Chapter 4
Indigenous Technology in Technology Education Curricula and Teaching

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The premise of this chapter is that indigenous technologies have a place in Technology Education, and a case is made for the integration of indigenous technology into Technology Education curricula. The potential outcomes are profound—students from both Western and indigenous cultures who are empowered to participate in the development and critique of technologies from multiple perspectives, widened scope for community participation in teaching and learning, and enhanced collective participation of the custodians of indigenous and Western knowledge systems. The implications of such an approach encompass content, materials and equipment, pedagogies and assessment. First, curriculum developers and teachers need to understand and commit to the value of an integrated approach.

Introduction

> . . ..I was travelling in Africa and—whilst reading a local newspaper in a Zambian airport lounge—came across an intriguing advert for a university research post in 'indigenous knowledge'. The more I read about it, the more intriguing it became and the more questions it raised for me, the most central being what is 'indigenous knowledge'? (Kimbell 2008, p. 8)

During my scholarship review for this chapter my eyes caught the short article entitled *Indigenous knowledge, know-how, and Design & Technology* from which I quoted the above excerpt. Knowing Richard Kimbell as an expert in Design and Technology, I was very keen to read about his views on indigenous knowledge from a Design & Technology perspective. My reading of this article and other literature

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identified a gap. The gap is that, despite extensive scholarship in indigenous knowledge systems (IKS) and indigenous technology in particular (e.g., Emeagwali 2003; Green 2008; Msila 2009; Nakpodia 2010; Odora Hoppers 2002; Vandeleur 2010; Zulu 2006), there has been little discussion on the integration of indigenous technology in the Technology Education curriculum. In addition, there are numerous reports that "Traditional approaches to learning . . . have not mobilized indigenous knowledge and expertise among many people" (Carvallo 2000, p. 769). Instead, institutions of learning have largely proven resistant to change, not accommodating indigenous technological forms and contributions. For instance, the findings of a comparative study between South Africa and New Zealand—two countries with significant indigenous populations—revealed technology lessons that are devoid of indigenous technology issues. Further, technology teachers seemed not to understand the concept (Gumbo and Williams 2012; Williams and Gumbo 2011). As a consequence, there seems to be too much emphasis on teaching western technological knowledge instead of balancing it with indigenous technological knowledge.

As a Technology Education specialist in South Africa, where the African population is nearly 80 % and the white population less than 10 %, I find this state of affairs concerning—particularly given the collaborative and cooperative pedagogical approaches, and diverse forms of technology that Technology Education presents; as well as the socio-cultural and multicultural realities that learners represent in Technology Education classes. At stake in this chapter is the need to integrate indigenous technology in the Technology Education curriculum, taking into account the ideas of Marilyn Fleer (Chap. 3), David Mioduser (Chap. 5) and Wendy Fox-Turnbull (Chap. 6), who all contribute to this book from socio-cultural, historical-cultural and multicultural perspectives.

The contention that IKS have been deliberately marginalised puts the blame squarely on the west's colonial practices, pushing the poles of IKS and western knowledge systems (WKS) further apart rather than bringing them closer. What complicates this matter even further is the polarisation of the western world (predominantly characterised by 'modern' technology) and southern world (predominantly characterised by indigenous technology). This polarisation has even translated into regional differences expressed through rural and urban contexts—the prevalence of indigenous knowledge diminishes into urban contexts. Hence, learners, who are much implicated in the discussions in this chapter, are now divided in two worlds. This challenges attempts to embed indigenous perspectives in the curriculum. However, the so-called modernised learner still shares ties with his or her indigenous milieu through occasional interaction with it. It is from this premise that I call for a paradigm shift in an effort to integrate (Marinova et al. 2010) indigenous technology in the Technology Education curriculum to enhance the collective and progressive participation of the custodians of both WKS *and* IKS. Further, I argue that both indigenous technology and western technology have potential to find a common course into the future (Omolewa 2007; Seemann 2000). Thus, my task in this chapter is to map out the educational parameters that characterise indigenous knowledge/technology in relation to the ideological orientation of western education. This enables me to argue for the integration of

indigenous technology in the Technology Education curriculum by offering reasons for its inclusion. Finally, my route brings me to a point of suggesting a Technology Education curriculum that integrates indigenous technology, and reflecting on the challenges that this poses to teachers.

A Case for Integrating Indigenous Technology into the Technology Education Curriculum

Defining Indigeneity, Indigenous Knowledge, Culture, and Indigenous Technology

I begin this section by briefly defining key terms used in this chapter, including indigeneity, indigenous knowledge, culture, and indigenous technology. Indigeneity (being indigenous) means the root of things or something that is natural/inborn to a specific context or culture (Odora Hoppers 2002; Van Wyk 2002). This definition does not come as a surprise when considering my South African context. I want to use a scenario of animals and plants, and languages, to illustrate the meaning of indigeneity: When talking about indigenous fauna or flora, it is expected that reference is made to animal or plant species that originate in South Africa compared to exogenous species. In institutions of learning and government institutions, a distinction is drawn between 'western' and 'indigenous' through indigenous languages. In South Africa, these refer to black cultures' languages, such as Tswana, Zulu and Shangaan, compared to the predominant languages—English and Afrikaans—which have European roots. In certain academic institutions in South Africa there is even a Department of African (Indigenous) Languages. For purposes of this chapter I use the term indigeneity to refer to the people indigenous to a specific context or region, and their knowledge systems, which include technology.

Let me come back to Richard Kimbell (2008) being intrigued by the concept of indigenous knowledge. In his quest to find out more about it, he scratched for the answer. He states that:

> . . . on the surface the question is easy to answer through examples . . . The bushmen of the Kalahari know how to find water in their parched landscape by reading the signs that they see in the environment but that others do not observe. This knowledge is central to their survival, and is passed down from generation to generation through an oral and experiential tradition. (p. 8)

But, perhaps providing one example only may not satisfy the broad meaning of the term. Thus, indigenous knowledge is that knowledge that is held and used by people who identify themselves as indigenous to a place based on a combination of cultural distinctiveness and prior territorial occupancy relative to a more recently-arrived population with its own distinct and subsequently dominant culture (Mugabe n.d.). Indigenous knowledge therefore has to do with the complex set of

activities, values, beliefs and practices, has evolved cumulatively over time, and is active among communities and groups who are its practitioners (Owuor 2007).

Owour (2007), in a study about indigenous Kenyans, observes that where formal education has had insignificant impact, oral art remains the most important means of transmitting knowledge and skills as a way of maintaining societal continuity from one generation to the next. Owour cites an example in this regard, stating that during initiation into adulthood among the Kikuyu, Maasai, Luhya, and Kalenjin communities, the elders prepare youths for their transitional roles and responsibilities in adulthood. This has implications for indigenous education in the Kenyan context. For example, Owour writes that the methods used in indigenous education are aimed at integrating character building, intellectual training, manual activities, and physical education. Specific trade skills are learnt through apprenticeship and youths' observations of the practices modelled by adults or trainers. There are therefore two kinds of knowledge, each learnt in particular ways. One is a specialised knowledge, such as indigenous medicine and spirituality. Specific members of the family are identified as custodians of the knowledge and mentored through exposure to the practice by those who are specialised in the field from the family or clan. The other is experiential knowledge, which is always acquired through personal exploration and practicality based on everyday lived experiences. Case-based research by Marchand (2008) draws from different contexts—minaret builders in Yemen, mud masons in Mali and fine-woodworkers in London. These cases demonstrate the role played by elders from indigenous craft and apprentice perspectives in knowledge and skills transfer to the young (inexperienced) ones on-site. Education and training happens through imparting innate knowledge, demonstrations and observations, while ensuring social, religious, and so forth cohesion.

These kinds of knowledge raise issues of epistemology—what and whose knowledge gets legitimised in the school curriculum? Since knowledge is power-, politics- and culture-bound (Apple 2000; Gegeo and Watson-Gegeo 2002), it is not value-free. It is contested terrain, in the context of this chapter between west and indigenous. The western approach to science and technology marginalises indigenous forms of science and technology (Emeagwali 2003), accusing them of being oral and devoid of proof (Castiano 2011). Such 'alternative forms' of knowledge and knowing have been unnecessarily restricted in the knowledge and curriculum domains. As a result, "There is a need to develop ..... the epistemological basis to technology studies in schooling. Without this depth of understanding the field of technology education has little hope of meeting its potential ...." (Seemann 2000, p. 1).

From the types of knowledge referred to above, Owour (2007) deduces that indigenous education involves the expertise of multiple teachers, given the multiple natures of roles and responsibilities in life through which young people are mentored and guided. This is the type of approach to education that I also grew up knowing, and to this day it is well known among my community members that "Ngwana o godisiwa le go rutiwa ke setshaba" (Tswana for: "It takes a community to raise and educate a child").

Culture is the way of life of a social group that includes actions, values and beliefs that can be communicated, with necessary modifications, from one

generation to the next. Nakpodia (2010) writes that culture is learnt; dynamic because it varies from one society to another; and a complex whole which includes knowledge, beliefs, art, morals, law and customs. Thus, one of the major functions of education is to transmit culture—understandings of technology, history, literature, philosophy, science, etc.—to the young (Lawton 1982). In line with this view, there are three important implications for education: culture is educationally transmitted, learnt and shared. According to Seemann (2000), cognitive activity is inseparable from its cultural milieu, and every society educates the younger generation as a means of passing down its socio-cultural attributes that guide what a child learns and becomes. This means that Science and Technology Education, too, are human enterprises that involve the transmission of cultural heritage (see also Fleer, Chap. 3) and should take into account IKS. Such an approach would align well with Technology Education—Seemann (2000) argues that indigenous communities' approaches to problem solving are holistic, characterised by the intertwining of culture, technology and environment.

Indigenous technology is a body of knowledge, developed by a culture, that provides methods or means to control the environment, extract resources, produce goods and services, and improve the quality of life (Cheek 1992). Indigenous technology includes technologies such as looms; textile, jewellery and brass-work manufacture; and technological knowledge in agriculture, fishing, forestry, resource exploitation, atmospheric management techniques, knowledge transmission systems, architecture, medicine and pharmacy (Odora Hoppers 1998). Obikeze (2011) describes indigenous technology in terms of tangible devices (knives, fishing nets, machines, bombs, electronic devices, and so on) and intangible devices (songs, jokes, ideas, skills, methodologies, organisations, and so on).

Bearing in mind the above definitions, I claim that technology is inherently cultural (Custer 1995; McCade and Weymer 1996; Potgieter 1998). This is consistent with Custer (1995), who argues that the notion of technology as artefacts extends beyond physical objects: "artefacts are seen as wonderful and diverse cultural expressions" (p. 223). When learners engage in a design and make task in the learning of Technology, reference is made to an artefact as a product that they should ultimately make. I propose that in this process, learners should be exposed not only to the western notions of design and making, but to indigenous forms as well. I critically reflect on the curriculum that I received in my formal education, which did not include indigenous knowledge forms. Even when my specialisation in Technology Education started, when I was studying for my Master's degree in Education, I was confronted by readings on western perspectives by western writers and technologists only. There were no attempts by the designers of the course to integrate indigenous technological perspectives, yet these are manifold.

- Food technology examples include dehydrated granular food products, which involve fermentation, frying and dejuicing; or products such as sorghum, maize, or other cereal fermented and made into alcoholic beverages; various types of cereal-based flour, pulverised tubers of various kinds and a wide variety of vegetable-based soups (Okagbue in Emeagwali 2003).

- Examples of metallurgical technology include carbon steel production 1,500–2,000 years ago on the western shores of Lake Ukerewe in Tanzania; copper smelting developed independently in West Africa around 900 AD (ATPS 2010; Emeagwali 2003; Sertima 1983).
- Then there is astronomical technology, like a stone astronomical observatory created in Kenya on the edge of the Lake of Turkana (Adams 1983; Tedla 1995). ATPS (2010) reveals tools technology of bone tools and blades in Southern and Eastern Africa 90,000–60,000 BC; use of iron smelting and forging for tools which appeared in Africa around 1200 BC.
- Construction of Great Zimbabwe more than 800 years ago and discoveries of ancient mines; ivory, gold, sacred birds of soapstone, divination bowls and dishes; sophisticated guns made from iron; currencies consisting of gold and brass made from metal coinage on East African and western coasts; discovery of Khoi ceramic pottery in Mpumalanga and of iron production in Cameroon; discovery of golden artefacts like rhino and bracelets at Mapungubwe can be categorised as architecture and engineering technology (Hall 1996; Emeagwali 2003; Asante and Asante 1983; Maluleka et al. 2006; Orevbu 1997; Tedla 1995).
- Transport technology includes construction of watercrafts for jungle canoes and dugouts from reed and wood, with cooking facilities (Sertima 1983).
- Agriculture technology includes cultivation and harvesting of barley, cowpea, millet, sorghum, yam, coffee and cocoa; the use of different cropping systems; and domestication of cattle (Atte 1992; Rowlands and Warnier 1996; Sertima 1983).
- Medical technology examples include aspirin; use of bark of salix capensis to treat musculoskeletal; rootbark annona senegalensis to treat cancer; herbs to treat retarded labour, malaria fever, rheumatism, snakebite, etc. (Emeagwali 2003; Jonathan 1996; Sertima 1983).
- Lastly, examples of communications technology include drumming scripts used to relay news over great distances and for celebratory music and dance (Tedla 1995).

Following the definition of indigenous knowledge above, I hold a view that technology resides in a knowledge domain, which is why I maintain that indigenous technology is part of IKS. According to Battiste (2002), indigenous knowledge comprises the complex set of technologies developed and sustained by indigenous civilisations. In Robyn's (2002) study on Native American Indians, Grenier finds a reason to see a synergy between indigenous knowledge and indigenous technology. Grenier claims in this regard:

> Since the very survival of Native peoples depended on their being able to utilize knowledge in balance with the natural environment, one could make the argument that indigenous knowledge is technology. (in Robyn 2002, p. 199)

Kimbell (2008) relates this synergy and sees it as befitting Design & Technology:

> Most of what might be termed the 'indigenous' knowledge that I came across in Africa—as well as most of the references to it that I have subsequently read—relate to practical knowledge; the kinds of know-how that make life live-able in the local situation. It's about growing or hunting for food, building shelters, or transport systems, developing tools and apparatus and systems. In short, indigenous knowledge is typically design and technology knowledge, which is 'know-how' rather than 'know-that'. (p. 9)

Kimbell's (2008) view was informed by his observation of an apt example of this know-how while in Zambia, at a beach construction site for dhows, the traditional Red Sea/Indian Ocean sailing craft with its characteristic triangular (lateen) sail:

> I watched as a big-ish 25 ft dhow was being constructed. Raw materials (typically branches/trunks of teak) were being selected, shaped and fixed, all by hand and without a single drawing. The builders 'knew' about the strength of the timber and how to shape and fix it, and they looked for particular pieces to do special jobs within the construction. (p. 9)

In this observation, Kimbell reflected on tacit knowledge. He realised that new members of the building group were being progressively inducted through participation in the 'mysteries' of the trade of building sailing craft. He concluded that it is not so much personal knowledge but participatory knowledge being demonstrated in this enterprise.

With the realities of indigenous technology and the possible benefits that it can bring to the entire humanity, I suggest that ignoring the importance of indigenous technology in Technology Education curriculum should be tolerated no longer. I thus concur with Rains (1999), who argues:

> When we fail to include sophisticated understandings of indigenous knowledge in the curriculum, when we fail to teach well, when we fall prey to historical amnesia, when we buy into the contemporary intellectual authority, we are granting jurisdiction over complacency within the status quo. (p. 328)

According to Custer (1995), a more balanced technological perspective is to begin with imagination and culture, and then consider and appreciate the wonderful diversity that has been created. Instead of form (machine, tool, artwork, score of music, etc.) being a distinguishing criterion, the emphasis should be on the ways in which the values, priorities and needs of various cultures take form through the creative energy of their people. It follows, then, that extending the learning of technology to include indigenous forms will enrich and expand the scope of learners' concepts of technology. Further, the fact that physical or technological artefacts cannot be separated from culture suggests that if the aim of the curriculum is to be culturally sensitive, then it must integrate indigenous technology. This leads me to explore the differences between IKS and WKS so that later on I will be able to argue for the inclusion of indigenous technology in the Technology Education curriculum.

Differences Between IKS and WKS

Recognising the differences between IKS and WKS supports efforts to bring the two together. Hence, my aim with this section is not to promote a dichotomous stance, but to acknowledge the very real differences so that we can begin to re-orientate our efforts to explore lines of convergence between them and facilitate integration.

IKS

Tedla (1995) explains the philosophy informing IKS-based education and characterises it in terms of academic excellence, spiritual development, community development and physical fitness and health. Regarding academic excellence, education content reflects the reality and needs of indigenous people; combines abstract learning with practical learning, and book learning with experiential learning; involves the entire community in the educational process, with local communities actively participating in shaping their educational destiny; produces communities of scholars and learners who are indigenous-oriented; forms study groups that focus on expanding knowledge about indigenous people and creating new ways of solving problems; and avoids purely individualistic and competitive approaches to education, for education is communal by its nature in order to enable one to live in harmony as a contributing member of the local and world communities. From an African community perspective, such education is informed by principles of ubuntu. Ubuntu is better understood through the values that define a communal society—group solidarity, conformity, compassion, respect, human dignity, a humanistic orientation and collective unity (Mokgoro 1997). The community defines the person as a person. In this sense, a definition of a person is expressed in terms of being a biological relative of a broad family. This explains the extended family ties of indigenous communities, which resonate to some extent with the concept of community of practice. The interdependency of such communities is described by Barab et al. (2002) as a group of individuals who are socially interdependent and who share mutually defined practices, beliefs, and understandings over an extended time frame in the pursuit of a shared enterprise.

Spiritual development is based on the notion that spirituality permeates all aspects of life of indigenous peoples. The held view is that this is a sacred world, and reverence for life dictates that everyone acts ‘right’ by each other. This means that spiritual education should include the development of a character that respects life, that is, that preserves, nurtures and affirms life; takes care of elders, orphans and the weak; learns from the wisdom of elders; is generous, honest, just and diligent; strives for excellence in everything; fights oppression with a clear heart and strong spirit; and believes in the community, in self, in life.

Community development suggests education that recognises the inseparability between and complementarity of the individual and community, inculcates respect for elders, teaches building and maintaining strong family ties, produces individuals that participate in the political, economic and educational life of traditional communities, and takes full control of the education of indigenous children and ensures their mastery of many practical skills—indigenous crafts, technologies and medicine. Such education changes the content that is taught to indigenous children so that it reflects the values and needs of their community, teaches all that is positive in traditional leadership and governance, strives to minimise individualism and competitiveness, produces people who participate voluntary community service on an on-going basis, and recognises that adults and elders have a duty to mentor the young.

Regarding physical fitness and health, education teaches preventative health measures, re-orientates towards food that is currently proven to promote good health, encourages learning from indigenous women in agriculture about naturally cooked food as a community involvement, and incorporates learning activities which include indigenous methods of teaching and games.

From these characteristics of IKS, it can be seen that an education relevant to indigenous learners should be holistic and informed by elements that emanate from the indigenous philosophical stance relating to academic excellence, spiritual development, community development and physical fitness and health. Most importantly, such education should recognise the role that indigenous elders can play in teaching the young ones.

WKS

The ideological stance of WKS-based education is explained by Coelho (1998) as a context where students bring stereotypical attitudes to the school formed by forces outside the school, like the family, media and interactions in the community. The school may unintentionally reinforce these attitudes through the curriculum it offers to students. Students of the dominant culture are harmed by a curriculum that represents, affirms, and celebrates only their cultural background and experience. Students whose cultural backgrounds are not validated by the curriculum receive the implicit message that their cultures are not worthy of study, and that people of these cultures have achieved little and contributed nothing to human history. Resultant impacts on such students include poverty (when they cannot find jobs because they are trained in redundant fields in the job market); unequal distribution of educational resources (e.g., their education receives far less funding compared to their western counterparts); lack of opportunities to learn (due to their marginalisation, some cannot afford education due to their poor backgrounds); difficulty engaging with the language of instruction (they predominantly receive their education through the medium of English); low teacher expectations (teachers tend to engage them minimally in learning activities as they view them as teachers think they cannot contribute much); and a mismatch between teaching and learning styles (teachers' pedagogical strategies do not accommodate these students' learning styles).

Western curricula tend to focus on the perspectives, experiences, achievements, contributions, inventions, discoveries, creations, beliefs and daily life activities of people of European ancestry, and may even distort or omit those of other groups. Such curricula are limited in their selection of knowledge that students should learn, providing them with a biased view of the world because they, at worst:

- study literature by Europeans but read little or no literature from other cultures;
- learn and know a lot about the arts of Europe but remain ignorant of the artistic forms and creations of the rest of the world;

- learn in social studies that the family usually consists of two parents and two children, and that people in the 'Third World' are poor because they have too many children;
- in the history class, they learn about the arrival of the European explorers and colonists from a European perspective;
- learn in mathematics, science and technology little of the involvement of other cultures in those fields;
- graduate with limited proficiency in any other language; and
- are taught mostly by teachers who are members of the dominant culture.

More traditional home-based education seems to have worked better when the provision of education was the responsibility of parents and families and later, for some, the church (Seemann 2000). This is important for Technology Education since it interfaces with other subject areas like Mathematics, Science and Arts—something that speaks well to the holistic philosophy that defines indigenous communities. This element of holism seems to have characterised the pre-industrial integrated curriculum, which was aimed at social empowerment and sustainability in the European context:

> The separation in the curriculum of mind from matter was the antithesis of village education in pre-industrial Europe. For many villages, the most highly prized individual was the chief artisan, such as the blacksmith, the carpenter, or the stone mason. Not only were they skilled in their craft but they also relied on them for practical community guidance in the social sense. The prowess of the artisan was deeply embedded in a social context that directly related to the natural environment from which his/her raw materials were derived. The artisan's prowess was necessarily defined by interdependent relationships found in the social, technical and environmental context of the craft. (Seemann 2000, p. 3)

In addition, "The context of human settlements generally dictated the things one had to know and become skilled in, in order to simply live" (Seemann 2000, p. 2). I thus hold a view that a holistic stance to education should be revisited because it offers a recipe for the integration of IKS and WKS (for more, refer to the three case studies cited earlier from Marchand 2008). The nineteenth century industrial revolution opposed to the integrationist approach, creating social strata based on status and oppression emulated by formal schooling system. For example, referencing the Indian context, Seemann writes that Ghandi once criticised the imposition of British education as a major contributor to the demise of rural India as a dynamic region of small cottage industry. Local innovation and small-scale rural productivity not only declined, but became less valued socially.

It seems that western societies will do well to revisit the educational system of the pre-industrial revolution to identify factors that promoted family and communal engagements, and ensured social development and sustainability. The London case study by Marchand (2008) attests to this possibility. As stated above, this provides a recipe for collaboration between indigenous and western communities.

Arguments for Integrating Indigenous Technology in the Technology Education Curriculum

There are multiple reasons for integrating indigenous technology in Technology Education, and I present them in this section alongside an understanding of the possible interplay between indigenous knowledge and indigenous technology.

First, indigenous technology integration will help dispel misconceptions held about indigenous populations. Indigenous populations have a history of being referred to by the colonial masters as primitive, lower order, backward, ethnic minorities, marginalised, etc. (Odora Hoppers 1998). The Technology Education curriculum, through its collaborative and design-based approach, has a role to play in dispelling these misconceptions. This is possible through engaging both indigenous and non-indigenous learners in collaborative design projects facilitated through relevant pedagogy. The integration can also deal with the disjuncture between school and home evident in terms of less-than-satisfactory relationships between the world of the school and the child's world (home and community) expressed through terms such as 'gap', 'polarity', 'contradiction', 'distance', and 'discontinuity'—with resultant alienation from one's parents' community as a consequence of schooling (Sarangapani 2003). Technology Education therefore has potential to be a subject of hope, bridging the gap between home and school by addressing authentic problems in students' environments. In fact, the technology practiced in the local context should inform teaching.

Another reason for integrating indigenous knowledge in Technology Education is to confront the process of colonisation, with its system of aggrandisement. Colonisation outlawed or suppressed IKS, contributing significantly to the low levels of educational attainment of indigenous populations and high rates of social issues, such as suicide, incarceration, unemployment and family or community separation (Association of Canadian Deans of Education [ACDE] 2010, p. 2). Indigenous forms of technology can instil interest in indigenous learners as they will learn about their communities' contributions. Integration can help restore identity and culture. Further, traditional ecological knowledge is increasingly becoming highly valued by scientists and environmentalists—yet it is being lost through loss of identity and links with the land, marginalisation by WKS, ownership structures being devalued and traditional ecological knowledge used by outsiders for economic gain, and so on (Michie 1999). A culturally-responsive Technology Education curriculum has potential to help facilitate respect for indigenous communities by their western counterparts and instil assertiveness of indigenous learners. There are also benefits for non-indigenous learners–indigenous knowledge can enhance their understanding of indigenous peoples, alternative ways of looking at the world and valuing traditional ecological knowledge (Michie 1999). The integration of indigenous technology can also expand their knowledge and appreciation of other forms of technology.

The next reason for integration has to do with contemporary school systems and the prevalence of de-contextualised teaching. Western-dominated educational programmes

can cause indigenous learners to reject or forget their cultural knowledge; many students attend boarding schools away from their villages and thus do not complete their education in their cultural context. The results are that indigenous students either end up being absorbed in conventional professional careers that detach them from their home, or they do not enter these careers, finding themselves lost somewhere between the traditional culture of their villages and the new culture of development (Michie 1999). Re-contextualised Technology teaching can produce professionals who will carry the onus to identify and actively contribute towards the development of their communities' technology.

To do this, teachers will need to adopt culturally-sensitive approaches to teaching that do not close down indigenous perspectives (Semali and Kincheloe 1999; Wlodkowski and Ginsberg 1995). Technology teachers should critically relate the subject matter and their teaching to the cultural milieu of all learners, including those with indigenous heritage. This calls for the construction of just and inclusive academic environments. Teachers should approach their teaching as hermeneuts (helping learners and other individuals to make sense of the world around them) and epistemologists (seeking to expose how accepted knowledge came to be validated) (Semali and Kincheloe 1999). This inclusive attitude will help transform research in the field of Technology Education by sensitising scholars towards the field of indigenous technology. It will also transform Technology teachers from being mere knowledge imparters and dispensers to becoming co-researchers with learners, and it will involve indigenous communities. As epistemologists, teachers will focus attention on ways knowledge is produced and legitimated. Creative ways to critically engage other forms of knowledge will ensure accommodation of indigenous technological perspectives. The project- and design-based approach of Technology Education offers excellent opportunities for students to explore, from different contexts and cultures, existing forms of technology, as well as future possibilities. Indigenous and non-indigenous learners can input into each other's contributions as they work on their design projects.

A further reason for integrating indigenous technology into Technology Education is to address concerns about the widening gap between rich and poor in the knowledge-based global economy (Carvallo 2000). The looting of indigenous knowledge and technology has contributed to this widening gap: Some pharmaceutical companies use indigenous knowledge to identify medicinal plants and extract the active ingredients and exploit them commercially, with little or no return to the owners of the knowledge; others exploit the genetic resources of plants cultivated by indigenous peoples for genetic materials that they have then patented (Michie 1999; Shizha 2006). This has violated indigenous people's intellectual property rights (Marinova et al. 2010). With its aim to produce critical and responsible learners, Technology Education can—and should—instil a character of respect for intellectual property and ownership of knowledge. Learners, through a Technology Education incorporating IKS, can learn about indigenous technology and begin to realise its value and the role it can play in the knowledge economy and global context. They can all learn how different forms of technology can add value to sustaining an economy that all can benefit from.

It can thus be deduced that indigenous technology has multiple roles to play in Technology Education curriculum and teaching—to address misconceptions that exist about indigenous people, relate teaching and learning to home and community knowledge, restore and affirm the identity and culture of indigenous learners, facilitate collaboration between indigenous and non-indigenous learners using relevant culturally sensitive pedagogies, and acknowledge the contribution that indigenous technology can make to the economy for all to benefit from.

How, then, might Technology Education curriculum and teaching integrate indigenous technology?

A Technology Education Curriculum that Integrates Indigenous Forms of Technology

My take is that Technology teachers should integrate indigenous technology in the curriculum, with sufficient emphasis on indigenous technology to restore its lost status and value. This means that Ministries of Education, and teachers, have to re-consider the Technology Education curriculum that they offer to learners.

Let me borrow Seemann's (2000) technacy concept to suggest a Technology Education curriculum that integrates indigenous technology. This concept represents a paradigm shift from an industry-driven approach to Technology Education curriculum, which by and large reinforces socio-economic strata that elevate western elites at the expense of the poor, the majority of whom happen to be indigenous. Rather, it is about a holistic approach to Technology Education in order to promote social empowerment, development and sustainability. In other words, 'technacy' is a holistic approach to perceiving, teaching, practicing and learning technology; it is a holistic technology problem solving, communication and practice; it is a view that recognises technology as value laden; it is about an integrated approach to subjects—resembling the philosophy of life out there; and it is based on Dewey and Archambault's (1974) opposition to divisions of curriculum and claim that disintegrated school curricula produce disintegrated minds. In other words, curriculum should be designed in such a way that it embraces the realities of indigenous communities which tend to integrate subjects. This will help not to over-emphasise the compartmentalisation of subjects in discrete forms. (See Chap. 10, this volume, for Cathy Buntting and Alister Jones' consideration of how technology can be aligned with other school subjects.)

Seemann (2000) argues that Design & Technology should be based on a framework that is socially innovative, and that it should maintain a link between learning and its application. Ironically, the theoretical model underpinning technacy emanates from western societies (it is based on the ideas of Hegel, Feuerback, Max, Dewey, Wortofsky, Schumacher, Papanak and Ihde). However, the model is attuned to the social learning styles and knowledge frameworks of indigenous Australians (Walker & Seemann in Seemann 2000). It also applies, in general, to other indigenous populations.

Based on the technacy concept and an integration of IKS and WKS, Technology Education might include the following:

- Central goal: To develop a learner who is a skilled, holistic thinker and doer who can select, evaluate, transform and use appropriate technologies that are responsive to local contexts and human needs (Seemann 2000). Such learners will have to be developed to adopt an open-mind approach to accommodate other forms of knowledge whilst ensuring respect for the philosophical profundities set in the local communities and those existent in other indigenous contexts.
- Content knowledge: Technological knowledge is packaged in such a way that it includes technologies existent in indigenous contexts sustaining the lives of people. The following pointers can help with the formulation of strands to be considered (amongst others):
  - the concept of technology as it relates to multiple contexts;
  - epistemological issues surrounding the concept of technology;
  - end-users' cultural values versus designers' cultural values;
  - technologies and designs that include indigenous contexts, including case studies;
  - technological resources and materials that include those in indigenous contexts;
  - principles of technological applications that embrace those in indigenous contexts;
  - profiles of prominent innovators and technologists, including those from indigenous contexts; and
  - trade value of the technologies, including those from indigenous contexts.
- Learning support materials and equipment: Design and put in place materials and equipment suitable to teach about both western and indigenous technology:
  - textbooks and other resources that represent the learners' technological milieu;
  - examples and learner activities that are attuned not only to western technology, but also to indigenous technology, and designers and innovators who learners can identify with;
  - incorporation of textbooks and other resources designed and written by indigenes who have a deep understanding of indigenous technology;
  - equipping Technology Education classrooms/labs with indigenous designers' and manufacturers' products; and
  - techno-labs designed in such a way that they reflect both western and indigenous technological worlds.
- Pedagogical approaches: A number of pedagogical approaches can be considered:
  - orientate teaching around culturally responsive pedagogy so as to be invitational to all learners;
  - teach about indigenous technology as packaged in the curriculum and relate it to regional and global contexts where appropriate;

  - adopt a community model of co-teaching—invite community-based technologists (para-teachers or elders) to teach about and demonstrate the technologies that they employ in their own settings;
  - plan learning activities so that learners will engage actively with community members (especially information-rich elders) in design projects—this process will ensure principles of ubuntu and community of practice as well as social cohesion, development and sustainability;
  - adopt flexible approaches to design, considering tacit knowledge existent in elders. Some designs can be done through mentoring and sharing of expertise by elders. Thus, the idea of design extended to a grassroots level enters because of emergent design (Carvallo 2000)—design of the learner's own interest which is relevant and applicable in his/her own context guided by the wisdom of elders; and
  - critical discourses on epistemological issues surrounding technology.
- Assessment: Plan assessment in such a way that it engages learners in content that they can identify with. Assessment should also be related to the learning materials and content above. It should target applied knowledge, be context sensitive and help to graduate the learner as an expert.

Challenges to Teachers

At this stage I want to reflect on a few challenges that teachers may face in their efforts to integrate indigenous technologies in the curriculum and teaching. The first has to do with attitude. Teachers should begin to show interest in other forms of knowledge and technology in order to accommodate all learners in their teaching, irrespective of the cultural background. Second, it should be the aim of every teacher to respect the knowledge that each learner brings to class, and to tap into it to enrich the teaching and learning activities. Third, non-indigenous teachers should want to treat indigenous teachers as mentors and producers of pedagogical knowledge. Finally, teachers should take advantage of building relationships within and beyond the school—interacting with communities and elders to exchange knowledge and wisdom.

Conclusion

The reality is that the technological world comprises both modern and indigenous forms of technologies. Thus, the future of Technology Education should be shaped by the integration of indigenous technology. Technology learners stand to benefit tremendously by being exposed to both worlds. For example, consider the *Zulu*

Fig. 4.1 The iconic Zulu Mama Chair is an integration of South Africa's first and third world reality by combining indigenous Zulu basket weaving craft with modern materials. The basket seat expresses the archetypal feminine activity of gathering, an appropriate gesture for indoor and outdoor café seating. The weaving work contributes to the economic empowerment of township crafters. The frames are made from rustproof, 60 % recycled stainless steel and can be finished in a variety of powder coated colours or polished stainless steel. The UV stable polyethylene plastic weaving material is also available in various colours. The *black coloured* plastic is made from recycled factory waste (http://haldanemartin.co.za/zulu-mama-chair-2/)

Mama Chair example below, which provides an opportunity for learners to learn from both IKS and WKS (Fig. 4.1).

In order for all learners to learn about indigenous technologies in an authentic and honourable way, I have argued in this chapter for the integration of indigenous technology into Technology Education. To do this, I have offered reasons for integrating indigenous technology, dichotomising between WKS and IKS for the sake of understanding the differences between the two for purposes of integration. Most importantly, I have presented a scenario for an integrated approach moving forward. In order for this to happen, teachers need to value the role that indigenous technology plays and integrate it in their teaching. This will arouse interest in learners, especially indigenous learners, many of whom are disenfranchised by lessons that do not integrate a representation of their indigenous world.

Technology is closely tied to the context in which it plays out, and this presents a golden opportunity to Technology teachers to integrate varied forms of technology, in this case IKS-based technology and WKS-based technology. There are multiple practical examples of indigenous technology in indigenous contexts, and teachers could harness this by designing projects for their learners that are related to these contexts. In the process, students could consider design projects that integrate the wisdom that elders can impart, either by interacting with communities or by inviting these elders to demonstrate their technological profundity in the class.

The outcome could be students who are empowered, open to other forms of knowledge, can work comfortably on design projects as they exchange ideas from multiple perspectives, and can tolerate each other as they work as teams and appreciate each other's ideas manifested through projects designed from varied contexts.

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