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Embedding Aboriginal Perspectives and Knowledge in the Biology Curriculum: The Little Porky

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This paper reports on an Action Research project that investigated the integration of Aboriginal and Western knowledge into science learning in a Montessori classroom in regional Queensland, Australia. Drawing on the local knowledge of fauna of community members, the study explored the teaching of science to 12-year 8–9 students in an Aboriginal independent high school in Queensland. The overall study covered 83 lessons that included an initial Short-beaked echidna study. It applied thematic analysis to data to explore the effect of this integrated approach on students' pride in heritage, cultural knowledge, learning and the Linnaean zoology taxonomy. Results revealed that the contextualisation of Aboriginal and Western science knowledge strengthened students' Aboriginal personal identity as well as identities as science learners and status of local Aboriginal knowledge.

■ **Keywords:** Aboriginal learners, Aboriginal perspectives, biology, teaching, contextualised teaching and learning

For Aboriginal and Torres Strait Islander young people, social advantage and disadvantage and education success and failure are linked to the Australian education system (Kenway, 2013). Currently economic and social advantage equates with education success while economic and social disadvantage equates with educational failure. It is also predictive of the need for intervention to prevent low levels of academic performance. Aboriginal and Torres Strait Islander learners are among the most educationally vulnerable and disadvantaged people in Australia. Sarra (2012) argues that it is the inadequate response of educational institutions to the learning conditions of Aboriginal students that causes the disadvantages experienced by them. They have the right to access the curriculum, participate in learning and achieve success and advantages from education on the same basis as their Western counterparts. A high quality successful education is significant to a young person aspiring for an attainable quality of life.

The underperformance of Aboriginal students in zoology provided the purpose of the study: to investigate the teaching and learning of both zoology classificatory systems and, Aboriginal and Western views and understandings of nature. The study contended that access to learning science can engage and appeal to Indigenous students if rich connections between what students already know beyond the school classroom about science and the formal science curriculum can be made. This study also argues that with people's knowledge, the Western taxonomical Linnaean-based zoology classification can be integrated in sensitive ways into science programs at the high school.

This paper examines the science curriculum in Australia and its influence on secondary Indigenous students from one school in Queensland. It provides a review of the literature focusing on Linnaean system of zoology, science curricula, embedding Indigenous knowledge, theoretical framework informing the study, methodology, analysis and discussion.

Literature Review

Access to education is crucial to an individual's potential to achieve a reasonable quality of life. The following

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review discusses several important issues related to Indigenous education and science including Linnaean system of zoology, science curriculum, Aboriginal knowledge in the science curriculum, culturally responsive pedagogies, communicating cultural understandings in science and cultural border crossing.

Linnaean System of Zoology

The Linnaean system of zoology nomenclature provides a framework for communicating information on biological classifications (Schuh, 2003). It has been used and adapted by Western biologists for 250 years. The zoology classification system that scientists use today is based on Linnaeus' arrangement and despite changes over time, 'Linnaeus is still honored for having first enunciated modern taxonomic principles' (Clary & Wandersee, 2013, p. 33). 'Inherent in the Linnaean system is the indication of hierarchical relationships' (Schuh, 2003, p. 59) to include kingdom, phylum, class, order, family, genus and species. 'Under the current system of codes, it is now applied to more than 2 million species of organisms' (Clary & Wandersee, 2013, p. 18). Species names are based on Latin, Greek or, nowadays, Latinised English. Linnaeus introduced the *binomen*, or 'Latin name' system (Clary & Wandersee, 2013). As such, 'names have meaning only when those who use them jointly understand the concepts attached to them' (Schuh, 2003, p. 60). When it is not understood, the very act of teaching students about the Linnaean system may inadvertently work to exclude them because the concepts and names are foreign and do not make sense nor do they come from a meaningful context. However, this does not mean that it cannot be studied in the secondary science curriculum.

Science Curricula

Science curricula mainly based on Western worldviews has been shown to be inadequate for supporting Indigenous people worldwide (Aikenhead, 2006). The customary and predominant Euro-American worldviews do not present secondary students with the cultural knowledge and rich experiences from Indigenous students' backgrounds and environments. Alternative views on science and zoology taxonomy have been found to be limited or excluded from curricula. Indeed, in Australia, Aboriginal worldviews about science, more specifically zoology, are not sufficiently represented in the mandatory Australian science curriculum. The science curricula largely depict mainstream cultural worldviews to the detriment of students from other cultural backgrounds, particularly Aboriginal students.

Aboriginal Knowledge: Embedding into the Science Curriculum

Aikenhead and Michell (2011) claim that 'ways of knowing nature are also known as Indigenous knowledge, Aboriginal knowledge, Aboriginal science, Indigenous science, Traditional knowledge, Traditional ecological knowledge, Native science, and so on' (p. 3). Battiste and Henderson (2000) defined Aboriginal knowledge as 'highly localized and social. Its focus is the web of relationships between humans, animals, plants, natural forces, spirits, and landforms in a particular locality, as opposed to the discovery of universal laws' (p. 44). According to Langton and Nakata (2007), there is an 'increasing global recognition of Indigenous knowledge as distinct, legitimate, valuable and vulnerable systems of knowledge' (p. 15). In this paper, Koora (pseudonym) Local Aboriginal Knowledge (KLAK) relates to the accumulated experience of community members, the local names, the hunter's knowledge of Koora animals, the local animal lexicon and the local knowledge of the surrounding bush that is unique to Koora.

Culturally Responsive Pedagogies

Embedding Aboriginal knowledge into the science curriculum and engaging students requires culturally responsive pedagogies that include local people and place. The place Koora refers to shifting the focus from 'teaching about local culture to teaching through the culture as students learn about the immediate places they inhabit and their connection to the larger world within which they will make a life for themselves' (Barnhardt & Kawagley, 2008, p. 113). Such an interrelationship is critical if Western teachers and schools want better outcomes for their Aboriginal students. The literature suggests two approaches for teaching science to Aboriginal students: (a) cultural understandings communicated through language and (b) the concept of border crossing. However, there seems to be still considerable debate among science educators about 'how best to create authentic learning experiences that combine Indigenous and Western science knowledges' (Sutherland & Swayze, 2013, p. 179).

Communicating Cultural Understandings in Science

Some educators valorise the communication of cultural understandings through language and argue that a pedagogically sound science program must use local language in order to incorporate Aboriginal understanding (Sutherland & Swayze, 2013). McKinley's (2005) work in New Zealand with Māori children argues that programs taught through Indigenous languages enable Indigenous knowledge systems to thrive, establishing 'a dialectal relationship between language and knowledge ... that continues to act as the wellspring' (p. 227). The task for science teachers is to identify and come to learn about ways of communicating that are inclusive of students' home language and provide them with an entry point into learning.

Cultural Border Crossing

Border crossing was advanced initially by Giroux (1992). He used this term to describe how individuals move from one culture to the next. Aikenhead (1996, 2001)

expanded this work further as a mechanism for assisting science teachers balance Western and Aboriginal science. He described this move or transition between students' life-world experiences and school science experiences as a *cultural border crossing*. Cajete (2008) explains that without border crossing, there are frequent science classroom conflicts with the teaching and learning of Aboriginal children. The result is assimilation when we force 'students to abandon or marginalize their way of knowing to reconstruct a new (generally dysfunctional) way of knowing. Unfortunately, the latter is more often the case' (p. 491). Aikenhead (2006) describes the border crossing process to help teachers construct culturally responsive cross-cultural science units. He describes the effective culture-brokering teacher as one who 'clearly identifies the border to be crossed, guides students back and forth across that border, and helps them negotiate cultural conflicts that may arise' (p. 235). Michie's (2011) border classification distinguishes between those who are successful and those who are not, as well as discriminating the degree of involvement. He claims that not all teachers are necessarily interested in or aware of their role in this border crossing process (or transition from developing local and known Aboriginal context to the often Western unknown ways of viewing nature).

'The alienation felt by many students toward science and mathematics is attributable to the fact that these students perceive a lacuna or chasm between their daily life experiences or 'life-world' and the classroom experiences they encounter as they step into the world of school science and mathematics' (Ezeife, 2003, p. 326). Aikenhead and Jegede (1999) claim that students from both Aboriginal and Western cultures share this feeling of 'foreignness' towards science subjects because of the difficulties they encounter in making the transition from their life-world culture into the mainstream subculture of science. Teachers are able to support students to be comfortable living both-ways (two-way learning). The *Melbourne Declaration on Educational Goals for Young Australians* (Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA], 2008) encourages a two-way learning for Aboriginal students: 'Australian schooling needs to engage Indigenous students, their families and communities in all aspects of schooling' (p. 15). In this Koora study, a culturally responsive teaching and learning program of science involved the local people, the families, students and KLAK to which the Western scientific knowledge could relate without distorting that Aboriginal worldview.

Theoretical Frameworks

The study was guided by two theoretical frameworks: (a) an Indigenist research framework that allowed a two-way approach to teaching and learning to flourish, and (b) the Montessori teaching and learning principles.

Indigenist Research Framework

The Indigenist research framework used in this study allowed for the production of real collaboration and genuine partnerships between Aboriginal people, students, and local knowledge. There are three principles informing this framework, (a) resistance as the emancipatory imperative, (b) political integrity, and (c) privileging Aboriginal voice.

Resistance as the Emancipatory Imperative

According to Rigney (1999, p. 116) 'Indigenist research is research undertaken as part of the struggle of Indigenous Australians for recognition for self-determination'. This framework emerged from 'the long history of oppression of Indigenous Australians which began after the invasion of Australia in 1788'. In terms of Koora, the research site, an Indigenist research framework represents a struggle for self-determination that draws on the past subjugation of the local Koora people since early settlement. It seeks to concretely address how local Aboriginal people in partnerships with the Western Linnaean zoology curriculum can work towards improving educational outcomes of students.

Political Integrity

In regard to the research contributions of non-Aboriginal Australians to the political struggle of Aboriginal people, Rigney (1999) claims that for Aboriginal people, it is:

> inappropriate that the research contribution to the political cause should come solely from non-Indigenous Australians. Indigenous Australians have to set their own political agenda for liberation.... research ... must be undertaken by Indigenous Australians.... Only in this way can research responsibly serve and inform the political liberation struggle. (p. 117)

Rigney does not discourage research by Western people in Aboriginal communities but insists that 'Indigenist research is research by Indigenous Australians which takes the research into the heart of the Indigenous struggle. In doing so, it makes the researcher responsible to the Indigenous communities and their struggle' (p. 117).

Privileging Aboriginal Voices

Rigney (1999) privileges the voices of local Aboriginal people and claims that 'Indigenist research... focuses on the lived, historical experiences, ideas, traditions, dreams, interests, aspirations and struggles of Indigenous Australians. It is Indigenous Australians who are the primary subjects of Indigenist research' (p. 117). In the Koora study, the discussion circles, the little Porky (*Tachyglossus aculeatus*, Short-beaked echidna) hunting and collection of local animal stories are about being part of the local Aboriginal family and who they belong to. In this study, Elders, Bolinga High School (BHS) Aboriginal staff and student participants are all agents of transmission of Aboriginal

culture because their voices were privileged in the science classroom and out bush.

The Montessori Framework

The virtues of the Montessori humanistic culture are defined in Maria Montessori's voluminous writings, which elaborate a holistic worldview centred on concentration, coordination, order, independence, respect and are student-centred (Cossentino, 2005). Lee (2008) explains that a decentralised role of the teacher is essential, that is, the Montessori Method requires pedagogues to question how they may be able to serve each individual child. Montessori is usually considered a pedagogical framework because of its focus on catering for individual needs of all students and an emphasis on teaching and learning practices that are allied to self-identity enhancement or formation (socio-cultural constructivist theory of learning). Moreover, the Montessori method is considered a theoretical framework as such because of its philosophical stance and holistic theory based on students' social, emotional, intellectual and spiritual work construction.

The Montessori Method advocates three stages to bridge the learning in order to teach content: (a) First Stage: The association of the sense perceptions with names, (b) Second Stage: The recognition of the object corresponding to the name and (c) Third Stage: Remembrance of the name corresponding to the object (Montessori, 1967, pp. 156–158). De Los Santos (1989) synthesises the three steps in this fashion: (a) 'This is . . . ' – the teacher introduces a concept, an object or a card by giving the child the exact terminology; (b) 'Find or point to . . . ' – when the child has successfully accomplished this task, the teacher enters the third step; and (c) 'What is this?' – the third step is used only when the teacher thinks the student can answer successfully. For example, the teacher would present around three to five picture labels, depending on the age of the students or their ability and also depending on the difficulty of the concept introduced. The three steps may be accomplished in one sitting or over the course of several sittings depending on the complexity of what is being presented.

The Montessori Method is place-based, that is, the non-Aboriginal teacher uses the Montessori principles to present materials and new information while being guided by local Aboriginal culture as to what to present to help students acquire the knowledge, skills and understanding that will help them become successful members of their culture and community. In other words, during the First Stage, Elders demonstrated how to successfully conduct local hunting; *this is* how Elders hunt the Porky; knowledge of the local terrain, when to, the tools required, asking permission to ancestors and so on. The Second Stage: I can hear the Elders saying to students: ≪*show me* how you do it now≫ while the students reply: ≪Is this how we do it Uncle?≫ Students actively participated in the hunting process alongside Elders; also Porky investigation and articulation of its skeleton. The Third Stage: living local Porky customs and an expected 'give back' moment after interactions with Elders and BHS Aboriginal staff (tell me what it is); enacting local views and understanding of nature via the Porky and its stories. Montessori-based teaching and learning approach gives Aboriginal students the opportunity to begin with what is familiar or what is part of a Queensland Aboriginal community place-based adolescent culture and relates the introduced non-Aboriginal information to that culture.

Methodology

Creswell (2015) defines action research designs as systematic procedures done by teachers to gather information and 'improve the practice of education by studying issues or problems they face' (p. 579). Teachers reflect on these initial concerns and 'collect and analyse data, and implement changes based on their findings' (Creswell, 2015, p. 579). Action research was the selected methodological approach and provided the basis for the analysis and methods used in the study. Kemmis and McTaggart (2000) describe action research as a methodology used by practitioners to improve their practice by studying the relationship between their teaching practices and the learning behaviours of their participants. They contend that action research best happens by spiralling through a four-step cycle of planning, acting, observing/collecting and reflecting/reviewing (and then revising the plan for another cycle). Creswell (2005) states that 'the action researcher weighs different solutions to his problems and learns from testing ideas' (p. 560) and spirals back and forth between reflection about a problem, data collection and action.

Research Context: Bolinga High School (BHS)

The research site is an independent Aboriginal high school in a remote Queensland community of approximately one thousand inhabitants. BHS was inaugurated on the 11th of August 1984 (BHS unpublished document 'prepared for the blessing of the school', 1984). The student population at BHS was composed of 100% Aboriginal enrolment led by five Western teachers (from 2004 until my departure in 2012). BHS is unique because the high school is a council run educational facility and a co-educational, non-denominational Aboriginal community school. It is an independent Aboriginal secondary school provided by the Bolinga Aboriginal Corporation for Education. BHS student population fluctuates from year to year and from the school enrolment, as of February 2007, the total BHS student population for the State Government Census for non-State schools was 97. A total average of 59% attendance was recorded in 2008 with 91 enrolments, 67% attendance in 2009 with again 91 enrolments, and 65% attendance in 2010 with 96 enrolments (Courier Mail, 2011).

Participant Selection

The study involved Aboriginal participants relating to each other and greatly influencing one another because of kinship and because they all belonged to the Queensland Aboriginal family. There were three sets of participants: (a) 12 Aboriginal students who volunteered to participate, all living locally in Koora and aged between 13 and 15 years old (six males and six females), (b) Elders and community members and (c) seven gatekeepers (seven Aboriginal BHS staff: two School Liaison Officers, two Aboriginal Education Workers or teacher-assistants, two Administrative Staff and one Culture Teacher). According to Creswell (2015), 'gatekeepers are individuals who have an official or unofficial role at the site, provide entrance to a site, help researchers locate people, and assist in the identification of places to study' (p. 617). The seven Koora gatekeepers were the '*Keepers of the Flame – the Culture Makers*'.

Data Collection Strategies

In this study, two important data collection techniques were used: the classroom observations with Porky lessons and semi-structured interviews for the collection of local animal stories.

Classroom Observations

Observations were considered an important data collection method in the study. Creswell (2005) contends that observation is a 'process of gathering open-ended, first-hand information by observing people and places at a research site' (p. 211). He argues that observation is an advantage when studying individuals who have difficulty verbalising their ideas. Observations were paramount to the action research animal study in order to individually support student participants' understanding of the Porky vertebrate concept and animal stories.

Semi-structured Interviews

The students asked Elders open-ended questions during discussion circles, in order for them to best voice their Koora animal experiences. Chilisa (2012) uses the expression 'talking circles' instead of 'discussion circles' and states that these bring people together in a quiet, respectful manner for the purpose of teaching listening and sharing (speak from the mind and from the heart). Creswell (2005) describes the use of qualitative interviews when researchers 'ask one or more participants general, open-ended questions and record their answers' (p. 214). The interviews did restrict the views of participants and they helped us, BHS staff and I, to embed local Aboriginal perspectives into the biology curriculum. We endeavoured to develop science lessons that gravitated around local fauna always privileging local Aboriginal voice.

Steps to Analysis

Liamputtong (2013) describes a common type of analysis in qualitative research called thematic analysis. 'It is a method for identifying, analysing and reporting patterns (themes) within the data' (Liamputtong, 2013, p. 249). It is perceived as a foundational method for qualitative analysis. Thematic analysis entails searching data sets to identify themes and patterns of meaning (Braun & Clarke, 2006). Liamputtong (2009) suggests: (a) reading through each transcript and trying to make sense of the interview data or classroom observations, (b) examining the transcripts or field notes and making sense of what is being said by the participants as a group, and (c) searching across the data set to find repeated patterns of meaning.

Coding in qualitative data analysis is critical and a five-step process is recommended in the literature for thematic analysis: (1) coding: tagging chunks of data with a label and name, (2) looking for meaning and interesting points, (3) rereading the data, naming codes and making notes about themes that emerge, (4) reviewing and grouping the recurring themes, and (5) looking for tentative concepts and viewing possible linkages relating to existing literature and theoretical frameworks.

Ethics

Ethics approval to conduct this study was granted by the Queensland University of Technology Human Research Ethics Committee. Participant consent was sought in written form using university ethics approved participant information and consent forms.

What Happened? Embedding Aboriginal Perspectives (klak) and Western Linnaean Heritage

Genuine acknowledgement and respect of Indigenous cultures is a necessary step which ensures culturally inclusive and equitable practices and opportunities for Aboriginal and Torres Strait Islander peoples within education in Australia. The analysis and interpretation of data provides explanations about the issues in science education in one secondary school. It draws on data from participants and provides important qualitative insights into science education for the students who participated in the study.

Integrating Linnaean System of Zoology and Aboriginal Science Knowledge

To provide a context for the focus of this paper, a Porky hunting party composed of secondary students, Aboriginal school staff and myself, the researcher, were initially created as way of bringing people together to learn about local Aboriginal perspectives pertaining to Porkys and to consider this learning could be

embedded in the zoology curriculum. The Porky hunting heritage was used as a springboard for the students to study more zoology and as a teaching moment. This approach was recommended by the Aboriginal staff at the school.

The lessons for learning about the vertebrate concept (in particular the Porky) were: (a) lessons leading to the articulation of the Porky skeleton, and (b) one lesson about defining the concept *Vertebrata* aimed at highlighting the Porky's spine. The Porky focus was divided into three sections and reviewed with the group. I led this revision.

(1) Section A: Cooking the Porky,
(2) Section B: Preliminary lessons with Porky bones, and
(3) Section C: The actual articulation of the Porky skeleton.

Section A: Cooking the Porky

The Porky's meat was first cooked and delicately divided into meat and bone trays.

Section B: Preliminary Lessons with Porky Bones Contained Three Tasks

A brief presentation of scientific equipment required to mount a Porky skeleton was deemed necessary in order to entice participants to engage in the Porky articulation lessons. A Porky stand made out of local bloodwood (a dark red Eucalyptus species native to Australia and plentiful in the region) was presented to students. The next lesson, *Echidna Skeleton Colour Me,* was optional. The student participants named and coloured the Porky bones using a legend for the common skeletal names. The participants were also exposed to the possibility of exploring scientific names as extension work, if willing to be challenged. The third lesson, *Label the unlabelled Porky Chart* (optional), used 21 individual loose labels of the same common (and scientific) Porky bone names.

Section C: The Actual Articulating of the Porky Skeleton Contained Three Lessons

Fourteen labelled Porky bone bags were prepared containing the 'uncleaned' Porky bones. Participants selected their preferred bags, cleaned and worked relentlessly in pairs or individually at the back of the classroom under supervision. In the following Porky bone lessons, adolescent participants weighed (grams), measured (millimetres and centimetres) and recorded values on a template while reviewing common and/or scientific names. They were then invited to articulate the Porky skeleton. Finally, the hands-on nature of this experience with the Porky bones helped us elaborate a definition of the vertebrate concept by defining the Porky's family in Aboriginal and Western terms.

Discussion and Analysis

All participants selected the *Echidna Skeleton Colour Me* activity format. An explanation on how to use the legend, the charts containing common and scientific bone names and the selection of colours resulted in a slow introduction. However, once the participants knew how the charts operated, it was pretty much self-explanatory and enjoyable.

Label the unlabelled Porky Chart with accompanying loose name labels of all common and scientific names (word reading activity) had little possibilities of failure because of the control chart (labelled chart) available to students. Also, there were some easier name labels that the participants could read to initiate the activity such as toe bones, rib cage, neck bones, tail bones and ankle bones. This was important to pass the message around that this activity was safe! All participants experienced difficulties with two of the twenty-one labels: locating the outer front and inner front leg bones. Not one student selected the scientific loose name labels of the Porky skeleton; however, students appeared to have enjoyed challenging themselves with the common names.

Bones were soaked in chemical solutions, for a few minutes each time, to help separate the meat from the bones. After the arduous initial work of removing as much meat as possible, some bones were still fused together with minute cartilage, even after two weeks of delicate brushing.

The optional lesson weighing and measuring of cleaned Porky bones was facilitated at two tables where measuring scales and bone bags were freely left available to participants and each student completed the exercise in their own time. In regard to the actual articulation of Porky skeleton, and during one of the many discussion circles, the Culture Teacher asked participants in a puzzled way 'Where do we start?' He wanted participants to sort this problem out and find appropriate reasons for their choices. The students' excellent eye/hand control and coordination and their skills in handling the diminutive drill and bones were astonishing for first timers. All participants calmly and methodically experimented with this material and they drilled microscopic holes on each of the individual bones to pass wire through and tied the bones together. After two days, all bones were secured to the bloodwood stand and putty was placed on strategic locations as reinforcement.

At the end of this process, participants sat in a circle and the articulated Porky placed on a red velvet mat, representing the blood of the vertebrates. The participants brainstormed potential names for the Porky family, for example: *black and white* (in terms of quills, underbelly, fur), *small bones, bent spine, the wriggly spine, the big head and the long tongue.* In regard to the Western explanation of the Porky family, I directed participants' attention by pointing to the Porky's back. Participants were invited to listen to Western zoology lexicon associated with the

concept of vertebrates: *flexibility/flexible and inflexibility-inflexible, stiff, spinal cord, vertebra and vertebrae.* I stated: 'the word scientists use is vertebrates/Latin *Vertebrata* for animals with inside bones because of tiny little vertebra, one after another, like here', pointing to the Porky spine again, further stating that 'vertebrae are all of these little rings of bones making up the spine'. Enlarged colourful photos of various local mammals' vertebrae could have better supported the circled discussion. Students also commented on collecting kangaroo or Brahman cow's vertebrae/vertebra regularly discovered in the Koora vicinity.

Positives and Challenges with Embedding Aboriginal Knowledges to Learn About Linnaean System

The successful contributing factors were our attitude and a prior positive relationship with the students as well as offering tactile and visual means of development via Porky articulation skills. Positives included the gatekeepers and their considerations while facing cultural complexities before any possible articulation of a Porky. This exemplified the enactment of Indigenist research framework and privileged Aboriginal voices of local people during discussion circles. The gatekeepers and students foresaw five Porky options. The third option below was the selected one as the sensitive issue of Porky 'totem' was considered:

(1) We cook the Porky and no one eats it to avoid crunching into the bones, though it is usually part of the ritual or celebrations.

(2) The students eat the Porky meat. In other words, some bones could be lost.

(3) The students eat the Porky meat if they wish to [Porky totem consideration]; however, a Porky Master Chef slices the meat and separates it from the bones in two trays.

(4) The students dissect the meat and gather all the bones together after consumption. This option means that in case of bone missing disaster, we have to search for another Porky. However, due to the time restraint, this is not an option.

(5) We catch a Porky and bury it in the soil so the ants can get to it. In three weeks' time, we go back to collect the skeleton. It must be deep enough so the Wedge-tailed eagles do not get to it.

Overall, the Porky articulation of its skeleton saw many other positives: respect for science equipment, participants' determination, excitement, dexterity, concentration for extended periods of time and fostered an admiration for the minute skeletal system (students comparing the Porky with human bones).

Freedom and repetition were other positive elements contained in all lessons and this strengthened the students' zoology knowledge: (a) naming of all scientific equipment (kidney basin, scalpel, the names of the chemicals used to clean bones, etc.); (b) reviewing regularly and purposefully the same common/scientific names of Porky bones when cleaning the bones; (c) colouring bones of the Porky skeleton/Echidna *Colour Me* legend; (d) placing the loose name labels on the unlabelled Porky chart; (e) measuring and weighing the Porky bones, and (f) articulating the Porky skeleton. The repetitive nature of the Porky lessons enticed the participants toward task completion because everyone succeeded by working individually or with a friend. The participants were allowed the freedom to select the activities and work with whomever they wanted.

Finally, attention to details meant a beautiful prepared environment such as a wooden base for the Porky skeleton made with local *Bloodwood* species, all varnished with natural oil, and wood burned with decorative designs (Figure 1a). A positive environment presented an enticing teaching site and the equipment ready to use and clearly laid out. For instance, just enough materials, that is, just a few cleaning instruments or few words on an instruction card. The following pictures below explain these notions. The aim was for the students to complete the task, to strengthen their concentration, to raise their self-esteem, to succeed, to acknowledge the cultural value of the small Porky and focus on the vertebrate concept.

I witnessed two Porky articulation challenges related to language. The largest challenge of all was the abundant Western lexicon that often clogged up the teaching site. The challenging lexicon vocabulary like kidney basin, scalpel, vertebra, vertebrae, vertebrate, vertebrates, *Vertebrata*, *Invertebrata*, invertebrates, overwhelmed and distracted the participants at times. Striking a balance was always a constant pedagogical challenge.

Another considerable challenge was that the participants were not overtly attracted to using the foreign scientific Porky bone names and not one of them reviewed the scientific name labelling of bones on all activities. The Western Latin challenge ahead was therefore considerable, such as kingdom, Phyla, sub-Phyla, classes and orders of the vertebrates (*T. Aculeatus*, Monotremata, monotreme, Short-beaked echidna, Porky). The scientific names quickly needed to become approachable, attractive, relevant and contemporary for local students.

Walking on the Cultural Bridge: Cultural Border Crossing and Interface Lessons

The Porky hunting and articulation of the skeleton highlighted a passage on the cultural border crossing between Aboriginal and Western views and understanding of nature. This work followed an extensive procedure and time consuming, yet a very valuable cultural process of acknowledging a local iconic figure with interface lessons. Embedding the Porky in the biology taxonomical curriculum meant that the sequence of work travelled from hunting and cooking the monotreme, naming, cleaning,

Porky bones bagged and labelled.

Student cleaning porky "cranium".

Enticingly prepared porky lab environment.

Porky articulation of the skeleton process.

FIGURE 1a

(Colour online) Porky articulation: beautiful environment.

weighing and measuring Porky bones, articulating the Porky, then defining the Porky family in the students' own terms first, then in Western terms. A terrific extension of learning occurred where gatekeepers, students, KLAK and Western knowledge walked hand in hand on the cultural border bridge.

The Porky lessons followed a continuum extending participants a little further each time or looking at a different perspective of the vertebrate concept. Each lesson built up on the previous one and prepared the terrain for something to come in the future (recording local animal narratives from Elders with an animal classificatory purpose in mind, not discussed here in this article). This data was converted into animal classificatory materials. Embedding the Porky in the biology curriculum lead the Aboriginal adolescent students toward the unknown Western Linnaean zoological charts constructed with vertebrates extracted from local Koora animal stories. Therefore, the Porky articulation of its skeleton and the localised animal narrative materials not only served as an engaging hook but it became the basis for the construction of a *First Classification of Animal Kingdom* charts from the non-Aboriginal animal knowledge tradition. Name and picture loose labels were presented for students to reconstruct the pyramidal Linnaean zoology taxonomical system.

Integration and Culture and Cultural Border Crossing

The lesson observations demonstrated integration and culture (theme 1) as well as integration of local people (theme 2) into the Koora animal program. *Integration and culture* was understood in this study as a genuine integration of Koora animal views and Western Linnaean heritage. KLAK referred to a social, emotional, intellectual and spiritual knowledge tradition whereas Eurocentric or Western Knowledge (EK) was uniquely intellectual. Embedding Aboriginal perspectives into the biology curriculum meant collaboration between KLAK and EK so both were equally celebrated in the zoology program. A series of keystone lessons (Porky and animal narratives) considered this remote Queensland Aboriginal community. Figure 1b exemplifies the little Porky with a leading role, followed by local narratives and then Linnaeus' taxonomical system on the cross-cultural border bridge (photo of Carl von Linné: Roslin, 1775).

FIGURE 1b
(Colour online) Walking on the bridge: Porky and narratives interface lessons.

The *integration of culture* signified that the Porky series of lessons, the Koora customs, the local Aboriginal identity and beliefs were honoured during the zoology lessons via privileging local Aboriginal voice. Gatekeepers decided how animal study and classification should be approached at school with Aboriginal adolescent students. Regular discussion circles were conducted with gatekeepers to assure proper integration of local knowledge tradition. This was a partnership in terms of two-way learning and teaching between the Western teacher and the Koora community members therefore, indeed a cooperative effort with local epistemologies (ways of knowing), ontologies (ways of being) and axiologies (ways of doing).

Integration and culture and the injection of the local iconic Porky enticed the students to participate in a customised science program that naturalised KLAK into the pedagogy and the curriculum. Authentic teaching meant that the students' everyday reality and experiences were always at the forefront while using the social, local and friendly Koora materials.

Implication 1 of Embedding KLAK in the Biology Curriculum: Aboriginal Porky and Western Textbooks

The main implication of embedding KLAK in the lessons is that science is not only found in Western textbooks, which do not usually include the cultural beliefs of the Aboriginal worldviews or for instance, the everyday Porky experiences and the knowledge of Koora Elders. The Aboriginal textbook can be read and interpreted by Elders and is the book of life, the book of the land, plants, animals and waterways (Uncle Wallace). Michie (2002) claims that 'the aim of the science curriculum should be to promote consideration of the differing worldviews, not solely to enrich Western science but to facilitate a two-way exchange of knowledge and of cultural understanding' (p. 37). Therefore, the curriculum should promote both textbooks. The significance of a balanced education was that Aboriginal science offered an additional rich and authentic perspective on nature. The two-way approach to teaching and learning helped Aboriginal students develop an understanding of other cultures, as a step towards slowly breaking down negative stereotypes against Western science. The localised zoology program gave Aboriginal students the necessary linkage or anchorage between their family day-to-day life experiences and science learning in schools (McKinley, 1996) as the Porky and local narrative lessons were webbed into the new curriculum. The Aboriginal students in Koora now possess two perspectives, two textbooks and two understandings on nature rather than a single Linnaean one, like most students in Australia.

Science is to be found inside two textbooks. Experts in the field of Aboriginal education favour a balanced two-way program in schools. McGregor (2000) among others recommends the co-existence model to engage participants (Aikenhead & Michell, 2011; Nashon & Anderson, 2012; Ober & Bat, 2007). In this regard, Trounson (2011) reported Nakata's words as he defined a culturally responsive program as one that must not endeavour to replace the core curriculum areas because he explains that these are there to support Aboriginal students for their future professions. In other words, Nakata promotes two textbooks and the incorporation into science teaching and learning of a range of both Aboriginal and Western perspectives.

Implication 2 of Embedding KLAK in the Biology Curriculum: Decolonising the Curriculum and Pedagogy Process

A further explanation of the significance of a balance and the implications of two-way teaching and

learning concerns the decolonising of the curriculum and pedagogy process. The little Porky exactly conveyed the message to students that cultures other than the dominant Western Anglo-Saxon culture in the society were valued in the science class. This counters the criticism that much of school science is divorced from reality. The dominant Eurocentric curriculum at school usually sends the message that the only science is Western and the only worthwhile contributions to that field have been made by Western people. These experiences at schools have left students with the sense that Aboriginal knowledge is devalued compared to Western science (Semali & Kincheloe, 1999). Some authors are very strong in their positions about the Western nature of science curricula taught in schools. Smith (2012) argues that Western science's attainment and maintenance of a position as the dominant and dominating form of knowledge is a form of ethnocentrism, racism or cultural imperialism which needs to be countered with a more balanced approach. Thompson (2004) describes that Aboriginal students must 'realise that their people's understanding of the world, their worldview, and their understanding of natural phenomenon is as valid as Western modern science' (p. 65).

Conclusion

Embedding the Porky narrative into the biology curriculum was central because since Koora foundation, the Porky hunting tradition appeared to have been unanimously acknowledged by most local Aboriginal Nations as the cultural hero, according to BHS Aboriginal staff. This is why this hunting Porky tradition was selected by the gatekeepers as a keystone activity at cultural interface along with orality (local animal narratives) as these lessons acted as cultural anchors. This legendary Porky partnership with the Koora people has lasted thousands of years with the original inhabitants of the area and continues to live on today. The Porky and narrative collection lessons were considered a safe avenue for any Aboriginal Nations currently living in Koora and for the 12 students in order to continue investigating their own Aboriginal identity and their sense of belonging to the Queensland Aboriginal family.

Embedding the Porky narrative into the biology curriculum was critical in Koora for the science class because of local history of Aboriginal maltreatment by government authorities of the past. Forced removal from ancestral lands and incarceration in Koora, last century, still anger Elders to this day when they recall their relatives' stories or their own education in the community. However, a small vertebrate is holding the community together. The little Porky is uniting the many resilient Aboriginal Nations and language groups together. Fortunately, the gatekeepers were also desperate to assist the little Porky and safeguard the students' cultural identity. The Porky and animal narratives reconnected the students to their forebears, to a kinship alliance with the Elders and with history. Therefore, for me, the goal of engaging the disengaged student participants was a very tangible one, ultimately because of the willingness of the gatekeepers and because of available KLAK at cultural interface.

Embedding the Porky narrative into the biology curriculum meant contextualisation to culture (teaching in context) or as Nakata (2008) puts it, working with 'what already exist in the community' (p. 199). Embedding Aboriginal perspectives meant integrating both local Koora animal views and Western Linnaean heritage. To assist me in this regard, materials were co-constructed using local fauna and gatekeepers to help student participants cross over the cultural bridge. The study was initiated from the participants' milieu; that is, from their familiar after-school and night-time experiences. 'The place' Koora with its rich Porky history was valorised and naturalised in the animal program. The familiar terrain, that is, what is known to the participants, the local custom or Porky hunting local heritage, meant contextualisation to culture prior to introducing the unknown Western pyramidal work. The lessons were contextualised to cultural experiences of the students therefore bridged from the participants' home experiences (KLAK) to the school's reality (EK). The suggestion was that every day experiences of students such as the Porky hunting and animal narratives were considered mandatory and transitional lessons prior to classifying vertebrates from local narratives and long before the introduction of the Western Linnaean classificatory system.

Embedding the Porky narrative into the biology curriculum meant the conflation of many similarities between local Koora and foreign Montessori ways of teaching and learning. Hatcher (2012) acknowledges that 'the sense of place is a challenging concept to bring into the science classroom because of the transition from an oral tradition to a Western, written one' (p. 7). However, the Koora Elders and BHS Aboriginal staff both believed in the delivery of an authentic approach to teaching about the local animals and this is very well aligned to the Montessori Method. Authentic and holistic learning for Montessori or for Koora Elders meant shared focus or emphasis on the acquisition of academic, social, practical and life skills rather than the main focus being on academics. The Porky work linked to local customs meant that the learning context was different; a combination of classroom work combined with the natural environment with Elders' bush experiences. As Hatcher (2012) states, it is a co-learning journey and a 'middle-ground' that needs to be reached.

Observation, imitation, trial and error, and repetition were valued during the Montessori Three-staged lessons. The local views in real context provided visual and verbal perceptions (First Stage: The association of the sense perceptions with names) in addition to the customary Montessori imagery link (animal photo cards to con-

struct the Linnaean structure in zoology). The second stage (The recognition of the object corresponding to the name): it is through that visual perception that students are able to enter the local views and understanding of nature. The third stage (Remembrance of the name corresponding to the object) meant internalising that and remembering. It is an exposure to the natural context and the recalling of these local Porky experiences and narratives that supported students to classify local fauna.

Rioux (2015) compares and contrasts the teaching and learning approaches of the local Indigenous BHS staff and Elders and those of the Montessori ways of operating in Koora to enact the curriculum. Children's understanding comes from the promotion of children's ability to find things out for themselves rather than learning being based on subjects and limited to what is given. For Montessori or for local Elders, children's understanding comes from their own experiences with bush or classroom materials. Montessori believed that children teach themselves using materials specifically prepared for the purpose rather than children being taught by the teacher. Children are active participants in learning rather than being passive. For Montessori, learning is based on the fact that physical exploration and cognition are linked rather than children sitting at their desks and learning from a whiteboard and worksheets. Children learn at their own pace and follow their own individual interest rather than learning from a set curriculum according to a timeframe that is the same for everyone. For Montessori, the environment and Method encourage internal self-discipline rather than the teacher acting as primary enforcer of external discipline. Similarly in Koora, during the Porky experiences, the student was left to develop freely and whenever the child expressed a keen interest in learning a new skill or a new topic, he/she was guided by example. The Elders' and Montessori's teaching is person-oriented rather than information-oriented. For local Koora people, it seems that the respect is gained more by how the teacher relates as a person rather than how he or she performs as a teacher. Community led lessons and curriculum were critical, that is, the teacher worked in collaboration with the children, Elders and the community adults, as well as Indigenous Education Workers, School liaison officers, Culture teacher and Indigenous administrative officers. Teaching was the responsibility of everyone including siblings, Aunties, and Uncles and not solely the teacher.

Embedding the Porky narrative into the biology curriculum was central in Koora and in the zoology program because this integration and culture positively engaged the students. The little Porky was the instigator of engagement and rekindled local Aboriginal knowledge in the science classroom. The Porky was the uncontested vertebrate hero in Koora, the most significant narrative of the thesis because the locally venerated egg-laying mammal was the engine that propelled the participants from the Aboriginal familiar to the unfamiliar Western classification as it powered local animal Aboriginal classification.

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Competing Interest Statements

None.

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