

Local Collaboration to Grow the Seeds of Stem Investment from School and Beyond

Michael Donovan^a

Corresponding author: Michael Donovan (michael.donovan@newcastle.edu.au)

^aThe Wollotuka institute, University of Newcastle

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Abstract

How to engage Aboriginal and Torres Strait Islander students with Science, Technology, Engineering and Mathematics (STEM) curriculum and disciplines is a question being argued across many educational forums. From the examination of the opinions of Aboriginal high school students in a PhD thesis, Aboriginal students stated that they follow teachers, not content. Relationship is one of the key foundations of working with Aboriginal students. Many educational pedagogical theorists argue the significance of the teacher-student relationship and the gaining of an understanding about all students to engage students to their education. So, what is important or different about the relationship between Aboriginal students and their teachers? The Aboriginal student participants in this study reinforced the importance of relationship in context to an Aboriginal student standpoint. Where the Aboriginal student and their Indigeneity is at the centre of the relationship and mandating that the teachers' pedagogical practices need to embrace them.

Aboriginal high school students from a variety of diverse socio-economic, cultural and geographical areas across New South Wales (NSW) were asked about what aspects of their schools, teachers and curriculum that engaged them to their education. The Aboriginal students stated that connecting with teachers, engaging with their culture and basing their learning in real world understandings are key to initiating their learning including engaging with STEM. The Aboriginal students' standpoint was based on their Aboriginality and for many non-Aboriginal teachers gaining an understanding from an Aboriginal standpoint was culturally foreign. Through teachers embedding aspects of Aboriginal cultural practice into their curriculum and engaging with examples of cultural relevance will allow for seeds of scientific inquiry so Aboriginal students' STEM discoveries can be nurtured into STEM careers and fields of study.

The singular term 'Aboriginal' will be used for all Aboriginal and Torres Strait Islander populations I acknowledge the great diversity amongst Aboriginal and Torres Strait Islander populations. The term "Indigenous" is only used when referring to other international studies of Indigenous peoples globally.

Introduction

Australian Aboriginal communities are some of the most disadvantaged groups globally. When examining educational outcomes there has been limited success of Aboriginal students compared with their non-Aboriginal peers in achieving educational benchmarks (Gillian, Mellor, & Krakouer, 2017). This can be noted in the Programme for International Student Assessment (PISA) 2012, when comparing the results of Australian and Aboriginal Australian students. Australian students were 19th in world-rankings but Aboriginal students would have been positioned 52nd based on their results (Organization for Economic Cooperation and Development (OECD), 2014), with Aboriginal students being cited as being approximately 30 months behind the educational benchmarks of their non-Aboriginal peers in literacy, numeracy and science (Dreise & Thomson, 2014, p. 1).

Much of the lack of success for Aboriginal students can be related to the inappropriate educational practices directed at them through the non-Indigenous pedagogical filters privileged by Western educational systems. A large range of educational researchers have repeatedly noted that pedagogical and systemic change needs to take into account the needs and learning behaviours of Aboriginal students (Donovan, 2015; Harrison & Sellwood, 2016; Nakata, 2007; National Aboriginal Education Committee, 1985; West, 2000). For example, Ladwig and King (2003) note that pedagogy is the primary point for any educational change or development. They inform us through their consolidation of educational research that pedagogical development has a greater influence on student improvement than the impact of curriculum and school organisation.

Teachers and teaching practice are consistent factors when examining any aspect of why Aboriginal students are not succeeding in Australian schools. Fullarton (2002) has shown that Aboriginal students experience limited engagement at schools and that a significant portion of this lack of engagement is associated with differences between classroom teachers and Aboriginal students. Teachers and their pedagogical decisions in classrooms should, therefore, be a key factor when examining the engagement of Aboriginal students in schools.

This paper will highlight the need for greater systemic change when engaging with Aboriginal students. As John Dewey (1916) has argued from the early twentieth century, schools are social organisations and there is a mandatory need for teachers to be able to engage with their students in an authentic relationship which supports the student to engage with the teacher and the teaching practices presented by them in the progression of their learning (Donovan, 2016). The focus of various Aboriginal pedagogical theories will highlight the engagement of socially constructed learning environments for Aboriginal students. The key themes of Aboriginal student centred relationships will inform readers of the significance of embedding Aboriginal Cultural Knowledge (ACK) and designing learning practices that locate the relevance of the learning experience within the Aboriginal students' worldview. These understandings will be presented to inform and support educators in maintaining the mandatory Australian curriculum standards to engage Aboriginal students with their education and inform all students about their local Aboriginal culture and histories (Australian Curriculum Assessment and Reporting Authority, 2016; Australian Institute of Teaching and School Leadership, 2011).

Methods

Why use a methodology of listening to Aboriginal student voice?

This study involved interviewing 52 Aboriginal High School students on what they believe is best for them in improving their educational experiences. The interviews were held at eight school locations to explore the potential relationships between diversity of place, socio-economic standing and cultural practice on the students' perspectives.

Specific schools were targeted, and each targeted school was asked to identify five high school students in stage 5 (Year 9 and Year 10; aged approximately 15 to 17 years of age) to discuss what they believe are best practices in engaging Aboriginal students at schools. A total of eight schools were visited in this rolling sample with initially four schools in a targeted region identified. The initial schools were targeted because they were located in a NSW region which covered both urban and rural areas. These four schools had the four largest Aboriginal student numbers in this region. Another four schools were then targeted that identified issues connected with Aboriginal education, that is, features that have been consistently highlighted in the literature about Aboriginal communities and engagement of Aboriginal students. These issues included a school in a low-socioeconomic area, which was also an urban school, a remote school, a school that had a high presence of Aboriginal culture which was a school that had a long standing Aboriginal languages

program, and an elite independent single-sex boarding school that had a long-term mentorship program.

Gender balance was not a request to schools when they identified students and as I intended to visit a single sex school I understood this imbalance might occur, so possible gender difference did not become a focus in this study. The study was approved by two relevant ethics committees, University of Newcastle Human Research Ethics Committee Approval Number: H-2013-0017 and the NSW DET SERAP Approval Number: 2013005.

School	Placement	Aboriginal student %	Male	Female
1	Initial	13	7	0
2	Initial	7	3	2
3	Initial	10	6	6
4	Initial	14	5	0
5	Secondary	11	2	3
6	Secondary	3	5	0
7	Secondary	17	5	4
8	Secondary	68	2	2

Table 1: Schools, gender numbers and Aboriginal percentages

The interviews took place using a Yarning Circle forum; this is a level space where all participants are equal in the value of their voice in the discussion. The Yarning Circle establishes a safe non-hierarchical place where everyone present around the circle has the opportunity to speak without interruptions. The participants sit in the circle facing each other, which allows for all participants to see each other comfortably in an open discussion space. In a Yarning Circle all voices are heard, and all voices carry the same equal value into the discussion (Bessarab & Ng'andu, 2010; Blair, 2008; Donovan, 2015). In this research context, the author facilitated the process through introducing the discussion topics and supported the open discussion. Occasionally I would clarify or probe for further comments or invite students into the Yarning Circle to allow their standpoint to be heard in the discussion. For many non-Aboriginal researchers, this structure may appear to look like a focus group structure. But for Aboriginal peoples this circular structure is the norm for community gatherings especially at important community meetings where the community gains guidance from the leaders (Elders) who bring their wisdom to the issue in open discussion to inform the community or suggest direction when developing viewpoints (Knudtson & Suzuki, 1997). It is a known structure; a comfortable space and this forum can be seen as a culturally secure space for open collaborative discussion with Aboriginal students.

The Yarning Circle evolved from informal introductions and establishment of cultural positioning or relationships of family and community between the author and the students. A personal introduction of who you are, your family and Aboriginal Nation is a significant feature and has been identified by other Aboriginal researchers as important practices when working in collaboration with Aboriginal communities (Blair, 2008; Hanlen, 2002). The author highlighted that this open discussion space was for all voices and they are all equally valued because of the unique Aboriginal voice that only Aboriginal students could present. From there we proceeded to some more targeted discussions around the research questions. Within these discussions the students gave their views on the issues they saw about school, teachers and the curriculum.

The Yarning Circles would last for approximately an hour with the larger groups lasting an hour and a half. All Yarning Circle discussions were recorded and transcribed for analysis. Transcripts and audio files were examined for identifiable themes within focus questions with particular attention drawn towards the considerations of Aboriginal English and Aboriginal cultural analysis of language use performed by an experienced Aboriginal educational researcher. As the discussions were a group development and single comments were not allocated to specific students' transcripts were not presented back to students for review.

Findings and discussion

What is the importance of an Aboriginal student centred relationship?

The establishment of an authentic or honest relationship between the teacher and the learner is a mandatory pedagogical feature when working with Aboriginal students. This understanding has not just been identified by Aboriginal pedagogical theorist (Heitmeyer, 2004; Hughes, More, & Williams, 2004; Sarra, 2011; Yunkaporta & McGinty, 2009) but other educational pedagogical theorists strongly identify the importance of relationship building between the teacher and all students (Bernstein, 1997; Boomer, 1982; Dewey, 1916; Ladwig & King, 2003; Vygotsky, 1978). Halse and Robinson (1999) highlight this when stating:

children of any cultural background who feel personal connections with their teacher are likely to be more cooperative, interested in learning, and willing to take risks and attempt new tasks (p. 208).

This understanding of relationship is of absolute significance when participating with Aboriginal students in order to effectively engage with the Aboriginal students within a non-Aboriginal classroom space. For many Aboriginal students' schools are foreign environments that are culturally different to their home understandings. The 1985 Blanchard report on Aboriginal education highlighted, when examining a traditional Aboriginal education system, that:

Early education of Aboriginal children was undertaken by those with whom they were intimate and kin. It was only later in life...that verbal instruction was given in a more formal and structured way, and that information was imparted by people who were strangers or relative strangers (Blanchard, 1985, p. 6).

Stepping away from this personalised environment and entering into school is generally the first step into a formal education setting for most Aboriginal children, as noted by the Australian Government's Close-The-Gap strategies highlighting the need to increase Aboriginal students early childhood attendance (Holland, 2018). For many Aboriginal students the setting of a school classroom is a culturally different environment from their home environment. Working with unfamiliar people outside their kinship-based network prior to formal schooling can be just one of the challenges Aboriginal students encounter when entering into a western school setting. Assisting Aboriginal students in engaging with culturally dissimilar teachers and school environments is a challenge to be addressed (NSW Aboriginal Education Consultative Group & NSW Department of Education & Training, 2004).

The development of a personalised relationship between the teacher and student could bridge the divide between home, community and school and allow the student to become more comfortable with the classroom, which could otherwise become a foreign environment for young people. Aboriginal parents in the NSW 2004 Review of Aboriginal Education highlighted this feature stating:

A teacher's relationship with their Aboriginal students is really important and it must be built on the foundation that the teacher understands and acknowledges the Aboriginal student, their life experience and their language (NSW Aboriginal Education Consultative Group & NSW Department of Education & Training, 2004, p. 78).

By developing a personal relationship with Aboriginal students, teachers should be able to connect to these students through sharing aspects of their life and culture, and working to develop the classroom as a cross culturally engaging space (Bishop, O'Sullivan, & Berryman, 2010; Donovan, 2009; Ladwig & Gore, 2005).

Within my research I argue that there is a need for this teacher-student relationship to be based from the Aboriginal students' perspective. I would state this relationship is about treating the students like your 'mob'. This relationship is *girrawabugany* (gear-waa-boo-gany) or 'like your mob'. From a contemporary Aboriginal perspective, 'mob' is a colloquial term for family and used to engage with the extensive kinship relationships that are part of traditional Aboriginal society. These extensive kinship relationships have adapted to engage contemporary Aboriginal society that includes the strong cultural obligations that follow kinship networks (Donovan, 2015).

This type of authentic Aboriginal relationship occurred at different sites in the study and allowed many of the Aboriginal students to want to engage with certain teachers at their school. As one student stated, *"he's a fun person that you can talk to about personal stuff and he'll be good with it, he'll be all cool. Yeh, I think I just being friends with him"* (Yarning Circle 2). As this quote demonstrates, if the teacher engages with the Aboriginal students in a personal or authentic manner then a relationship of understanding could develop including expected behaviour in the classroom and collaboratively connecting the diverse pathways of their experiences together (Bishop, Ladwig, & Berryman, 2014; Donovan, 2011; Yunkaporta & McGinty, 2009). As another Aboriginal student stated, *"a teacher that connects with you, like makes it more interesting rather than just all theory."* (Yarning Circle 6)

Active Pedagogies and Aboriginal student engagement

Humour was another personality trait that many Aboriginal students identified as an enjoyable characteristic of a good teacher and which supported the teacher-student relationship. The expression of humour is an established behaviour within Aboriginal communities so if a teacher engages with this well-known behaviour then Aboriginal students will respond to these practices (Hudsmith, 1992). The use of humour can be expressed through a humourous absurdity to make a point or as a joke with the students in a collaborative manner. The Aboriginal students highlighted comments such as *"so when you're having a joke and he'll make a joke with you but you can make a joke with him, have a laugh at him as well. He takes it pretty alright"* (Yarning Circle 7). This collaborative humourous connection is noted as a social function that the Aboriginal students identified as an engaging pedagogical practice.

A significant finding which emerged in this study was that when Aboriginal students were asked about the curriculum, many of their responses actually focused on teacher practice more than the relevance of the curriculum content being presented. The Aboriginal students' engagement was based on the teacher not the curriculum content. One Aboriginal student stated, *"It's probably not the class itself it's probably just the teacher"* (Yarning Circle 1). The Aboriginal students' comments were focused more on the pedagogical practices than the educational content and the Aboriginal students engaged with teachers who they believed they could trust and who valued them as Aboriginal people. In other words, those teachers with whom they felt they had established an appropriate relationship from an Aboriginal worldview.

Another example of how pedagogical practice was identified over curriculum content was highlighted when examining the electives selected by the Aboriginal students. Many of these electives included strong elements of physicality or hands-on practices as key elements of their subjects. The argument that Aboriginal students engaged in learning practices with hands-on elements has been consistently made by Aboriginal pedagogical theorists (Harris, 1987; Heitmeyer & O'Brien, 1992; Hughes & More, 1997; Malin, 1990; Yunkaporta & McGinty, 2009). The physicality of the electives that the students identified were clear features of some subjects such as woodwork (TAS) or visual arts but was also an engaging aspect of other, less obvious subjects. This included one student noting that certain teachers used role plays and re-enactments in History and English as positive behaviours to engage with content. This also included many students disengaging with science due to the promises by some teachers to have practical experiments as part of their curriculum. This disengagement with the Science curriculum was highlighting at one school where a student stated, "*in Science we don't have many experiments and it's all just written tasks; it lacks the interest of the students in that subject*" (Yarning Circle 3). Students appeared to feel less engaged with the content being presented due to the limited practical experiences compared to the theoretical presentation of the sciences. This standpoint of engagement based on curriculum or teacher was reinforced in another Yarning Circle where the author asked, "*is it the subject or is it the teacher?*" and three different students replied automatically, "*the teacher*" (Yarning Circle 7).

Understanding Aboriginal culture through real-world experiences

Aboriginal Cultural Knowledge (ACK) is ever present in an Aboriginal household. It is part of everyday activities, and while some aspects of ACK are easily recognised, at many times it is the subtle or covert understandings that are underlying within these actions that reflect the cultural knowledge. The presentation of ACK is continuously imparted to Aboriginal children; as Heitmeyer highlights:

Education can be considered one of the principle means by which culture and knowledge are transmitted from one generation to the next. Aboriginal societies had an education system with their own teaching methods as a means of transmitting knowledge about the land, history, kinship, religion and the means of survival. Younger generations learned from older generations by participation, observation and imitation. (Heitmeyer, 2004, pp. 222–223).

Furthermore, West (2000) highlights some negative manifestations that can occur due to the differences in cultural experience as highlighted in one of his case studies:

The skills and characteristics of the Aboriginal students which were positively valued, or simply considered normal, at home became irrelevant or disabling in school because of the contrasting cultural practices...This conflict gradually developed into a vicious cycle where the students became marginalised both socially and academically (West, 2000, p. 213).

The presentation of aspects of Aboriginal culture to Aboriginal students will help connect these students to the learning experience by placing that learning experience into the context of the Aboriginal learners' worldview (McKnight, 2015).

While the content itself is important for Aboriginal students, having the learning activities connect to the Aboriginal students' worldview and their preferred learning habits is an important feature to establish connections with the students (Gay, 2002; Matthews, 2015; Perso, 2012). One Yarning Circle highlighted that many teachers never made clear the relevance of their learning in the context of the Aboriginal students' worldview. This group of Aboriginal students stated, "*it's got to be real life, but that never happens...we get examples like a man bought sixty watermelons, stuff like that*" (Yarning Circle 2). This irrelevance occurs both

through the content not connecting to the student worldviews and through forms of conceptual presentation that fail to engage with the Aboriginal students intellectually.

Place and Context

Australian society does not in general have a very accurate understanding of Aboriginal society, culture or history. Teachers are no different; Aboriginal society has not been effectively addressed within our education system and unless individuals have attempted to engage in these areas much of their understandings can be inaccurate (NSW Aboriginal Education Consultative Group, 2011; NSW Aboriginal Education Consultative Group & NSW Department of Education & Training, 2004).

To effectively support Aboriginal students there is a need to engage and involve the local Aboriginal Community to incorporate locally specific cultural knowledge and practices into the students' education. In doing so a more accurate presentation of Aboriginal culture can be presented to the students and this content would have a distinctly local focus because of involvement of the local Aboriginal Community (Riley & Genner, 2011).

Partnerships with the local Aboriginal Community are the most beneficial way to share Aboriginal Community knowledge for Aboriginal students and all students in a class (NSW Board of Studies, 2008). But partnerships for Aboriginal People are not a simple event. A partnership is more than an agreement; it is a request for both parties to work together and develop a relationship to resolve an issue and improve the educational experiences for their Community. A partnership with an Aboriginal Community becomes a reciprocal relationship. A reciprocal relationship is a relationship where both parties give to the partnership for the benefit of both parties in a constant cycle. Through establishing desired outcomes identified by the Community, a course can be designed and implemented for the benefit of the Community (Heitmeyer, 2004; Lowe & Bub-Connor, 2014; Perso & Hayward, 2015).

Aboriginal Cultural Knowledge (ACK) is a foundational element of Aboriginal society. These foundations are present within Aboriginal Communities, but as Aboriginal Communities have varied histories, contact points and connections with other aspects of multicultural Australian society, these foundations may have various outlooks (Price, 2015). ACK is evident across all Aboriginal Communities; this knowledge can be seen in the stories that are held within communities or families (Rose, 2012). These stories are lived versions of history and in many examples, differ from the recorded non-Aboriginal version of that incident. Through engaging with local Aboriginal narratives, a more complete history may be presented to inform the students of the complex co-existence histories of Australian society.

When designing and developing curriculum to engage Aboriginal students through featuring ACK, the teacher must involve the local Aboriginal Community in the support and teaching of that content to give a well-informed examination of Aboriginal understandings. Embedding community partnerships in curriculum development and teaching practice will extend the learning to more than a broad single-sided Eurocentric version and instead engage with the inclusion of the cultural subtleties and deep understandings of local Aboriginal Community knowledge (Donovan, 2009).

With a clearer understanding of local Aboriginal culture, history and society being presented to the teachers, hopefully the teachers will be able to present a richer view of Aboriginal society to engage the Aboriginal students and to inform non-Aboriginal students more effectively within their curriculum. This position is highlighted by Ladwig and King when they state:

...valuing all cultural knowledge requires more than one culture being present and given status within the curriculum. It means legitimating these cultures for all students, through the inclusion, recognition and transmission of the relevant cultural knowledges (Ladwig & King, 2003, p. 21).

The use of ACK has greater significance than just engaging the Aboriginal students; it should also inform non-Aboriginal students and give a broader picture of the local environment as Aboriginal cultural images can be overlaid across the contemporary Australian landscape. Griffiths supports these ideas in stating:

such an approach aligns with a critical pedagogy in which the curriculum knowledge presented to students connects directly with the experiences, concerns, and world of students in ways that have not traditionally occurred (Griffiths, Amosa, Ladwig, & Gore, 2007, p. 3).

Using local ACK and localising content examples allows all students some local reference points that relate to their known world and environment.

Engaging with the students' through their known world is a significant element of place and context for Aboriginal students (Heitmeyer, 2004). As argued earlier, engaging through this known world is founded upon the teacher embracing a relationship with their students and connecting in an authentic manner: I argued this as a girrwaabugany relationship. Through a deeper relationship with their students, the teacher can locate Aboriginal students' learning in the students' home and life experiences (Donovan, 2015). To do this we must first learn as much as possible about the students' background and experiences. Classrooms are social environments and should be places where students want to come (Dewey, 1916). For Aboriginal students the presence of an Aboriginal guest, an Aboriginal education worker or a parent as a role model or mentor will help link these two worlds of their known Aboriginal cultural world and their school environment (Gillian, Mellor, & Krakouer, 2017). Too often the Aboriginal students' worlds are ignored or criticised, but as supportive educational professionals, teachers must start where the students are at in their localised known world and experiences. Education is therefore a social resource that should never be limited or denied to any member of society (United Nations, 1948; United Nations General Assembly, 2007).

Deep knowledge and understanding should be presented with connections to cultural understandings to gain important connections to the Aboriginal students' worldview. These connections would place the learning experiences into a framework or schema for the Aboriginal students and maintain an engagement with them. Griffiths acknowledges the need to present students cultural understandings in accurate portrayals and beyond a tokenistic response when he states that:

receiving a pedagogy in the classroom which, through its weak connection to these students' life experiences outside of the school, their background and cultural knowledge, may in effect be contributing to their further alienation from schooling" (Griffiths, Amosa, Ladwig, & Gore, 2007, p. 9).

As the student may identify that the teacher presents the students culture as less worthy in their classroom context.

Conclusion

The understandings identified by the Aboriginal students across the diverse landscapes of this study reinforce the idea that the curriculum content has some importance to engaging Aboriginal students

in classroom learning. But across all the sites examined in this study, the Aboriginal students engaged with the teacher in specific classes not the curriculum, the relationship that the teacher built with the students and the manner that the teacher presented the learning in their classrooms was the primary feature of engagement. These relationships were built from the Aboriginal student perspective as a gurrwaabugany relationship; an authentic relationship for the Aboriginal students towards their teachers. For a more complete engagement of Aboriginal students with their learning experiences, teachers should engage with the local Aboriginal community to support the teachers transitioning Aboriginal students from the known world of the Aboriginal student into the foreign environment of a western classroom. This process of embedding cultural knowledge can be supported by schools by presenting accurate portrayals of Aboriginal culture through engaging with Aboriginal communities in curriculum development and inviting Aboriginal guest presenters. Through using these positive culturally informed learning experiences all students will benefit from the learnings of the oldest continuous cultural on planet Earth.

Acknowledgments

I am a member of the Gumbaynggirr Nation of north coast NSW. I have worked in Aboriginal education since 1992, working from schools through to University. The primary source for this paper came from my PhD in examining; what form(s) of pedagogy are necessary for increasing the engagement of Aboriginal school students? My research interests include Aboriginal education, quality teaching and pedagogy, use of ICT and working with Aboriginal communities. I am a Life Member of the NSW Aboriginal Education Consultative Group (AECG) since 2013. I convene an International Research Network (IRN) under the World Educational Research Association (WERA).

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