are able to organise themselves without much external intervention (Folke, et al., 2003). The teachers in this study self-organised to transform their personal goals for sustainability into a mission of personal and social change through leading their respective schools to take local sustainable actions. I argue it is important for schools to encourage students to self–organise because self-organisation facilitates learning (Folke et al, 2003). One way to do this is by providing opportunities and structures that enable students to self-organise, such as through student councils and interest clubs. The four schools in this study provide opportunities for students to self-organise to varying degrees. Kieran (Whanilla SS) writes contracts for students who wish to work around the school in their own time. Mel (Reliwarra SC) and Denise (Hollindale SS) run student interest clubs during lunch times and after school. At Fontana SS, Lyn (principal) and Kim (education for sustainability coordinator) allow time and space for students to set agendas through the student council which places school-based sustainable practices on its agenda.

Teaching and learning demonstrates higher order thinking skills

For Education Queensland (2002), higher order thinking involves the transformation of information and ideas and is evident when students combine facts and ideas and synthesise, generalise, explain, hypothesise or arrive at some conclusion or interpretation. According to Bloom's taxonomy (Bloom, Engelhart, Furst, Walker, & krathwohl, 1956) and Bloom's revised taxonomy (Anderson & Krathwohl, 2001) which provide a model for organising thinking, higher order thinking skills include analysing, evaluating, synthesising and creating. I propose that higher order thinking is a feature of

resilience thinking (Walker & Salt, 2006) in that resilience thinking provides a framework for managing change in social and ecological systems via continual adaptation through cycles of change. The framework requires levels of understanding and skills from the top three levels of Bloom's taxonomy.

The teachers and students in this research are making connections between local and global environments through classroom-based units of work. The units of work apply theoretical and practical components of education for sustainability by engaging students in (a) researching, analysing, and synthesising sustainability issues, and (b) evaluating and creating local-level solutions which have multiple-level consequences. At Whanilla SS and Reliwarra SC students learnt about features of ecosystems, identified a degraded local ecosystem, carried out an evaluation assessment, and then created a sustainable alternative. Student councils at all four schools applied the education for sustainability learning in the classroom to create improved energy and water school systems. I argue higher order thinking requires critical thinking skills. I further propose that education for sustainability can also be used as a vehicle for developing critical literacy. When students have high levels of critical literacy they are able to make choices rather than accept those imposed on them. This implies self-organisation.

Teaching and learning demonstrates flexibility

Flexibility is an important element of resilience as flexibility is necessary for adaptation to change (Folke, et al., 2002). If, as argued in this thesis, sustainability and resilience includes creating and keeping opportunities for the future open, then I argue the incorporation of flexibility into teaching and learning is evidence of social-ecological resilience in schools. I suggest flexible teaching and learning in schools means appreciating there are multiple ways of understanding any one thing and includes exploring different options for presenting and understanding knowledge and concepts. When teachers present learning and assess student understanding of concepts in a number of different ways, students can begin to understand and accept flexibility. The principals in this study model flexible leadership approaches which have supported increased principal and teacher learning. The teacher participants have adopted a flexible approach to education for sustainability by allowing students to choose and lead sustainability projects. At Reliwarra SC, Mel (education for sustainability coordinator)

developed the School Environmental Management Plan (SEMP) in 2007 with her Year Seven class. During one of the interviews Mel said she realised some of the goals the students set were unrealistic. Rather than intervene, Mel let the students review their goals at the end of the year, reflect on why the goals had not been achieved, then modify the SEMP and future action plans. The flexible approach is an example that provides variation from the structured "one shot" order of learning schools seem to often take.

5.2.6 Curriculum organisation domain

Curriculum includes "all the planned, guided and implemented learning that occurs in a school" (Queensland Government Department of Education and Training, 2006a). The Australian Government's *Framework for Environmental Education for Sustainability* (DEH2005) describes an education for sustainability curriculum which involves "understanding the present environment – how it has been shaped, the value in which it is held, and seeking to mitigate adverse effects on it" (p. 13) and argues effective education for sustainability is spread throughout the school. Fien (2001) explains education for sustainability curricula should be interdisciplinary, integrating sustainable principles and practices into all relevant subjects and supporting students to explore sustainability questions, issues and problems in contexts relevant to them and their community, from local to global. Taking this advice, in 2000 the Australian Government's first *National Action Plan* (DEH2000), recommended the integration of environmental education principles into mainstream curricula. The updated 2009 National Action Plan (DEWHA2009) reasserts the need to make changes to curricula in order to reorient education systems toward sustainability.

Education for sustainability curricula are best organised around local contexts. Fien and Tilbury (2002) argue that because we can only effectively bring about change at a local community level, education for sustainability should be embedded in local contexts. Maller (2005) and Krasny and Tidball (2007, in press) link locally based environmental education with increased social capital, Hopkins and McKeown (2002) contend locally relevant education for sustainability enables adaptive capacity, and Tomashow (2002) and Stewart (2006) propose local natural history education is the foundation for development of more sophisticated global understandings such as global environmental change. A study by Lieberman and Hoody (1998) into the potential of using local schools' surroundings and community to improve student learning found enhanced

student performance in reading, writing, maths, science and social studies standardised tests; reduced discipline and classroom management problems; increased student engagement and enthusiasm for learning; and greater student pride and ownership in accomplishments.

Learning for resilience builds onto a curriculum organised around education for sustainability as resilience contributes to sustainable futures and a loss of resilience reduces options for the future (Folke, et al., 2003). Transformation towards sustainability in a way that promotes resilience is more likely to occur when people accept change, consider a range of viable options for the future, and modify their actions so that they can work towards a shared view of a desirable future (Fazey et al., 2007). Any curriculum which is intended to build resilience requires the integration of both education for sustainability and resilience attributes with teaching and learning practices. This includes, for example, participatory learning approaches to encourage critical thinking, diversity and action, and problem solving approaches that consider future options. Adding a resilience perspective to the curriculum can assist students to learn to manage change; help students develop a wider understanding of the world by ensuring links across systems, scales, time and space are made explicit; and enable students to become independent, proactive learners across their lifespan.

Discussion of the curriculum organisation indicator statements

Curriculum organisation is flexible

A flexible curriculum allows space for adaptation and change according to circumstances, and promotes successful learning by allowing teachers to make learning relevant to students (Cowley & Williamson, 1998). I propose a flexible curriculum takes advantage of learning opportunities as they emerge, and incorporates new knowledges and understandings so students appreciate the changing nature of knowledge. A narrow, backwards looking and prescriptive curriculum may not incorporate new understandings and research, may not allow for student diversity or changes in school demographics, and may fail to model flexibility. Given the uncertain future that present school generations face, a flexible curriculum makes sense. Curricula in the four schools in this study were flexible enough to incorporate education for sustainability. The education for sustainability coordinators applied a whole-school

integrated approach to implementing education for sustainability. This means students met prescribed learning within a curriculum that addressed ecological, social, cultural and political sustainability issues. This was a strength in each of the schools.

Curriculum organisation is local, problem and futures based

A local curriculum fits under the category of place-based education which, Smith (2002) explains, aims to "ground learning in local phenomena and students' lived experience" (para 4). A locally based curriculum applies the immediate environment as a place for learning. Teachers develop their own activities to meet the interests of students and local communities rather than rely on traditional textbook material (Wither, 2001). According to Orr (2005) and Gruenewald (2003) the importance of place in primary education is often overlooked. Place-based pedagogies are effective when they enable students to connect what they learn at school to their own lives, communities and regions (Gruenewald, 2003; Smith, 2002).

Smith (2002) argues that because place-based education is context specific, generic curriculum models are generally unsuitable. Smith (2002) offers a list of five place-based curriculum approaches. I find four of these include resilience-enhancing properties and have been applied in practice by teachers in this study. These four approaches are: cultural studies, nature studies, real-world problem solving, and induction into community processes. Cultural studies involve students in local cultural or historical phenomena directly related to their lives. Students begin by investigating familiar contexts and then extend to regional, national and global scales. Nature studies engage students in hands-on ecological learning where students move outdoors to reinforce concepts learnt in classroom work. Real-world problem solving requires students to identify school or community issues they can investigate and address in some way. Students identify local problems, select one to focus on, study its characteristics and dynamics, develop potential solutions, and then (with teacher assistance) organise and participate to resolve the problem. Induction into community processes draws students into the economic life and decision-making processes of their local communities. Ideally, school staff and students become resourceful agents that can be called on to address important community needs (though this tends to be ambitious in practice).

I argue a local place-based curriculum is a powerful method for enhancing resilience. The approach allows students to understand how they are connected to their local places, allows them to consider what the local area was like in the past, and imagine how they might live in the future. The teachers in this study were shown to apply Smith's (2002) four curriculum approaches to provide students with a more integrated view of social and ecological systems than is usual in state primary schools, and hands-on experience of the diversity of local systems. Whanilla SS, Fontana SS, Hollindale SS and Reliwarra SC have each developed a locally relevant curriculum and included direct hands-on active learning as well as classroom work. Whanilla SS and Reliwarra SC's creek rehabilitation studies engaged students in real-world learning. Students identified the condition of the local creek as an ecological and social problem, studied the creek's characteristics and dynamics, developed solutions, then organised and participated in the creek's rehabilitation. Students learnt about local government and community processes and increased their capacity to become resourceful future agents in the local area. Other activities involved students in auditing and monitoring water, energy and waste and developing and taking actions to reduce some ecological impacts.

Curriculum organisation is culturally inclusive

Inclusive education aims to develop the full potential of every individual (UNESCO2010). A curriculum is inclusive when educational opportunities are enhanced for all students and includes Aboriginal and Torres Strait Islander people, at-risk groups, students with disabilities or special needs (Queensland Government Department of Education and Training, 2006b). The Queensland Government identifies schools have a responsibility to develop values of inclusion and respect for cultural difference. The Department of Education and the Arts has made a commitment to developing and supporting a culturally diverse Queensland by, for example, embedding inclusive education practices at all state schools (Queensland Government Department of Education and the Arts, 2005). Education Queensland's (2005) *Inclusive Education Statement* declares inclusive education "is about shaping the society in which we live and the type of society to which we aspire" (p. 1).

Indigenous knowledge is one area often neglected in Australian curriculum frameworks (Hickling-Hudson & Ahlquist, 2003). Indigenous knowledge is defined by UNESCO (2006, "Introduction," para. 2) as "the local knowledge that is unique to a culture or

society". While multiculturalism has contributed to the recognition of languages and cultures of diverse ethnicities, Australian mainstream education remains predominantly Eurocentric. Education Queensland has a commitment to inclusive education and states teachers need to "provide localised responses that consider the interrelated social, cultural, geographic and economic factors that impact on their student communities" (Queensland Government Department of Education and Training, 2005, p. 6). Given fourteen percent of Whanilla SS, nineteen percent of Hollindale SS, and five percent of Fontana SS and Reliwarra SC's student populations are Indigenous (Australian Curriculum Assessment and Reporting Authority [ACARA], 2010), there is a strong case for including Indigenous knowledge and understandings into the curriculum at these schools. A review of the data I collected at the four schools indicates non-western cultural understandings are overlooked. Although Hollindale SS does explicitly address social sustainability, the curriculum unit overviews I reviewed do not explicitly include Indigenous understandings.

Indigenous communities are often positioned as being more vulnerable than western societies to threats such as climate change due to social and economic disadvantages which can prevent them from taking actions to secure their lives and livelihoods (Kofinas & Chapin III, 2009; Macchi et al.2008). A new body of research, however, indicates indigenous communities may be more resilient to global hazards than previously thought. In a recent Australian Broadcasting Corporation radio interview with Vicky Tauli-Corpuz (McVicar, 2010), Chair of the United Nations Forum on Indigenous Issues and founder and director of the Asia Indigenous Women's Network, Tauli-Corpuz argued that indigenous people are more resilient than western people to environmental changes such as climate change. This is because thousands of years of living with and in nature provides an accumulation of indigenous knowledge and memory of ecological processes and change missing in highly developed societies. Tauli-Corpuz's view is supported by the *Report of the Indigenous Peoples' Global Summit on Climate Change* (Galloway et al.2009) which argues "Indigenous peoples interpret and react to the impacts of climate change in creative ways, drawing on traditional knowledge and other technologies to find solutions that society at large can replicate to counter pending changes" (p. 1). That traditional Indigenous knowledge can enhance western scientific knowledge systems to assist multicultural societies manage change is maintained by researchers such as Salick and Ross (2009) and Crawhall

(2008), who explore how oral heritage, cultural resources and traditional knowledge in three different parts of Africa provides insights into sustainable living.

A culturally inclusive curriculum can develop cultural literacy, which Polistina (n.d.) describes as "the ability to examine other cultures critically and gain ideas about sustainability from them" (p. 1). Kofinas and Chapin III (2009) contend indigenous communities contain high levels of social memory, defined as the collective memory of past experiences retained by groups of people, which has the capacity to enhance resilience and sustainability. Considering Indigenous people inhabited Far North Queensland for thousands of years before westerners, I suggest local Indigenous communities hold a wealth of ecological knowledge, memories and strategies for coping with local-level change which can inform and deepen our collective understanding of community sustainability and resilience. It seems to me that if we aspire to opening rather than limiting future options, then primary schools will do well to embrace the opportunities local cultures can offer.

Curriculum is integrated

An integrated curriculum transcends the boundaries imposed by traditional subject groupings (Murdoch & Hornsby, 2003). It has been argued that an integrated approach helps students make connections across curricula and provides multiple contexts for students to develop, extend and demonstrate more complex understandings (Murdoch & Hornsby, 2003). Wallace, Venville and Rennie (2005) state that an integrated curriculum that focuses on interesting and important ideas promotes wholeness and unity rather than separation and fragmentation. The literature recommends that, for maximum effect, education for sustainability should be interdisciplinary and integrated across the whole school (see for example, DEH2005; Ferreira, Ryan, & Tilbury, 2006; Tilbury, et al., 2005). Resilience research does not specifically address the linkages between integrated curriculum practice and resilience. However, Fazey et al. (2007) discuss two education approaches aimed at developing adaptive capacity which are relevant here. These are variation to practice and the application of modern, research-led teaching practices (which a well-designed integrated curriculum is). According to Fazey et al. (2007), when people vary the way they do things, they gain experience of different perspectives which, in turn, improves transferability skills, builds confidence in dealing with new situations and results in new cognitive abilities. Dedicated application of

research-led teaching practices enables both students and teachers to more fully appreciate the nature of dynamic and complex social-ecological systems. I propose that when education for sustainability is interdisciplinary and integrated across a school, the potential for enhancing resilience increases.

There are different ways to integrate a curriculum (see Wallace, et al., 2005). All four schools in this study apply a school-specialised approach (Wallace, et al., 2005) to integrate education for sustainability. The approach is similar to theories of best practice in education for sustainability. Under a school-specialised approach schools adopt a long-term curriculum commitment to a particular area. Education for sustainability is embedded into the school infrastructure and staffing. It is not relegated to one or two keen staff. Education for sustainability in the four schools was shown to be integrated into multiple subjects and consistently applied and related to school-wide activities.

5.2.7 Networks and partnerships domain

Networks and partnerships are considered important for sustainability (Ferreira, et al., 2006). In school education, a review of sustainability programs worldwide reveals partnerships are critical to successful implementation of education for sustainability (Henderson & Tilbury, 2004; Hopkins & McKeown, 2002; Tilbury & Cooke, 2005). In Australia, federal and state government policies promote the importance of partnerships for the establishment of education for sustainability. The *Framework for Environmental Education for Sustainability* (DEH2005) advises outcomes are best achieved through collaborative action with the local and broader community. In Queensland, the Department of Education, Training and the Arts' *Environmental Sustainability Strategic Plan* (2008) endorses the expansion of school-community relationships and partnerships. Partnerships can be cross-sectoral; involve multiple stakeholders (such as other educational institutions, community members, government agencies, non-government organisations, businesses, and industry); be bounded by predetermined outcomes or a jointly developed vision; and can be formal or informal. However, the most successful partnerships are based on solid relationships and trust, are voluntary, participatory, collaborative, credible and transparent (Tilbury, et al., 2005).

Networks and partnerships, it can be argued, do build resilience because collective action has been shown to facilitate adaptation (Newman & Dale, 2005). Networks and

partnerships provide support, access to resources and spread risk (Tompkins & Adger, 2004). There are different configurations of networks and partnerships, and these matter because they impact on resilience. Newman and Dale (2005) differentiate between bridging and bonding networks. Bonding networks are horizontal (Putnam, et al., 1993), typically formed between people who know each other well such as family members, friends, neighbours and colleagues, and are characterised by closed but strong, tightly connected and high-trust ties. Bridging networks are vertical (Putnam, et al., 1993), more formal and varied and have lower levels of trust, but provide access to a diverse web of resources normally out of any one organisation or community's reach. Bridging networks are important to resilience because they provide links to vertical networks (see Chapter Two) which enable cross-scale knowledge transfer and learning (see Blann, et al., 2003; Fabricius, et al., 2007).

Discussion of the networks and partnerships indicator statements

Networks and partnerships are cross-scale, diverse and flexible

Diverse partnerships and networks include cross-scale vertical and horizontal relationships (Putnam, et al., 1993) that include people from different sectors. Diverse partnerships are considered crucial for sustainability (DEWHA2009; DEH2000, 2005; Tilbury & Cooke, 2005; UNESCO2002a). Tilbury et al's (2005) *A National Review of Environmental Education and its Contribution to Sustainability in Australia* reports diverse partnerships offer "great potential for challenging the world views and the assumptions of partners" (p. 19). The Australian Government's *National Environmental Education Statement* (2005) advises diverse partnerships (a) link student learning to life outside school boundaries, (b) encourage and develop active and informed student citizenship, and (c) provide access to greater resources. Folke et al. (2003) find diverse partnerships and networks spread risks and create buffers against "putting all eggs in one basket" (p. 362).

The schools in this study have formed cross-scale vertical and horizontal partnerships and networks. The schools work with government agencies such as the Queensland Department of Primary Industries, local councils, local business and non-profit organisations such as Conservation Volunteers Australia, and local community members. Participant teachers and principals consistently report the partnerships enable

deeper learning and, importantly, more access to key resources that enable the schools to carry out rehabilitation work beyond their individual capacity. At Whanilla SS and Hollindale SS, local community members who had small businesses contributed machinery and labour. At Whanilla SS, the local council provided machinery, labour and invaluable advice. At Reliwarra SC, the local council provided machinery, guidance and materials for the students to rehabilitate the creek adjacent to the school. Fontana SS partnered with the local council to establish a whole-school waste management system and local businesses and community members to establish and maintain extensive school gardens. I find these partnerships have been highly instrumental and necessary to building resilience through education for sustainability, given the current paucity of funding for education for sustainability in Queensland state schools.

Emergent from the data is the importance of a flexible partnership or network arrangement. Flexibility enhances resilience and adaptive capacity as flexible systems are able to respond to change (Folke & Rockström, 2009). Very tightly structured and rigid systems suppress innovation and delay adaptation and possible transformations (Folke & Rockström, 2009). Transformation to sustainable social practices is more likely if people are flexible (Fazey, et al., 2007). Participant teachers and principals reported partnerships and networks were more useful if they were flexible. Sustainability is emergent, and flexible partnerships are more efficient at adapting to emergent needs than ones that have formal, predetermined expectations. Social and ecological systems are complex and unpredictable. Many of the projects Whanilla SS, Fontana SS, Hollindale SS and Reliwarra SC undertook were long-term and needs changed over time. Flexible partnerships and networks did enable emergent needs to be met in many respects.

The status of partnerships may change in the future for schools such as Reliwarra SC, who are actively seeking formal partnerships with private organisations as a way of increasing the school's future prospects. Mel (education for sustainability coordinator, Reliwarra SC) says formalising the relationships will ensure Reliwarra SC can make concrete and dependable plans. In Mel's words:

> [The formal relationships are] going to allow us to drive the programs we want. I can't ever see the funding coming from EQ, unfortunately. Setting up [external] partnerships will allow us to expand what we can

> offer the kids. Partners – that's where we're going to get the expertise and monetary support from to move these projects along and get them up and running.

Reliwarra SC's deliberate attempt to establish formal partnerships with organisations which may enhance student options for the future, displays a forward looking vision and intent to create a desired future that is concurrent with resilience properties.

So far in this chapter, I have presented my indicator framework and argued a rationale for each of the proposed indicator statements. A large part of any research is the contribution to knowledge and understanding. The following section discusses this.

5.3 Contribution to knowledge and understanding

In this research I developed a set of qualitative indicators by exploring the ethos, governance, physical surrounds, resource management, teaching and learning, curriculum organisation, and networks and partnership attributes of the schools as set out in the Australian Government's *Framework for Environmental Education for Sustainability* (DEH2005). Because this is novel research with time limitations, the indicators are tentative and have not been developed into testable indicators. As mentioned previously, I see the indicators as a set of researched propositions that provide a starting point for further research into the place primary schools have in enhancing community-scale resilience. The indicator development process led me to develop emergent understandings about each domain which I now discuss further.

School ethos

I argue that a school ethos includes a shared vision, goals and objectives. A whole-school ethos is an important starting point for schools wishing to implement education for sustainability because the ethos forms the basis for how schools organise education for sustainability as well as how roles are assumed by members of the school community (DEH2005). From a resilience perspective, a shared vision will value characteristics (outlined in Chapter Two) which enhance future community options. These are adaptability, transformability, diversity, self-organisation, social capital, memory and creativity. A sustainable school ethos, then, will merge multiple understandings from both the sustainability and resilience fields of understandings. The process of developing a whole-school ethos was the most overlooked element in each of

my case study schools. Although the four schools have a vision, goals and objectives, these are developed and most widely understood by the leaders and key teachers only. These deep understandings are not shared by all school staff. All schools have and are allocating (somewhat limited) time to help other teachers develop understanding of education for sustainability. Nevertheless, developing whole-school understanding of education for sustainability and resilience requires time and willingness and greater resourcing than the schools presently have. While state schools can access rich policy settings, additional funding for wide-scale implementation is not yet coming through the state system.

Governance

I identified seven components of school governance from an education for sustainability perspective which parallel social-ecological resilience theory. These are flexibility and adaptability, creativity, democracy, altruism, tenacity and recursiveness, trust, and active principal support. I contend school leaders who apply these practices set directions and lead the school in ways that provide resilience-enhancing feedback loops – secondary effects which magnify primary effects. At both Whanilla SS and Fontana SS, self-organisation is a feedback loop of the democratic and trusting structures set up by each of the principals. Kieran (education for sustainability coordinator, Whanilla SS) feels enabled by Elizabeth's trust. In Kieran's words, "if your principal trusts you, you try to live up to it". As a consequence, Kieran independently implements and oversees education for sustainability at Whanilla SS. At Hollindale SS Lyn (principal) encourages teachers to self-organise and is setting up structures to support teachers to make their own decisions. At the student level, the democratic structure of the student councils enables students to self-organise school-based actions for sustainability. At teacher level in all four study schools, evidence indicates feedback loops derived from flexibility, adaptability and tenacity have expanded possibilities for student learning and action through education for sustainability. The key teachers have developed education for sustainability in their schools through a cyclic adaptive learning process that involves implementation, reflection and adapted re-implementation. Importantly, creativity supports diversity and leads to greater adaptive capacity. Folke et al. (2002) tell us diversity is critical to retaining the function and structure of any system faced with change and disturbance. Creativity supports a larger array of solutions to emerge. In this research, I argue creativity expanded the diversity of opportunities for student

learning and greater actions through and for education for sustainability. All four principals innovatively managed timetables and budgets to enable the implementation of education for sustainability. At the classroom level, student and teacher creativity enabled the emergence of new initiatives which expanded student learning and action and enhanced the whole-school transformation.

Physical surrounds

Physical surrounds are the physical areas in and around the school. I identified landscape diversity, minimal litter, control of invasive weeds and pest animals, and sustainable technologies as elements that correspond and are coincident with current resilience theory. All schools in this study have (a) increased landscape heterogeneity in and around their school grounds due to deliberately establishing a diversity of native and vegetable gardens and wildlife corridors, (b) minimised litter, and (c) implemented a number of sustainable technologies. Whanilla SS and Fontana SS have reduced invasive weeds and pest animals.

According to Kofinas and Chapin III (2009), resilience can follow from a group's capacity to innovate. The leaders, teachers and students in this research demonstrate a capacity to collectively innovate new ways of arranging the physical surrounds of the school in order to enhance sustainability. The process engages school community members in social and adaptive learning practices which enhance resilience directly by opening, rather than reducing, diversity of local ecological systems, and indirectly, through feedback loops, increased social capital elements such as trust and developing relationships through external partnerships. Improving the schools' physical surrounds involves students learning alongside adult teachers, members of the local community and organisations who share practical and scientific knowledge.

Resource management

This study suggests sustainable school-based resource management involves more than reducing waste, water and energy use, and increasing biodiversity. Resource management engages people in actions that reduce a community's ecological footprint on Earth, but does not necessarily build resilience. If we consider resilience is key to enhancing adaptive capacity, then school-based resource management needs to provide the skills, knowledge and understandings to enable people to build capacity to manage resources in ways that open rather than limit local options for the future. A school may

collect, sort and bundle their paper and newspaper waste then send the materials away to be recycled. While the school is engaging in sustainable practices by reducing waste to landfill, the process is not necessarily promoting resilience because (a) “Simply collecting [the materials] and sending [them] away doesn’t leave the community in a stronger position” (Hopkins, 2008, p. 55), and (b) students are not developing the skills, knowledge and understandings necessary for resilience. To enhance resilience through school-based resource management, students need to learn how to optimise self-reliance by finding local solutions. When students and school members negotiate local solutions, resilience is enhanced through feedback loops which strengthen local economic and social capital which, in turn, promote community level self-reliance. Both Whanilla SS and Fontana SS provide examples of resilience-enhancing resource management. Both schools sort paper and organic waste for recycling at school. Paper is shredded and used as mulch in the gardens or as food for the worms and organic waste is composted and used as fertiliser for the vegetable gardens. I argue this process promotes resilience because students are learning the skills to be more self-sufficient, knowledge about cycles and systems, and understandings about sustainability.

Teaching and learning

I explained above that effective teaching and successful learning in education for sustainability is said to produce students that are reflective and deep thinkers, ethical and responsible citizens, and connected and autonomous learners (DEH2005). Producing such students, although effective for enhancing sustainability, does not necessarily provide capacity to build resilience. A system’s resilience is dependent on a general capacity to adapt (Tompkins & Adger, 2004; Walker & Salt, 2006). I propose that creativity, self-organisation, higher order thinking, and flexibility are indicators of teaching and learning approaches that have the effect of promoting resilience and adaptive capacity. I further argue that enhancing resilience through education for sustainability requires teaching and learning that is causative, consequential and contextual. Causative teaching and learning produces an effect. At Fontana SS, education for sustainability has created strong links between the school and the local community. This has enhanced the social capital the school draws upon. Consequential teaching and learning can lead to change. Education for sustainability at Whanilla SS has changed school-based practices leading to 50 per cent reductions in waste, electrical power and water consumption. Contextual teaching and learning is relevant to students

and can promote greater capacity for self-organisation. At Fontana SS, students have independently set, organised and accomplished a number of sustainability goals. Education for sustainability programs taken up through isolated activities may address sustainability issues, but fail to build resilience if these are not connected to the places where the students live and go to school. Not all education for sustainability initiatives in a school can be held to build resilience capacity. The integrative and nested nature of curriculum is important here.

Curriculum organisation

The *Framework for Environmental Education for Sustainability* (DEH2005) explains an effectively implemented education for sustainability curriculum is cross-disciplinary and involves learning in and outside the classroom. I identified four curriculum characteristics which, I argue, can enhance resilience: flexibility, local and problem based, culturally inclusive, and integrated. Resilience is the capacity to manage change and consequently, flexibility is an important dimension of curriculum in that a flexible curriculum has the capacity to incorporate emergent knowledge and understandings. Integrated, cross-disciplinary learning approaches enable members of the school community to make greater and more explicit links across systems, scales, time and space.

One area of curriculum I deem as largely absent in the four schools in this research is that of inclusion of Indigenous knowledge. Education Queensland policy encourages teachers to incorporate local social, cultural, geographic and economic factors (Queensland Government Department of Education and Training, 2005) and Indigenous people comprise 14.3% of the total population of Far North Queensland (Queensland Government Office of Economic and Statistical Research, 2006). Yet, my own experience in school education in Far North Queensland is that Indigenous worldviews are often underrepresented or treated in a tokenistic manner. I argue Indigenous understandings can play a critical role in creating ownership in the context of building local community resilience. The challenge is to authentically integrate Indigenous knowledge systems and perspectives into the curriculum.

Networks and partnerships

Networks and partnerships are shown to be very important for both sustainability and resilience. In Chapter two I argued that because sustainability issues have social,

economic and technological implications, problem solving requires multi-level and interdisciplinary approaches. Chapter Two and this chapter described networks and partnerships in relation to bridging and bonding relationships. In bonding networks people know each other well and have high levels of trust. Bridging networks are formed out of necessity between people who may not know each other well, but are important because they provide links to resources that are otherwise difficult to access (Putnam, et al., 1993). This study indicates both flexible bridging and bonding networks and partnerships are necessary for schools wishing to extend education for sustainability to full capacity. Networks and partnerships have been useful for (a) providing resources to accomplish work, and (b) for reaching levels of ecological understanding that would otherwise not be possible. At Whanilla SS, bridging networks enabled the school to access specialist scientists to extend student knowledge and bonding networks provided access to machinery, labour and expertise which enabled the school to rehabilitate the wetlands area adjacent to the school.

This study suggests networks and partnerships can create positive feedback loops that have the effect of enhancing community-level social-ecological resilience. In all four schools, the formation of networks and partnerships necessitated ongoing interactions which led to increased levels of social capital networks between school community members and local individuals and external organisations. Second, student learning has transcended traditional outcomes to include greater consideration of a larger social-ecological system. For example, students have been exposed to features of resource management which necessitate negotiation with government bodies, other organisations and individuals. Working across social-ecological systems provides a different perspective to learning which, I argue, has the capacity to enhance community resilience.

Conclusion

In this chapter, I have applied the understanding of resilience and education for sustainability developed in the first part of the thesis. I have combined the Australian Government's *Framework for Education for Sustainability* located in the *National Environmental Education Statement* document (DEH2005) and the literature on social-ecological resilience with the narratives in Chapter Four and other data collected to

develop a set of indicators which aim to help understand the potential for school-based education for sustainability to build resilience. Indicators provide a tool to facilitate critical evaluation and continuous improvement. I see the indicators presented in this chapter as a starting point for considering resilience through education for sustainability. Although I have provided a rationale for each indicator statement, by themselves the indicator statements lack meaning. To overcome this I have critically analysed and provided descriptors for each set of indicator statements. The explanation of the indicators constitutes an understanding grounded in the narratives as well as the literature on education, sustainability, and resilience. I have also discussed the contribution this study makes towards understanding resilience through school-based education for sustainability. The next chapter concludes the thesis by discussing the implications for education for sustainability.

Chapter 6. Conclusion of the Thesis

It is not the strongest of the species that survives,
nor the most intelligent that survives.
It is the one that is the most adaptable to change
(Charles Darwin, 1809–1882)

Introduction

Charles Darwin's words encapsulate one of the main tenets of resilience. I began this thesis by emphasising the importance of adaptation to successfully manage a future predicted to be very volatile. I discussed social-ecological resilience as an approach that recognises the importance of adaptation and transformation. Throughout the thesis I stress resilience is an important element of sustainability because resilience provides capacity to manage (often erratic) change without losing options for the future. I argue that successfully implemented education for sustainability in primary schools provides the skills, knowledge and understandings to build student and teacher capacity to manage change in ways that open rather than limit future choices. The aim of the research was to explore whether and to what extent whole-school approaches to education for sustainability promote resilience. I have done this by examining the ethos, governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships attributes of four Far North Queensland state schools that prioritise a whole-school approach to education for sustainability. I analysed collected case study data from a resilience perspective to consider whether and how resilience can be enhanced through education for sustainability. In Chapter Five I presented a number of suggestions for how education for sustainability can be modified to further promote resilience. In this last chapter, I explore the implications of the research for practice and further research, discuss the limitations of the study, and conclude with a personal reflection.

6.1 Implications for education for sustainability

Education for sustainability that enhances resilience thinking needs to embody practices to build resilience. The education for sustainability practices I have described in this research align with a number of attributes of resilient social-ecological systems. These include critical thinking, self-organisation, flexibility and social capital building. This research has highlighted a number of attributes of education for sustainability which

have the potential to enhance school-level resilience. Over the last twenty years education for sustainability has emerged, developed and seems to have now stabilised. However, stability does not reflect the changing nature of the world. I propose that for education for sustainability to be more effective within changing conditions, there needs to be an incorporation of new and further understandings. One way to do this is by integrating resilience concepts into existing education for sustainability curricula and by embedding resilience thinking into the school ethos. Two concepts I found missing from present curricula in the case study schools are: an understanding of the interconnected nature of social and ecological systems, and inclusive cultural understandings.

Teaching and learning about social and ecological systems has traditionally positioned people and ecosystems as two separated systems. In Chapters One and Two I explained that a resilience approach considers social and ecological systems to be irretrievably linked, and that delineation between the two is "artificial and arbitrary" (Berkes, et al., 2003a, p. 3). I argue here that to maximise resilience through education for sustainability there needs to be a reconceptualisation of the relationship between social and ecological systems. One way this can be achieved is through teaching, learning and curricula which emphasise interconnections and lead students to understand, value and recognise the ecological processes which underpin our existence on Earth.

The second implication arising from the four case study schools in this research is that education for sustainability understanding is primarily Eurocentric. In Chapter Five I discussed the importance of cultural inclusion for the purpose of enhancing resilience in school communities. Cultural demographics vary between different areas of Australia. Because sustainability and resilience are context dependent and local knowledge is often stored within community networks, I argue that building social-ecological resilience requires the inclusion of the local culture. In Far North Queensland, a high proportion of the population is of Aboriginal and Torres Strait Islander background and this makes a case for integrating Indigenous knowledge and understandings about social and ecological systems. I propose this is one area of education for sustainability which requires review.

A third significant implication concerns scale. Chapter Two explained that cross-scale influences are a key feature of resilience in social-ecological systems because complex

systems are affected by internal and external cross-scale interactions. This has implications for a school's capacity to influence community-scale resilience. Cross-scale laws, rules or socio-cultural norms that limit or control innovation work against resilience (Westley, et al., 2007). This study indicates that enhancing school community level resilience requires a whole social-ecological systems approach because the school community is susceptible to rules and demands of systems operating at different temporal and spatial scales. Westley, Zimmerman and Patton (2007, p. 207) explain:

> Individuals in an organization … may try to introduce a new program or service to clients, only to find that the rules of the broader system demand that the new service be made to resemble the old as much as possible.

The principals in this research expressed feeling constrained by systemic barriers imposed by educational governing bodies positioned at scales above the school community level. Reliwarra SC wanted to include sustainable technologies such as rainwater tanks and solar panels into their new high school building plans. They were unable to do so due to inflexible systemic building constraints imposed by state government bodies responsible for school designs in Queensland. When Mel (education for sustainability coordinator, Reliwarra SC) introduced litter free lunches, she faced an overwhelming amount of resistance from parents who, as consumers, can access many supermarket isles filled with packaged products for school lunch boxes.

The capacity for change is an important element of resilient social-ecological systems. The principals and teachers in this study are trying to use "leverage points" (Hjorth & Bagheri, 2006) within their spheres of influence to initiate school community-level change for sustainability. Fien and Tilbury (2002) argue we can only effectively make changes within our spheres of influence. This includes ourselves and our local communities. However, this study indicates that even our immediate spheres of influence are vulnerable to cross-scale spatial and temporal interactions out of our immediate control. If, as Lebel et al. (2006) argue, strengthening the capacity of societies to manage resilience is critical to effectively pursuing sustainable development, then the question remains, who decides when to intervene and identifies desirable courses of action?

One last point refers to the terminology of systems and complex adaptive systems. Education for sustainability applies systems theory as a framework to describe interactions between systems. Systemic thinking is a key education strategy (Tilbury & Cooke, 2005). Resilience scholars apply the concept of complex adaptive systems to study relationships within social-ecological systems. This research has led me to realise systems theory encourages the identification of connections and relationships, and incorporates notions of complexity and uncertainty (see for example, Sterling, 2005), but is predicated on a stable view of the world which tends to overlook the likelihood of change. Complex adaptive systems theory differs in that it integrates the concept of likely change. Chapter Two explained the dynamics of change through the metaphor of the adaptive cycle. Throughout this thesis, I have argued that if education for sustainability in schools is to continue to be successful it will have to provide the opportunities for learning the skills and knowledge to build capacity within school communities to manage change in ways that open rather than limit future options. I now further argue this requires adopting a complex adaptive systems view of the world. This includes understanding cycles of change within complex adaptive systems which are dynamic, unpredictable, non-linear, flexible and self-organising.

6.2 Limitations of the study

Various levels of limitations applied to this study. The first concerns time. Because of the structure of a PhD study, the data collection provides a snapshot in time. Although I collected different types of data to answer my research question, both the participants and I as the researcher were limited by time constraints. If I had been able to conduct a longitudinal study which collected teacher, principal and student experiences of implementing education for sustainability at regular intervals over an extended period of time, I may have collected quite different data. Interviews with more participants from each of the case study schools would have also provided different data. However, principals and teachers are extremely busy. As it was, I felt grateful to be extended the time generosity of the participant teachers, principals and students.

My inexperience as a researcher was another limitation. Although I was scrupulous through all stages of the research – for instance I designed the interview schedule to maximise the potential to gather unbiased, meaningful and useful data – I missed

emergent opportunities which may have enriched the data I collected. This was evident in the transcripts from the interviews when, in hindsight, I saw missed opportunities where I could have probed participants for more extended explanations of phenomena. Unfortunately, due to participant time limitations, I was unable to conduct follow-up interviews. Nevertheless, all participants were happy with the narratives and considered these to be fair and accurate representations. Reliwarra SC, Hollindale SS and Fontana SS consented to publishing their narrative without amendments, while Whanilla SS changed various parts to more accurately represent their story.

A second set of limitations concerns methodology and methods. There are many ways of conceptualising a problem. The way I framed and conducted the research is only one possible approach among many. Any research approach informs the selection of methods and determines what information is gathered as well as how the information is interpreted (Kayrooz & Trevitt, 2005). It is quite possible, for example, that I could have gathered quite different data through a quantitative approach designed to collect wide-scale data. However, as my research was exploratory within a community context, it made sense to take a qualitative approach which was more amenable to gauging people's perceptions of events and phenomena such as school practices (Kayrooz & Trevitt, 2005). Relevant also is the theoretical lens I applied to interpret my research. Theories illuminate and provide understanding of some features at the expense of others. For example, I chose a social-ecological resilience perspective within an education for sustainability understanding rather than say, a purely ecological, social, social learning, or educational perspective.

The third set of limitations is that universal claims are unable to be made about this study. This study was limited by scope. Qualitative research is rarely wide ranging, but is usually well positioned to lay the exploratory ground work to provide a starting point for further studies. One strength of the case study approach is it accommodates different data collection methods which provide useful information about particular phenomena. This was particularly helpful in this study because the research was novel. Implementing different data collection methods under the case study approach allowed me to investigate the research problem from a number of perspectives. This research paves the way for large-scale research into factors that build resilience at school community level.

6.3 Directions for future research

This is an exploratory study based on in-depth case studies within an education context. Much of the existing research on social-ecological resilience comes from a natural resource management perspective. At the time of finishing this thesis the only other known work on education and social-ecological resilience originates from Dr Marianne Krasny at Cornell University (see http://krasny.dnr.cornell.edu/research.php), Keith Tidball - also at Cornell University (see www.dnr.cornell.edu/cals/dnr/people/academic-staff.cfm?netId=kgt2) and Fazey et al. (2007). Krasny's work investigates social-ecological resilience through civic ecology education, Tidball's research focuses on community education and resilience, while Fazey et al. (2007) explore relationships between teaching approaches and social-ecological resilience. This thesis raises possibilities about the potential role school education can play in enhancing school community-level resilience.

Further research can explore different dimensionalities of education and social-ecological resilience. Building resilience requires a multi-level whole-of-system approach, and more research is required into ways resilience can be enhanced through education for sustainability. Further research may follow on from the tentative propositions I have explored in this study. Longitudinal studies of schools that implement whole-school approaches to education for sustainability will further understanding of ways and means resilience can be enhanced in an education context. Different research approaches may further understanding beyond the scope of this small-scale qualitative case study. For example, a large-scale quantitative approach applying surveys based on the findings from this research may be able to derive more universally applicable conclusions.

Additional research may also build on this study's proposed set of indicators. Indicators are said to be useful for making the obscure obvious (Hoernig & Seasons, 2005; Redefining Progress, 2006; Redefining Progress and Earth Day Network, 2002). Yet, to date, little work on indicators exists that brings together both the education for sustainability and resilience fields of inquiry. The indicators I have developed are only tentative as they are based on a small and specific sample group of primary schools. The

indicators have not been subjected to testing and evaluation. Further research may lead to rigorous testing, evaluation and refinement of my proposed indicators as well as the development of a set of complementary quantitative indicators. Also, similar work in large high schools would also prove insightful. Large-scale indicator work on resilience through education for sustainability has the potential to enhance knowledge and understanding in an educational area which, to date, remains largely unexplored. Such studies can inform educational bodies with an interest in education for sustainability and lead to the incorporation of resilience building attributes into current understanding and practices.

Conclusion

This study set out to investigate whether and how education for sustainability in primary schools may foster school community-level resilience. Throughout this thesis I have argued that the purpose of including resilience theory into current education for sustainability understandings and practices is to promote characteristics which elevate the community to a stronger adaptive position to face the many predicted and unpredictable changes the future is likely to bring. That resilience is fundamental to long-term sustainability is strongly argued by resilience scholars (Adger, 2007; Folke et al., 2002; Walker & Salt, 2006). Yet resilience is not easily measured or observed. Through investigating the characteristics (ethos, governance, physical surrounds, resource management, teaching and learning, curriculum organisation, and networks and partnerships) of four Far North Queensland schools, I found that in this case, many of the principles, practices and processes of implementing education for sustainability, parallel research on social-ecological resilience. This suggests education for sustainability has the capacity to enhance local-level resilience. This research has led me to develop a number of propositions about resilience through education for sustainability which represent my current understanding and are true for the four schools in this study.

Resilience acknowledges feedback loops

For the schools in this study resilience is a consequence of implementing education for sustainability. For each school, the aim of implementing education for sustainability was to teach students to value and preserve ecological systems, increase local level sustainability and lower the school's ecological footprint. Identifiable resilience

properties emerge through the direct actions and processes of reaching these goals. As principals teachers and students planned and implemented sustainability initiatives the feedback loops (a) nurtured creativity, self-organisation and higher-order thinking, and (b) enhanced acquisition of local knowledge and development of collaborative relationships with members of the local community. This study indicates that education for sustainability can and does, in the four case study schools, enhance resilience; albeit, unplanned and unintentional. If, as resilience scholars argue, resilience is essential for long term sustainability, the implications are resilience should be planned and explicitly written into education for sustainability approaches.

Self-organisation is an easily identifiable indicator of resilience

Self-organisation is an important element of resilient social-ecological systems. Resilience is explained as the capacity to buffer perturbations, self-organise, learn and adapt (Folke et al, 2002). But how can these elements be identified or assessed? How do we know whether a community has the capacity to learn and adapt when faced with change? How does a teacher pre-empt whether a child has the ability to buffer perturbations? This study suggests self-organisation may be a useful early indicator of individual and/or group resilience in school contexts. In response to concerns about deteriorating ecological systems, the education for sustainability coordinators in this study mobilised a reorganisation of school systems to incorporate education for sustainability. The initiatives encouraged learning which lead to self-organised student action for sustainability and opened the way for further activities in and outside school boundaries. For instance, some students I spoke to reported initiating sustainable resource management practices at home. Self-organisation is evident at Whanilla SS and Hollindale SS where learning extended to the tuckshop convenors who independently integrated sustainable practices into their existent routines. I propose the autonomous and voluntary uptake of sustainable practices, in this case, can be categorised as self-organisation and can be considered an early indicator of resilience because the feedback loops can lead to adaptive learning and enhanced resilience.

Scale matters

Chapter Two explained that scale refers to influences imposed on a system due to internal and external forces. In thinking about resilience through education for sustainability, scale matters because schools are situated at the community scale, but are

subject to forces imposed on them by policies, rules and laws at levels above and by the norms and expectations of the local community. Locally based education for sustainability is linked to increased social capital (Krasny & Tidball, 2007, in press; Maller, 2005), adaptive capacity (Hopkins & McKeown, 2002), academic performance, student enthusiasm for learning, and reduced discipline and classroom management problems (Lieberman & Hoody, 1998). Fien and Tilbury (2002) argue for education for sustainability to be embedded in local action because "we can only effectively change the things we have most time to work on and, for most of us, this is ourselves and our local communities" (p. 6). The understanding I have developed about the importance of locality with regards to resilience through education for sustainability is best explained through a personal anecdote.

During 2009 I became aware of a school in my local area that took up education for sustainability. By enquiring about the school's initiatives, I learnt about a student-led plastic bag management scheme in the local area. To increase awareness of plastics in the area and encourage the community to recycle plastic bags, students negotiated to install a plastic bag recycling bin in the local supermarket where people can deposit unwanted plastic bags. There is no plastic recycling facility in Cairns, so students arranged to transport the plastic bags to the nearest plastic recycling station 400 kilometres away in Townsville. The initiative is ongoing. Plastic bags are collected and sent to Townsville on a monthly basis. From an education and sustainability perspective the initiative is commendable. Students identified a local sustainability problem and addressed the issue through action aimed at social change. However, from a resilience understanding of education for sustainability, the initiative is lacking because it does not build local community capacity. The initiative is not adding to the local economy, helping the community acquire any new skills which can lead to better long-term resource management, nor lowering the community's ecological footprint on Earth because community members are still using the same number of plastic bags. The management problem is simply passed on and businesses and economies elsewhere are benefiting. A resilience-enhancing alternative might be to campaign for plastic bag reduction by educating the community about problems associated with plastic bags and provide other options, or to find an alternative use for the used plastic bags within the local area which will directly benefit the local community.

My conclusion is that education for sustainability has the potential to foster school community-level resilience. This research indicates schools can purposely organise and enact education for sustainability with intent to enhance resilience. In the case of the four schools in this study, the identified resilience-enhancing characteristics of education for sustainability resulted from an unplanned feedback loop. If, as argued throughout this thesis, resilience is necessary for long-term sustainability, then this study highlights the need to plan for resilience within education for sustainability. Due to the contextual nature of education for sustainability and resilience and the small scale of this study, I am not able to make general statements about resilience through education for sustainability. The indicators I have developed provide a starting point for further research and discussion. Because the field is in its infancy, more data can help further understandings by highlighting where theory can be further developed to identify new issues and indicate future paths for both research and action.

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