Cultural Studies of Science Education
https://doi.org/10.1007/s11422-021-10084-2

FORUM

Decolonizing school physics through an indigenous artifact mediated pedagogy

Vongai Mpofu[1]

Received: 19 August 2021 / Accepted: 20 September 2021

Abstract
In this commentary, I consider several theoretical and methodological aspects of Nadaraji Govender and Edson Mudzamiri's study. The commentary starts with an examination of the purpose for making physics understandable to learners of indigenous background and decolonization of school physics in Govender and Mudzamiri. Next, I offer an alternative *Ubuntu/Unhu* conceptual framework-based interpretation of Govender and Mudzamiri's reported findings. To end the paper, I discuss the key contributions of Govender and Mudzamiri's study wherein I bring to the attention of researchers in indigenous knowledge and science education the need to design their studies with due consideration of aligning research frameworks and methodologies to the decolonizing of school science contemporary reform.

Keywords Indigenous artifacts · Indigenous knowledge · Pedagogy · School physics · Ubuntu/Unhu

> A legitimate way of integrating indigenous knowledge into the science curriculum is not in a tokenistic, 'add-on' approach to diversify the curriculum, but rather is to be done through a critical exploration of the complex ecologies of knowledges and practices, that is exploring indigenous learners' underlying pervasive, and often implicit ontologies with deserving respect.
>
> de Sousa Santos, Oddora-Hoppers

In this commentary, my assertions are rooted in the decolonization of science curricula, indigenizing school science, indigenous and qualitative research and related theoretical

Lead Editor: A. W. Oliveira.

This commentary addresses theoretical and methodological aspects of Nadaraj Govender and Edson Mudzamiri's study entitled: Incorporating indigenous artefacts in developing an integrated indigenous pedagogical model in high school physics curriculum: views of elders, teachers and learners. https://doi.org/10.1007/s11422-021-10076-2

✉ Vongai Mpofu
tvmpofu@gmail.com; vmpofu@buse.ac.zw

[1] Department of Science and Mathematics Education, Faculty of Science Education, Bindura University of Science Education, FSE Complex, Shashi view, P. Bag 1020, Bindura, Zimbabwe

and/or conceptual frameworks. My comments will be weaved with alternative views on the research process and findings inclusive of the proposed Integrated Indigenous-Physics Pedagogical (IPP) model in Nadaraj Govender and Edson Mudzamiri's study, in an effort to provide scholars and educators such as science teachers with insights into the various orientations in indigenizing school sciences and their implications to the decolonization of science curricula. My commentary is largely hinged on the argument that research on the issues of integrating indigenous knowledge (IK), and school science is a complex task that borders on dynamics and colonial legacies of cultural and knowledge hegemony.

At a broad level, Govender and Mudzamiri's study provide insights into one way, which can be adopted to develop culturally (an indigenously) sensitive curriculum models for successfully integrating IK into Western oriented school science (WSS). The authors used data on views of the Elders, teachers and learners in a Karanga community of Zimuto in Zimbabwe to insight on how an artifact mediated IIP model can be developed. The twofold purpose of Govender and Mudzamiri's study was to make school physics understandable, hence accessible to learners with indigenous background and contributing to the ongoing decolonization of school science research efforts. Govender and Mudzamiri draw on the relevance to learners' argument for integrating IK in WSS in Africa and elsewhere– a shared concern among not only African science education scholars but others elsewhere such as Glen Aikenhead and Olugbemiro Jegede, Ray Barnhardt and Angayuqaq Oscar Kawagley, Edward Shizha and Moyra Keane. In fact, as also noted by Keane (2008) inherent in research on integrating IK into WSS are a number of potential outcomes. Two main outcomes which are rather overlapping than exclusive are to address (1) science curricular relevance and (2) colonizing hegemony. Research has approached these outcomes from various angles inclusive of pedagogy, a comparative understanding of the nature of IK (NIOK) and Western science (NOS), and making science concepts understandable, thus accessible to many learners of indigenous background. Govender and Mudzamiri, hence adopted a pedagogical reason to facilitate learners' learning of physics concepts with better understanding and thereby hoping to contribute to the decolonizing of science education movement in Africa. The making learning of physics concepts understandable to indigenous learners research focus is in line with the teaching for conceptual change and integrating IK science education scholarship of authorities like Peter Hewson and Mariana Hewson (1984) and George Sefa Dei (2002). Such scholars conceive effective teaching as that which is involving tapping from and connecting to the learners' prior knowledge that is indigenous culture, language and knowledge. By adopting such a socio-cultural and indigenous stance on developing an IPP model, Govender and Mudzamiri begin to answer the key question: What indigenous artifacts mediated IIP model can emerge from the views of Elders, physics teachers and learners? Their answering of this question draws from the Elders', teachers' and learners' perspectives about how indigenous artifacts can be integrated in the teaching and learning of mechanics at advanced level in Zimbabwe.

This commentary reflects on the theoretical and methodological aspects of Govender and Mudzamiri's research approaches to provide answers to the two questions that they investigated. To do this, I draw and weave literature on decolonizing of science education of which both school science and school physics are part of, indigenous knowledge and science education and indigenously responsive pedagogies. The commentary starts with an examination of the purpose for making physics understandable to learners of indigenous background and decolonization of school physics in Govender and Mudzamiri. Next, I offer an alternative *Ubuntu/Unhu* conceptual framework-based interpretation of Govender and Mudzamiri's reported findings. To end the paper, I discuss the key contributions of Govender and Mudzamiri's study wherein I bring to the attention of researchers in IK

and science education the need to design their studies with due consideration of aligning research frameworks and methodologies to the decolonizing of school science contemporary reform.

Accessibility and decolonization of school physics: a theoretical and methodological reflection

The paper by Govender and Mudzamiri summarizes the findings of the views of Elders, teachers and learners about integrating IK through artifacts into school physics and their synthesis into an IIP model from a study located in a Zimuto Karanga community in Zimbabwe. They make salient purpose of drawing from indigenous artifacts to soften the learning of complex physics concepts, thus making physics accessible to indigenous learners and by so doing contributing to the decolonizing of school physics and science education at a broader level. I subsume indigenous African artifacts as both physical/tangible objects, language and creative art (e.g., metaphors, taboos, stories). All forms of artifacts are made from the local resources and used by community members to sustain life. Thus, what ought to be incorporated in the physics classrooms is the indigenous physics aspects in creating and using artifacts. So, developing indigenously sensitive pedagogy within a specific community for integrating IK in the teaching of physics insight on how it can be done in other scientific disciplines (e.g., chemistry, biology) taught in schools and would promote understanding of both IK and physics as well as contribute to the decolonization science curricula. Notably, Zimbabwe's current curriculum frameworks informing school science, provide a mandate for underpinning the teaching of all subjects, including physics on the *Unhu/Ubuntu* or Heritage-based philosophy. However, as noted by scholars like Vongai Mpofu (2016) and Edward Shizha (2007), in Zimbabwe and possibly elsewhere the implementation of IK science teaching across disciplines inclusive of physics has been a challenging task for teachers. Though numerous interrelating challenges can be attributed to this, the challenge on how to develop indigenously sensitive curriculum models based on cultural resources and facilitate effective teaching and learning is Govender and Mudzamiri's primary focus. Hence, the authors' contributions, through this study, of developing an indigenous artifacts mediated pedagogy to bring IK into science classrooms, is a very welcome novel in science education and to indigenous people.

Among Govender and Mudzamiri's assertions is one that says, "the proposed curriculum model, in contextualizing the curriculum, support efforts to decolonize the Western influenced curriculum" (p. 2–3). This comes in light of intensifying movements on decolonization science curriculum in African nations. Notably, this strand can be viewed as overarching the three other interrelating research themes pursued in science education across the Globe. These research strands are categorized by Barnhardt and Kawagley (2005, p. 17) as: (1) documentation and articulation of IK systems; (2) delineating epistemological structures and learning or cognitive processes associated with indigenous ways of knowing; and (3) developing and accessing educational strategies integrating indigenous knowledge, Western knowledge, and their ways of knowing. I note that Govender and Mudzamiri's paper fits to the decolonizing drive within theme 3. Perhaps, the extent to which Govender and Mudzamiri contribute to this agenda can be referenced to the "legitimacy" of their research frameworks and methodology for the cause. However, these authors make reference of the decolonization agenda without providing its definition. Yet, in the literature this term, decolonization remains variably defined, which probably point to the need for zeroing

in on its definition in context. So, in this examination I go by the description of decolonization as a process that takes on board the dominated and marginalized perspectives of indigenous people, their ways of knowing, and knowledge within their cultural lenses. This dovetails with the stance adopted by some scholars as Keane, Constance Khupe and Maren Seehawer (2017) that decolonization guides on the need for research on IK to break it free from the Western research hubris and incorporate indigenous ways of knowing. Thus, in science education, research and pedagogies that are decolonizing therefore ought to be reflective of the holistic worldview of the participating community, wherein I embrace Mpofu, Femi Otulaja and Emmanuel Mushayikwa's (2014a, b) frame of a worldview as an indigenous people's (involved in research as part of IK enterprise) paradigm in which philosophy, ontology, epistemology, methodology, axiology (values) and rhetoric/language (POEMAR) elements interact into a unique of interpreting and explaining phenomena.

Govender and Mudzamiri framed their research in a *Unhu/Ubuntu* infused Socio-Cultural Theory of learning of Lev Vygotysky (1978). Notably, many scholars caution on how IK is brought into school science. To such scholars, moving IK into school science through either pedagogies or or/and reference materials might fall at position of the continuum from retaining the IK exclusion from school science status quo (colonization) to completely indigenizing school science (decolonization) through partial inclusion. For instance, as drawn from Keane (2008), the exclusion of IK from school science (colonized school science) can be prolonged when such attempts as in textbooks turn to be blotted or fragmented. Research therefore need to guard against such ways of bringing IK into school science, which might be deemed '*illegitimate*" by researcher as Catherine Odora Hoppers (2002) and other categories of people with interest in liberating IK through its inclusion into school science. Meshach Bolaji Ogunniyi (2007, p. 965) also cautions that Indigenous Knowledge Systems (IKS), which is the backbone of IK, "is not just about artifacts, but [rather] the epistemologies, ontologies and metaphysical systems underpinning these artifacts and the ways that they are used to create a sense of wholeness, relatedness or complementarity amidst a collocation of human dilemmas". In relation to pedagogy, Cliff Malcolm (2002) brings to our attention that even the research frameworks designed within social-constructivist approaches are an attempt to direct learners to particular and usually predetermined explanations of phenomena, which in this case are Western scientific ways. So, I opine that despite Vygotysky's socio-cultural theory of learning's prominence use across educational fields inclusive science learning, its incorporation with Unhu*/Ubuntu* to inform a research chasing a decolonization agenda may water down this purpose. Arguably, the independent use of *Ubuntu/Unhu* as a research framework might have alternative answers to Govender and Mudzamiri research questions. Yet, the construct of *Ubuntu/Unhu* remains variably defined in literature, at times is referred to as an African philosophy, others it is described either as an ontology or epistemology or axiology or paradigm. Therefore, to make its theoretical framing of a study clearer, I take as my starting point the paradigmatic perspective of *Unhu/Ubuntu,* which I draw from literature related to it as a philosophy, ontology, epistemology, methodology and axiology as well as the relation of these features to context, culture and language.

In a philosophy frame, *Unhu/Ubuntu* pivots Afrocentrism on humanism-human dignity (Malcolm 2007). Along the same vein, Nkonko Kamwangamalu (1999) sees the philosophy of *Ubuntu* as representing a set of African ontologies' core values inclusive of respect for all humans, human dignity, sharing, obedience, humility, solidarity, caring, hospitality, interdependence and communalism. Moyra (2008) espouses *Ubuntu* as both an ontology and a way of living. She provides harmonious relationships among members of a community as expressing each person's humanity. Within this worldview,

relationships within local communities as Shizha (2010) puts across are governed by a set of values, which in turn shapes indigenous Africans' behaviors. This places the axiological system at the center of the ontological, epistemological, methodological and lingual dimensions of indigenous African paradigms. The axiological system shapes, builds and sustains relationships on the principle of "I am a person through other persons [and] because we are, therefore I am" (Malcolm 2007, p. 62). The indicators of *Ubuntu* are context specific as directed by culture of the community in question, which according to Byang Kato (1975) a philosophy lies at the heart of a community's culture. Mpofu (2016) heeds of the complexity of the construct culture. However, Patricia Phelan, Ann Davidson, Hanh Cao's (1991) simplified description of term culture is it embodies attitudes, beliefs, values expectations, skills and norms of a group of people. It is therefore the physical or tangible level (cultural form), which is human sense (sight, hearing, feeling, smelling and tasting) observable, visible and reflective of a community's culture, philosophy, paradigm and IK. These cultural forms such as artifacts, metaphors, taboos, ritual and ceremonies interrelate into social semiotic resource systems for the survival of a community (Lemke 2001). Gardner (2000) sees language as central to, holding and manifesting culture, paradigm and knowledge of an indigenous community. The United Nations website for cultural diversity pressed on this view by referring to language as more than a tool for communication, but rather a culture, nature, history, humanity and ancestry as well as traditions that inspires knowledge and respect of history. I glean from this discourse a paradigmatic frame of *Unhu* as a culturally, grounded set of interrelating ontological, epistemological, methodological, axiological and lingual philosophies about the world which members of specific community share. The methodology dimension does not only relate to process of knowledge production, but also to how knowledge is transferred and shared within a community (Mpofu et al. 2014a, b; Mpofu 2016).

Figure 1 below summarizes the way I see the *Unhu* paradigm as an alternative research framework of the study by Govender and Mudzamiri.

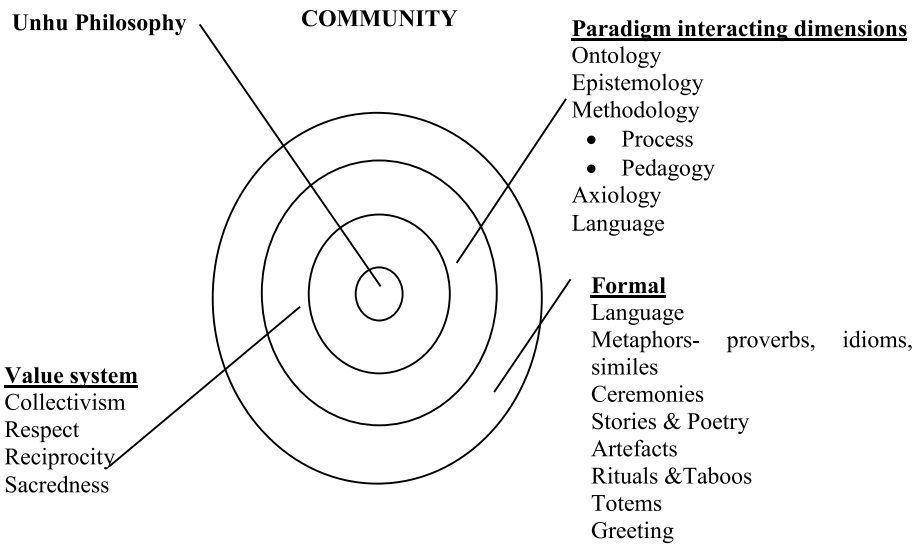

Fig. 1 *Unhu* research framework (Source-self)

The *Unhu* framework of research in Fig. 1 above guides that in conducting research in a local context such as the Zimuto Karanga community (white background bounded with borders), IK existing in the community has been constructed by the first indigenous people settlers through interaction with the environment as guided by their shared culture. Philosophy and paradigm. The knowledge system develops and grows as the community respond to emerging life challenges and strive for the survival of all its members. This knowledge corpus inclusive of skills, values, and attitudes, which has been mainly generated to sustain life (survival purpose) has largely remained orally and experientially transferred across generations to the present. The indigenous pedagogies associated with oral transfer of knowledge are practical, participatory and revealed. Learning in the practical dimension is gained through life sustaining chores such as construction of infrastructure, farming, hunting, smelting and hunting. In the participatory category, learning is largely experiential as the members participate by being present and/doing in the community events such ceremonies while learning through revelation comes in form visons and dreams. All this is underpinned by a strong values system framed within four main and overlapping pillars-collectivism, respect, reciprocity and sacredness. These pillars enclose many other values inclusive of commitment, hardworking, presents and faith. Underlying the value of sacredness is the ontology of spiritualism, in which a hierarchy of spirits-*Musiki* (God or creator) and ancestors (the living dead) is believed to be connected to and holistically guiding the world of the living (Malcolm 2007). Spiritualism led to the communities believing that everything in the community is spirited, of value to the community hence should be accorded due respect. The formal level inclusive of language, totems and artifacts are revealing epistemologies, ontologies, metaphysical and pedagogical systems underpinning how a community create a sense of belonging, relatedness, complementarity and working to engage in life sustaining practices.

The above framework allows us to recognize that Govender and Mudzamiri's Socio-Cultural Learning (SCL) theory incorporating *Unhu/Ubuntu* (U-SCL) led them to combine indigenous and Western qualitative methods in examining how reforms on indigenizing school science can be pursued. They developed an IIP model from the collective voices of key community and school science stakeholders (Elders, teachers and learners) within to a particular Karanga community. Elders were engaged through *matare/imbizo* (cultural meetings) to uphold *Unhu* collective value in handling community issues. Teachers and learners participated through focus group discussions (FDGs); a method grounded in Western qualitative research approaches. As such, the attention given to this combining of indigenous and Western research aspects impresses that Govender and Mudzamiri's U-SCL is consistent with the drive on blending indigenous and Western qualitative research aspects when researching on a phenomenon that is intersecting indigenous and Western science extant indigenous knowledge and science education literature. The integration of IK aspects into the teaching and learning of mechanics concepts focus in Govender and Mudzamiri is an IK and school science intersecting phenomena. Perhaps for example, to Elders and learners of Zimuto Karanga community, incorporating aspects of their culture into physics teaching and learning may make them feel enfranchised and decolonized from an understanding that this is elevating their IK to valuable status from primitive zones and continuous exclusion from physics curricula. However, there seems to be some tensions and contradiction to pursuance of the decolonization of both IK and school physics emerging from the way Govender and Mudzamiri brought in the *Unhu* aspects in both the research framework and methodology.

The first issue is particularly embedded in Govender and Mudzamiri's design and use of their Socio-Cultural Learning (SCL) theory incorporating *Unhu/Ubuntu* research

framework and whose inclination is strong on SCL theory. As reported in their study, "the twin perspective, African humanity and a Western worldview within Vygotskian framework, combines the socio-cultural realities of the indigenous community together with modern teaching and learning theories of constructivism". In the literature, the adoption of constructivist approaches is supported on the strength of starting teaching from the learners' experiences and understandings related to the new concepts being introduced. However, this does not necessarily lead to the decolonizing of neither an IK bodies (indigenous physics) nor a science curriculum, rather it uses prior knowledge of the learners to enhance their understanding of concepts being taught, thus provides pedagogical strategies for learners to assimilate into Western scientists' (physicist) social constructions. In fact, I tend to agree with Malcolm's (2002, p. 26) observation that social-constructivist frameworks provide integrating IK into school science approaches designed to lead learners to particular and usually predetermined explanation. So, IK examples such as artifacts used as prior knowledge will serve to bring about conceptual shifts from indigenous to Western science, rather than decolonizing school physics.

Second, there seems to be some methodological tensions emanating from the way Govender and Mudzamiri aligned the methods of data collection to participants, that is, the cultural meetings to Elders and FDGs to teachers and learners, when in fact they share the same Karanga culture and within limited sample characteristics (e.g., totems, educational levels of Elders and community roles). While the authors try to provide adequate source and method triangulation in collecting data, the study's data from different but related methods rise a pertinent 'method divide' issue. The latent message is Elders in the Zimuto Karanga community has only the indigenous worldview, and the converse is true to teachers and learners. Yet the participants not only belong to the same Karanga cultural grouping, but teachers form part of the community who partake in community issues as Elders and learners also are taught through cultural meetings at home. Moreover, all the participants have experiences and are directly or indirectly experiencing colonialization and globalization. The participants gained some of the Western science experiences through Western institutionalized schooling. Thus, all the participants are bound to be holding multiple paradigms (indigenous, Christian and Western science) in which they can reveal in different contexts. So, in the absence thick descriptions of participant characteristics to justify the researchers' choices, this method divide may be suggestive of Govender and Mudzamiri's Western research orientation that often compromise the yielding of authentic indigenous data hidden in not only in modern or Western paradigms, but also in deeper levels of IK. This comes in light of the authors' report that "… between 60 and 80% of the people [in the community of research] are now Christians…". This observation does not necessarily mean that they do not hold and practice their indigenous culture. In fact, literature reports that as a result of colonialism and globalization, most Africans hold multiple paradigms in which they reveal in response to different situations.

A third issue is connected to the author's acknowledgment that "totems can represent a spirit being, sacred object, or symbol that are used to identify clans". In fact, in the Shona culture of which the Kangaras are part of, totems are not only central to relationship building, but reflect and ground the entire axiology system of community members and are used in positively reinforcing learning (Mpofu 2016). In the *Unhu* research framework in Fig. 1 above, totems and other aspects of the formal level manifests all the cultural aspects of indigenous people inclusive paradigm, philosophy and knowledge. The authors' adopting transformative participatory research (TPR) present their effort to engage in their study a culturally responsive and sensitive design. However, the non-reference to how totems were linked to the design, methods and artifacts might

have limited Govender and Mudzamiri's collection of data at deeper level of the IK of the Zimuto comunity. In collecting data related to indigenous knowledge in indigenous communities, the richness of data is a factor of the extent of relationships among participants and researchers, of which totems play a key role.

The final issue arising from Govender and Mudzamiri's field access is their Western orientated research protocols which is evident in the author's reporting that:

> We complied with both IK and WS ethical approaches. For the indigenous communities, it was paramount to first establish trust through respectful approaches which involved first consulting with the local headman who then consulted with his elders. For the university, ethical considerations required written and signed consent forms. The headman represented the elders and signed on their behalf, having first communicated orally with the elders, who gave oral permission... Pseudonyms are used to ensure anonymity and confidentiality of the participants".

However, literature on conducting research on aspects of IK with indigenous people particularly Elders in their committees teaches us that these standard protocols of classical research are actually contradictory and more of a violation of indigenous research protocols (Malcolm et al. 2009; Mpofu et al. 2014a, b). As a consequence, participants agree to partake in the research more as information providers, rather than as collaborators who are committed to transformation. Yet, the *Unhu* research framework guides on complete collaboration.

In this section, I intended to examine research methodological and theoretical frameworks in relation to making science understandable and contribution to the decolonization school science agenda of the study by Govender and Mudzamiri. It should be emphasized that selection of theories and methodology tools for indigenizing school physics needs to be done with consideration of the unique overarching purpose. For instance, the approaches adopted by Govender and Mudzamiri through the qualitative TPR design seem suitable to developing an IIP model in order to enhance the understanding of mechanics concepts, but rather limited in significantly contributing to the decolonization of school science.

Integration indigenous knowledge and physics for learning

In their thematic analysis, Govender and Mudzamiri collate the views of Elders, teachers and learners into six themes which they merged into the main find that "all participants (teachers, learners and elders) thought that IK-Physics integration would be worthwhile and beneficial for learning (p. 49).'' In doing so, Govender and Mudzamiri are consistent with the focus on indigenizing school physics for making its concepts understandable—a finding from which is not only consistent with social constructivist and conceptual change learning theoretical arguments, but also some IK integration into school science scholars as in Maria Sotero et al. (2020) who have emphasized that.

> The inclusion of indigenous knowledge in the teaching-learning process can facilitate the understanding of subjects being developed on the conceptions of science, which are often distant from student experiences, and thus can represent a first step to opening doors to scientific literacy. In this way, local knowledge constitutes a pedagogical, instructional and communicative tool for the educator (p. 2)

Their use of the participants' view in developing IIP model is also consistent with literature as exemplified in the vignette above. Within the focus of indigenizing school physics to make it understandable to indigenous learners, Govender and Mudzamiri were therefore able to accomplish it in their research study. However, it is evident in the themes: (1) African Philosophy as Respect/Ubuntu, (2) Culture Views and Indigenous Languages, (3) African Cultural Context and Local Environment, (4) Indigenous Resources, (5) Indigenous Teaching Methods and Learning Strategies and (6) Indigenous Context Approach to Assessment presented that the analysis was more inclined to social constructivism than to *Unhu* (Fig. 1). Thus, this limited the contribution of the IIP model developed to the decolonizing of school physics.

Evident in Govender and Mudzamiri's presentation and discussion of findings across themes is surface level IK of artifacts data from which they emerged. For instance, the following vignettes used as evidencing the data from which theme 1 on African philosophy as respect/Ubuntu seems to be not rich enough to support finding.

> All the elders in the community together with our children have deep knowledge about all our artifacts passed down through our traditional means... Yes, this is what we use for our livelihoods. A person with these artifacts is among the respected in our community. We wish to see our children being taught about these artifacts so that they do not go extinct. If these artifacts disappear, we will die of hunger and diseases... Without this knowledge you will not be a valuable member of the community, all the grown-ups have to know the artifacts (p. 11)

As in the vignettes above the authors use expert artifact knowledge as a basis of respect. The use of the respect as *Unhu* as the community's philosophy seems not be openly expressed. Rather, evident is that the children of the Zimuto community seems not to see the value artifacts in the present day. Thus, it appears that Govender and Mudzamiri's assertion that the "crucial to their survival, the elders emphasize the foundations of African philosophy of connectedness; the wellbeing of all the people and not just particular individuals, social justice, tolerance, dialog, cooperation, gender-based equality, protection of the environment and a quest for deeper wisdom in understanding the cosmos" is weakly connected to the data.

Significance of the integrated indigenous-physics pedagogical (IPP) model

The main contribution of Govender and Mudzamiri's work is that it models for science educators (lecturers, teachers and policy makers) how integration of IK into the teaching and learning of school science subjects like physics can be done through collaborating with community members (Elders, teachers and learners). In addition, they suggest an artifact mediated pedagogical model from which science educators can draw upon lessons and transfer knowledge to use this culturally sensitive pedagogical model to their contexts on further research. Like other culturally sensitive science curriculum frameworks, such as, the culturally aligning classroom model (CACS) of Mpofu (2016) this model extend beyond classrooms to inform policy and curriculum design issues. Uniquely, the model point to the importance of mediating teaching and learning of often abstract and complex concepts of sciences with cultural resources extant in the local communities such as

artifacts. In fact, the formal level of the *Unhu* framework (Fig. 1) provide educators with alternative resources to consider. Moreover, Govender and Mudzamiri's IIP model points to the fact that such resources will effectively mediate the learning of science (physics) with the support of language as resources, such as code switching English and Indigenous languages during teaching. Directly, the model emphasizes on easing the learning scientific concepts by using IK as prior knowledge– a purpose which is supported by a substantial scholarly work such that of Jegede, Aikenhead and Ogunniyi. These works attribute the decontextualized of western sciences from the indigenous backgrounds of the learners to the challenges they face in learning science related subjects such as physics in comparison with their counter parts whose background are western. As such their learning science concepts involve crossing cultural borders (Akenhead 1997) and indigenizing school science is one powerful tool to assist these learners to overcome most science learning barriers. However, rebuttals on indigenizing science curricula mainly for softening the learning of scientific concepts are intensifying on the basis of its potentiality in prompting the science hubris with a hidden aim of directing all learners to see the world with the single scientific worldview. So, this weakens the proposed model's contribution to the current decolonizing of science curricula movement across levels of education and nations.

Govender and Mudzamiri's study from the standpoint of a research process, which is seemingly rigorously limited to move the indigenization of science classrooms to decolonizing levels as alluded to is providing strong lessons to science education research. My intend is not in way to take any credibility from this study, rather I intend only to outline critical issues that makes indigenized curricula valuable to the communities and nations in which they are offered. In fact, an immense body of literature put decolonization of science education through indigenization to prerequisite the learning accessibility of science subjects to converge with Govender and Mudzamiri's primary focus. Making decolonizing of science education a main endeavor as informed by the alternative *Unhu* framework guides research flex conserving Western research approaches and skew toward indigenous ways of researching. Many studies (Keane, 2008; Khupe, 2014 Greg Lowan-Trudeau, 2012) exemplify that adopting indigenous aligned theoretical frames, methodologies, methods among others gives studies an explorative power to employ the cultural formal level to holistically interrogate and characterize the unique ontologies, epistemologies, pedagogies and axiology of a particular community from covert to overt levels. By so doing, pedagogical models constructed from such rich indigenous data become powerful science education tools. This contrasts most data in Govender and Mudzamiri's study that tend to carry the general character of African indigenous communities and similar communities in other continent of this Globe.

References

Barnhardt, R., & Kawagley, A. O. (2005). Indigenous knowledge systems and Alaska native ways of knowing. *Anthropology & Education Quarterly, 36*(1), 8–23. https://doi.org/10.1525/aeq.2005.36.1.008

Dei, G. J. S. (2002). Learning culture, spirituality and local knowledge: Implications for african schooling. *International Review of Education, 48*(5), 335–360. https://doi.org/10.1023/A:1021283730231

Gardner, E. B. (2000). Where there are always wild strawberries. *Canadian Journal of Native Education, 24*(1), 7–13.

Hewson, P. W., & Hewson, M. G. A. (1984). The role of conceptual conflict in conceptual change and the design of science instruction. *Instructional Science, 13*(1), 1–13. https://doi.org/10.1007/BF00051837

Kamwangamalu, N. M. (1999). Ubuntu in South Africa: A sociolinguistic perspective to a pan-African concept. *Critical Arts, 13*(2), 24–41. https://doi.org/10.1080/02560049985310111

Kato, B. H. (1975). *Theological Pitfalls in Africa*. Evangel Publishing House.
Keane, M. (2008). Science education and worldview. *Cultural Studies of Science Education, 3*(3), 587–621. https://doi.org/10.1007/s11422-007-9086-5
Keane, M., Khupe, C., & Seehawer, M. (2017). Decolonising methodology: Who benefits from indigenous knowledge research? *Educational Research for Social Change, 6*(1), 12–24. https://doi.org/10.17159/2221-4070/2017/v6i1a2
Khupe, C. (2014). *Indigenous knowledge and school science: Possibilities for integration* [Thesis]. http://wiredspace.wits.ac.za/handle/10539/15109
Lemke, J. L. (2001). Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching, 38*(3), 296–316.
Lowan-Trudeau, G. (2012). Methodological métissage: an interpretive indigenous approach to environmental education research. *Canadian Journal of Environmental Education (CJEE), 17*, 113–130.
Malcolm, C. (2002). *Science for all: Learner-centred science*. Routledge.
Malcolm, C. (2007). The value of science in African cultures. In D. Corrigan, J. Dillon, & R. Gunstone (Eds.), *The re-emergence of values in science education* (pp. 61–76). Sense Publishers.
Malcolm, C., Keane, M., Nirmala, G., & William, K. C. (2009). Transformative action research: Issues and dilemmas in working with two rural South African communities. In K. Setati, R. Vithal, C. Malcolm, & R. Dunphath (Eds.), *Researching possibilities in mathematics, science and technology education* (pp. 193–212). Nova Science Publishers.
Mpofu, V. (2016). *Possibilities of integrating indigenous knowledge into classroom science: The case of plant healing* [Thesis]. http://wiredspace.wits.ac.za/handle/10539/20706
Mpofu, V., Mushayikwa, E., & Otulaja, F. S. (2014). Exploring methodologies for researching indigenous knowledge of plant healing for integration into classroom science: Insights related to the data collection phase. *African Journal of Research in Mathematics, Science and Technology Education, 18*(2), 164–175. https://doi.org/10.1080/10288457.2014.928451
Mpofu, V., Otulaja, F. S., & Mushayikwa, E. (2014). Towards culturally relevant classroom science: A theoretical framework focusing on traditional plant healing. *Cultural Studies of Science Education, 9*(1), 221–242. https://doi.org/10.1007/s11422-013-9508-5
Odora-Hoppers, C. A. O. (2002). *Indigenous knowledge and the integration of knowledge systems: Towards a philosophy of articulation*. New Africa Books.
Ogunniyi, M. B. (2007). Teachers' stances and practical arguments regarding a science-indigenous knowledge curriculum: Part 1. *International Journal of Science Education, 29*(8), 963–986. https://doi.org/10.1080/09500690600931020
Phelan, P., Davidson, A. L., & Cao, H. T. (1991). Students' multiple worlds: Negotiating the boundaries of family, peer, and school cultures. *Anthropology & Education Quarterly, 22*(3), 224–250. https://doi.org/10.1525/aeq.1991.22.3.05x1051k
Shizha, E. (2007). Critical analysis of problems encountered in incorporating indigenous knowledge in science teaching by primary school teachers in Zimbabwe. *Alberta Journal of Educational Research*, *53*(3), Article 3. https://journalhosting.ucalgary.ca/index.php/ajer/article/view/55295
Shizha, E. (2010). The Interface of neoliberal globalization, science education and indigenous African knowledges in Africa. *Journal of Alternative Perspectives in the Social Sciences., 2*(1), 26–58.
Sotero, M. C., Alves, Â. G. C., Arandas, J. K. G., & Medeiros, M. F. T. (2020). Local and scientific knowledge in the school context: Characterization and content of published works. *Journal of Ethnobiology and Ethnomedicine, 16*(1), 23. https://doi.org/10.1186/s13002-020-00373-5
Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press.

Vongai Mpofu is a science educationist with a specialty in Chemistry in the Faculty of Science Education at Bindura University of Science Education. She coordinates the designing of secondary school science teacher programs, teaches chemistry, pedagogy of sciences, history and philosophy of science, and research to undergraduate and postgraduate students, and develops teaching, learning and research materials. She also supervises student research including PhD and trains on research and its supervision. Her main research interest is in science education including STEM teaching, indigenous knowledge and school science and indigenous qualitative research. She is an awardee of the Seeding Labs Instrumental Access Laboratory Equipment grant 2020 and is actively involved in other grant applications in science education.