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Infusing Indigenous Knowledge Systems (IKSs) in Technology Education: A Case of Food Processing and Preservation in a Rural Agricultural-based Economy

Joel Timire[1] & Bekithemba Dube[1]
[1] Centre for Diversity in Higher Education Research, Central University of Technology, South Africa.

ABSTRACT
This empirical paper discussed the lack of indigenous knowledge systems in the senior phase Technology education syllabus with reference to food processing and preservation for a sustainable rural agricultural-based economy. This omission robs learners of their heritage and history as they may not be able to apply generational knowledge to perpetuate food security in a rural agricultural-based economy. The paper was grounded in critical emancipatory theory, which argued for the inclusivity of all forms of knowledge based on the history and aspirations of a people. In this qualitative paper, structured interviews were administered to 4 Technology education lecturers from 4 Universities of Technology (UoTs) in South Africa. Participants were purposively selected and responded to 2 questions. Thematic analysis was used to analyse and present the data. The study found that IKS broadens learners' educational experiences from which the development of appropriate technologies could emerge. IKS could be infused into the curriculum through the involvement of knowledgeable community resource persons. The study recommended the inclusion of indigenous knowledge systems in the Technology education syllabus to empower learners from rural agricultural-based economies. The study provides insights into the nature of knowledge and skills relevant in dynamic and evolving economies for curriculum planners and research scholars.

Keywords: *Appropriate Technology, Food Processing and Preservation, Indigenous Knowledge Systems, Traditional Practices.*

Correspondence
Bekithemba Dube
Email: bdube@cut.ac.za

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INTRODUCTION
The teaching of Technology in the Senior Phase (Grades 7-9) in the South African schools includes technological concepts such as food processing and preservation. The bulk of the concepts on this topic are modern scientific and Eurocentric food processing and preservation techniques that introduce learners to the fundamentals of the food and nutrition environment. At this stage, learners are introduced to the fundamentals of food science. The Senior Phase Technology curriculum is designed

to expose learners to the basics of technology and the technological process.[1] A closer look at the content of the Senior Phase Technology syllabus reveals a glaring imbalance between Eurocentric and Afrocentric knowledge, hitherto referred to as indigenous knowledge systems. This imbalance prejudices rural learners whose local economies are sustained by agriculture. Historically, rural economies that are agriculturally based have utilised appropriate technology to process and preserve food for generations. [2]

The appropriate food processing and preservation methods used in rural areas have not been captured and documented for educational purposes.[3] This has affected the knowledge capture and transmission through generations. Without formal recognition in the curriculum, knowledge of food processing survives on traditional folklore and information. and is classified as an Indigenous Knowledge System (IKS).[4] Consequently, Masekoameng and Molotja argue that IKS in rural food processing and preservation are dying a slow death with the passage of time as the older generation departs without transferring the knowledge and skills to the younger generation.[5] It is with this understanding that the researchers argue for the rethink of the Technology curriculum towards integration of IKS. This study supports the observation by Huho that including IKSs in formal education programmes promotes diversity and inclusivity of knowledge to the benefit of learners from diverse socio-economic backgrounds.[6] By arguing for IKS, the study does not undermine the Eurocentric contribution to the curriculum, however, it submits as argued by Jans, Kaindi and Meile that blending modern (Eurocentric) knowledge with traditional (Afrocentric) knowledge ensures sustainability and continuity of knowledge production and dissemination.[7] The result is a balanced knowledge ecosystem in which Eurocentric and Afrocentric knowledge systems complement each other as opposed to being competing entities.

This paper comes against the view that various studies have been conducted on the inclusion of indigenous knowledge systems in mainstream education programmes. In a book chapter entitled 'Indigenous Knowledge Systems and the Curriculum', Shizha argues that the education system that was introduced by colonial regimes and continues to be provided in African schools is largely dependent on imported systems, which are Eurocentric in nature.[8] According to Shizha, an indigenized school curriculum enhances the success, cognitive development, and academic achievement of learners.[9] There is a history of fierce debate between oppositional positions taken on the question of including indigenous knowledge (IK) in the science curriculum.[10] Their research into the inclusion of Māori knowledge in the science curriculum in Aotearoa New Zealand indicates that such efforts often employ emblematic aspects, extracted from authentic cultural contexts, and treated in isolation from the historical socio-political relationship between Māori and Western cultures. In this way, including indigenous knowledge in the science curriculum exposes deeper layers of cultural knowledge to caricature, in the form of distorted representation.

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[1] Department of Basic Education, *Curriculum and Assessment Policy Statement: Technology* (Pretoria, SA: Department of Basic Education, 2012).
[2] Tom Tom, "Decades of Land and Agrarian Reform in Zimbabwe: A Review of Transformative Social Policy Lessons for Other African Countries," *The African Review*, October 14, 2024, 1–28, https://doi.org/10.1163/1821889x-bja10143.
[3] Fatma Osman Ibnouf, "The Value of Women's Indigenous Knowledge in Food Processing and Preservation for Achieving Household Food Security in Rural Sudan," *Journal of Food Research* 1, no. 1 (2012): 238.
[4] J Okoye and K Oni, "Promotion of Indigenous Food Preservation and Processing Knowledge and the Challenge of Food Security in Africa," *Journal of Food Security* 5, no. 3 (2017): 75–87.
[5] M R Masekoameng and M C Molotja, "Contribution Of Indigenous Food Preservation And Processing Practices To Food Security Of Rural Households In Sekhukhune District Of Limpopo Province, South Africa," *African Journal of Food, Agriculture, Nutrition and Development* 23, no. 7 (2023): 24115–35.
[6] Julius M Huho, "Reducing Food Loss and Waste through Innovative Food Preservation Technologies Applied by Women in Rural Areas in Kenya," *International Journal of Latest Research in Humanities and Social Science (IJLRHSS) Vol* 3, no. 1 (2020): 76–82.
[7] C Jans, D W Mulwa Kaindi, and Leo Meile, "Innovations in Food Preservation in Pastoral Zones," *Rev Sci Tech* 35, no. 2 (2016): 597–610.
[8] Edward Shizha, "The Indigenous Knowledge Systems and the Curriculum," in *African Indigenous Knowledge and the Disciplines* (Brill, 2014), 113–29.
[9] Shizha, "The Indigenous Knowledge Systems and the Curriculum."
[10] Elizabeth McKinley and Georgina Stewart, "Out of Place: Indigenous Knowledge in the Science Curriculum," *Second International Handbook of Science Education*, 2012, 541–54.

In a study carried out in Australia on the incorporation of indigenous knowledge systems into the curriculum, Austin and Hickey discovered that there was a dire need to incorporate local indigenous knowledge and perspectives in the draft national curricula of History, Maths, Science, English, and Art.[11] The study recommended the reconceptualization of what constitutes Science as currently taught in schools. This study is corroborated by Wilujeng and Prasetyo who carried out a study on the indigenous Javanese people and science education.[12] The results of the study propose four steps to integrate indigenous knowledge into the science curricula: fragmented, connected, sequenced, and integrated. Further, this study establishes a significant connection between what learners encounter in the school and their lives beyond the classroom for cultural sustainability. It is worthwhile to note from this study that the indigenous knowledge incorporated into the science curricula includes attitude, knowledge, and skill aspects. Another study carried out by Mandikonza to establish sustainability practices that have been passed down for many generations and have enabled people to survive in their environment and derive benefit from the practice found that certain indigenous sustainability practices could be incorporated into the formal science teacher training classroom with a view to expanding the teaching and learning of science curriculum concepts.[13] An interesting study done by Mudaly who invited an indigenous knowledge expert to teach pre-service student teachers indigenous farming techniques established that consciousness-raising had occurred among the participants about the value of indigenous knowledge.[14] The participants in this study endorsed the IK expert as a legitimate teacher in higher education. This is one research that demonstrated that using IKS to transform and decolonize the curriculum by engaging an IK expert to teach brought previously marginalized IK to the center.

While the above studies have made contributions to the study of indigenous knowledge systems in the school curricula, none of the studies has focused on the infusion of IKS in Technology education with reference to rural food processing and preservation. Thus, the study is unique as it argues for the infusion of indigenous knowledge systems in Technology education to ensure the perpetuity of sustainable rural agricultural-based economies by harnessing appropriate food processing and preservation technologies. Considering this, the aim of the study is to explore the benefits of including indigenous knowledge systems in the Technology Senior Phase curriculum, with a special focus on rural food processing and preservation technologies that have sustained rural communities for ages but are now in danger of extinction. The paper is arranged as follows: theoretical framework, then methodology, findings, and conclusion.

THEORETICAL FRAMEWORK

This study is grounded in critical emancipatory theory as advanced by Karl Marx who views it as seeking self-clarification of the age struggles and wishes of the age; Jurgen Habermas who advocates for the securing of the moral validity of social struggles; Max Horkheimer and Michel Foucault who take the normative orientations of struggles for emancipation as being directed at social justice.[15] It is Karl Marx in particular, who identified two critical elements of CET relevant to this study namely: (1) a connection to social and political struggles of emancipation and (2) self-reflexivity. Participants in this study are seen as fountains of generational knowledge and wisdom that have taken a back seat in formal education and are in a constant struggle for social justice and recognition of the traditional body

[11] Jon Austin and Andrew Hickey, "Incorporating Indigenous Knowledge into the Curriculum: Responses of Science Teacher Educators," *The International Journal of Science in Society* 2, no. 4 (2011): 139–52.
[12] I. Wilujeng and Z. K. Prasetyo, "Elaborating Indigenous Knowledge in the Science Curriculum for the Cultural Sustainability," *Journal of Teacher Education for Sustainability* 20, no. 2 (2018): 74–88.
[13] Caleb Mandikonza, "Integrating Indigenous Knowledge Practices as Context and Concepts for the Learning of Curriculum Science: A Methodological Exploration," *Southern African Journal of Environmental Education* 35 (2019).
[14] Ronicka Mudaly, "Towards Decolonising a Module in the Pre-Service Science Teacher Education Curriculum: The Role of Indigenous Knowledge Systems in Creating Spaces for Transforming the Curriculum," *Journal of Education (University of KwaZulu-Natal)*, no. 74 (2018): 47–66.
[15] Robert J Antonio, "The Normative Foundations of Emancipatory Theory: Evolutionary versus Pragmatic Perspectives," *American Journal of Sociology* 94, no. 4 (1989): 721–48; Shannon Brincat, "On the Methods of Critical Theory: Advancing the Project of Emancipation beyond the Early Frankfurt School," *International Relations* 26, no. 2 (2012): 218–45; Fawzia Gilani-Williams, "Islamic Critical Theory: A Tool for Emancipatory Education.," *International Journal of Islamic Thought* 5 (2014); Fabian Freyenhagen, "Critical Theory: Self-Reflexive Theorizing and Struggles for Emancipation," 2018.

of knowledge. Food processing and preservation are used in this study for demonstrative purposes to illustrate one area in education in which indigenous communities have been disenfranchised and alienated from their traditional practices. This makes CET suited for this study. Furthermore, CET addresses contested knowledge spaces within communities that have seen the sidelining of one body of knowledge (traditional) over the furtherance of another (modern). This constitutes social injustice in the view of these researchers. In this way, CET problematise sites and processes which exclude other forms of knowledge in the curriculum. Thus, CER moves towards fair representation of different knowledge systems as an act of empowerment especially. This theory empowers the argument that the Technology subject should engage IKS while appreciating the contribution of Eurocentrism to the curriculum.

METHODOLOGY

This study is located within the transformative paradigm largely because it seeks to change the current status quo of technology education. Locating this paper in the transformative paradigm, the researcher was convinced that "African cultures are repositories of a substantiated body of knowledge on how to maintain harmonious communities,"[16] including issues of food security. Transformative paradigm with its "associated philosophical assumptions provides a framework for addressing inequality and injustice in society using culturally competent, mixed methods strategies." [17] In doing so, transformative paradigms "address[es] power issues, social justice, and cultural complexity throughout the research process."[18] The researchers chose to locate this study in this paradigm since it correlates with TP emphasises the theory of the study which both of them seek to "deliberate include groups that have historically experienced oppression and discrimination on the basis of gender, culture, economic levels, ethnicities/races, and sexual orientation, and disabilities, and in a conscious effort to build a link between the results of the research and social action."[19] The research was conducted using 4 purposively selected University of Technology lecturers. Three were males, (Coded M1, M2, and M3) and 1 female, (Coded F1). Open-ended group interviews were administered and this enabled us to probe further for clarity.[20] Prior consent was sought from the identified participants through emails. The interviews were conducted online through the Teams platform. Participants needed to respond to two questions which are; What are the benefits of including indigenous knowledge systems in the Technology Senior Phase curriculum with reference to food processing and preservation? How can IKS be integrated into the Technology education subject? To analyse data the researchers used the thematic approach suggested by Squires,[21] which provides seven steps:

Step 1: Reading and rereading all the collected data: The data from the interviews and focus group discussion were read and reread, to get the essence of the implementation of the new curriculum.

Step 2: Drawing up a preliminary list of themes arising from the data: Major issues and themes were identified and arranged according to the research question of the study.

Step 3: Rereading the data: By rereading the data, the researchers checked if the themes they had identified corresponded with what the participants said and with the research questions.

Step 4: Linking the themes to quotations and notes: The themes emerging from the data were linked to various scholarly views.

Step 5: Perusing the categories of themes to interpret them: During the interpretation of the data, the researchers remained cognisant of the research question.

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[16] Tim Murithi, "An African Perspective on Peace Education: Ubuntu Lessons in Reconciliation," *International Review of Education* 55 (2009): 223.

[17] Donna M Mertens, "Transformative Paradigm: Mixed Methods and Social Justice," *Journal of Mixed Methods Research* 1, no. 3 (2007): 212.

[18] Lisa M Given, *The Sage Encyclopedia of Qualitative Research Methods* (Sage Publications, 2008).886.

[19] Mertens, "Transformative Paradigm: Mixed Methods and Social Justice."2.

[20] Judith R Boyland, "A Social Constructivist Approach to the Gathering of Empirical Data," *Australian Counselling Research Journal* 13, no. 2 (2019): 30–34.

[21] Vicki Squires, "Thematic Analysis," in *Varieties of Qualitative Research Methods.* , ed. J.M. Okoko, S. Tunison, and K.D. Walker (Springer Texts in Education, 2023), 463–68, https://doi.org/10.1007/978-3-031-04394-9_72.

Step 6: Designing a tool to help discern patterns in the data: Through this, the researchers were able to determine the patterns during data analysis.
Step 7: Interpreting the data and deriving meaning: the researchers identified themes which then became the subheadings.

To validate data, the researchers did member checking where data put in themes was sent back to the participants.[22] The following section discusses the results which respond to the research questions.

PRESENTATION OF FINDINGS AND DISCUSSIONS

This section presents and discusses the data generated from the participants.

Benefits of including indigenous knowledge systems in the Technology Senior Phase curriculum with reference to food processing and preservation

In responding to this question, the participants detailed some traditional food processing and preservation technologies that sustained rural communities.

1. IKS enhances cultural preservation: Boiling and roasting Grains

The study participants indicated that IKS for inclusion of Technology Education is important since it enhances cultural preservation. The sentiments below capture the discussion of the participants;

> M1: *"….. the staple crop sustaining rural communities was white maize. Consumption of the crop started while it was still green in the field. It could be boiled or roasted at this stage. The main preservation method applied to green maize for future consumption involved harvesting the green maize, and boiling it with the sheaves on the cob until the sheaves turn golden yellow. The addition of salt was optional during the boiling. After the boiling, the sheaves are opened and used to suspend the maize cob on the roof thatching in the roundavel kitchen. The smoke from the fireplace dries the maize cobs. The soot that gathers around the maize cobs add flavour. After 2 weeks the maize cobs are completely dry and look rusty brown from the soot. The sheaves are then detached from the maize cobs which are packaged and stored in a cool and dry place. The maize cobs preserved using this method are consumed 8-10 months after preservation or during times of food scarcity. Preparing them for consumption would involve pre-boiling for a few minutes to soften them before eating them. Most households considered maize cobs preserved in this way a delicacy fit for special occasions and entreating guests. Knowledge of these practices in the school curriculum promotes the preservation of our culture."*

In addition,

> M2: "*Allied maize processing and preservation methods that are still being practised involve harvesting the dry maize cobs, removing the sheaves, erecting a granary that sits on four poles and 2-3 metres from the ground and loading the dry sheaveless maize cobs. When the need for maize meal arises, the required quantity is shelled, pounded with a pestle and mortar and ground into a fine mealie meal. Young male adults were taught to erect the granary structures, while young female adults were taught how to pound and grind the maize meal. This is how our cultural practices have sustained our communities for ages……"*

While in discussion, M3 noted that;

> *"…infusing IKS into Technology education facilitates knowledge and skills transfer relative to societal needs and to keep up with the everchanging technological landscape. This is in line with upholding cultural traditions, making sure that cultural norms and values are not obliterated by modernity."*

[22] Linda Birt et al., "Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation," *Qualitative Health Research* 26, no. 13 (November 10, 2016): 1802, https://doi.org/10.1177/1049732316654870.

F1 observed that

> "*some learners come from rural communities that have no access to modern food processing and preservation technologies and could do better with locally developed and affordable appropriate technology. Such learners learn better if they are not alienated from their cultural traditions."*

All 4 participants concurred that infusing this knowledge into the Technology Senior Phase syllabus would enable learners to appreciate the correlation between modern science, IKS and cultural traditions. In modern food processing and preservation methods, the aim is to eliminate any one of the three conditions conducive to bacterial growth namely: moisture, oxygen, and warmth.[23] The indigenous methods of preserving white maize as described here might not have been grounded in scientific reasoning but shows that traditional knowledge is scientific in nature. Drying the maize cobs after boiling eliminates moisture thus making it bacterial-resistant. Salt dehydrates bacteria through osmotic pressure and together with soot adds flavour to the food. Exposing food to soot is akin to the modern method of smoking food as applied to fish, meat (*biltong*), and green vegetables. This method also targets the elimination of moisture from the food. It is argued in this paper that modern science and indigenous knowledge have a complimentary and symbiotic relationship. Indigenous knowledge systems have been treated in isolation yet clearly reflect scientific logic. If indigenous knowledge is infused into mainstream education, learners benefit from both modern and traditional bodies of knowledge.[24] This also bodes well with the transformative paradigm adopted for this study as we advocate for curriculum transformation in Technology education to accommodate cultural diversity.

2. IKS drives appropriate technology innovation: Interring Tubers

Another benefit noted by the participants is that IKS promotes technology innovation. In a discussion, F1 noted that

> "*Potatoes and sweet potatoes were the main tubers grown by rural communities. The common processing and preservation method identified by all the participants involved interring the harvested tubers. After harvesting the tubers and carting them to the homestead, a $1m^3$ hole is dug in the yard. All 5 walls of the hole are plastered with raw cow dung paste. The paste is allowed to dry. Ash that has been accruing from the fireplace is sprinkled around the walls. The tubers are then put into the hole without having washed them. After every load, more dry ash is sprinkled until the hole is full to the brim. Dry earth is then rammed gently into the hole. Finally, the hole is covered with asbestos or zinc sheathing and a final layer of earth. This underground 'silo' will keep the tubers fresh for consumption later, especially off-season."*

This method of preserving tubers is both scientific and sustainable for rural communities that have no access to modern food processing and preservation technologies. Cow dung paste, which they also use to plaster or smear on the floors, has anti-bacterial properties.[25] This is corroborated by Girija, et. al., Sharma and Singh and Gupta, Aneja and Rana who agree that cow dung has antibacterial, antimicrobial, antiseptic and prophylactic properties.[26] In addition, M1 states,

> "*We would smear the cow dung paste to an open wound and it would heal within days. The argument here is that if modern science can confirm and validate indigenous knowledge systems, then what is the reason for not exposing our learners to these truths? Through exposure to modern and traditional bodies of knowledge, learners are empowered to harness*

[23] B. Sivasankar, *Food Processing and Preservation* (PHI Learning Pvt. Ltd., 2002).
[24] Mohammad Shafiur Rahman, "Food Preservation: An Overview," *Handbook of Food Preservation*, 2020, 7–18; James S Chacha et al., "Revisiting Non-Thermal Food Processing and Preservation Methods—Action Mechanisms, Pros and Cons: A Technological Update (2016–2021)," *Foods* 10, no. 6 (2021): 1430.
[25] M K Mohan Maruga Raja, Ravi Manne, and Agilandeswari Devarajan, "Benefits of Cow Dung-a Human Ignored Gift.," 2021.
[26] D Girija et al., "Analysis of Cow Dung Microbiota—a Metagenomic Approach," 2013; Bharti Sharma and Maneesha Singh, "Isolation and Characterization of Bacteria from Cow Dung of Desi Cow Breed on Different Morpho-Biochemical Parameters in Dehradun, Uttarakhand, India," *Int. J. Adv. Pharm. Biol. Chem* 4, no. 2 (2015): 276–81; Kartikey Kumar Gupta, Kamal Rai Aneja, and Deepanshu Rana, "Current Status of Cow Dung as a Bioresource for Sustainable Development," *Bioresources and Bioprocessing* 3 (2016): 1–11.

this knowledge in technology innovations that are responsive and sustainable in their domains."

Gupta, et.al., also observe that cow dung is a cheap bioresource that has uses as burning fuel, mosquito repellent and as a cleaning agent.[27] All this knowledge is already embedded in indigenous practices. Javed, et.al, argue that cow dung extract mediated the green synthesis of zinc oxide nanoparticles for agricultural applications.[28] If this knowledge is not captured and assimilated into the formal education system, then future generations will have been shortchanged. The study argues here for the infusion of IKS especially on practices that have sustained rural communities for ages and those practices that are fading into the sunset with the older generation.

Similarly, Krishnadevi, et.al., point out that ash has antibacterial properties.[29] Kirgiz, et.al., and Amutha and Sridhar concur by concluding that ash from the leaves of Glycosmis mauritiana (Lam) has antibacterial and antifungal properties against human pathogens.[30] The use of ash on cow dung plaster has been shown to reinforce the plaster against moisture and the proliferation of microbials.[31] Juxtaposing modern science against indigenous knowledge reveals a common thread of deep-seated and age-old wisdom in the latter that is explained by the former. The only difference is in the validation and publication of indigenous knowledge in the knowledge economy. While indigenous knowledge systems lack the rigorous experimentation and testing of the knowledge underpinning traditional practices, modern science has closed that gap through research. Infusing IKS in technology education means that scholars are empowered to improve traditional technologies to move with the times.

Curriculum reforms in Technology education with the infusion of IKS have the potential to be a key driver in the development of appropriate technologies in food processing and preservation in rural areas to achieve food security. However, M2 felt that IKS has been overtaken by the latest developments in science and technology that place eminence in mass production and preservation of food. He acknowledged the importance of IKS in "*cultural preservation"* but argued for a more scientific approach to studying the scientific logic behind each traditional food processing and preservation practice. M1 felt that infusing IKS into Technology education *"broadens learners' filed of experience thus empowering them to come up innovative designs of technologies that embrace both traditional and modern science and are relevant to specific communal needs."*

It is thus the posture of this paper that infusing IKS in Technology education helps learners to solve local problems through the design of appropriate technology using modern science and traditional practices. This is in line with the critical emancipatory theory with a transformative agenda as advanced in this paper.

3. IKS promotes technological skills transfer: Sun-drying Canes

The African sugarcane, which is grown in the same field and at the same time with maize, supplies the glucose dietary needs of the human body. All 4 participants agreed that the African sugarcane, (*Ipwa*), differentiated from the commercial sugarcane by its thin stalk and short maturation cycle is found in most maize fields of rural communities during the growing season. When the cane has matured, as shown by the drying tussles and leaves, it can be consumed right there in the field by peeling, chewing the molasse, sucking the sweet juice and spitting out the residue. The same canes can be harvested

[27] Gupta, Aneja, and Rana, "Current Status of Cow Dung as a Bioresource for Sustainable Development."
[28] Zoya Javed et al., "Cow Dung Extract Mediated Green Synthesis of Zinc Oxide Nanoparticles for Agricultural Applications," *Scientific Reports* 12, no. 1 (2022): 20371.
[29] K Krishnadevi et al., "Environmentally Sustainable Rice Husk Ash Reinforced Cardanol Based Polybenzoxazine Bio-Composites for Insulation Applications," *Polymer Bulletin* 77, no. 5 (2020): 2501–20.
[30] Mehmet Serkan Kırgız et al., "Physico-Antibacterial Feature and SEM Morphology of Bio-Hydraulic Lime Mortars Incorporating Nano-Graphene Oxide and Binary Combination of Nano-Graphene Oxide with Nano Silver, Fly Ash, Zinc, and Titanium Powders," *Buildings* 13, no. 1 (2023): 172; S Amutha and S Sridhar, "Green Synthesis of Magnetic Iron Oxide Nanoparticle Using Leaves of Glycosmis Mauritiana and Their Antibacterial Activity against Human Pathogens," *Journal of Innovations in Pharmaceutical and Biological Sciences* 5, no. 2 (2018): 22–26.
[31] Zengxiao Cai et al., "Fabrication of a Cost-Effective Lemongrass (Cymbopogon Citratus) Membrane with Antibacterial Activity for Dye Removal," *RSC Advances* 9, no. 58 (2019): 34076–85.

from the field, taken home to be peeled, and dried on top of the roof or flat rock surfaces (*Ruware*). The effect is that moisture evaporates, and the cane shrinks considerably, leaving a high sugar contrate on a thin 'stick'. This candy stick is then packaged and stored in a cool dry place to be enjoyed off-season. Nothing goes to waste as the peels and residue are fed to the livestock.

Drying the sugarcane draws out the moisture, while the remaining sugar concentrates are like syrup which dehydrates bacteria, thereby inhibiting bacterial growth.[32] While this knowledge is in the public domain, indigenous technologies applying the same knowledge and the reasoning behind the application remain unexplained phenomena. In a discussion, F1 noted that;

> Learners need to be exposed to such scenarios so that those who "*come from rural backgrounds have an opportunity to 'plough back' that knowledge in their communities by improving the traditional technologies for better productivity."*

In addition, M1, noted that;

> "*Rural communities may not have the capacity and access to modern food processing and preservation technologies such as canning, edible coating, cold preservation, pasteurisation, pickling, and sublimation.*

Two participants testified that at one point their rural parents made a living by trading in sugarcane 'sticks' in nearby towns.

M1 and M2 identified the benefit of entrepreneurship as accruing to rural communities through the infusion of IKS into Technology Education. This showed that if indigenous technologies are fully integrated with modern science, communities stand to benefit through income-generating projects that are sustainable over time. The views expressed by the two participants showed their parents were in a constant struggle to survive amidst the ever-changing world. Their knowledge and skills sustained them to a point and when modernity set in, only those who could afford the new technologies remained afloat. This brings to the fore issues of emancipation and social justice, issues that could be addressed through education by recognising and accommodating IKS.

The researchers argue that IKS in Technology education could be the bedrock of technology transfer leading to entrepreneurial undertakings. This has the potential to cascade down to employment creation and the upliftment of rural agricultural-based communities.

4. IKS fosters health and safety consciousness: Gathering Wild Mushrooms

Participants F1 and M3 pointed out that the gathering of wild mushrooms and their subsequent processing and preservation was a predominantly feminine domain. In a discussion, F1 noted that

> "*Only experienced women were involved in gathering wild mushrooms, a much sought-after delicacy when in season. The most critical part was in differentiating edible wild mushrooms from poisonous ones. The researchers were interested in finding out how the wild mushroom gatherers could tell apart poisonous mushrooms from non-poisonous ones. I was raised in a rural area, and I was trained by my grandmother how to tell if a mushroom variety was edible or not. During the mushroom gathering season, her grandmother would take her to the bushes and test the wild mushroom variety by squeezing it. If it releases juice, then it is poisonous. Poisonous wild mushrooms were also conspicuous by their abundance as tortoises that feed on mushrooms left the poisonous ones untouched while selectively feeding on the non-toxic mushrooms. This training helped to avert fatal disasters in which whole families have reportedly perished after consuming wild poisonous mushrooms."*

[32] Bart Lievens et al., "Microbiology of Sugar-rich Environments: Diversity, Ecology and System Constraints," *Environmental Microbiology* 17, no. 2 (2015): 278–98; Omer N Alsawmahi et al., "Enzyme Activity, Sugar Composition, Microbial Growth and Texture of Fresh Barhi Dates as Affected by Modified Atmosphere Packaging," *Journal of Food Science and Technology* 55 (2018): 4492–4504; Luke Mizzi et al., "Assessing the Individual Microbial Inhibitory Capacity of Different Sugars against Pathogens Commonly Found in Food Systems," *Letters in Applied Microbiology* 71, no. 3 (2020): 251–58.

This was indeed corroborated by a report in The Herald, on February 19, 2020, that showed that a rural Chirumanzu woman (63) in Zimbabwe and her two children aged 28 and 15 died after consuming poisonous mushrooms. Six family members survived after hospitalisation. Moor-Smith, Li and Ahmad found out that the most poisonous mushroom, *amanita phalloides* can be easily confused with the edible mushrooms such as the puffball and the paddy straw mushroom.[33] These mushrooms are responsible for 90% of the world's mushroom-related fatalities. Further, participant F1 stressed that such accidents were unheard of in her lifetime.

After the edible mushrooms have been gathered, some are cooked for immediate consumption while the rest are boiled in salted water and sun-dried. The boiling has the effect of breaking the cell membrane of the mushroom making it easy for digestion. The salt is a preservative that dehydrates bacteria during and after the drying process. The dried mushroom is then packaged in calabashes and stored in a cool dry place. At times when relish is scarce, the dried mushroom is prepared in a peanut butter gravy, making a sumptuous relish to go with a maize meal thick porridge called *sadza* or *pap.* When it comes to safety in consuming mushrooms, the whole family relies on the judgement of the mushroom gatherer, exhorted Participant F1.

It can be argued here that teaching or training in indigenous knowledge and practices is as vital as it is in learning scientific and technological concepts. Lack of training leads to tragedies such as reported in the consumption of toxic mushrooms. A lot of research has been conducted on mushroom farming technologies. Synchronising IKS and modern mushroom-growing technologies leads to a more sustainable supply of mushrooms in rural economies. The advantage of embracing modern technologies in mushroom farming is that the mushrooms can be supplied throughout the year with no risk of growing toxic mushrooms. Similarly, infusing IKS into Technology education has the potential to improve safety in food handling as learners share research findings with their communities as well as facilitate the adoption of appropriate mushroom farming technologies that ensure a constant supply of mushrooms throughout the year. The researchers steadfastly maintain that the infusion of IKS in Technology education has both emancipatory and transformative dimensions.

Integration of Indigenous Knowledge System into Technology Education in South Africa

This section responds to question 2 of the study, which is how IKS can be integrated into the technology curriculum and the first point raised is the promotion of research and publication.

1. ***Infusion of IKS through research and publication***

The responses to this question revealed a deep departure from the value attached to traditional practices in favour of formal education. All the participants echoed the view that curriculum transformation in Technology education was imperative to realise equity and reflect diversity.

M1 said that,

> "*there was a need for extensive research into traditional food processing and preservation practices with a view to bringing them into the public domain through publications. This would enhance the acceptance of IKS by the broader academic community. Currently, IKS is viewed as being primitive and devoid of scientific reasoning."*

According to Henri, et.al., there is a need to understand how and where studies have woven IKS and Western sciences together to learn about frameworks and processes used and identify best practices.[34] They support the idea of creating databases on various topics on IKS so that any scholar can locate a discipline of their interest. The study argues here that the topic of traditional practices in food processing and preservation, for example, could be added to such a database and be available for educational purposes. The dearth of publications on IKS was brought to the fore by Mbah, Ajaps and

[33] Maxwell Moor-Smith, Raymond Li, and Omar Ahmad, "The World's Most Poisonous Mushroom, Amanita Phalloides, Is Growing in BC.," *British Columbia Medical Journal* 61, no. 1 (2019).

[34] Dominique A Henri et al., "Weaving Indigenous Knowledge Systems and Western Sciences in Terrestrial Research, Monitoring and Management in Canada: A Protocol for a Systematic Map," *Ecological Solutions and Evidence* 2, no. 2 (2021): e12057.

Molthan-Hill who looked into IKS and climate change.[35] Only 2 databases and grey literature searches yielded 39 relevant articles on the subject. However, as far back as 2002, Loubser experienced the reluctance by the National Research Fund (NRF) to approve projects in the IKS focus area.[36] Interestingly, Loubser reports that at the First South African Colloquium on IKSs held in Bloemfontein projects by 9 government departments in the natural sciences and humanities disciplines focusing on IKS were mentioned.[37] Of these projects, 253 were funded by the NRF to the tune of R30 million. This demonstrates that there is an opportunity for growth and resources for research on IKS, provided the funders are satisfied with the impact the research will have on Strategic Development Goals (SDGs).

2. *Infusion of IKS through content development*

However, F1 stressed that studies into IKS abound but curriculum planners were not receptive to transformation and preferred to stick with the current literature which is mainly pro-Eurocentric. She was of the view that academics should consider developing IKS content and resource materials before lobbying for the infusion of indigenous knowledge systems into the Technology education syllabus.

> "*Doing so works to the advantage of learners from an early age as some may opt for careers aligned to the development of appropriate technologies that incorporate IKS and science with an inclination on food processing and preservation."*

This view was shared by M2 who pointed out that the recommended textbooks for the Technology Senior Phase that he was using to train Technology education teachers only had basic information that had little to do with IKS but took a scientific trajectory.

> "*I once asked my students to tell me some of the methods that were used to preserve food in their cultures and got muted responses. This showed a serious lack of IKS awareness in our current crop of trainee teachers."*

Tharakan argues in the paper *Indigenous Knowledge Systems for Appropriate Technology Development* that content on IKS needs to be reviewed and evaluated contextually to determine the applicability, relevance and sustainability of the IKS in the development of appropriate technology.[38] The researchers are in favour of this approach towards IKS content creation as it recognises the diverse disciplines such as environment, water, sanitation, agriculture, and technology in which IKS plays an important role. Carm advocates for a methodical approach to content development that considers cultural sensitivities and the validation of the IKS content by both indigenous community leaders and scientists.[39] The researchers are of the view that the content must be tested for authenticity, currency, veracity, and validity in its context before publication. This would avoid the proliferation of fake knowledge touted as IKS.

3. *Infusion of IKS through engaging community resource experts*

A common thread in all the participants' responses on how IKS could be infused with Technology education was making use of knowledgeable community experts when drawing up the content. F1 also suggested that,

> "*Technology teachers could invite resource experts from the community who are knowledgeable in specific traditional practices to share with learners their knowledge and experiences."*

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[35] Marcellus Mbah, Sandra Ajaps, and Petra Molthan-Hill, "A Systematic Review of the Deployment of Indigenous Knowledge Systems towards Climate Change Adaptation in Developing World Contexts: Implications for Climate Change Education," *Sustainability* 13, no. 9 (2021): 4811.

[36] J A Loubser, "Unpacking the Expression" Indigenous Knowledge Systems"," *Indilinga African Journal of Indigenous Knowledge Systems* 4, no. 1 (2005): 74–88.

[37] Loubser, "Unpacking the Expression" Indigenous Knowledge Systems"."

[38] John Tharakan, "Indigenous Knowledge Systems for Appropriate Technology Development," in *Indigenous People* (InTech, 2017), https://doi.org/10.5772/intechopen.69889.

[39] Ellen Carm, "Inclusion of Indigenous Knowledge System (IKS)–A Precondition for Sustainable Development and an Integral Part of Environmental Studies," *Journal of Education and Research* 4, no. 1 (2014): 58–76.

This is corroborated by Mudaly who invited an expert in traditional agricultural practices from the community to teach university students.[40] M2 argued that,

> "*lecturers were constrained in inviting IKS experts from the community to conduct lessons because it is difficult to ascertain the credentials of the resource persons and the educational benefits of the content to the students."*

While the researchers feel that lecturers have the academic freedom to invite community leaders who can enrich the learning experience of their students, the expectations of the invited expert might be at variance with the institution with regard to remuneration. This point was confirmed by M3 who felt that *"some external experts on IKS may not view sharing their indigenous knowledge with students as a community service but an opportunity to be compensated financially."* The researchers argue that this challenge could be navigated by having a budgetary component dedicated to such contingencies. This is normal practice in universities that give a token of appreciation to Public Lecture guest speakers. As in the case of Mudaly in which the expert took some time to grow the plants with the students, a contract with the expert could be drawn up to the satisfaction of all involved parties.[41] In a study, *The role of IKSs in the management of forest resources in Mugabe area, Masvingo, Zimbabwe* by Tanyanyiwa and Chikwanha, it was found that the youth are not appreciative of IKS methods which they viewed as '*primitive and old fashioned'*.[42] The researchers recommended that IKSs needed to be well communicated to the youth. It is argued here that this is where community experts on the subject can be roped in to educate learners.

Mpofu and Miruka report that the transfer of indigenous knowledge could only be possible through incorporating IKS into the normal systems of 'modern' learning like schools.[43] They argue that this is because the young generation spends most of their time at these 'modern' institutions of learning. A compelling argument has already been made in this paper for the infusion of IKS in food processing and preservation in Technology education. The findings from Mpofu and Miruka's study point to the fact that IKS risk being extinct hence documentation of this knowledge should be instituted to preserve it.[44] This was amply demonstrated in Mudaly's study in which an indigenous knowledge expert was invited to share agricultural knowledge with undergraduate students.[45]

The researchers submit that indigenous knowledge experts have a role to play in passing on their knowledge and skills to the younger generation, while academics and researchers need to capture and document these experiences before they are lost in the passage of time. These are the core tenets of emancipation and the transformative agenda that education has to play in society.

RECOMMENDATIONS

It is recommended that there should be the engagement of experts on Indigenous Knowledge Systems when developing a curriculum that is responsive to community needs and aspirations. This would entail making budgetary provisions to compensate the experts. Further, academics could collaborate in developing study materials on a variety of indigenous knowledge topics. This could be done through seminars and focused workshops.

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[40] Mudaly, "Towards Decolonising a Module in the Pre-Service Science Teacher Education Curriculum: The Role of Indigenous Knowledge Systems in Creating Spaces for Transforming the Curriculum."
[41] Mudaly, "Towards Decolonising a Module in the Pre-Service Science Teacher Education Curriculum: The Role of Indigenous Knowledge Systems in Creating Spaces for Transforming the Curriculum."
[42] V. I. Tanyanyiwa and M. Chikwanha, "The Role of Indigenous Knowledge Systems in the Management of Forest Resources in Mugabe Area, Masvingo, Zimbabwe," *Journal of Sustainable Development in Africa* 13, no. 3 (2011): 132–49.
[43] Dephin Mpofu and Collins Ogutu Miruka, "Indigenous Knowledge Management Transfer Systems across Generations in Zimbabwe: IKS in Other Contexts," *Indilinga African Journal of Indigenous Knowledge Systems* 8, no. 1 (2009): 85–94.
[44] Mpofu and Miruka, "Indigenous Knowledge Management Transfer Systems across Generations in Zimbabwe: IKS in Other Contexts."
[45] Mudaly, "Towards Decolonising a Module in the Pre-Service Science Teacher Education Curriculum: The Role of Indigenous Knowledge Systems in Creating Spaces for Transforming the Curriculum."

CONCLUSION

This study has revealed the numerous benefits of infusing IKS in Technology education. Among such benefits are the driving of appropriate technology innovation, enhancement of cultural preservation, the promotion of health and safety consciousness, and the facilitation of technological skills transfer. This could be possible through research and publication, content development and facilitation by community experts. This study is therefore of the position that it is possible to infuse IKS in Technology education with respect to food processing and preservation practices if the right strategies are employed.

BIBLIOGRAPHY

Alsawmahi, Omer N, Fahad Y Al-Juhaimi, Abdullah M Alhamdan, Kashif Ghafoor, Isam A Mohamed Ahmed, Bakri H Hassan, Kheled A Ehmed, Diaeldin Abdelkarim, Mahmoud Younis, and Nasser Alashmawe. "Enzyme Activity, Sugar Composition, Microbial Growth and Texture of Fresh Barhi Dates as Affected by Modified Atmosphere Packaging." *Journal of Food Science and Technology* 55 (2018): 4492–4504.

Amutha, S, and S Sridhar. "Green Synthesis of Magnetic Iron Oxide Nanoparticle Using Leaves of Glycosmis Mauritiana and Their Antibacterial Activity against Human Pathogens." *Journal of Innovations in Pharmaceutical and Biological Sciences* 5, no. 2 (2018): 22–26.

Antonio, Robert J. "The Normative Foundations of Emancipatory Theory: Evolutionary versus Pragmatic Perspectives." *American Journal of Sociology* 94, no. 4 (1989): 721–48.

Austin, Jon, and Andrew Hickey. "Incorporating Indigenous Knowledge into the Curriculum: Responses of Science Teacher Educators." *The International Journal of Science in Society* 2, no. 4 (2011): 139–52.

Birt, Linda, Suzanne Scott, Debbie Cavers, Christine Campbell, and Fiona Walter. "Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation." *Qualitative Health Research* 26, no. 13 (November 10, 2016): 1802–11. https://doi.org/10.1177/1049732316654870.

Boyland, Judith R. "A Social Constructivist Approach to the Gathering of Empirical Data." *Australian Counselling Research Journal* 13, no. 2 (2019): 30–34.

Brincat, Shannon. "On the Methods of Critical Theory: Advancing the Project of Emancipation beyond the Early Frankfurt School." *International Relations* 26, no. 2 (2012): 218–45.

Cai, Zengxiao, Rechana Remadevi, Md Abdullah Al Faruque, Mohan Setty, Linpeng Fan, Abu Naser Md Ahsanul Haque, and Maryam Naebe. "Fabrication of a Cost-Effective Lemongrass (Cymbopogon Citratus) Membrane with Antibacterial Activity for Dye Removal." *RSC Advances* 9, no. 58 (2019): 34076–85.

Carm, Ellen. "Inclusion of Indigenous Knowledge System (IKS)–A Precondition for Sustainable Development and an Integral Part of Environmental Studies." *Journal of Education and Research* 4, no. 1 (2014): 58–76.

Chacha, James S, Liyan Zhang, Chigozie E Ofoedu, Rashid A Suleiman, Joachim M Dotto, Ume Roobab, Adedoyin O Agunbiade, Haile Tesfaye Duguma, Beatha T Mkojera, and Sayed Mahdi Hossaini. "Revisiting Non-Thermal Food Processing and Preservation Methods—Action Mechanisms, Pros and Cons: A Technological Update (2016–2021)." *Foods* 10, no. 6 (2021): 1430.

Department of Basic Education. *Curriculum and Assessment Policy Statement: Technology*. Pretoria, SA: Department of Basic Education, 2012.

Freyenhagen, Fabian. "Critical Theory: Self-Reflexive Theorizing and Struggles for Emancipation," 2018.

Gilani-Williams, Fawzia. "Islamic Critical Theory: A Tool for Emancipatory Education." *International Journal of Islamic Thought* 5 (2014).

Girija, D, K Deepa, Francis Xavier, Irin Antony, and P R Shidhi. "Analysis of Cow Dung Microbiota—a Metagenomic Approach," 2013.

Given, Lisa M. *The Sage Encyclopedia of Qualitative Research Methods*. Sage Publications, 2008.

Gupta, Kartikey Kumar, Kamal Rai Aneja, and Deepanshu Rana. "Current Status of Cow Dung as a Bioresource for Sustainable Development." *Bioresources and Bioprocessing* 3 (2016): 1–11.

Henri, Dominique A, Jennifer F Provencher, Ella Bowles, Jessica J Taylor, Jade Steel, Carmen Chelick, Jesse N Popp, Steven J Cooke, Trina Rytwinski, and Deborah McGregor. "Weaving Indigenous Knowledge Systems and Western Sciences in Terrestrial Research, Monitoring and Management in Canada: A Protocol for a Systematic Map." *Ecological Solutions and Evidence* 2, no. 2 (2021): e12057.

Huho, Julius M. "Reducing Food Loss and Waste through Innovative Food Preservation Technologies Applied by Women in Rural Areas in Kenya." *International Journal of Latest Research in Humanities and Social Science (IJLRHSS) Vol* 3, no. 1 (2020): 76–82.

Ibnouf, Fatma Osman. "The Value of Women's Indigenous Knowledge in Food Processing and Preservation for Achieving Household Food Security in Rural Sudan." *Journal of Food Research* 1, no. 1 (2012): 238.

Jans, C, D W Mulwa Kaindi, and Leo Meile. "Innovations in Food Preservation in Pastoral Zones." *Rev Sci Tech* 35, no. 2 (2016): 597–610.

Javed, Zoya, Gyan Datta Tripathi, Mansi Mishra, Meghana Gattupalli, and Kavya Dashora. "Cow Dung Extract Mediated Green Synthesis of Zinc Oxide Nanoparticles for Agricultural Applications." *Scientific Reports* 12, no. 1 (2022): 20371.

Kırgız, Mehmet Serkan, Jahangir Mirza, Stanca Cuc, Doina Prodan, Codruţa Saroşi, Ioana Perhaiţă, Rahela Carpa, Marioara Moldovan, Dorin Popa, and Simona Varvara. "Physico-Antibacterial Feature and SEM Morphology of Bio-Hydraulic Lime Mortars Incorporating Nano-Graphene Oxide and Binary Combination of Nano-Graphene Oxide with Nano Silver, Fly Ash, Zinc, and Titanium Powders." *Buildings* 13, no. 1 (2023): 172.

Krishnadevi, K, S Devaraju, S Sriharshitha, M Alagar, and Y Keerthi Priya. "Environmentally Sustainable Rice Husk Ash Reinforced Cardanol Based Polybenzoxazine Bio-Composites for Insulation Applications." *Polymer Bulletin* 77, no. 5 (2020): 2501–20.

Lievens, Bart, John E Hallsworth, Maria I Pozo, Zouhaier Ben Belgacem, Andrew Stevenson, Kris A Willems, and Hans Jacquemyn. "Microbiology of Sugar-rich Environments: Diversity, Ecology and System Constraints." *Environmental Microbiology* 17, no. 2 (2015): 278–98.

Loubser, J A. "Unpacking the Expression" Indigenous Knowledge Systems"." *Indilinga African Journal of Indigenous Knowledge Systems* 4, no. 1 (2005): 74–88.

Mandikonza, Caleb. "Integrating Indigenous Knowledge Practices as Context and Concepts for the Learning of Curriculum Science: A Methodological Exploration." *Southern African Journal of Environmental Education* 35 (2019).

Masekoameng, M R, and M C Molotja. "Contribution Of Indigenous Food Preservation And Processing Practices To Food Security Of Rural Households In Sekhukhune District Of Limpopo Province, South Africa." *African Journal of Food, Agriculture, Nutrition and Development* 23, no. 7 (2023): 24115–35.

Mbah, Marcellus, Sandra Ajaps, and Petra Molthan-Hill. "A Systematic Review of the Deployment of Indigenous Knowledge Systems towards Climate Change Adaptation in Developing World Contexts: Implications for Climate Change Education." *Sustainability* 13, no. 9 (2021): 4811.

McKinley, Elizabeth, and Georgina Stewart. "Out of Place: Indigenous Knowledge in the Science Curriculum." *Second International Handbook of Science Education*, 2012, 541–54.

Mertens, Donna M. "Transformative Paradigm: Mixed Methods and Social Justice." *Journal of Mixed Methods Research* 1, no. 3 (2007): 212–25.

Mizzi, Luke, Daniele Maniscalco, Sotiria Gaspari, Christina Chatzitzika, Ruben Gatt, and V P Valdramidis. "Assessing the Individual Microbial Inhibitory Capacity of Different Sugars against Pathogens Commonly Found in Food Systems." *Letters in Applied Microbiology* 71, no. 3 (2020): 251–58.

Moor-Smith, Maxwell, Raymond Li, and Omar Ahmad. "The World's Most Poisonous Mushroom, Amanita Phalloides, Is Growing in BC." *British Columbia Medical Journal* 61, no. 1 (2019).

Mpofu, Dephin, and Collins Ogutu Miruka. "Indigenous Knowledge Management Transfer Systems across Generations in Zimbabwe: IKS in Other Contexts." *Indilinga African Journal of Indigenous Knowledge Systems* 8, no. 1 (2009): 85–94.

Mudaly, Ronicka. "Towards Decolonising a Module in the Pre-Service Science Teacher Education Curriculum: The Role of Indigenous Knowledge Systems in Creating Spaces for Transforming the Curriculum." *Journal of Education (University of KwaZulu-Natal),* no. 74 (2018): 47–66.

Murithi, Tim. "An African Perspective on Peace Education: Ubuntu Lessons in Reconciliation." *International Review of Education* 55 (2009): 221–33.

Okoye, J, and K Oni. "Promotion of Indigenous Food Preservation and Processing Knowledge and the Challenge of Food Security in Africa." *Journal of Food Security* 5, no. 3 (2017): 75–87.

Rahman, Mohammad Shafiur. "Food Preservation: An Overview." *Handbook of Food Preservation*, 2020, 7–18.

Raja, M K Mohan Maruga, Ravi Manne, and Agilandeswari Devarajan. "Benefits of Cow Dung-a Human Ignored Gift.," 2021.

Sharma, Bharti, and Maneesha Singh. "Isolation and Characterization of Bacteria from Cow Dung of Desi Cow Breed on Different Morpho-Biochemical Parameters in Dehradun, Uttarakhand, India." *Int. J. Adv. Pharm. Biol. Chem* 4, no. 2 (2015): 276–81.

Shizha, Edward. "The Indigenous Knowledge Systems and the Curriculum." In *African Indigenous Knowledge and the Disciplines*, 113–29. Brill, 2014.

Sivasankar, B. *Food Processing and Preservation*. PHI Learning Pvt. Ltd., 2002.

Squires, Vicki. "Thematic Analysis." In *Varieties of Qualitative Research Methods.* , edited by J.M. Okoko, S. Tunison, and K.D. Walker, 463–68. Springer Texts in Education, 2023. https://doi.org/10.1007/978-3-031-04394-9_72.

Tanyanyiwa, V. I., and M. Chikwanha. "The Role of Indigenous Knowledge Systems in the Management of Forest Resources in Mugabe Area, Masvingo, Zimbabwe." *Journal of Sustainable Development in Africa* 13, no. 3 (2011): 132–49.

Tharakan, John. "Indigenous Knowledge Systems for Appropriate Technology Development." In *Indigenous People*. InTech, 2017. https://doi.org/10.5772/intechopen.69889.

Tom, Tom. "Decades of Land and Agrarian Reform in Zimbabwe: A Review of Transformative Social Policy Lessons for Other African Countries." *The African Review*, October 14, 2024, 1–28. https://doi.org/10.1163/1821889x-bja10143.

Wilujeng, I., and Z. K. Prasetyo. "Elaborating Indigenous Knowledge in the Science Curriculum for the Cultural Sustainability." *Journal of Teacher Education for Sustainability* 20, no. 2 (2018): 74–88.

ABOUT AUTHORS

Joel Timire is a lecturer in Mathematics and Technical Education with 34 years experience in education. He holds a PhD in Curriculum Studies from the University of Free State. He has extensively collaborated as a co-researcher with established researchers in the area of engineering teacher development. He is building his research profile under the tutelage of the Center for Diversity in Higher Education Research.

Bekithemba Dube is a full Professor in curriculum studies. He holds PhD in Curriculum Studies from the University Free State (UFS). He has written extensively on the area of Curriculum, Politics and Religion in Post colonial African countries. He has published more than 120 articles and book chapters in accredited journals in the past 6 years. He has successfully edited three books on curriculum, politics and religion and edited 4 special issues on education. He is currently the section editor for the Alternation Journal, Section Editor for the Research in Social Science and Technology Journal, Associate Editor E-Journal of Humanities, Arts and Social Sciences and Associate Editor for the e-

Journal of Religious and Theology Studies all accredited with DHET. He has served as a Head of the Department for Education Foundation and Department of Curriculum Studies at UFS. He is a visiting Professor at Appalachian State University (USA) and he has received funding such as Thuthuka, the USDP award with Colorado State University (USA) and UKSADP with University of Highlands and Inlands (Scotland). He has received various excellent awards for being exceptional in research, teaching and engaged scholarship.