Diverse, Disengaged and Reactive: A Teacher's Adaptation of Ethical Dilemma Story Pedagogy as a Strategy to Re-engage Learners in Education for Sustainability

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The Value of Sustainability

The United Nation's *Brundtland Report* defines sustainability as patterns of living that '... meet the needs of the present without compromising the ability of future generations to meet their needs' (United Nations World Commission on Environment and Development (WCED) 1987). Australia has recognised education for sustainability as an issue of great importance, a national priority. The *Australian Sustainable Schools Initiative* (AuSSI) was implemented in over 2,000 schools Australia-wide (Australian Government – Department of Sustainability, Water, Environment, Population and Communities 2011). One would therefore expect to see education for sustainable development reflected in the structure and content of the new Australian Curriculum which is currently being developed and implemented. In the new curriculum documents, sustainability appears as one of the cross-curricular priorities, together with Aboriginal and Torres Strait Islander histories and cultures and Asia and Australia's engagement with Asia (Australian Curriculum, Assessment and Reporting Agency (ACARA) n.d.a). The curriculum outlines the relationship between sustainability and English, mathematics, history and science. Science '... provides content that, over the years of schooling, enables students to build an understanding of the biosphere as a dynamic system providing conditions that sustain life on Earth'. Students are expected to gain an understanding that life is interconnected through ecosystems and that humans depend on ecosystems for their survival and well-being. Scientific understanding

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and scientific inquiry provide the knowledge and skills to 'forecast change and plan actions necessary to shape more sustainable futures'. A focus on sustainability allows science education to address systems change processes, their causes and consequences, thereby '. . . assisting students to relate learning across the strands of science' (Australian Curriculum, Assessment and Reporting Agency (ACARA) n.d.b). These statements emphasise science education's leading role in preparing learners for sustainability thinking, planning and action.

With such a strong curriculum emphasis, it would seem that the teaching of sustainability is set to become a widespread and integral component of Australian classrooms. But the presence of sustainability in science classrooms might not be easily achieved due to its 'meta-position' which embraces science, society, the environment, culture and the economy. In other words, sustainability is situated at the nexus of scientific methods and sociocultural perspectives which examine differing human interests, motivations and cultural values. Are science teachers well prepared to engage their students in debates whose resolution is not amenable to solely scientific content and processes (Robottom and Simonneaux 2012)? Robottom (2012) concludes that whilst a scientific element is undoubtedly necessary within an education for sustainability discourse, it is insufficient for a rigorous educational exploration of 'socio-scientific' (or science in everyday life) issues. A lack of preparedness to address socio-scientific issues might explain many science teachers' hesitancy to embrace education for sustainability – after all they are the product of science teacher education programmes that focus almost entirely on scientific content and processes with a high level of epistemic certainty and predictability. However, according to the Sustainability Curriculum Framework (Australian Government – Department of Water, Environment, Heritage and the Arts 2010), students of education for sustainability

> . . . will be able to assess competing viewpoints, values and interests; manage uncertainty and risk; make connections between seemingly unrelated concepts, ideas and outcomes; and test evidence and propose creative solutions that lead to improved sustainability. (p.5)

We may conclude from this statement that education for sustainability has strong links to sociocultural perspectives due to its connection to human activities, interests and cultural values.

According to the Framework for Values Education in Australian Schools, our future depends on young Australians developing a solid foundation of intellectual, physical, social, moral, spiritual and aesthetic abilities (Australian Government – Ministerial Council on Education, Employment, Training and Youth Affairs 1999; Australian Government – Department of Education, Science and Training 2005). In this respect, values education has been identified as a vital ingredient of effective education for sustainability. At its heart lies the recognition that, as a national value, sustainable development starts with individual value systems which shape people's attitudes to the (natural and social) environment, which, in turn, affect their abilities to make decisions that impact the future of not only the nation but the world beyond. These decisions are clearly ethical in nature since their outcomes will affect current and future generations.

Making sound ethical decisions requires informed decision-making skills based on sound scientific knowledge of the environment, high-level awareness of the environmental impact of science and technology and an ability to engage in critical thinking and critical reflection, thus being able to distinguish between beneficial and potentially detrimental policy decisions. Gower (1992) discusses our moral obligations towards future generations and raises an interesting point: despite the rich stock of ideas as to how moral issues 'should' be examined, tested and resolved, often there is a dialectic, or opposition, between one set of ideas and another – this can lead to important insights even if the dialectic remains unresolved (p. 11). From this perspective, the task of science teachers is not only to prepare students to participate in an informed and competent manner in the public discourse on science but also to enable them to gain insights from uncertainty associated with the highly complex issues of sustainable development. The question is whether or not science teachers can cope with uncertainty and multiple potential solutions.

Science Education for Sustainable Development

With regard to solving global problems in a world of rapid change and development, much hope is invested in education, especially science education. This uncritical yet popular perspective, which assumes that education is responsible for solving the world's problems, has been critiqued and labelled 'educationalisation' by authors such as Depaepe and Smeyers (2008). Despite this critique, it seems that imbuing science education with a special role in facilitating sustainable development is still an appropriate view due to the complex nature of the environmental challenges facing us. Drawing on Polanyi's critique of markets in capitalist societies, Sharma (2012) regards science education as a central element of a societal response because major environmental issues such as climate change can be viewed as products of the commodification of nature in market-dominated societies. This view is supported by UNESCO's (United Nations Educational, Scientific and Cultural Organisation) 'Science and Technology Education' website which emphasises that science and technology education is an essential tool in the search for sustainable development. However, UNESCO also laments that current science and technology education has lost relevance and is unable to adapt to the challenges facing education systems. UNESCO therefore encourages development of curricula and policies for science education that employ multidisciplinary approaches that promote (1) gender-sensitive, sociocultural and environmental knowledge, (2) life skills and (3) scientific literacy (United Nations Educational, Scientific and Cultural Organisation 2011).

According to Van Eijck and Roth (2007), high-ranking scientists have expressed an urgent need for improvement in science education. The authors view this demand as an expression of the growing consciousness that high-quality science education is vital not only for sustaining a lively scientific community capable of addressing global problems, such as global warming and pandemics, but also for bringing

about and maintaining a high level of scientific literacy in the general population. This sentiment is echoed in a report on a recent conference in South Africa where physicists from around the world discussed the role of science and science education in relation to achieving sustainable development. It was concluded that '... the problem-solving style of scientists and engineers is a mindset sorely needed for the sustainable development challenges facing developing countries and an ever-increasingly globalised world' (Moore 2006, p. 42).

Several fundamental questions arise from the expectations invested in science education described in the previous statements. Is the high hope invested in science education for helping us solve our problems appropriate? Is it appropriate to try to address socio-scientific issues such as sustainable development with the mindset of a scientist? It seems that different mindsets are at work in science labs and in science classrooms. Robottom (2012) contrasted his own experiences as a researcher conducting research for its own intrinsic value with addressing socio-scientific issues in education and concluded that 'socio-scientific issues are necessarily and irrevocably located within a community context' (p. 97), which implies shared community values.

If we accept that creative problem-solving practised by scientists and values learning grounded in shared values of communal concerns are required for preparing both future scientists and non-scientist decision-makers for managing systemic global change policies, are science educators rising to the occasion? Is creative problem-solving as a way of thinking applied by successful scientists actually taught in science classrooms?

Traditionally science has been taught as if it could and should be value-free (Allchin 1998). Science teachers adopting a technical and scientistic view of science tend to shy away from addressing values because of a trenchant belief that values lie outside the domain of science education. In our own research, we have found it increasingly difficult to find science teachers willing to collaborate on a project that seems to be 'slightly outside the norm of science education', preferring to delegate the teaching of creative thinking to colleagues in the arts and humanities. This 'silo' view of one's discipline fails to heed the growing worldwide realisation that everything taught in schools influences how students understand and shape the human culture/natural environment relationship (Bowers 1993; Orr 1992). Such an integral perspective, which promotes a broader approach to how we think about education and its relationship to society, is fuelled by a realisation that the resolution of global environmental crises requires knowledge, skills and values drawn from various disciplines: complex curriculum solutions for complex problems.

In this respect, there is a pressing need to reconsider the pivotal role of science education in fostering education for sustainability. Some might say that a 'macroshift' in thinking (Laszlo 2008) is required of science educators if their discipline is to benefit from integration with other disciplines, such as the arts and humanities. This demand for change in thinking is grounded in the insight that engagement in values learning as part of education for sustainability will contribute significantly to a scientifically literate citizenry for the twenty-first century (McInerney 1986; Zeidler 1984).

Lack of Engagement and Proactivity

In recent years, concerns have been voiced about falling student numbers in mathematics and science-related disciplines. Studies by Australian psychologists have identified disconcerting levels of hopelessness and feelings of helplessness amongst many adolescents (Fien 2001). These issues are especially problematic since young people represent the leaders and decision-makers of the future, and it is their decisions that will need to be both ethically and sustainably sound.

So, how does one educate a somewhat reluctant generation challenged by unprecedented global problems? How does one educate young people who seem to have 'abandoned ship'? Are our current methods of instruction and thinking about curriculum sufficient? Traditionally, the response to similar educational conundrums, at least in science education, has been that if students do not perform well in science, we must inject more science content into the curriculum and timetable more science classes in the school week. Environmental education curricula have been treated in a similar way. However, this approach is based on a deficit view of learners' access to knowledge: preparation of future leaders from this perspective focuses primarily on content learning. The question arises as to whether this is enough.

Uzzell (2008) points to a widespread mistaken assumption in educational circles that global crises can be resolved solely by developing children's knowledge levels. This belief is grounded in the conviction that children will assume the role of 'little experts' when they return home after school whereupon they will positively influence their parents to conserve water, save electricity and recycle – thus transforming societies and cultures. Unfortunately, for proponents of the 'content plus' approach, research funded by the European Union (cited in Uzzell 2008) has concluded that the widespread assumption that the provision of more environmental facts to students will lead automatically to enhanced concern and action in the community through passive osmosis has been shown to be false.

At this point, we would like to draw on Steven Covey's (1989) scholarly work on personal empowerment and leadership education. Covey distinguishes between our 'circle of concern', issues we are concerned about, and our 'circle of influence', issues we can actually do something about. For 'reactive' people, the circle of concern is much larger than their perceived circle of influence, thereby leading to a sense of hopelessness and lack of proactivity. In comparison, 'proactive' people's circle of influence is much larger, leading to a sense of empowerment. Applying Covey's model to young, disengaged learners, it seems that for many, there is a mismatch between the two circles. Most students in the so-called developed world lack neither concern about the environment nor do they lack content learning or opportunities to engage in learning about the environment. There is already plenty of attention paid to that in current curricula. There seems to be a correlation, however, between many students' experience of 'voicelessness' and disengagement and their experience of a diminished personal circle of influence: it rarely overlaps with their circle of concern.

Responding to student disengagement by adding more content – and thereby adding more problems without adding a sense of empowerment – is unlikely to lead to enhanced engagement. It seems that this approach can only exacerbate the problem by increasing students' circle of concern whilst failing to increase their perceived circle of influence. Based on our long-term experiences with ethical dilemma pedagogy as a way of engaging students in deep learning through moral dilemmas, we argue that ethical dilemma story pedagogy, in a supporting role for traditional science curricula, may counteract the trend of disengagement by giving students opportunities to practise decision-making and problem-solving with their voices being heard.

Our research has shown that ethical dilemma stories have the potential to engage a diverse range of learners in issues related to the use of science and technology in daily life, especially to issues of sustainability. From a pedagogical point of view, our approach addresses the requirements of successful programmes for education for sustainability, as suggested by Fien (2003) by promoting care and compassion for the environment and for stakeholders. Because students are not just passively taught but are actively involved in trying to make ethical decisions and to finding solutions to problems that relate to the curriculum of their lifeworlds, they are more likely to re-engage with science and sustainability issues. This strategy seems to sit well with what Covey argues the leaders of the future need: the new leaders born and bred in the Knowledge Age, which started with the fall of the Berlin Wall, cannot rely on the same strategies that worked for leaders of the Industrial Age. These new leaders will have to find their voice and thus enhance their moral integrity (Covey 2004).

This perspective has direct implications for how we view curriculum development for future science education – curricula that are successful at enhancing students' environmental awareness and agency and that encourage future citizens to get involved and be active rather than closing down and becoming helplessly reactive. We believe that ethical dilemma story pedagogy can help counter the chronic disengagement amongst science learners.

Ethical Dilemma Story Pedagogy: A Sociocultural Perspective

Ethical dilemma stories are stories with characters and a storyline that contain one or more ethical dilemma scenarios. The story is best told freely by the teacher who breaks the storyline at appropriate junctures to pose ethical dilemma questions. Students are instructed to engage with each dilemma question, thereby making a series of ethical decisions on behalf of the story's character. Ideally, the story has direct curricular links to specific concepts or skills as well as perceived relevance to students' lifeworlds. Examples of ethical dilemma stories, including suggestions for teaching, are available at www.dilemmas.net.au.

In our research, we use the approach to dilemma story pedagogy suggested by Gschweitl et al. (1998). According to this approach, one of the key pedagogical

aspects of ethical dilemma learning is the requirement for students to reflect individually on a dilemma question and to record in writing their decision and the reason for their decision, thereby engaging with their personal values. The next step is to interact in small groups with peers to compare and contrast their decisions, thereby promoting critical reflection on their decision-making values. We have found it best to build up group sizes gradually during the course of the story as students encounter each successive dilemma question. The reason for a staged approach to group work is that discussing personal values and decisions is not often done in public, especially not amongst adolescent peers. Building up group size allows students to 'warm-up' to having this type of unfamiliar discourse in class, thereby building rapport and trust. The teacher ensures that 'rules of engagement' are clear from the beginning and that, because there is no single correct answer, it is okay to voice an opinion that is different to that of other students. Ethical dilemma story pedagogy is thus an approach to values learning that employs ethical dilemma stories as a means to engage learners in:

- Critical thinking about a dilemma problem that has no clear cut, black-and-white answer
- Critical self-reflection on taken-for-granted assumptions grounded in personal values, which involves individual reflection and explanation of dilemma decisions
- Social learning through subsequent discussions with peers
- Emotional learning through promoting active and empathic listening skills when different views are shared in class
- Problem-solving by codeveloping suggestions for possible solutions

Ethical dilemma stories date back to the psychologist, Lawrence Kohlberg, who based them on an 'ethic of justice' as a means of engaging learners in moral reasoning. Kohlberg (1984) was interested in how moral development progresses. He developed a stage theory of moral development that he applied when analysing student responses to dilemma problems. Subsequent feminist researchers, notably Carol Gilligan, added an 'ethic of care' to Kohlberg's theory, thereby opening the door to the multidimensional and multivocal nature of the moral domain (Gilligan 1982).

Gilligan's work is of particular importance for ethical dilemma story pedagogy since she recognised the importance of words, language and storytelling as a form of human discourse essential to a moral life. Parker Palmer defines discourse as what humans do every day that involves the use of language in the form of speaking (Palmer 1993). With the moral self being a shared or distributed product of social relations and communicative practices, the role of social-cultural-historical-institutional contexts has gained importance in the field of moral learning, especially with a view to human action and interaction or, as we would like to add, inaction (Tappan 2010). According to Tappan, a sociocultural, dialogical view has become increasingly influential in moral education, especially through the inclusion of the theoretical and empirical work of Vygotsky and Bakhtin. Tappan (1997) outlines areas of overlap between sociocultural theory and theoretical aspects of moral

development, such as the assumption that higher moral functioning – for example, ethical decision-making – is mediated by words, language and forms of discourse such as storytelling. Furthermore, this mediation is made possible through inner speech resulting in an inner moral dialogue. There is interplay between the inner moral dialogue of the individual and processes of social communication whereby the person becomes engaged in social relations with moral implications. Consequently, moral development is always shaped by the particular social, cultural and historical context in which it occurs. Applying Tappan's outline to our work, we can say that in the context of values learning through ethical dilemma story pedagogy:

- Moral functioning in the form of ethical decision-making is mediated through the telling of dilemma stories and the discussion and discourses involved in solving the dilemmas.
- At every dilemma situation in the story there is a break where students are requested to reflect individually on how they would solve the ethical dilemma. They are then asked to write down their decisions plus their reasons why they would decide in a certain way.
- This phase of individual reflection is followed by an exchange of ideas between pairs, at first, with growing group sizes as the story progresses, culminating in a whole-class discussion at the end.
- Our research into students' responses and decisions indicates that they are influenced by their social, cultural and historical context.

Active involvement in problem-solving, where students' opinions count and where the teacher facilitates rather than determines the decision-making process, promises to provide a natural antidote to student disengagement, hopelessness and helplessness. It is important to emphasise that we are not suggesting the replacement of traditional content learning in science curricula. Rather, we are excited by our research which is demonstrating how ethical dilemma pedagogy is being incorporated into mainstream science lessons in a variety of ways by creative teachers committed to promoting education for sustainability.

Preparing the Teachers for Ethical Dilemma Pedagogy

The key to success of ethical dilemma pedagogy is a teacher who is convinced of the importance of socio-scientific issues in science education, cognisant of ways to establish and maintain a social constructivist learning environment and prepared to take on the role of a facilitator rather than that of a traditional knowledge dispenser. As part of the project teachers received intensive professional development in ethical dilemma pedagogy which included professional learning about theoretical aspects such as the social constructivist nature of ethical dilemma pedagogy as well as practical aspects of the role of the teacher as facilitator. Teachers were not only introduced to the structure and nature of ethical dilemma stories but also encouraged and trained to write their own locally relevant stories that would sit well within their

curriculum. Furthermore, teachers were encouraged to adapt the existing model of dilemma story pedagogy (Settelmaier 2009) to their needs. Teachers in the project accepted the challenge and creatively adapted and remodelled our suggested 'recipe'. It was entirely up to the individual teacher's professional judgement as to how much science content they would teach before engaging their students in an ethical dilemma lesson. For this reason, some teachers chose to use an ethical dilemma story as an introduction to a new topic, others taught content first to prepare their students for the story and yet others used a story as the culminating finale of a curriculum topic.

Student Diversity in Ethical Dilemma Story Research

In this chapter, we draw on some of the results of our 3-year research into ethical dilemma story pedagogy funded by the Australian Research Council (ARC) to illustrate its effectiveness in diverse classrooms. This project is investigating science and mathematics teachers' experiences in designing and implementing ethical dilemma story pedagogy as part of education for sustainability as well as their students' dilemma learning experiences. Of special interest is how ethical dilemma story pedagogy successfully engages students across a diverse range of academic abilities and sociocultural backgrounds by tapping into the personal values they bring from home.

For this purpose, we are less concerned with demonstrating students' attainment of dilemma-learning outcomes (such as critical thinking, critical reflection, collaborative decision-making) and more with identifying the qualities of dilemma story teaching that spark students' interest and deep involvement in science-related learning. In our research across a variety of contexts, we have found that some students 'get' an ethical dilemma whilst others do not. Sometimes students find an ethical dilemma deeply engaging compared to other students who find it mildly concerning. Local relevance seems to be one of the key factors as described in our earlier work (Settelmaier 2009). The key question that we address here is: *what makes dilemma story teaching more or less compelling for students?*

In the next section, we present a synopsis of a case study conducted at Hardbridge College (a pseudonym), a Western Australian middle school renowned for its success in educating students from a low socio-economic suburban area with a multicultural student population, including a large number of Australian Aboriginal students. Yet it's not only the students who have culturally diverse backgrounds, so do some of their teachers, such as MeiLing Chow, the young Asian science teacher with a strong Buddhist background, who was the participating teacher in this case study. At the time of the fieldwork, she was in her 6th year of teaching. The case study focused on her three Year 10 science classes and in particular on the effect of the dilemma stories on her students' thinking about and engagement in science. Other publications (Chow et al. 2011; Settelmaier 2009; Settelmaier et al. 2010) describe in detail the research and teaching methodologies and data

analyses. Suffice to say that the case study results presented here were generated in accordance with an interpretivist epistemology that employed teacher and student interviews, classroom observations, a student questionnaire and analysis of student work samples, all of which were subjected to grounded theorising within the sociocultural perspective on dilemma thinking outlined above.

Sociocultural Context of the Case Study

There are several aspects we would like to discuss briefly in relation to the sociocultural context of the case study, including the impact of mining on families in Western Australia, Australian Aboriginal culture, multicultural issues and Buddhist environmental ethics.

Hardbridge College is a Year 8–10 government secondary school situated in a low socio-economic area in the Perth foothills, with wealthier suburbs occupying the hilltops of the Darling Range. The population is mostly working class and multicultural consisting of Anglo-Celtic Australians and migrants from Asia and Europe, in particular from Balkan countries. Some parents of students work in the mines, which usually means 'fly-in fly-out' work rosters which can put severe strain on family relationships. Despite the relatively good income from mining, wealth is hard to come by since family break-ups are common. At Hardbridge College, some students' families have migrated from overseas, and it can be assumed that some students have experienced life as refugees before settling in Australia, especially students from Afghanistan and Balkan countries.

There is a large Australian Aboriginal community in the local area. According to Simon Forrest (2002), Head of Curtin University's Centre for Aboriginal Studies, an Aboriginal is a person who has practices, language, behaviours, values and beliefs common with other Aboriginal people. Aboriginal identity is strongly related to the often complicated kinship system distinguishing language and culture groups. In more traditional groups, this system is referred to as 'skin group' system in which an individual identifies with family members who may not be biologically related to them as father, mother, brother, sister, uncle and auntie. What many Aboriginal Australians share is a strong connection to 'the Land'. A strong sense of connectedness and family bonds affect social structure, economic behaviour, language and spiritual values. The existence of preferred Aboriginal learning styles has been discussed in the literature, e.g. Ryan (1992), referring to Aboriginal students' preference for group-based learning, storytelling as a vital aspect of teaching and strong community involvement in education.

According to the Census Document 2006, Western Australia is the most culturally diverse of all Australian states and territories. Whilst the majority of the population is of Anglo-Celtic origin, a high number of people were born overseas and speak languages other than English at home. In Western Australia, religious diversity as well as linguistic diversity is higher than in other parts of Australia

(Australian Bureau of Statistics 2007). These trends were reflected in Mei Ling's Year 10 class which represents a snapshot of the multicultural nature of Western Australia.

As Mei Ling is a practising, devout Buddhist with knowledge of Buddhist scripture, a factor influencing her work as a science teacher is Buddhist environmental philosophy. Srivastava (2005) reminds Buddhists that there is no need for them to go to the modern prophets of environmental 'doom and gloom' but instead to revisit and reread their own ancient texts since it was the Buddha himself who, in *the Buddha Vacana*, apprehended today's impending eco-crisis. He advocated proper management of natural resources and protection of natural environments from human encroachment. He stipulated the pillars of Buddhist environmental thought as stewardship of nature and protection of nature. It is important to note that Buddhist theory of nature conservation is 'cosmo-centric': neither is a human being regarded as the master nor is nature his slave or something to be exploited for human consumption or pleasure. It is rather the abandonment of selfish thought in favour of the moral precepts of loving kindness (karuna), joy (mudita) and friendliness (metta) – which translates into eco-friendliness – and a concern for the well-being of nature (Srivastava 2005).

At Hardbridge College, teachers are required to make adaptations to the curriculum so that it is more culturally relevant and community based. Low literacy and numeracy levels plus many problems common in low socio-economic areas tend to affect student learning. The students are organised in year groups taught by teacher teams with a strong focus on pastoral care. Mei Ling is an energetic and dedicated science and mathematics teacher in her 6th year of teaching. She is always interested in finding new ways to engage her students in education for sustainability.

> As a science educator, I am passionate about issues of pollution and sustainability. I feel that students are not given enough opportunities in school to explore environmental issues. Yes, there might be the odd lesson that teaches about pollution and recycling, but how often do the students treat it seriously?

Mei Ling is concerned that sustainability does not rate highly on her students' priority list.

> For many it's just another Science topic, especially in my school where the majority of my students come from low socio-economic backgrounds, with 47 % of the school population being Aboriginal students. Science education seems to be largely irrelevant to my students. It is either too boring or the boys complain that they are not doing enough experiments that 'blows things up'. Some students somehow have the idea that they already know everything, already have it all worked out, and that Science is not going to be any use for them in their future!

Mei Ling's comments touch on one of the major concerns raised in this chapter: chronic lack of engagement in science due to a perceived lack of curriculum relevance to students' lives. Mei Ling's students are very culturally diverse, with a large cohort of Aboriginal students and a minority of White students in some classes. Many have problematic and unstable family backgrounds. We observed that

Mei Ling maintained a high degree of rapport and mutual respect with her students. We never witnessed situations where students were confrontational towards her or pushed the limits of acceptable behaviour. Mei Ling saw ethical dilemma teaching as a potentially valuable way to engage her otherwise disengaged students in meaningful learning about issues of sustainability.

> When I was first introduced to dilemma story teaching I immediately saw the potential of engaging my students in a topic that might interest them. I believed that this innovative teaching approach might help me connect with their interest in topical issues in the world beyond school, while at the same time connecting with the Science curriculum. I really liked the idea of tapping into the students' personal values in an attempt to engage them in learning science.

Like all the other participating teachers, Mei Ling received extensive professional development in ethical dilemma story pedagogy. Subsequently, she wrote two dilemma stories designed for her Year 9 and 10 science classes. *The Prime Minister Dilemma* story raises the question of how future government funds should be allocated: for fixing catastrophic environmental problems or for providing half of Australia's population with an escape to a new life on a newly discovered habitable planet. Here, we focus on the second of Mei Ling's dilemma stories: *The Mining Dilemma* which she taught in three Year 10 classes during 2011. Both dilemma stories can be viewed on our website www.dilemmas.net.au.

The Mining Dilemma

The Mining Dilemma addresses the environmental impact of the Western Australian 'mining boom' which provides jobs for many families but also threatens to destroy pristine wilderness areas of 'outback' Australia. The story is told through the eyes of a boy named Akiki whose father works in the mining industry in a remote region of Western Australia, requiring him to leave his family for weeks at a time. The father is offered a high-level job in a northern town (in the Kimberley region) that will enable him to live with his family. However, there is a sting in the tail in that the mining company requires him to open a new mine close to the town in an environmentally sensitive area. The community is confronted with the decision as to whether a mining project that is likely to damage the delicate environment is to go ahead. The main dilemma question is:

What is more important to the community – the environment or improved job prospects?

Mei Ling prepared the students for the Mining Dilemma teaching story by providing preliminary science lessons on the geology, chemistry and technology of mining for minerals, which are topics associated with the 'Natural and Processed Materials' and 'Earth and Beyond' strands of the K-10 Science Syllabus of Western Australia (Government of Western Australia – Curriculum Council 2010). She taught the Mining Dilemma story over two 60-min lessons as a culmination to

this science topic. During the dilemma teaching, she directed the class to engage in a series of individual reflective thinking and small-group discussions. In order to support students who struggle with basic literacy skills, she provided a PowerPoint presentation whilst telling the story to the whole class. Her collaborating Society and Environment colleague taught the students about the major environmental effect mining can have on a community and steps mining companies can take to protect both the community and the environment from harm. The Mining Dilemma story provided a cross-curricular link to the Society and Environment curriculum strands of 'Resources' and 'Place and Space' (Government of Western Australia – Curriculum Council 2010)

Aaron

Aaron is an Australian Aboriginal boy who engaged meaningfully in dilemma-learning activity, in the process drawing upon his family values to personalise and resolve his dilemma thinking. Aaron has a relatively high literacy level and was keen to support fellow students struggling with poor reading skills by reading aloud to the whole class passages on Mei Ling's PowerPoint presentation of the Mining Dilemma story. When asked how he would resolve the dilemma if he had been in Akiki's situation, he responded as follows.

Aaron: I made the decision that his dad should stop working in the mines and stay with his family
Intvr: And why did you make that decision?
Aaron: Because if he loves his family, then he'll stay with his family and try and get another job in the Kimberleys. There might be less pay, but at least you'll be with your family.
Intvr: Family is an important thing for you?
Aaron: Yep.
Intvr: Are you close with your family?
Aaron: Yeah.

Aaron's responses are very much in line with traditional Aboriginal culture where family ties are very tight and important in everyone's lives. The link between Aaron's responses and his cultural and social background becomes clearer in the following excerpt:

Intvr: What did you find interesting about the story?
Aaron: That his father had a hard choice to pick. And we didn't really know which choice we had to pick so it was just really interesting for me to know which one he was going to pick.
Intvr: Does any of your family work in the mines?
Aaron: My dad used to, but we asked him to stop working there, and he stopped and he started working somewhere else now.

Intvr: He stayed with the family?
Aaron: He used to work out in the mines, but now works for people who get into the mines. Like, helps people get jobs.
Intvr: He doesn't fly-in, fly-out anymore?
Aaron: Nope.
Intvr: Do you like it that way? Or do you prefer seeing less of your dad?
Aaron: Nah, it's better with my dad here.

Many families in Western Australia are subject to a 'fly-in fly-out' regime resulting in family members being separated often for weeks at a time. Many students in Mei Ling's class have parents working in the mines. Whilst the mining boom has been responsible for making Western Australia the richest of the Australian states, it seems that this wealth does not extend to Mei Ling's school community where poverty is widespread. Nevertheless, the story has a strong resonance with the lives of many of Mei Ling's students. When asked how he had liked the dilemma story approach, Aaron said that he liked it, '. . . cause it kept me on task'.

Intvr: How did it keep you on task?
Aaron: Like, other times I would rip out my iPod and start listening to it, but this had me thinking sometimes.
Intvr: What did it make you think about?
Aaron: Most of the times I couldn't even sleep, just thinking about what would he do? Stay with his family or go up to the mines?
Intvr: It affected you pretty deeply?
Aaron: No. Not pretty deeply, just that it made me think for some reason.

Aaron's comments indicate that the Mining Dilemma story had resonated with his personal beliefs and values; it had engaged him in dilemma thinking; it had '*made me think*'.

Marisa

The Mining Dilemma story also elicited the personal values of Marisa, a European Australian girl, engaging her deeply in thinking about the family-environment dilemma confronting Akiki.

Marisa: He [Akiki] had to decide whether he wanted his dad to be home constantly and have the mining through the town he's just moved to or keep the town as it is and have his dad still working away.
Intvr: What was the dilemma of the story?
Marisa: That he had to choose between seeing his dad. He was put into a bad position, he had to choose and it was a tough decision.
Intvr: Did you guys have to place yourselves as Akiki?

Marisa: Yeah. We were asked what we would do if we were in that position, and we had a bit of a debate about it.

Intvr: And what did you talk about?

Marisa: How the Kimberley was such a nice place, and putting mines there is a stupid idea because there's families living there and it would pollute the area, and noise pollution and all that, eventually people would have to leave anyway... Lots of parents have to work away, and it's just something you have to learn to deal with. And it's better off that way, rather than a year or so and they have to move again.

Unlike Aaron, Marisa was prepared to 'sacrifice' Akiki's father living with his family in order to protect the environment. She explained that she was opposed to mining in the Kimberley region because its long-term effects could cause problems for everybody.

> I think it's better that his dad can choose working away [from the family in his current job], and they don't mine in the Kimberleys. Because it's not necessary. He's got a job where he is. And that's another thing; he would get a higher position, better pay. But umm it's still ruining their home. Their family, he had a younger sibling I think, it would affect him and everything.

The personalisation of the Mining Dilemma story for Marisa becomes clear in her next comments:

Intvr: How do you feel normally about mining?

Marisa: My step-dad works away... like mining is something that needs to be done. It brings good income, and everything. And it sucks that he goes away but it's part of life. And I've still got my mum as Akiki still had his mum.

Her family values expressed a conflict between having a dad who is with the family and the necessary 'evil' of mining which provides an essential family income. The story seemed to have deeply touched Marisa. When asked whether she could identify with Akiki's feelings, she said:

> Yeah!... Yeah, like it's a hard decision. Like if my stepdad had the decision to work here, like we're considering moving to Collie [a rural coal mining town] 'cause we'd be right on site and he'd come home every day. But then we'd have to move and stuff, like Akiki, and we've come to the decision that we're going to stay [in Perth]. And that's what I think Akiki should have done.

Marisa's subsequent comments highlight aspects of the widespread feeling of helplessness amongst adolescents. When asked what she thought about environmental protection, she responded:

> I think the environment is important, but they're going to mine regardless. So, there's no laws against it and companies pay lots of money for the mining they do. So, it's not like they're going to stop it. So, I haven't really thought that much about it but they're going to mine anyway, and global warming's going to kill the earth anyway. So... there's not really much you can do to stop it.

Marisa's further comments confirm that she had engaged in dilemma thinking about environmental protection versus mining:

Marisa: There are not very many positive aspects of mining compared to the negative. Like with the whole environment and stuff. But again, it supplies many jobs, it employs thousands of people, so it's kind of a win-win-situation.

Intvr: Do you think it's possible to mine while looking after the environment or do you think that's not possible?

Marisa: I don't know. At the moment I don't think it is, but in the future they could come up with a way to. At the moment I just think it's destroying the environment.

We conclude that The Mining Dilemma Story case study illustrates how deeply engaged Aaron and Marisa were in dilemma thinking, with Marisa evidencing a more nuanced perspective. Aaron can be viewed as an example of a student who normally doesn't engage in science or learning but who was drawn into dilemma thinking by the values-based questions in the story. In struggling to resolve the family-vs-environment dilemma facing Akiki, the main character of the story, they arrived at different conclusions based in large part on their different family values. Although many of the Year 10 students indicated that they were in favour of protecting the natural environment, ultimately Akiki's father's job prospects were regarded by many as being more important. This resolution is not surprising given that many of these students' families face the daily spectre of unemployment and poverty. Regardless of the ways in which the students resolved the dilemma, the results confirm that this ethical dilemma teaching story successfully engaged these socioculturally and academically diverse Year 10 students in science-related learning.

Summary and Conclusion

Our research has found that ethical dilemma story has the potential to re-engage students in science learning, especially when it is paired with sociocultural issues relating to sustainable development. The goal of ethical dilemma story pedagogy is to support students' growth as responsible, autonomous, democratic citizens, capable of practising an ethic of consistency, capable of evaluating the consequences of their actions and able to practise both empathy and care in their adult lives. These character strengths are sought after in decision-makers of the future – people on whose decisions the sustainability of the world's resources will depend. We believe that science education for sustainability should have an important role in developing these character strengths in students. It is for this reason that we are working with science teachers to investigate implementation of ethical dilemma pedagogy in their classrooms.

Teachers in our research have been developing ethical dilemma teaching stories as curriculum resources aimed at the lifeworld interests of their students. In this chapter, we have focused on one science teacher, Mei Ling, whose Year 10 science class was an exemplar of academic and sociocultural diversity. Our research has shown that ethical dilemma story pedagogy has been successful in getting Mei Ling's diverse adolescent students involved in resolving ethical dilemmas linked to their normal science curriculum.

Relevance of the storyline to students is important if they are to identify with the character in the story and to engage in problem-solving on his/her behalf. In Mei Ling's case, her Mining Dilemma story seems to have struck a chord in students' minds and hearts due to the similarities between the main character and their own lives. We have learned through our work with other teachers that a teacher's enthusiasm for the content of a dilemma story, especially one she has authored, is not a sufficient guarantee of student engagement. If students cannot attach personal significance to the dilemma in the story, if they find the story too far removed from their lifeworlds, then they are unlikely to feel compelled to engage in dilemma thinking.

Mei Ling's case study supports earlier research which found that in a class of diverse students a good dilemma story can (and should) elicit differing responses, some of which might be due to cultural differences. In the Mining Dilemma Story, Marisa voiced a more nuanced understanding and personal resolution of the family-vs-environment dilemma than did Aaron, who was opting in favour of a strong family connection over financial gains, even though there was evidence that both had engaged in dilemma thinking. It is only natural, and indeed educationally desirable, that a range of perspectives is elicited and voiced in response to dilemma thinking. This is supported by Killen et al. (2010) who argue that varying application of moral principles reflects the diversity of life experiences students bring to the classroom: group functioning, group identity, cultural expectations and traditions all influence moral considerations.

Applied to our case study, it would be easy to jump to the conclusion that Marisa's comments were representative of her more individualistic European Australian cultural background since they were more clearly focused around individualism, independence and separation, whilst Aaron's ethical decision-making seemed to reflect the collectivist nature of Aboriginal culture with its strong family bonds. Yet, Smetana cautions against drawing such simplistic conclusions. The cross-cultural application of theories of moral reasoning has generated much interest and controversy, especially in relation to the distinction between individualistic and collectivist cultures (Smetana 2010, p. 143). In contrast to proponents of theories of structural moral development, such as Kohlberg who deemed that moral development followed universal principles, researchers such as Nucci (2010) have become increasingly cautious and tend to look beyond the cultural surface when exploring moral reasoning. They contend that within cultures with a recognised collectivist nature, individual decision-making can focus on individual needs and interests, whilst in individualistic cultures, individuals may opt for collectivist

values. What does this mean for our scenario of culturally diverse Year 10 science students engaged in ethical dilemma thinking? We conclude that whilst students may be strongly influenced by their home cultures, individual responses to ethical dilemmas might differ from the cultural norm, and so we should be wary of stereotyping particular ethnic or racial groups, especially individuals within these groups, as having special interests or needs.

Also of importance to the quality of student engagement in dilemma thinking is the teacher's style of delivery. We have witnessed how the tone of storytelling, where the teacher abandons reading a prepared script and speaks directly from her heart, can be far more captivating as in the case of Mei Ling who told the story more or less freely. She had designed a PowerPoint presentation to support the delivery of the Mining Dilemma in order to help engage the visual thinkers amongst her semi-literate students. It was fascinating to observe an Aboriginal boy (Aaron) seize the initiative to read the story aloud to the whole class, thereby (wittingly or unwittingly) supporting his cultural peers struggling with poor functional literacy skills. Whatever the mode of delivery teachers choose, it is important that they are sensitive to what works best to capture students' interest and captivate their imagination, to ensure that the storyline and the central character resonate with students.

This is a good moment to recall that ethical dilemma pedagogy is not a search for a single best answer, even though as teachers we might be tempted to steer students towards our personal view or belief. In the case of education for sustainability, it could be very tempting to abandon the 'teacher as facilitator' role and adopt the 'teacher as instructor' role of the content expert, pointing out to the class the 'politically correct' answer. However, the pedagogical goal of ethical dilemma teaching is to enable students to develop key ethical decision-making capabilities:

- Awareness of and critical reflection on their own values and the values of their peers
- Ability to engage deeply in dilemma thinking – to struggle with the horns of a dilemma
- Ability to negotiate and justify a personal or shared resolution of a dilemma

The results of this and other case studies give hope to science educators interested in making their curricula more socially responsible and inclusive. Whilst we are not suggesting that ethical dilemma story pedagogy is a 'magic bullet' that will solve all problems afflicting science education, there are strong indicators that student engagement with important issues of sustainability can be enhanced through this approach. If socially responsible science education is to successfully meet the pressing challenge of sustainable development, then classroom discourse on values and the ethical implications of science, on the way scientific knowledge is obtained and used in daily life, and on how science and environmental issues are interlinked is inevitable.

We believe that a particular strength of ethical dilemma story pedagogy is that it supports students in finding their *voice* as critically aware decision-makers and

prospective leaders in the Knowledge Age. We close with Mei Ling's perception of the value of ethical dilemma pedagogy for engaging otherwise difficult-to-engage students in science-related learning.

> The fact that my students are not very bright academically and for them to be able to think critically, to have discussions about it at home with their parents, and lastly to be able to produce posters is truly amazing. I strongly recommend any teachers to give dilemma teaching a go, to try it with an open mind, and to simply enjoy the discussions that will follow on naturally from the students.

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