Title: Cultural resources of minority and marginalised students should be included in the school science curriculum.

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Abstract

This paper responds to Schademan (2009) "What Does Playing Cards Have to Do With Science? A Resources – Rich View of African American Young Men". Like Schademan, the response takes a resource-rich view to explore the notion of agency and elements of cultural resources that minority and marginalised students bring to the classroom. The paper examines the deficit model, the need to adopt capacity building perspective, and a classroom study, which sought to contextualise capacity building with a group of Australian indigenous students in a science class. As science educators, we need to reject the deficit model by developing capacity building pedagogies that affirm minority and marginalised students' lived languages, experiences and knowledge in their learning.

Introduction

This paper is a response to Alfred Schademan (2009), which presents an argument for teachers to adopt capacity building perspectives when working with minority and marginalised students in school science classrooms. I make the argument through a blend of theory, Schademan's insights and draw on my experiences and a vignette to represent the argument.

Reading Schademan reminded me of a recent conversation I had with a colleague about my school experience in a rural primary school in Zimbabwe. Here is an extract of dialogue I had with my colleague (C):

C: Growing up and learning in rural Zimbabwe, can you recall a day at school you will never forget?

Me: That was when I moved to a new village school in grade three more than thirty years ago. I remember it as if it was yesterday. I can still feel my brother shaking on my arm.

C: What happened that day?

Me: I was with my young brother who was starting school. When we approached the big imposing gate at the school, there was a huge man standing next to the gate and

waving a big stick. I can still recall his voice shouting: “You leave your village outside the gate! When you get through this gate you will speak in English! If I hear anyone speaking their village language they will be punished. We will teach you the ‘Queen’s language’ here”. I was very afraid that day, not for myself but for my brother, who was shaking on my arm. You see, at that stage of my schooling, I had acquired a few English words, perhaps about twenty or more, and my brother had not. I also had learnt that standing upright and saying, “Sorry, sir” or, “Thank you, sir” would get you out of trouble, even if you did not mean it from your heart. I had been taught in the village to say sorry to someone only if it comes from your heart. Reflecting back, of course, I never left my village outside the gate. I used my village knowledge and language in the classroom to think and negotiate into the ‘Queen’s language’.

It is imperative for teachers to acknowledge and value resources that students bring to the classroom. Schademan examines the resources related to science that African American young men learn and develop by playing a card game called Spades, a common cultural practice in African American communities that dates back to the Civil War Era. Schademan takes a resource-rich view of the players as they demonstrate proficiency at a number of dimensions of the game, including language use, strategic thinking, mathematics, memorizing and counting cards, predicting the cards to be played, and the consideration of multiple variables in decision-making. Schademan urges for science teachers to create culturally compatible pedagogies in their classrooms that support robust forms of learning for African American young men. Creating culturally empowering pedagogies can be achieved by helping students to use their existing cultural resources in new, productive and meaningful ways.

Like Schademan, I take a resource-rich view to explore the notion of agency and elements of cultural resources that minority and marginalised students bring to the classroom. I will illustrate that cultural resources are attributes students have, and resource-rich views are analytical tools that teachers need to develop to understand and reveal students’ rich cultural resources. I will also illustrate that cultural resources are tools that the students employ to engage with learning, and, according to Schademan, tools to combat deficit views, and provide “science educators and researchers with empirical findings to inform culturally affirming pedagogies that foster connections between student resources and practices central to science” (p. 8).

Cultural Resource-rich Views

Schademan employs a cultural, historical, activity, theory framework in order to place the resources of the Spades players within a larger historical and cultural context of African American experience with the game. Drawing from William Sewell's (1992) relationship between resources, agency and power, Schademan analyses the contextual features that affect resource use. Sewell (1992) defines agency as acts that occur when an individual brings resources learned in one context to bear upon another, and thus positions humans as active agents of change. According to Sewell, power occurs through acts of accessing and using resources learned through engagement in practices, in an attempt to further accumulate resources. Humans engage in acts of agency when they transpose resources learned in one context to another. Thus, contexts in which one's cultural resources are valued, recognized and legitimized are empowering, and contexts in which one's cultural resources are not valued, are unrecognized and marginalized or even forbidden, like the context my young brother encountered the day he started school, are dis-empowering.

My work attempts to distinguish the elements of minority and marginalised students' cultural resources, and explore how these elements can be used more productively in science classrooms. There is need to explore the elements of these cultural resources and how these elements can be employed to "combat deficit views" (Schademan, 2009, p. 8) and address capacity building perspectives.

I find it helpful to draw from Pierre Bourdieu's (1986) cultural sociology as a starting point to describe the contested aspects of concern to students when learning classroom science. Bourdieu's cultural sociology suggests that an individual's habitus and cultural capital informs their agency. Habitus refers to patterns of thought, behaviour, and taste created and formulated as a result of internalization of culture or objective social structures through the experience of an individual or group. Cultural capital is associated with culturally authorised attributes, skills and awards an individual acquires, which include knowledge and forms of language. Richard Jenkins (2002) observes that Bourdieu was characterising the concepts of habitus and cultural capital to communicate a theoretical stance, a certain way of looking at the world.

Beginning with the perspective that communities of minority and marginalised groups are places with multiple strengths, Tarra Yosso (2005) challenges Bourdieu's interpretation of cultural capital for these groups. Yosso conceptualises the notion of the capital of minority and marginalised groups as forms of community cultural

wealth, including aspirational, navigational, social, linguistic, familial and resistant capital nurtured within communities. The community cultural wealth and experiences of minority and marginalised students need to be acknowledged in the classroom. According to James Gee (2005), students' lived experiences are foundations for academic learning, and they must be recognised, respected and valued.

While I draw from Bourdieu, I have found it useful to explore the notion of 'cultural disposition' instead of habitus. Bourdieu's cultural sociology suggests that habitus is the site of interplay between structure and practice, and that while structure and practice can be observed directly, habitus can not. In this sense, habitus can be understood as a person's mental and inner processes formulated as a result of cultural disposition (Jenkins, 2002). This means, at a practical level, classroom teachers might not have the tools to access the students' habitus. It thus makes sense to me, as a classroom teacher, to explore the accessible cultural dispositions of students.

In my work, which explores the notion of agency and how indigenous students negotiate language and culture in science classrooms, my thinking reconciles Bourdieu's and Yosso's notions of capital, which I conceptualise as 'cultural resources' of the students. Barbara Rogoff (2003) suggests that human development occurs on at least three levels: personal, interpersonal and cultural/institutional, and that these three levels are inherently interwoven in all human activities. I will distinguish the interwoven elements of cultural resources (cultural disposition, community cultural wealth and cultural capital), which I propose inform the agency of students.

In my work, cultural disposition refers to a student's patterns of behaviour created as a result of cultural experience. This was the source of my anxiety the day my brother started school more than thirty years ago. Before that day, my brother had only experienced our village cultural habits, but was being asked to leave his village ways outside the gate. In Schademan's study, cultural disposition is highlighted through the marginalised position of African American young men, and cultural habits in their communities. Community cultural wealth refers to an array of cultural knowledge, skills, abilities and contacts possessed by a student's community. It is important to highlight at this point that the student is not expected to know or have acquired most of this community knowledge. In Schademan's study, this refers to buckets of knowledge systems in African American communities, including the "card game called Spades, a common cultural practice in African American communities

throughout the United States" (p. 1). Cultural capital refers to a student's acquired skills, awards, knowledge and forms of language. The day my brother started school, what he had acquired was our village language, and yet he was asked to speak in English. In Schademan's study, cultural capital refers to a number of dimensions of the Spades game African American young men have acquired, which include "language use, strategic thinking, mathematics, memorizing and counting cards, predicting the cards to be played, and the consideration of multiple variables in decision-making" (p. 1).

I find using the computer analogy helpful to illustrate and explain these elements of cultural resources, though it is much more complex than the computer analogy. Cultural disposition is like computer hardware. Community cultural wealth is like all the software in the computer. The software is in the computer, but an individual might not have acquired the skills to use the software. Cultural capital is like a handful of computer programs that an individual has learnt to use.

It is important to emphasize that these elements of cultural resources are interwoven (Rogoff, 2003) and expressed through language. Bourdieu's position is that language and culture are unthinkable without the other. According to Jenkins (2002, p. 152), "language cannot be analysed or understood in isolation from its cultural context and the social conditions of its production and reception". Donald Winford (2003, p. 35) reminds us that languages are not "merely systems of rules … they are also vehicles of social interaction and badges of social identity … shaped by socio-cultural forces". As such, my perception, even faith, in any language, including that of Standard Australian English, the language of formal education in Australia, is conditioned by social practice, social relationships and attendant ideologies.

It becomes imperative to pay particular attention to the student's language when learning school science. According to Lev Vygotsky (1978), the most important moment in child development is when the child begins to use language not only for social communication, but for controlling his or her own actions and cognitive processes. This means that language is used not only to communicate, but reflect, categorise and for other cognitive functions (Mirolli and Parisi, 2006). Thus a student's own language(s) comes to serve as their primary tool of manoeuvre when learning.

The Deficit Model

According to Schademan, taking a resource-rich or asset-based view of the Spades players challenges the "deficit views often held of African American young men and their historically poor academic performance in science" (p. 30). The deficit views blame the student, without looking at the learning environment or instructional practices (Biggs, 2003), and thus explains failure in terms of poor motivation, low interest and low ability levels of students. The focus is to criticise and pass judgment on the student. Biggs (2003) suggests in the deficit model, that knowledge is 'delivered' with little time for interaction and digestion of new ideas. The learning environments are teacher-centred and curriculum-driven, rather than student-centred and to promote student interaction and deeper understandings of the subject.

As an educator, I struggle with educational approaches that work from the assumption that minority and marginalised students come to the classroom with cultural "deficiencies" and "lack" necessary knowledge, social skills, abilities and cultural capital. Pauline Taylor (2005) writes that in Australia, indigenous students' place is built on historically derived social constructions of deficit and disadvantage that are replicated through policy implementation processes. The policy implementation processes based on the deficit model fail to acknowledge, legitimise and build upon the students' cultural resources (Boykin, 1994). These traditional approaches can be replaced by those that acknowledge and value the students' cultural resources.

Acknowledging and valuing elements of the cultural resources (cultural disposition, community cultural wealth and cultural capital) of the students becomes important, since contexts in which one's cultural resources are not valued are dis-empowering (Sewell, 1992). Like Sewell, Bourdieu, Boykin and Schademan, I suggest that these elements of cultural resources are tools that the students use to engage with learning science. John Smyth (2007) urges for educators to reject pedagogies that use deficit and token approaches by listening to and valuing the students' lived experiences. In my work, I conceptualise the deficit model as disregarding the three elements of cultural resources, and the token approach as valuing only one or two elements of the cultural resources.

In Australia the discourse used is that of "closing the gap" on both opportunity and academic achievement of indigenous students. At the opening of the 42nd

Australian National Parliament in early 2008, the then Prime Minister of Australia, Mr Kevin Rudd pledged to build new educational opportunities for indigenous students. Australia has been described as a "high quality – low equity" country in that Australian schools, while operating under high quality policy frameworks, have found it difficult to address equity issues in teaching, learning and assessment effectively in practice (Klenowski, 2009).

Geoff Masters (2009) reports Australian indigenous students from North Queensland perform among the lowest five per cent of students nationally. The report suggests that by grade 9, the 'gap' in achievement level of students in literacy, numeracy and science between non-indigenous Queensland students and indigenous students living in very remote parts of the state is, on average, equivalent to six to seven years of school. The report emphasizes that there are factors beyond remoteness underlying these 'achievement gaps', which include higher proportions of students from lower socio-economic backgrounds and higher proportions of indigenous students speaking English as a second or third language.

Australian indigenous people are either Aboriginals (found all across Australia) or Torres Strait Islanders (originating from North Queensland). Karen Martin (2007) notes that while there has been extinction of the majority of original indigenous languages since European settlement – the number has dropped from about 250 to between 50 and 60 – the remaining languages have survived as the first languages of communication within indigenous communities. Martin also notes that indigenous people have an elaborate sign language. Indigenous students from remote parts of the state of Queensland arrive at school speaking at least one home language and a Creole. If they do have command of Standard Australian English, it is usually as a second or third language.

Science curricula in Australia at both state and national level make little real concession to indigenous students' cultural resources. The new national science curriculum in its current draft iteration proposes that science knowledge refers to facts, concepts, principles, laws, theories and models that have been established by scientists over time. The Queensland Studies Authority website advises that it is currently developing a range of materials to support the inclusion of Australian indigenous perspectives into the school curriculum. Such materials can be integrated into existing curriculum, but the ontological structure of the

curriculum remains untroubled by this "inclusion" (Chigeza and Whitehouse, 2010).

In my opinion, inclusion of Australian indigenous ways of knowing into the structure of the science curriculum can be the first 'gap' that needs to be closed. Indeed, Schademan insightfully calls for spaces where marginalised students can "display their resources as well as exercise their agency" (p. 34) when learning science. The second 'gap' can be to improve classroom teachers' culturally affirming pedagogies that foster connections between students' cultural resources and practices central to science (Schademan, 2009). According to Robin McTaggart and Gina Curro (2009), Australian indigenous ways of knowing and languages awareness needs to permeate right through the Key Learning Areas, the curriculum in teacher education and educational research practice. I suggest that once these two 'gaps' are closed, then "closing the gap" on both opportunity and academic achievement of Australian indigenous students becomes easily achievable.

Capacity Building Perspective

In this section, I build on my work, my experience and Schademan's paper to illustrate why teachers need to adopt a capacity building perspective in science classrooms with minority and marginalised students. I argue that a capacity building perspective can empower minority and marginalised students by affirming their lived languages, experiences and knowledge in their learning.

Dawn Sutherland (2003) writes that when the idea of capacity building was introduced as a goal in development education, a multitude of policies that reflect people-centred approaches were created. The idea of capacity building, originally argued for by Paulo Freire (1970), is closely associated with programs in developing nations; hence the goal of capacity building recognises historically oppressive policies and seeks change.

Capacity building in science education links the concepts of science with the everyday lives of the students and their community (Sutherland, 2003), and cues teachers to identify the congruencies and incongruencies between school and home, and to create negotiated spaces through praxis. From a capacity building perspective, Deborah Eade (1997), emphasises that: 1) students' experiences and knowledge play a central role, 2) awareness learning, self esteem, and the capacity for political action are mutually reinforced, and 3) marginalised students have the right and the capacity

to organise and challenge authority in order to create learning environments that are not oppressive. Hence, a capacity building perspective, as a goal in science education, affirms the students' cultural resources.

A capacity building perspective shifts approaches to education from a deficit model or token approach to one of building existing capacity, where arrays of cultural knowledge, skills, abilities and contacts possessed by socially marginalised students are recognised and acknowledged. In my work, I suggest that a capacity building perspective should satisfy two conditions: 1) acknowledge and value all the three elements of cultural resources, and 2) use these elements of cultural resources as springboards to build the students' capacity. Schademan's study is an example of a capacity building perspective because it acknowledges and addresses the three elements of cultural resources.

Acknowledging and valuing the elements of cultural resources implies using the students' cultural disposition to inform pedagogy (in this case capacity building), community cultural wealth as context to situate learning experiences, and cultural capital as currency they use to make meaning. This position aligns with Schademan who argues for science pedagogies that provide agency to students by drawing upon their cultural resources in order to increase their feelings of empowerment. A capacity building perspective acknowledges the multiple strengths that minority and marginalised students bring to science classrooms, and serve the larger purpose of greater social and racial justice (Chigeza and Whitehouse, 2010).

Using the students' elements of cultural resources suggests an attempt to help the student negotiate from their: 1) cultural disposition to move towards a more scientific disposition, 2) community cultural wealth as contexts of experience to scientific contexts, and 3) acquired cultural capital to acquire scientific capital. As Jenkins (2002) insightfully puts it, Bourdieu's cultural sociology views agency and structure as dialectical – structure influences human action, and humans are capable of changing the social structures they inhabit. A significant finding in Schademan's study is that the Spades players use, learn and develop resources, such as the ability to make observations and draw inferences, that they can fall back on to inform future actions and decisions, including when learning science. In the next section, I will describe a classroom study, which sought to contextualise capacity building with a group of Australian indigenous students in a science class, to draw connections to Schademan's study.

A Classroom Study with Indigenous Students

For twenty years, I have been invited to quiet offices by school administrators and distanced researchers and given advice how to improve my science classroom practice with different groups of indigenous students from southern Africa and North Queensland. Every time I left these quiet offices, I could not help reflect how far the office was from my science classroom and how far removed the advice I had been given was from my science classroom experiences with indigenous students.

My classroom experiences with indigenous students are dynamic and interactive socio-cultural environments. These learning environments are shaped by the agency of indigenous students as they interact with each other, me, the science curriculum and material resources in ways that afford their agency while constraining what they can accomplish (Tobin, 2005). I recognise that indigenous students are active knowing beings. This has persuaded me to facilitate a more democratic and autonomous educational structure which reflect the students' agency acting in concerned, responsible and creative ways.

I draw on Bourdieu's cultural sociology for its agency - structure dialectical stance, and that theory and research are mutually implicated. Bourdieu's cultural sociology attempts to reconcile the notions of objectivism and subjectivism to transform them into a dialectical relationship between agency and structure in terms of habitus, cultural capital and cultural field. Students' agency both constructs their science world and is in turn conditioned by it: conditioned by not only the constraints of that world but also by the enabling power inherent in it (Webb, Schirato and Danaher, 2002). I take this agency - structure dialectical relationship as my practical and theoretical standpoint.

Indigenous students engage in acts of agency when they transpose their cultural resources from one context to another (Sewell, 1992). Thus indigenous students use their cultural resources to interact with classroom science organisational structures in a dialectical relationship, as they produce and reproduce science. The epistemological approach I argue for considers (westernised) school science knowledge in dialectical relationship with indigenous students' cultural knowledge systems, in a science classroom where the students engage with formalised science learning. I adopt this agency - structure dialectical standpoint to investigate how a group of indigenous Torres Strait Islander middle school students were socialised into

understanding school science curriculum, as a means for exploring their learning of physical science concepts.

My agency - structure dialectical standpoint aligns with Stephen Kemmis and Robin McTaggart's (2000) epistemological position on the nature of truth about practice in the human and social sciences. Kemmis and McTaggart perceive practice as reflexive and to be studied dialectically. Being reflexive meant I had to conduct research with conscious attention to the effects of my position, and dialectical meant I had to explore opposed and often contradictory, but mutually necessary aspects of human, social, and historical reality, in which each aspect helps to constitute the other. I also consciously explore my own journey as a science educator and field negotiator.

By adopting a reflexive dialectical perspective, I was able to investigate my practice from the perspective of the insider with other group members: forty four indigenous Torres Strait Islander year 9 students between 2007 and 2008 in a wholly indigenous school in Far North Queensland. The forty four students (twenty three girls: G1, G2... and G23) and (twenty one boys: B1, B2... and B21) come from the Torres Strait and Cape Districts in Far North Queensland and board in the school.The purpose of my study was to look beyond the rhetoric of the 'gap' in achievement, to explore how the group of students can best use their cultural resources to engage with science curriculum as a cultural field: how students employed everyday Creole and formal science language, participated in science activities, and applied and related to the science concepts of energy and force. I also explored how the structure of the mandated Queensland Studies Authority science curriculum learning outcomes enhanced or limited the agency of the students. I sought to affirm: 1) the cultural disposition of the students by adopting a capacity building perspective, 2) the students' community cultural wealth by situating learning contexts, and 3) the students' cultural capital by using individual student's acquired skills, knowledge and forms of language in the science classroom. I employed qualitative instruments to capture the students' socio-cultural interactions and science learning in the science classroom. Kemmis and McTaggart (2000) suggest classroom action research typically involves use of qualitative, interpretive modes of inquiry and data collection by teachers with a view to make judgements about how to improve their own practice.

What I Observed in the Classroom

In the science learning activities, I sought to facilitate the students to negotiate from their everyday cultural ways of talking, thinking, knowing and doing on the concepts of energy and force, to school science ways of talking, thinking, knowing and doing. A context I used to situate the learning activities on the topic of Heat transfer is the Kup Mauri, which is a traditional sand oven. This context attempted to use the students' cultural resources to transform the physical science subject matter, an idea which aligns with Schademan, who encourages educators to "build connections between student resources learned through cultural practice and those central to science" (p. 9).

When learning, the students were observed to talk and explain science to each other using a combination of direct action (gestures) and a variety of Creole languages. Only 7 students were proficient in Standard Australian English, and the majority of students struggled to understand science concepts as taught in English. However, when Creole terminology was used in the classroom, the students were better able to talk about science in ways they could not do in the official language of instruction.

Science learning using the Kup Mauri: A Kup Mauri is a shallow hole on the ground with a layer of smooth rocks. You set a wood fire to heat the layer of rocks to high temperatures. Heat energy transfers from the fire to the rocks. You wrap the food in coconut or banana leaves, or aluminium foil. Normally meat (e.g. pork) is put next to the hot rocks and vegetables at the top. In this learning activity, students used their community knowledge and languages to explore the concept of heat energy transfer including the rationale to cover the food with an insulating material (coconut or banana leaf, or aluminium foil) to explore how heat energy transfers through conduction and convection. Students investigated physical properties of traditional materials used and modern material substitutes and compared this traditional oven with the conventional ovens in terms of energy efficiencies. Extension activities were related to the thermal flask (how we keep our coffee warm).

Here is an extract of dialogue I had with four students (B1, B2, B3 & G1) learning about energy transfer with the Kup Mauri in March 2008:

> Me: Why do you put pork at the bottom and vegetables at the top?
> B1: Its more hot so you put pork, if you put vegetables it burns.
> Me: So we can learn about heat distribution in the Kup Mauri oven.
> B1: Mister we can learn science when cooking Kup Mauri, that's cool.

B3: No science is them big words, I hate them.
Me: Yes we can learn science when cooking Kup Mauri, and today we will use two science words: conduction and convection to describe how heat follows.
G1: My aunt say if you are slake and not cover the Kup Mauri the food burns. (students laugh)
B2: I was told that, why so mister?
Me: What do you think?
G1: Aunt says wind make food burn.
Me: What in the wind will make food burn?
B1: Aha! Oxygen mister, *Yupla* (you me fellows) that experiment, when you cover the fire stops and when you open you have fire.
Me: How can we test this?
[Conversation interrupted by Dean of Students entering room to make a sports announcement]

In my opinion, this conversation can imply that the students had started to realise that their traditional and everyday knowledge systems had an abundance of opportunities to explore an authentic scientific inquiry, able to generate authentic scientific knowledge. This idea is echoed by Schademan, who argues for science educators to expose the "relationships between forms of cognition that arise through cultural practice, and those that are central to disciplines like science" (p. 9). An argument emerges that science curriculum and pedagogical frameworks that embrace old and emerging dimensions of Australian indigenous students' cultures can enrich year 9 science learning in the same way western ways of knowing have enriched dimensions of indigenous culture.

With careful and creative thought, it is quite possible to position these indigenous students as knowledge creators capable of controlling their own learning. A conclusion from Schademan is the importance of attending to the contextual features that both invite in, and encourage the development of, marginalized youth resources in relation to science. I observed indigenous students may develop quite good understandings of the science concepts as discussed with each other and expressed in Creole language and direct action (gestures). The learning activity using the Kup Mauri has evidence of seven students with facility in English using Creole language substitute words and direct action to 'translate' the science instruction words for the benefit of students with limited to severe difficulty communicating in English. But unless these students are highly able to translate both language and concepts accurately into English, they are likely to be judged as attaining only "low" levels of academic achievement.

In the state, national and international assessment regimes, Standard Australian English is the language in which these indigenous students are expected to produce or reproduce scientific understanding and demonstrate their control of relevant genres, which may partially explain the standardised testing results discussed earlier. Indigenous middle school students learning science must accommodate and negotiate differentiated traditional knowledge systems, a number of languages, school science taught in English, and their own emerging youth cultures and dialects. Home language and Creole thinking students learning a westernised science curriculum in Standard Australian English must be outstanding field negotiators in order to be positioned as successful learners within formal education systems. In reality, only a small percentage of students are so adept and indigenous students who do succeed in these fiendishly difficult and complex negotiations are rarely fully appreciated for how skilled they are (Chigeza & Whitehouse, 2010).

What we can learn

Science curriculum and pedagogy that fail to recognise indigenous students' cultural resources can be dis-empowering. Such curriculum and pedagogy marginalise the indigenous students because they do not acknowledge and value their lived languages, experiences and knowledge in their learning, and do not adequately facilitate the students' negotiations from their vernacular language and cultural ways of knowing into science (Chigeza, 2008). As science educators, we need to address these deficit and token approaches by developing capacity building pedagogies that affirm the students' cultural resources in their learning.

According to Schademan, when students use their agency through the transposition of cultural resources in productive ways, they "make science their own" (p. 35). But, if minority and marginalised students' cultural resources continue to be ignored by educators, curriculum writers and policy makers in science learning, it can become problematic for these students to participate on an equal basis with their counterparts, whose cultural resources (e.g. styles of communicating knowledge) are part of the science curriculum. As science educators, we need to rethink science literacy and classroom discourse. We need to rethink how we can acknowledge and accommodate culturally different styles of communicating and representing the knowledge of indigenous students in our classrooms.

Communicating and representing the knowledge of indigenous peoples includes storytelling, ceremony, songs, ritual and sharing a diversity of languages and dialects – what Martin (2007) describes as multi-literacies. The resource-rich view can be an organisational tool that teachers can use to understand and reveal indigenous students' rich cultural resources. As educators, we can not continue to restrict science literacy to print-based forms of reading and writing, and deny indigenous students' socio-cultural, oral, gestural and spatial language dimensions.

A capacity building perspective can affirm these students' lived languages, experiences and knowledge in the science curriculum. Indeed, Schademan asks science educators to: 1) recognize the rich resources that students like the Spades players bring into our classrooms, 2) implement reform-based pedagogies that draw upon the scientific and cultural resources of the students, and 3), make classrooms dynamic places in which all students have a voice in creating change. I concur with Schademan that insights into these questions may provide a basis for creating empowering science pedagogies that legitimatise, rather than marginalise, the valuable cultural resources which these marginalised students bring into our classrooms, but which tend to go unrecognised in so many cases.

Conclusion

Minority and marginalised students need to explore connections between their cultural resources and the practices of science. Such pedagogies encourage these students to use their agency through the transposition of their cultural resources in productive ways. By doing so, Schademan believes that educators may take steps towards accomplishing culturally compatible classrooms, where marginalised students put their cultural resources to use in productive ways.

I suggest that a capacity building perspective can acknowledge and utilise cultural resources minority and marginalised students bring to the classroom. According to Gee (2005), students' culture, lived experiences and home language are foundations for academic learning and they must be recognised, respected and utilised to anchor abstract concepts. As science educators, how can we effectively develop capacity building perspective if we do not start where our students are, and walk the journey with those students? As science educators, we should acknowledge and utilise the culturally different styles of communicating and representing knowledge of all our students. Such an approach will enable minority and marginalised students to learn

and demonstrate their school science understandings in their well established cultural ways of being in the world.

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