ABSTRACT

              Over the last ten or so years this researcher's educational
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liberating and empowering for students. Although there have been a number of
motivating themes, the central one has been his work with student images of
the future. He has taken these seriously and used them to inform by
educational practice. These images are both compelling and concerning. He
justifies importance and then describe ways he has changed his own practice
in view of his findings. He has come to realize that the science education
that he has provided has been based on a view of curriculum that undervalues
the temporal dimension. To address this aspect he has used the concepts and
techniques of the futures field to enrich pedagogy and develop the concept of
a transformational curriculum. (Contains 42 references.) (Author/YDS)

The future: The hidden dimension in science education

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Over the last ten or so years my educational focus has been on providing a science education program that is both liberating and empowering for students. Although there have been a number of motivating themes, the central one has been my work with student images of the future. I have taken these seriously and used them to inform by educational practice. These images are both compelling and concerning. I will justify their importance and then describe ways I have changed my own practice in view of my findings. I have come to realise that the science education that I have provided has been based on a view of curriculum that undervalues the temporal dimension. To address this aspect I have used the concepts and techniques of the futures field to enrich pedagogy and develop the concept of a transformational curriculum

Introduction

Responsibility for the future is the central core and crystallised essence of all responsibility, always and everywhere. This responsibility for the future not only is the all encompassing responsibility, but also is prior to and a primary condition of man's responsibility in and for the present. This function is considered to be fundamental for human behaviour as human behaviour, pertaining to both mankind as a whole and man as an individual (Polak, 1973, p. 9).

On the bigger canvas of educational concerns my interests have focused on locating science education on the total map of school learning, especially in terms of student emancipation and empowerment and the intersections and overlaps between the various curriculum areas. My motivations are many but the one I wish to focus upon in this paper is student images of the future.

In this paper I will look at the nature of student images of the future and why they are important, what student images of the future look like, the scope of the futures field and finally its application in science learning.

The central theme is showing that the valuing and use of student images of the future provides a novel way to meaningful and empowering learning. For, as Boulding (1996) points out, that

As long as we can imagine a better world with minds adequately equipped for the complexities of the twenty first century, we will be able to work towards better futures (p. 229).

These images identify student concerns and aspirations and by so doing provide indicators for appropriate curriculum, direction to an empathetic teaching and learning program and a compelling reason why science education should take an STS approach or be a central component of a seamless

curriculum. I would add another 'T' and insist that a science curriculum also be transforming, personally and culturally. For, as Maslow (1971) reminds us,

If an ultimate goal of education is self-actualisation, then education ought to help people transcend the conditioning imposed upon them by their own culture and become world citizens (p. 191).

The end of the millennium provides us a unique symbolic opportunity to 'take stock and consider our position' (Beare & Slaughter, 1993, p. 161). It is also a time to suggest ways forward that will lead to a sustainable ecology and a world worthy of generations to follow.

Students images of the future

I want to start my discussion by describing a 1988 encounter with a student futures image elicited using a guided fantasy approach. At an intuitive level I understood that our expectation for the future must be powerful motivators of what we do or do not do in the present. This was at a personal level and I had not explicitly connected this to my teaching. The first futures imaging activity with students impacted acutely upon me.

The imaging process

I have used a futures imaging approach to elicit student images of the future. In this exercise the aim is for students to let go of the present and project themselves into the future by taking part in a guided fantasy. By imaging a future twenty years on, it is assumed that students can learn to mentally project themselves into the future, and become more aware of the underlying mental pictures which colour their world view, expectations hopes and fears.

In the process of futures imaging students are instructed to close their eyes. They are then guided through a relaxation exercise in readiness for the mental projection into the future. By means of a story, students are taken on an imaginary journey twenty years into the future and asked to imagine what life would be like; to take note of the state of the environment, the types of housing, transportation, clothing and so on. They are also asked to be aware of any aspects of their images that seem to sum up life twenty years on. That is, they are asked to look for symbols or metaphors of a future time.

Students are directed to write about, or draw, illustrations to represent their images of the future and then talk about their experiences, describing what they saw and how they felt. The sharing of experience is important in developing a collective view of concerns and expectations but also identifies and provides the opportunity for follow-up with students who seem distressed.

I will use Abigail's (a pseudonym) case to start the illustrations for it was her images and a subsequent interview that had such a profound effect on me.

> In the street I saw a massive house without a roof so you could see inside it. Then I saw a lady with really long blonde hair. I said 'hello', but she just walked on. I walked down the road and into an old shop. Looking around it looked deserted, but there was a man there all frozen and he would not move, like he was dead. The shop had no back wall and it looks like a really old one. I walked out of the shop. Saw a windy road, really wide, but no one was using it. No one else was around, except another guy who looks like Captain Cook. Any way the road looked like this with a thin bridge and a massive pit of snakes here.
>
> Then I turned around and saw a deserted subway with all the lights still on (Abigail, 1989).

Figure 1 Abigail's description of her futures image.

Abigails description has dream like qualities and is rich in symbolism. There are dystopic elements such as the lack of human contact, the frozen man and the deserted subway). The snake as a symbol is ambivalent. It is usually imbued with energy and Jung suggests that psychologically, the snake is a symbol of anguish expressive of abnormal stirrings in the unconscious (Cirlot, 1962). Captain Cook, the road and lights are indicative of a journey of discovery, although as we will see it wasn't particularly positive. These images do seem authentic and revealing of deep-seated ideas. It is helpful to question the nature of the symbolism, to ask what they mean for the student and to look for patterns in their appearance as images do tell us something about their worldview.

I followed up the imaging exercise with a limited number of interviews. Abigail was one in the first of those. I will look at extracts from this interview because it identifies a state of mind, although suggestive in the imaging, clearly not apparent in day to day teaching situations.

David	Um … now, I might have asked you this before, What sought of feelings did you have associated with that? Was it really good, fun, terrible…?
Abigail	I don't know, but I felt a bit lonely as I was walking down the road because there wasn't any houses or anything, there was only a few people … I didn't feel anything.
	…
David	Can you say anything about the future image in terms of your life now … ?
Abigail	No, I don't know what I am going to do. I don't reckon I will be alive in the year 2 000. In the year 2 000, I think the world will end.
	…
David	How does this effect your school life?
Abigail	Part of me thinks that its going to end and some of me thinks that it wont … So I don't think about it.
	…
David	Is there anything in that image of the future exercise that we did that meant something to you or was important to you?
Abigail	Well, that no one was around and that. No one is going to be around in 30 years time, that had a significant part.
David	Do you think we could change that? Just because we think it, it doesn't mean that we can't do something about it. Is there any thing we can do to make sure there are people in 30 rears time?
Abigail	I don't think there is anything you can do.

David   Do you feel fairly powerless?
Abigail   If the world's going to blow up, it's going to blow up and there's not
               anything we can do to change people if they're going to blow it up.

This millennium doomsday scenario left me quite disturbed. I had looked at imaging responses from a number of classes and noted a significant number of dystopic futures scenarios, but this first interview brought home the reality of the images for the student. It was at this point that the importance of student's images of the future became central to my educational thinking.

The argument is regularly made when I discuss this work that the images are just fantasy, all children have these and they are not particularly important in determining what happens in a person's life. Lets look at what the 'experts say'.

Why student images are important?

I will very briefly look at three areas that have informed my view that student images of the future are of significance: Jungian psychology, personality psychology and history. The first two are more concerned with the individual as they operate within a social setting. The historical evidence looks at the issue from a community/societal perspective.

From a Jungian perspective

Jungian psychology supports the idea that images of the future emerge directly from worldview material of the conscious and subconscious and that this information is on the same plane as physiological fact (Jung, 1933, p. 6). Jaffe (1983) describes this process as the ego confronting the images as though they were reality, 'not only perceiving them passively, but actively participating in their play and reaching an understanding with them' (p. 77). Kelsey (1976) notes that these images are outside conscious control and 'cannot be called up or stopped at will like concepts can' (p. 179). Images produced through guided fantasy are thus genuinely retrieved from the pool of ideas, images and feelings that makes up an individual's worldview and out of which the individual acts. Jung (1974) contends that the material that forms the images draws upon a wealth of subliminal perceptions and is connected to a person's level of mental health.

These dream like images of the future, then, convey to us in figurative language, 'thoughts, judgements, views, directives, tendencies, which were unconscious either because of repression or through mere lack of realisation' (Jung, 1974, p. 34). In cases like Abigail's, and I suspect with the ten percent or so of students who do not wish to take part in the imaging process, that their concerns for the future have been, to varying degrees, repressed. This is a survival mechanism that Singer (1972) identifies as a psychological anaesthetic. She says,

... for repression is a kind of psychological anaesthetic, but when there is a great suffering an anaesthetic serves a purpose. It leaves the wound untouched, but the patient is able to tolerate it (p. 83).

It has become clear that for a significant number of our students their images of the future are like looking directly into the 'blackness and finding only experiences that seen meaningless and devouring [which] is worse than any sickness' (Kelsey, 1976, p. 47). However, it is the nature of the response to these images that is also important. Rather than ignoring what is experienced it is essential to do something about curing the 'sickness'. For they not only provide indicators of deep-seated concern for the future, 'but it is clear that they also offer a prognosis or anticipation of the future and a suggestion as to the course of treatment as well (Jung, 1933, p. 7).

Not all images of the future are as disturbing as I have suggested in this initial analysis, but even so any image of the future, utopic or dystopic, can be more than a passing fantasy.

Personality psychology and future images

One of the most significant aspects of human psychology, one that distinguishes us from many if not all other living things, is our ability to plan ahead (Loye, 1998). We can articulate a vision of where we want to go, and develop a means for getting there (Taylor, Pham, Rivkin & Armor, 1998). That is, we have visions of possible futures.

Personality psychologists have also made the observation that images of the future are 'real' and that 'we routinely act in the present in the context of some model of the future' and that 'the brain and nervous system is already a future study system. (Gordon, Gerjuoy, & Jungk, 1987, p. 19)).

The value of positive imaging of future events is that they regulate our behaviour and emotions. They guide current self-conceptions and actions (Markus & Nurius, 1986), enhance problem solving ability (Fiske & Taylor, 1991), and help in overcoming stress and coping with situations (Lazarus & Folkman, 1984).

These studies have been concerned with the mundane and immediate future rather than images twenty years on that not only image personal futures but the future of the world environment. The intermediate and distant future, in terms of their consequences, are vitally more important than immediate concerns for reasons both for the individual and for the wellbeing of society. They are far enough in the future to not have restraints imposed upon them by the current state of affairs. Decisions can be made now and life style adjusted without frenetic activity and compromise. Responsibility can be taken for futures, personal, societal and of the yet to be born (Tough, 1991). Purpose becomes more than survival for today but planning for a better tomorrow. Therefore, the existential anxiety associated with immediate concerns is diluted with the promise of better things to come (Frankl, 1964). The confirmation that mental simulation of achieving a better future helps people perform planning tasks effectively and by so doing raising self esteem, is a compelling reason to take this approach further.

A view from history

The first writer to deal explicitly and in depth with images of the future from a historical perspective was the Dutch social scientist Fred Polak (1973). In his study, The image of the future, he traces the history of images of the future in Western society from the Sumerian times to the mid 20th century. He shows that images of the future are central to the health of a civilisation and act as a 'guiding star for human civilisation'.

Social change will be viewed as a push – pull process in which a society is at once pulled forward by its own magnetic images of an idealised future and pushed from behind by its realised past. Poised on the dividing line between past and future is (hu)man(ity), the unique bearer and transformer of culture (Polak, 1973, p. 1).

Polak (1973) was the first in the West to realise the importance for a society or culture of having an ideal dynamic image of the future.

Polak's study of history, with a particular focus on futures images, has revealed a correlation between a society's general health, that is an ability to flourish or go into decline, and the nature of the dominant image of the future. He comments,

The rise and fall of images of the future precedes or accompanies the rise and fall of cultures. As long as a society's image is positive and flourishing, the flower of culture is in full bloom. Once the image begins to decay and lose its vitality, however, the culture does not long survive (Polak, 1973, p. 19).

In the process of searching out futures that have both an embeddedness in the cosmos and a utopian dimension, 'humanity crosses the frontiers of the unknown and is transformed from a society of action that responds to the moment, to a society of thought, that takes account of the consequences of actions' (Polak, 1973). It seems that our current Western society is in the former phase but is capable of transition to a new vision which is presaged in the images generated by the few who take the trouble to take images of the future seriously.

The argument that our current loss of direction is due to rapid change that we cannot keep pace with is not seen as a reason for our current malaise. It is rather that technological 'progress' has outstripped society's ability to maintain a viable spiritual dimension. Society has lost its sense of transcendence and utopias have skewed or distorted to meet shallow, materialistic and narcissistic needs.

In summary

Images of the future and optimistic responses to those images are important for the psychological health of individual, local community, nation and the world community. Although undirected images of the future of a significant number of students are dystopic in aspect, that does not mean that preferred images cannot be created and interacted with. Even dystopic images of the future can be of value provided they are actively rejected and re-visioned.

What do student images of the future look like?

Some examples from my own work

Students' images of the future can in general be identified as either utopic or dystopic, although this is an oversimplification and a range of categories along a continuum and categories cutting across are identifiable. Some are identified by students as times they could live but are lacking in warmth, human contact and conceitedness towards the Earth. There are of course cases where personal opinion as to their nature may vary. For example some high technology scenarios may be positive for those who are technocratic in nature but alienating for those who need a more humanistic culture. Students sometimes indicate their preference for such a culture. In general though I have placed technocratic images more to the dystopic end of the spectrum. Two other categories are recognizable. The first is associated with a more primitive way of living than at present and is usually associated with utopic visions. The second is where the future appears very much as it is now. The main categories then are utopic, primitive cultures (often described as good times to live), dystopic, technocratic (domes, skyscrapers and computers) and 'did not take part'.

The utopian visions are in the main humanistic with benign technologies whereas the dystopic visions are often high-tech and have humans living in a degraded environment. A utopian vision of the future contains elements that identify a pleasant, happy, safe and environmentally healthy image whereas a dystopian vision will be the antitheses of this.

A second dimension to students' futures images is the quality of their response to the image. High quality responses see utopian futures images as futures worth working towards and dystopic visions as those to avoiding at all costs. Low quality responses are uncritical, dismissive, naive or fatalistic and are all disempowering. Some utopian visions read as naive and uncritically constructed worlds. High quality responses were generally recognisable from comments and paper records and willingness by students to respond at length and interact in animated discussion. Low quality responses were

sometimes recognisable from comments of resignation or not caring. Being unprepared to take part in the activity was taken as a low quality response.

Utopian futures images

A typical utopian scenario is illustrated in the following example.

In the year 2016 I saw a world which was clean and very beautiful. The seas and lakes were clear of rubbish and any kind of pollution. There were lots of animals in their natural habitat. There were many kinds of plants and trees. Every garden was full of beautiful flowers and plants. Even along the roads and paths plants were placed. The people looked happy and friendly. They were altogether and having a good time. The children were playing in the yards and swimming in the clear, clean ocean. The air smelled good and not of car petrol and chemicals like our air. The houses were mostly brick homes with big front and back yards. Lots of families had pets and were walking them. It didn't seem like anybody hated living in this year. It looked like a good place to live and I felt very comfortable visiting there (Susan, 1996).

Some images on the surface seen fine but on closer analysis an underlying dystopic element can be detected. At first glance, Emily's image gives the impression that all is well but there is sensory deprivation and a lack of warmth that suggests a not too pleasant place to be.

I think I was in the city. I don't know, or something like that. There weren't many people, it was really early in the morning. I saw one car and it was really old. I saw a Pizza Hut. There was no pollution and I couldn't hear anything and that's about all (Emily, 1996)

Dystopic futures images

The next two are typical dystopic futures visions. The first illustrates a low level response where the 'I don't care' identifies resignation and hopelessness. The second scenario is just as bleak but the author has a more positive response seeing the image as possible but not desirable. This student is more likely to work against trends that take us in this direction.

Mine was a destructive one. Dystopic. Nobody was happy and all the buildings had cracks all over them. People had cheap clothing and dirty clothes. Kids didn't have much food. There wasn't any bread and that. I didn't care (Frank, 1996).

In my time where I travelled 20 years into the future I had rather a disturbing experience. The little town which I imagine once was a beautiful town there is now nothing but a few old buildings which are crumbling and the streets are littered with rubbish and only a couple of people who looked very weak and weary and all there clothes were ripped and over worn. The river that was just a couple of hundred meters from the town was disgusting, the water as a brown black colour and it was full of rubbish such as cans, petrol drums, papers and an old car. The trees that used to be nice and healthy are now dead or dying. The environment the last few people live in is not very nice. The air above them is that dirty that you can't see through it. Even the sights around are disgusting as there is nothing there as all the trees are dead or dying and there is virtually no grass. I just hope that it is not like that when it is the year 2016 (Carter, 1996)

Although nuclear holocaust scenarios were not as common as they were in a study I did eight years ago, they are as debilitating as ever. Bobby's vision illustrates a desperate future world.

When I walked over the hill I was extremely distressed by what I saw. Everything had been totalled. Buildings, landscapes, people, animals all by a nuclear war. I did not fit in because all the people were mutated and deformed. They had to wear radio - active suits to survive. No trees or plant life to be

seen anywhere. The city had only just started to be rebuilt and plant seeds have been planted, but they won't grow very well (Bobby, 1996)

Dystopic visions are often extreme in nature but others are far more believable and as such more powerful. Dave's is of this type.

I walked past all these bushes and you couldn't see much. But once you got past these bushes there were a couple of houses. They were pretty new but nothing special. I walked past someone working in the garden. Everyone was wearing masks ... everyone was wearing them. There were a couple of kids playing. That was alright. I walked a bit further and there was a dead person lying on the footpath. I walked down past a little creek and there were heaps of rubbish around it and it looked brown. I walked through a door and there was lots of water and it sprayed all over you and then you go past a heater and it (got) you pretty dry. There was nothing much there. Nothing like vegetables fresh or anything. They weren't growing (Dave, 1996).

Degradation of the environment and the quality of life are usually associated with human mistakes and technological excesses.

The table below summarises the types of images found for a one class study. The high proportion of dystopic and high technology scenarios is a concern.

Futures category (N = 24)	Female	Male	Percentages
Utopic	4	2	25
Dystopic	2	8	42
Into the past			Included in Utopic
Same as now		1	4
High tech		3	12
Did not take part	1	3	17
Totals	7	17	100

Table 1 A single class analysis of images of the future (1996)

Authenticity

Having taught most of the class for two years I was able to use my knowledge of their dispositions to life to help in the interpretation of their reports. Although there were some surprises, in most cases my observations matched student responses and by so doing added confidence to the accuracy of the interpretations.

What other studies have found

I have reviewed over twenty studies (three between 1955-1976; five between 1982-1989; and thirteen between 1990-1996) undertaken, mainly in the Western world, of student views of the future. There are a number of themes and observations that arise out of these studies. Clearly students have concerns about their futures. Their personal futures are perceived as brighter than both local and global futures, and local futures seem more positive than global futures. In general student views are more pessimistic than optimistic.

Beyond seven, students in the personal area, have concerns about growing up, relationships and acquiring an education suited to getting a worthwhile job which will be fulfilling and financially adequate. At the local and global levels they are concerned with racial equity, global and local wars, environmental degradation, and technological materialism.

There are gender differences. In general girls are more concerned with humanistic issues and boys those technological. Girls are more likely to be concerned with relationships, the state of the environment (particularly endangered species) and issues of equity than boys. A minority of boys has fanciful visions of technological futures and solutions to problems provided by new technologies.

The nature of student view of the future change as they get older. By the end of primary school many students have become aware of social, economic and environmental issues and their complexity. They are concerned about their own future and that of their local community and are fairly optimistic that the quality of life will improve for them. They are less optimistic about the global situation improving. Their choice of preferred futures indicates that many would like to see a future based on greater environmental awareness and personal and community action.

Between the 3rd and 7th grades students' ideas about the environment and global issues develop a great deal but not generally as a result of the school curriculum but rather from television and other forms of mass media. They request to be better informed about the world around them and better able to contribute to its future (Hicks & Holden, 1995). By senior school level students have developed different expectations about the future and different skills for coping with it. They come up with fairly traditional lifestyle and think the future will be better than their current lives. They are pessimistic about conditions improving for the majority of people in their local community and even more pessimistic about life improving for people in the rest of the world. Generally, pessimism increases with age, with those in their 20's more negative than those in their teens (Eckersley, 1996).

In the main studies suggest that student images of the future are not well developed and are more likely to be pessimistic than optimistic. They generally feel they have little control over the future. Futures are often seen in terms of developments in science and technology. Students have limited skills and poorly developed levels of concern about the future and they hold fears for what the future might bring.

The images, views, visions that students display towards the future tend to the fragmentary, one dimensional, pessimistic and sometimes fearful. What is clear from the research summarised is that students' views of the future suggest they are well aware of the upheaval of our times and the jeopardy that they may bring.

Student view of the future in summary

Student images of the future can be disregarded as youthful fantasy and considered unimportant but this is not the view of many authorities (Bell & Mau, 1971; Boulding, 1989; Eckersley, 1988; Hicks & Holden, 1995; Hutchinson, 1992;Loye, 1989; McGregor, 1989; Oscarsson, 1996; Wager, 1987; Wilson, 1987). They argue that images of the future have a crucial role to play in societal development and the development of the individual, and that studying images of the future should be of central concern. There is evidence to suggest that visions of the future can and do effect the young and that they tend to live out these life scripts (McGregor, 1989; Wilson, 1989). It is also likely that dystopic visions of the future are one of the factors effecting student motivation to strive for academic excellence and one of the influences on school retention rates (Toffler, 1974).

The importance of student images of the future, from a psychological standpoint, is not so much how objective they are or how likely. For the students they are real (Calvin, 1997; Demasio, 1994; Loye, 1989; Wilber, 1983) and like any other prior knowledge needs to be considered in the educative process. Futures images, like prior conceptions, can be changed and 'that which is unbearable may become acceptable if we can give up certain prejudices and change our point of view' (Singer, 1972, p. 4).

Thus far I have describing and identifying the importance of student images of the future. I want to finish by very briefly looking at the implications for science education.

The futures field

Explicitly giving curriculum a futures dimension required identifying, defining and integrating those concepts and techniques that make up futures studies and using them tor exploring the future. The value of the futures thinking is that it fosters forethought, planning, creative imagination, and the capacity to formulate options and make informed choices. It is involved with moral issues such as responsibility for the environment and the consequences of various courses of action. It is integrative in that it draws from many traditional subject areas, opens up relationships between factual and value questions and is empowering of students by enabling positive responses to the notion that they can exercise significant control over their futures (Slaughter, 1989). Futures studies provide ways to explore possible, probable and preferred futures, both individual and global.

Because futures studies is not like other established fields in academia, it is constantly being misunderstood and misused (Dator, 1996). Futures is often associated with, what Slaughter calls, the "hard pole" of the futures field. However, the futures field spans a spectrum of activities and projects from the 'hard core' of futures research and forecasting normally associated with commerce and the military, through futures studies associated with scenario writing, social research, education and communication, to the 'soft pole' of futures organisations which are about alternative ways of living.

The futures field has its own set of concepts, methods, techniques and agendas in the same way as other fields of study do. A sense of the futures field can be gauged form Slaughter's (1996) analysis (Table 1).

The major reason for studying futures is to understand alternatives and the choices they pose. When we are little interest in the future or fail to plan for contingencies or desirable outcomes, events happen because of continuing trends or plans made by others. When the time/event draws near it is usually then too late to consider alternatives. But because the future remains open in so many ways and is not preordained, it is possible to work towards desirable outcomes. The futures' openness it worth studying.

Alternatives and choices are core concepts of the futures field. Alternatives refer to the array of possibilities or lines of development. Choices refer to the process of selecting from these possible scenarios. It follows that the wider the range of alternatives, the more choices there are. To make the creation or selection of possibilities possible the futures field has defined a number of useful concepts and techniques (Slaughter, 1995). For example, by developing a futures wheel for logging, a set of first, second and third level implications can be generated. A cross impact matrix could then be used to see how various predicted outcomes impact upon each other. From these deliberations various scenarios, possible, probable and desirable can be weighed up and choices made.

Planning and decision making are intimately connected with our hopes, dreams, fears and therefore effect out happiness and motivations. These perceptual aspects are not always considered in decision making that takes a rationalistic and particle view of a situation. This is the problem with economic rationalism, which discounts quality of life for efficiency.

Concepts, capacities, perceptions, tools and process can all be used to address a broad range of issues (energy supply in the future), themes (sustainability) and applications (futures in education).

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Implications for science learning

I think there are at least two important reasons why student images of the future and the futures field are essential learning in education and in particular science education. The first concerns developing skills in imaging and processing of images into dynamic action. This lack of skill in foresight and planning is described by Slaughter (1995) as a deficiency in our current way of operating. The central point of using foresight and teaching about futures is to show that everyone is involved; all are capable of pursuing ends and purposes which lead away from some outcomes and towards others (Slaughter, 1995, p. 127). The second is more directly related to science education. Aspects of student images of the future are often associated with technologies arising from scientific discoveries and frequently in destructive and dehumanising ways. Themes identified by students in their imaging include environmental concerns, social coherence (locally and globally) and technology. These are intimately related to science at the level of the technical but clearly involve moral and spiritual concerns as well. When science learning is divorced from humanitarian concerns we portray a positivistic and partial view which by neglect devalues much of student worldviews. As Munford (1970) has pointed out, of that which we value and gives richness to our lives 'only an infinitesimal part is visible or can be reduced to any mathematical order' (p. 54).

Exacerbating this reductionist view is the problem of a fragmented curriculum, as is evident particularly in the secondary curriculum where each curriculum area can only partially address issues that in the main are more holistic in nature. We only deal in depth with one or two dimensions of an issue and marginalise the others. The time dimension and in particular the futures part of this is rarely dealt with at all. The idea of holism and the seamless curriculum as vital for connecting valuable and authentic learning with students' total personality is a key issue for consideration when looking for a picture of education for the twenty first century.

Student images of the future clearly have implications for education. Hicks & Holden (1995) suggest that in the face of the prevalent fears students have of the future, it is becoming increasingly important to focus on people's images of preferred futures. 'If they can be elaborated and envisioned more clearly then perhaps they can provide the basis for creating a more just and sustainable future' (p. 51). Students do feel responsible as citizens for what happens although they are unclear on where to go and what to do. Aspects of the research already surveyed indicate that, in the main, students have been given few strategies for managing changes in their lives and planning in a systematic and conscious way for their personal futures.

The success of Western society is based on scientific knowledge and technical skill and for its continuity must rely on a sound science educational programme. Science and associated technologies have made life more materially comfortable than ever before in the history of the human species. It has also produced some of are most troublesome problems. Although science by itself is insufficient to solve these problems, it is necessary. Slaughter (1995) comments that science can 'only access a part of reality. It is 'silent on questions of value, purpose and meaning - the very questions now at stake' (p. xvii). I do not think that needs to be true for science education.

I have come to the position that in acquiring scientific knowledge in isolation will inevitably force the development of a limited, one sided, conscious mind, and repress the intuitive and 'other'.

Students' mental state is well understood as being relevant to learning but that their mental state may be directly connected to science content is not in general acknowledged or at least not explicitly addressed. Slaughter (1995) observes that

... the future in schools remains a missing dimension, a blank and largely empty space. This helps to explain why many young people feel anger and despair. At some level they instinctively know that the future is important. But on the whole, the messages they get from school, commerce and media are not helpful (p. 24).

What has become increasingly apparent to me is that in our time in particular we all need to learn more about ways of thinking about the future, and 'this is more important for children, who will find themselves living in a world in which change will be even more rapid and interrelated than now and who will, hence, have to learn future thinking from a very early age (Masini, 1993, p. 3).

The time dimension

I think the reason for a limited concern for the futures field has been the almost exclusive focus on conceptual learning. As a result, the time frame has been collapsed into a restricted present that not only limits our knowledge and the wisdom of our past but also possibilities, personal, community and global, for the future.

Our educational curriculum, and in particular science education, has developed from experiences and needs of the past and evolves with the intension of prepare for the future - yet it does not use the concepts, methods and techniques of the futures field. Slaughter (1995) points out that these 'have been taught explicitly in schools, colleges and universities for over twenty-five years', yet 'perhaps 99 per cent of the teaching profession worldwide are unaware of the fact of its significance' (p. 24).

To help me with this concern I use a framework which looks at the intersection of time and the social dimensions. This is illustrated in diagram form in Figure 2. The four quadrants I have named futures studies, histories studies, personal histories and personal futures.

Traditionally science programs come from the bottom - right section, although our courses do not usually have a strong historical flavour. What has been traditionally taught is a body of 'technical' ideas generated from three hundred years of science. In more resent times students' personal experiences and worldviews have become increasingly acknowledged as central to successful leaning and content is often connected to social issues and concerns. However, both the futures quadrants remain problematic in the sense of being explicitly examined.

Futures in science education

In terms of the time dimension, science learning has, in the main, existed in the present for student and employer needs in the present or an unexamined future. The nature of science as revealed by its history has been largely ignored and the place of science in planning for the future, tacit, token or taken for granted (Gough, 1988). This is not, I am sure the intention of our curriculum writers. If A statement on science for Australian schools is examined we find plenty of references to the future. It mentions the future on fourteen occasions, once with respect to scientific literacy, seven times with respect to further study and employment and six times with respect to learning something about the future. It also identifies concerns for the future as being part of the science study. For example; 'Australia's future depends on the wider community's appreciation and understanding of science' (p. 4). In the working scientifically strand we find,

Considering positive and negative personal, social, economic, technological and environmental implications of scientific knowledge and its uses; assessing the implications of uncertainty; analysing risk; evaluating social and environmental impact; acknowledging human responsibility for the effects of science; making decisions about their own use of science; exploring the uses of science in different workplaces and the prospect of careers in science (p. 17).

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This aspect of working scientifically can be considerable enhanced by the use of concepts, capacities, perceptions methods and processes identified as making up the futures field.

What now needs to be addressed is a curriculum framework in which the futures field can be embedded: the rational, the content and the methodology. This must, however be left for another tine.

In conclusion

A significant aspect, or even perhaps the central essence, of student worldviews is their image of, and expectations for the future. These are rarely elicited and even more rarely taken into account in the science education process. When they are elicited and a conscious effort is made to value and use them, they can be a powerful vehicle for authentic learning. That is, connecting learning to student understood needs, immediate and future.

On analysis of student's images of the future it becomes clear that they are holistic and inclusive of strongly held values, moral beliefs and the aesthetics as well as the conceptual. What is also clear is a strong emotional association with these images. Damasio (1994) talks about memories of the future and points out that,

Images of something that has not yet happened and that may in fact never come to pass are no different in nature from images you hold of something that already has happened. They constitute the memory of a possible future rather than of the past that was (p. 97).

What I have presented as individual crises in way of student expectations for the future I believe also reflects a crisis in society. Students of today as leaders in that future society will have to face significant challenges. Therefore, to make explicit the futures dimension is an imperative for both the psychological welfare of our students now and their success as proactive citizens of the future. Slaughter points out,

If individuals, groups and societies cannot envisage future states of affairs in which substantial improvements can be effected the present becomes that much harder to bear (Slaughter, 1988, p. 2).

It is my belief with Polak's (1973) that once students became conscious of creating images of the future, they became participants in the process of creating this future. The underlying purpose of studying and considering possible futures is to enrich our understanding and ability to act now, in the present (Slaughter, 1988). For the individual, the outcome is a quenching of existential fears and growth as world citizens.

I also conclude that we must accept much more of what students bring to the classroom by way of their worldview, and in particular their images of the future. Their worldviews are constructed from the emotional, aesthetic, spiritual as well as the rational and should not be excised from our science programs and pedagogy. 'The appeal of the image lies in its picture of a radically different world in another time' (Polak, 1973, p. 13), one that respects far more the dignity and sacredness of life.

The intersection of the two dimensions, the teleological and the social has provided a way of conceptualising a balanced, holistic, seamless curriculum and how science learning can be conceived within such a curriculum. It provides a framework within which to consider how a science curriculum can value the extent of both dimensions.

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Web sites

The Futures Study Centre*   http://www.futures.austbus.com/links.htm

The World Futures Studies Federation http://www.fbs.qut.edu.au/wfsf/wintro.htm

World Futures Society   http://www.wfs.org/

Futures Studies: http://www.eou.edu/ps/futurist.html

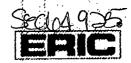Futureweb   http://www.cl.uh.edu/futureweb/

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