# A Time to Build? Decolonising Education through Integrating African Indigenous Knowledge in the Science Curricula in Tanzania

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**Abstract**

*This study aimed to critically examine the implications of excluding African indigenous science knowledge from the Tanzanian science curriculum. Grounded in critical pedagogy, the paper interrogates how the overreliance on Western science in curriculum policy and classroom practices replicates colonial power relations while marginalising indigenous ways of knowing. Drawing on documentary review, the paper draws on indigenous scholarship, curriculum studies, and cognitive science to explain how students' underperformance in science may be linked to the abandonment of indigenous knowledge systems. The paper argues that integrating indigenous knowledge into science curricula can improve students' learning, support sustainability, and challenge existing power over what counts as scientific knowledge. Rather than suggesting instructional or technical solutions, this paper seeks to provoke a critical rethinking of what constitutes legitimate scientific knowledge in Tanzanian education by situating the discussion within contemporary geopolitical tensions and shifts.*

**Keywords:** *critical pedagogy, indigenous science, science curriculum, sustainability, western science*

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## 1. Introduction

The role of Indigenous Knowledge Systems (IKS) in promoting science learning and sustainable development is well acknowledged (Shizha, 2020). Nonetheless, IKS is a neglected aspect in the science education discourse. For instance, a closer look at the current policy discourse on science education in Tanzania reveals sentiments of human capital theory. That is, according to the Tanzania Development Vision (TDV) 2050, the country is aspiring to educate a science workforce that will help it compete in a technology-driven world of work (United Republic of Tanzania [URT], 2025). Indeed, this aspiration

is well justified given that competition in the global economy favours those who control and invent technological innovation. For instance, variances in social and economic development among countries tend to associate with their variances in the development of science and technology (Kasongo & Makamu, 2024; Stromquist, 2002; Torres, 2002).

Consequently, many interventions in science education in Tanzania and similar contexts have tended to adopt best practices from countries that have prospered at the expense of indigenous science knowledge, raising the possibility of dissonance between how science is applied in daily life and what is taught in science classrooms. For instance, the 2014 revised 2023 Tanzanian Education and Training Policy (ETP) emphasises the use of relevant tools to comply with "the requirements of modern science and technology" (URT, 2014, p. 31). Indeed, the phrase "indigenous," as well as other similar terms (e.g., traditional; native; ethnoscience), is not mentioned anywhere in the ETP, which guides the provision of education in the country.

Moreover, there is a lack of coherence among the national vision, policy documents, and the science curriculum. For instance, while the Tanzania Development Vision 2050 emphasises the decolonisation of education, policy, and curriculum documents remain silent on the matter. Consequently, this effect is attributed to the conduct of science education research, in which there is a paucity of studies on indigenous science knowledge. Despite sustained investments in science education reform, current practices remain anchored in Western epistemological traditions that prioritise abstract, decontextualised scientific concepts, standardised assessments, and Eurocentric histories of scientific discovery. These practices rarely engage learners' indigenous knowledge. As a result, a critical link is missing between school science and students' everyday experiences, raising questions about epistemic justice, relevance, and meaningful participation in science learning.

### *1.1 Statement of the Problem*

Despite efforts made to improve students' performance in the country, the performance rates for science subjects have remained unpromising for many years. For instance, students' pass rates in the Certificate for Secondary Education Examination (CSEE) are 47.8 and 46.5 for biology and physics, respectively, over 13 consecutive years from 2008 to 2020 (MoEST, 2021). In other words, more than half of the students who complete secondary education score less than 30 marks (out of 100) in these science subjects according to the grading system in the country (URT, 2014). Previous studies have been conducted in this regard, highlighting instructional and material flaws within the education

system. A review of the literature using databases such as Scopus, Web of Science, and ERIC suggests a paucity of studies associating poor performance in science with little emphasis on IKS. In this paper, we draw on cognitive science research to argue that these unpromising performances in science may partly be due to the abandonment of indigenous science knowledge. Nonetheless, the need to adopt indigenous knowledge should not be justified solely in terms of academic performance. Rather, the paper argues that for students to feel like fully contributing members of the scientific community, they need opportunities to engage with their local environments. This would somehow add to their sense of belonging and, so to speak, open the possibility of a fulfilled life and empowerment for these students. Indeed, critical approaches to science education which intend to interrogate structures associated with colonialism, oppression, and maintenance of other exploitative regimes are widely emphasised for building a sustainable future (Bazzul, 2014). It is now time to build the science curriculum around indigenous knowledge, which is often taken for granted. However, it may have a tremendous impact on the generation of scientists that a country would wish to have. In particular, we employ critical pedagogy as a framework to understand how overreliance on Western science can be dehumanising to Tanzanians as natives.

### *1.2 Purpose and Research Questions*

The purpose of this paper is to critically examine the implications of excluding African indigenous science knowledge from the Tanzanian science curriculum. Grounded in critical pedagogy, the paper attempts to interrogate how the overreliance on Western science in curriculum policy and classroom practices replicates colonial power relations while marginalising indigenous ways of knowing. Specifically, the study illuminates how the neglect of indigenous science reinforces epistemic injustice, undermines students' sense of belonging in science, and disconnects school science from learners' lived socio-cultural experiences. That is to say, the paper discusses how the neglected indigenous science reproduces the colonial legacy, which our founding father, Mwalimu Nyerere, fought against at all costs. The paper attempts to respond to a broader question: Why is African indigenous science knowledge largely excluded from the Tanzanian school science education pipeline, and how does this exclusion reflect enduring colonial and Eurocentric power relations in curriculum policy and practice? This broader question leads to the following two specific research questions:

i) What are the educational, cognitive, and socio-cultural implications of the overreliance on Western science in Tanzanian science education, particularly for students' learning, identity, and sense of belonging?

ii) How can critical pedagogy offer a framework for decolonising science education by integrating indigenous science knowledge in the context of contemporary geopolitical and epistemic shifts?

Essentially, this paper views a geopolitical shift from the age of liberal optimism, when the West assumed moral legitimacy, to the era of populism and the rise of China as a great opportunity to adopt Southern epistemologies (e.g., indigenous science knowledge systems). This is not to suggest that the country should lean more towards China in the light of science education policy. Rather, the geopolitical shift should be a point of reference as the country embarks on policy changes in this regard. Drawing on insights from curriculum studies, cognitive science, and indigenous science scholarship, the paper concludes that abandoning IKS may partially explain persistent challenges in students' science performance. Rather than suggesting instructional or technical solutions, this paper seeks to provoke a critical rethinking of what counts as legitimate scientific knowledge in Tanzanian education by situating the discussion within contemporary geopolitical tensions and shifts.

### *1.3 Significance of the Study*

This study contributes to the science education scholarship by positioning indigenous science knowledge within the critical pedagogy debate, thereby moving beyond narrow, performance-oriented explanations of science curriculum reforms. Drawing on indigenous scholarship, cognitive science, and curriculum studies, the paper deepens our understanding of how students' cultural capital, prior knowledge, and lived experiences shape and are shaped by science learning and meaning-making. Thus, the paper offers theoretical discussions on epistemic justice by interrogating the universality and neutrality of Western science. At the practice and policy levels, the study offers a critical lens for identifying inconsistencies between Tanzania's development visions, educational policy, and curriculum documents. It highlights the need to maintain coherence among the national vision, curriculum reform, and instructional practices, while encouraging educators and practitioners to recognise indigenous science knowledge as legitimate. Generally, the paper positions science education as a pathway to empowerment and sustainability, thereby contributing to ongoing efforts to decolonise education in the country and other postcolonial contexts.

## 2. Literature Review

The years after 1960 were pivotal in Tanzania's history. Notably, soon after independence from the British in 1961, Tanzania (then Tanganyika) embarked on a serious effort to transform its education system. Particularly, there was,

among political leaders and policy circles, a sense that true independence should be accompanied by educational transformations that would liberate colonial education (Nyerere, 1968). The establishment of the University College, Dar es Salaam (now the University of Dar es Salaam) in 1961 is one such effort. It was envisioned that the university would prepare post-independent intellectuals to lead the targeted liberation struggles. The Education for Self-Reliance (ESR) (Nyerere, 1968) was introduced with tenets such as making education more practical through instituting vocational education. These radical shifts emphasised the nationalisation of education, notably the use of Swahili as a medium of instruction in basic education. Socialism was the prevailing ideology; thus, education had to reflect its tenets, such as free and universal primary education. Generally, the decolonisation message dominated much of the 1960s and 1970s. By then, decolonisation entailed shying away from donor dependency in both financial and technical support, colonial education, and the occupation of various political and administrative posts by Tanzanians.

During the 1980s, Tanzania, like many other countries, was swept by globalisation, which led to the introduction of Structural Adjustment Programs (SAPs) among other things. The SAPs aimed to prepare a workforce that could compete in the global science– and technology–driven world, a competition associated with socio-environmental injustices. That is, it introduced noticeable shifts from socialism to capitalism (URT, 2000). In particular, neo-liberal policies of privatisation, cost-sharing, capital accumulation, and democratisation took hold. The development of human capital was also an important aspect during this wave (URT, 2000). To complicate matters, the fall of the Berlin Wall in 1989 heightened geopolitical tensions, further reinforcing convergence in development and education. Indeed, the 1990s marked the age of liberal optimism when the West assumed moral legitimacy. Likewise, the Cold War and arms race resulted in convergence in science and technology (Voda & Havlík, 2021). Further, humanitarian interventions have become a powerful tool for transferring best practices in development and education. Therefore, it is not surprising that the Tanzania 1995 and 2014 revised in 2023 educational policies identified science and technology as a strategic goal of science education in the country (URT, 1995; 2014).

Marked by the introduction of Western science subjects as compulsory in basic education (URT, 2014), the shifts have opened a new page in science education as we know it today. Since then, science education has been seen as a vehicle for preparing scientists to lead technological innovation efforts. The school curriculum has also reflected this noble emphasis. For example,

science is a significant section of the school curriculum from kindergarten to university (URT, 2014). At the primary school level, students learn science as an integrated subject called science and technology. The subject is compulsory for students in Standard Three to Six of the primary education cycle. Meanwhile, at the secondary school level, science is taught in separate subjects: physics, chemistry, and biology (URT, 2014). The supremacy of science is also reflected in tertiary education, where programmes in science and technology are highly advertised and even categorised as national strategic priorities for student loan allocations. Indeed, these programmes do enjoy a high esteem in society.

As in other countries, the curriculum for science subjects in Tanzania reflects the hegemonic influence of Western science as a universalised body of knowledge that emphasises universal scientific laws, laboratory-based experimentation, and examination-driven content coverage. While such practices align with global standards, research consistently shows that they marginalise indigenous modes of inquiry such as observational learning, community-based experimentation, and orally transmitted ecological knowledge (Zidny et al., 2020). As a result, learners are positioned to engage with science as an abstract and decontextualised body of knowledge rather than as a lived practice embedded in their socio-cultural environments (Ogunniyi, 2008). Moreover, curriculum materials and textbooks in science education continue to foreground Western scientists and Eurocentric trajectories of scientific discovery, while African and local contributions remain largely absent (Kinyota & Kavenuke, 2018). In such curricular representations, Western knowledge systems are seen as universal while indigenous knowledge is rendered invisible or inferior (Handayani et al., 2018).

A study analysing the curricula for science subjects in Tanzania, South Africa, and the United States (Kinyota, 2020) revealed similarities in the content of science across the three countries, suggesting convergence in science content and processes. Likewise, analysis of science textbooks in Tanzania (Kinyota & Kavenuke, 2018) indicated that only Western science philosophers are featured in the textbooks, implying an imposed hegemonic universality of Western science knowledge. This convergence is indeed a reflection of the effects of globalisation, which neglects local cultures, in this case, indigenous science and its associated knowledge systems. This imbalance reinforces a narrow image of who produces legitimate scientific knowledge, thereby marginalising indigenous ways of knowing and perpetuating epistemic injustice within formal schooling. According to Apple (2004), knowledge involves a selective tradition, in which knowledge from the ruling class is selected and emphasised for a purpose, while other knowledges are neglected, diluted, excluded, or

reinterpreted. Even research in science education has overlooked indigenous science as a possibility for improving science learning, instilling a sustainability culture, and decolonising the curriculum. For instance, earlier studies on the challenges facing science education in Tanzania (e.g., Kafyulilo & Tilya, 2019; Kinyota, 2020; Mkimbili et al., 2017; Semali & Mehta, 2012) have referred to Western science currently taught in schools without suggesting the means to decolonise it. Meanwhile, indigenous science is known for promoting the sustainable use of the environment.

Globalisation involves convergence such that societies are subjected to 'the same forces' (Arnove, 1980, p. 49) with the faith that cultural hybridisation (Torres, 2002) is possible. As a consequence of globalisation, people's (e.g., policymakers, students, and teachers) attitude towards science has continued to be that of Western science as universal. That is to say, very few are concerned that cultural infrastructures (e.g. indigenous scientific practices and methods of knowledge production) are diminishing as globalisation intensifies. Seen from this light, the inclusion of indigenous knowledge in science curricula is neglected altogether. However, there has been debate over teaching science subjects in Swahili, assuming that Swahili is understood by many students and is rooted in Tanzanian culture. While this assertion is still contested, the debate has tended to overlook indigenous science knowledge as a special language in its own right.

This paper attempts to bring to light the issue of indigenous knowledge and how it could lead to improved science learning, sustainability, and the decolonisation of the curriculum. In the present paper, indigenous science is defined as systems of scientific knowledge developed by a given culture or society as part of human survival (e.g., traditional medicine). Indigenous science knowledge is associated with specific ways through which indigenous peoples view their world. It has also been referred to as Ethnoscience or native science (Abonyi et al., 2014; Zidny et al., 2020), meaning knowledge systems rooted in a specific culture. With specific reference to Africa, Shizha (2020) refers to African indigenous knowledge systems (AIKS) as local knowledge unique to a specific cultural group in each locale. It has been termed as people's knowledge/community-generated knowledge/experiential knowledge/tacit knowledge/situational knowledge (Emeagwali & Shizha, 2016; Shizha, 2020). Western science is used to refer to a colonially imposed, hegemonic body of Western ways of viewing the natural world.

## 3. Critical Pedagogy: A Theoretical Lens

The study is anchored in critical pedagogy, drawing primarily on the works of Paulo Freire and critical theorists. Critical pedagogy provides a relevant lens for examining how power, ideology, and history shape what counts as legitimate scientific knowledge in schools. It challenges the neutrality and universality claims of Western science and emphasises dialogue, problem-posing, and the validation of learners' lived experiences. In particular, critical pedagogy enables us to move away from simplistic and descriptive thinking about school science (such as studying why students fail in science subjects) to normative thinking (such as questioning the essence of science itself). In this case, questions such as why science should be learned in school and whose science knowledge is legitimate are as important as the study of science itself. Critical pedagogy is linked to critical theory, which can be traced back to the works of Karl Marx, Paulo Freire, and the Frankfurt School. In particular, the Frankfurt school is credited with making critical theory popular. Critical theory is concerned with how entities (e.g. what is learned in school science) are shaped by power relations. Hence, it seeks to confront all forms of power domination in order to bring about a just society (Apple, 2004; Apple & Au, 2009; Zembylas, 2019).

Critical pedagogy draws on critical theory and is more of a Brazilian movement championed by Paulo Freire. After being disappointed by the aftermath of colonial rule in Brazil, Freire sought a just society built on principles of shared knowledge and dialogue. In educational sciences, Freire coined the phrase' banking education', which he described as education that treats students as having nothing to contribute to the learning process, as well as one that reproduces existing power structures. Freire was strongly opposed to banking education (e.g., learning a prescribed body of science) and saw it as both dehumanising and unjust. Instead, '… people in marginalised positions have the opportunity to collectively struggle against oppression, to voice their concern, and create their own representations' (Kellner & Share, 2007, p. 61). As Apple and Au put it:

> Freire's critical pedagogy … seeks to be a pedagogy that enables students and teachers to be 'subjects of their own history'. … who can look at reality, critically reflect upon that reality, and take transformative action to change that reality, thereby deepening their consciousness and working toward a more just world. By using the teaching methods of problem posing and dialogue, Freire's critical pedagogy aims to challenge all hierarchical power relationships, including the student–teacher relationship. In this way, Freire's critical pedagogy invites students and teachers to become change agents both in their classrooms and in the world around them (Apple & Au, 2009, p. 997).

Apple and Au (2009) argued that Freire's critical pedagogy calls on educators to be conscious of how scientific knowledge and its production relate to and reproduce power structures. Critical pedagogy encourages students in science classrooms to be critical of what they learn and of what is considered legitimate science knowledge. In other words, science classrooms become avenues for critiquing science knowledge and its sources. Further, it encourages students and teachers to go beyond mere recitation of theories and principles, such as Archimedes' principle, Newton's laws of motion, and Darwin's theory of evolution. Instead, they should also actively engage in the debate of whose knowledge should be taught in schools. For instance, it can be applied to challenge the dominance of white male scientists in science textbooks used in Tanzanian schools. Essentially, critical pedagogy treats scientists and scientific knowledge as products of a particular culture while rejecting the claim that science is objective, universal, and uninfluenced by individual perspectives.

## 4. Methodology

### *4.1 Research Design*

The study adopted qualitative document review as its key methodology. Document analysis was considered relevant given that the study seeks to cross-examine how knowledge, ideology, and power are embedded within the science education pipeline, that is, in policy and curriculum documents, as well as in scholarly discourse. In other words, the study thoroughly scrutinises existing documents to offer a critical assessment of the exclusion of African indigenous knowledge from the science curriculum.

### *4.2 Sampling of Documents*

Documents were purposefully selected to ensure alignment with the study's focus on science education, indigenous knowledge systems, curriculum policy, and critical pedagogy. Thus, the review included national vision and policy documents, as well as peer-reviewed scholarly materials. Scholarly materials were identified through targeted databases such as ERIC, Google Scholar, Scopus, Web of Science, using key search phrases such as critical pedagogy, indigenous science, science education in Tanzania/Africa, science curriculum, and indigenous knowledge systems.

### *4.3 Inclusion and Exclusion Criteria*

Documents were included in the review based on the criteria detailed in Table 1

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Direct relevance to science education, science curriculum policy, or critical pedagogy | Addresses science education solely from a technical perspective without referring to knowledge production, ideology, or power |
| Explicit engagement with indigenous knowledge, indigenous science, ethnoscience, or indigenous knowledge systems. | Exclusively focusing on indigenous knowledge in non-educational settings. |
| Focus on Tanzania, sub-Saharan Africa, or comparable postcolonial contexts. | Opinion pieces and non-scholarly sources lack academic rigour |
| Peer-reviewed journal articles, authoritative books, policy documents, or officially endorsed curriculum materials. | Duplicates or those providing insufficient theoretical or methodological details |
| Published in English. | Published in languages other than English |

### *4.4 Analysis of Documents*

Selected documents were analysed using critical discourse analysis and thematic analysis, focusing on the identification of recurring themes related to the supremacy of Western science, the sidelining of indigenous science knowledge, and assumptions about the supremacy and universality of science. The analysis also focused on themes that highlight the implications of the marginalisation of indigenous science to learners' identity, epistemic justice and sense of belonging. Guided by critical pedagogy as a theoretical lens, the analysis scrutinised how curriculum and policy texts challenge or reinforce colonial power relations and how the role of indigenous science is conceptualised in scholarly literature. Insights from selected documents were synthesised to develop a coherent critical narrative.

## 5. Findings and Discussion

### *5.1 What Does Research in Cognitive Science Say Regarding Indigenous Science in Relation to Students' Performance?*

Cognitive scientists have devoted time and resources to studying how learning occurs at the mental level. Indeed, cognitive science has had a tremendous influence on science education, in particular, on how science should be taught to enhance students' understanding. In this paper, we focus on the domain of cognitive science, which examines how conceptions are formed and their

effects on students' understanding of science concepts and, consequently, their performance in science subjects. This focus is selected to understand persistent students' failures in science subjects in relation to how conceptions are formed. It is well acknowledged that students come to school with some preconceptions about science (DiSessa, 2015; Stylos et al., 2021). For instance, how we feel when we approach hot objects becomes the genesis of our knowledge of heat and energy, even before we are exposed to these fancy concepts taught in schools. These preconceptions can either support or be in variance with accepted scientific knowledge (DiSessa, 2015). As we interact with the environment and one another, we engage in a continuous and often unconscious process of meaning-making.

Through this process, new meanings are formed, others reinterpreted, while others are discarded altogether (DiSessa, 2015; Tapia et al, 2019). As such, the ideas that students bring into science classrooms tend to be context-dependent. They also tend to be personal and resistant to change (Champagne et al., 1982). Further, it is important to note that students use these preconceptions or prior knowledge to make sense of new knowledge, so that successful learning depends on reconciling pre-conceptions with new knowledge. In other words, learning new scientific knowledge depends on how that new knowledge will be reorganised in mental structures. That is, students' preconceptions influence their conceptual understanding of science concepts. As societies engage in solving daily-life problems, they can produce scientific knowledge that can be considered indigenous science. Endeavours such as children's play, the extraction of local medicine by local healers, and even the building of houses by local constructors involve the use and production of scientific knowledge. As products of society, much of what students bring into science classrooms is influenced by their interactions with these indigenous sources of science knowledge and forms an essential part of their preconceptions.

To better understand the influence of indigenous science on students' learning of science, it is very important to review the two opposing views of the concept which has emerged from cognitive science. First, there is the classical view of the concept, in which students' preconceptions are seen as mistakes or false ideas that must be discarded before meaningful learning of accepted science concepts can take place (Von Aufschnaiter & Rogge, 2010). In other words, students must unlearn what they already know before they can learn new knowledge, especially when students' preconceptions contradict accepted scientific knowledge. When translated into indigenous science, this view entails that, for meaningful understanding of accepted scientific knowledge to take

place, students should be helped to unlearn their preconceptions of science, which they acquired before joining formal schooling. That is to say, the science knowledge acquired by students from the local environment is considered a misconception which acts as a barrier to understanding science (Gilbert & Watts, 1983). Educators who hold this view of the science concept emphasise identifying topic-specific preconceptions and correcting them using relevant instructional design. Unfortunately, there is evidence suggesting that the classical view of concepts overlooked many important aspects, thereby being less effective in developing conceptual understanding of science (Champagne, 1982; Tapia et al., 2019).

Moreover, it places less value on students' prior knowledge and treats the concept as static and unchanging. On the contrary, the actional view of science can address this oversight by the classical view of the concept. The actional view discourages the use of the phrase 'misconceptions'; instead, it emphasises the use of phrases such as 'alternative conceptions' (Gilbert & Watts, 1983). Proponents of the actional view have shown that students' preconceptions are highly diverse and context-dependent, making them difficult to detect and confront. Concepts are thus dynamic and active, such that new ones reorganise existing experiences (in this case, pre-conceptions). That is to say, preconceptions (including those contradicting accepted science) are valued and viewed as constituting the natural process of conceptual development. Thus, they are not to be replaced; rather, they are used as building blocks for acquiring new knowledge. Preconceptions are viewed as immature and less developed concepts (DiSessa, 2015; Tapia et al, 2019).

In relation to science education and indigenous science, the actional view treats indigenous science knowledge, which students bring into science classrooms, as building blocks of new accepted science knowledge. Indeed, cognitive science research has shown that preconceptions and new conceptions cannot be easily separated. Instead, they complement each other (DiSessa, 2015). This being the case, a meaningful understanding of science concepts depends greatly on how students' preconceptions, in this case, their indigenous science knowledge (Handayani et al., 2018; Zidny et al., 2020), are complemented by the learning of accepted science concepts. Indeed, Abonyi et al. (2014) found that integrating indigenous knowledge improved science learning in Nigeria. Essentially, integrating indigenous science into the school curriculum is likely to improve students' learning of science by providing an authentic context for learning. However, the aim of integrating indigenous science into the curricula should not only be to improve science learning but also to foster empowerment and a sense of belonging to a science community among students. It also

involves empowering the natives by ensuring their voices are heard in relation to scientific knowledge.

### *5.2 Indigenous Science Versus Western Science: Towards Decolonising the Science Curriculum*

The historical development of scientific discovery, and much of what later came to inform science education, is dominated by Eurocentric worldviews, hence the popularisation of Western science (Ogunniyi & Ogawa, 2008; Zidny et al., 2020). That is to say, science education has, to a greater extent, ignored a multiperspectival approach to scientific knowledge that respects indigenous knowledge systems (Zidny et al., 2020). This tendency continues to the present day. For instance, current policy discussions in Tanzania are silent on indigenous science knowledge. Even discussions on reforming the basic education curriculum have tended to overlook the issue. This is not, by any means, surprising, given that education is seriously considered a means to achieve social and economic development, as defined using a neo-liberal perspective (Misiaszek, 2015). As a consequence, there is convergence regarding best practices in science education, particularly the science curriculum. Science has also enjoyed the status of being universal. Hence, masking any discussion about the historical contexts associated with the production and popularisation of scientific knowledge.

The 'politics of constructing scientific knowledge' (DeJong-Lambert, 2004, p. 129) can be traced back to the late 1950s when the Soviet Union and the West were struggling for technological supremacy. Nonetheless, the fall of the Berlin Wall in November 1989 marked an explosion of the age of liberal optimism, in which the United States of America (USA) and its Western allies assumed moral legitimacy. During this time, we had entered a world in which the USA remained unchallenged. It was an era of convergence in development and education. Science and technology were considered important tools for waging economic prosperity and competition (Stromquist, 2002). There were at least four pillars that dominated the 1990s and which are closely associated with convergence in science education. First, there was the notion of consensus, which held that politics and democratic elections are intertwined. That is to say, it was assumed that there was an indisputable connection between democracy and prosperity. The idea being that as a country grows economically, it becomes a democracy and vice versa.

Secondly, there was a clear vision of prosperity that is driven by the global free market. This pillar is closely connected to the third, which concerns the moral legitimacy of the West. This was marked by humanitarian intervention, such

as that in Liberia during the late 1990s. State sovereignty was broken in the name of human rights, while in some cases, military intervention was used. The fundamental idea was that people do not want to live in shackles, while the West is there to help. Essentially, the West assumed moral legitimacy that other countries wished and/or were somehow forced to be like the West. This pillar was associated with deliberate efforts to borrow best practices in science education from the West (DeJong-Lambert, 2004). Approaches to teaching science, such as inquiry-based instruction, the scientific method, and problem-based learning, are among the examples of this convergence. Finally, it was assumed that there is a universal liberal global order. Indeed, one impact of this global order has been the blurring of the national state's powers to decide on matters considered global (Stromquist, 2002). As a consequence, science and technology, as important features of globalisation, have converged, which in turn has led to convergence in science education.

Throughout history, many societies have invented scientific knowledge as humans struggled to master their environment. For example, the Dogon of Mali are among the early discoverers of astronomical knowledge. (Akpan, 2011). Also, the Great Pyramids of Egypt represent early discoveries in mathematics and engineering. Knowledge and discovery of iron smelting in Nigeria, metallurgy in ancient Sudan, the concept of time in Zimbabwe, and traditional medicine across many African countries were documented before the popularisation of Western science (Emeagwali & Shizha, 2016). Likewise, different societies in Tanzania had developed many ways to combat diseases, such as treating snake bites with special stones. Also, indigenous ecological knowledge is widely used to interpret environmental changes and guide agricultural decision-making. For instance, by using plant phenology, animal behaviour, and wind patterns, local communities are reported to predict rainfall and plan cultivation cycles (Chang'a et.al., 2010).

Unfortunately, these indigenous science discoveries are rarely acknowledged or featured in formal science curricula in Tanzania. In response, there has been a huge movement to promote indigenous science knowledge. Numerous writers (e.g. Abonyi et al., 2014; Misiaszek, 2015; Ogawa, 1995; Ogunniyi & Ogawa, 2008; Snively & Corsiglia, 2000) have advocated for the inclusion of other perspectives (e.g., Buddhism, Ubuntu) in science education discourse. In particular, the recognition that other cultures have their ways of viewing the natural world. While others (e.g., Abonyi et al., 2014) have taken a radical view that considers replacing western science with indigenous science, others (Ogawa, 1995; Ogunniyi & Ogawa, 2008; Zidny et al., 2020) have taken a soft stance that emphasises the integration of indigenous science knowledge

with Western science. Others have noted that overreliance on western science disempowers local communities and continues the Western colonial mindset.

**Table 1**

*Featured Western Scientists in Tanzanian Science Textbooks*

| Scientists' names | Sex | Race/ Nationality | Science concept/topic | Grade |
|---|---|---|---|---|
| Michael Faraday | Male | White-United Kingdom | Electrolysis | Physics, Form 3 |
| Robert Bunsen | Male | White-Germany | Heat sources and flames | Chemistry, Form 1 |
| Gregor Mendel | Male | White-Czech Republic | Genetics | Biology, Form 4 |
| Isaac Newton | Male | White-United Kingdom | Laws of motion and astronomy | Physics, Forms 2 and 3 |
| Charles Robert Darwin | Male | White-United Kingdom | Evolution and natural selection | Biology, Form 4 |
| Henry Louis Le Chatelier | Male | White-France | Chemical equilibrium | Chemistry, Form 3 |
| Jean-Baptiste Lamarck | Male | White-France | Evolution and natural laws | Biology, Form 4 |
| Archimedes of Syracuse | Male | White-Greece | Archimedes' principle | Physics, Form 1 |
| Friedrich Gustav Jakob Henle | Male | White-Germany | Anatomy and loop of Henle | Biology, form 3 |
| Robert Hooke | Male | White-United Kingdom | Theory of elasticity | Physics, Form 2 |
| Democritus | Male | White-Greece | Atomic theory | Chemistry, forms 1 and 2 |
| John Frederic Daniell | Male | White-United Kingdom | Electrochemistry and Daniell Cell | Physics, Form 3 |
| Amedeo Avogadro | Male | White-Italy | Molecular theory and Avogadro's constant | Chemistry, Form 3 |
| Georg Ohm | Male | White-Germany | Electrochemistry or Ohm's law | Physics, Form 3 |
| Georges Leclanche | Male | White-French | Electrical Cells | Physics, Form 3 |
| Robert William Boyle | Male | White-Ireland | Boyle's law or Gas law | Physics, Form 2 and Chemistry, Form 3 |
| Wilebrord Snellius | Male | White-Netherlands | Astronomy and laws of refraction | Physics, Form 3 |
| Nicolaus Copernicus | Male | White-Poland | Astronomy and Copernicus law | Physics, Form 3 |
| James Prescott Joule | Male | White-United Kingdom | Thermodynamics | Physics, Form 3 |

*Source*: Extracted and modified from (Kinyota & Kavenuke, 2018)Indeed, the convergence in science education is reflected in the content of school science curricula in many countries, including Tanzania. Notably, homogeneity in

curriculum content is alarming. In education systems, including Tanzania's, textbooks constitute essential curriculum materials that are derived from the syllabus. As shown in Table 1, science textbooks are dominated by knowledge discovered by white male Western scientists. Further, analysis of science textbooks in Tanzania reveals that indigenous science knowledge almost never featured in the secondary education curriculum (Kinyota & Kavenuke, 2018). Nonetheless, teachers have an opportunity to integrate indigenous science by using indigenous knowledge as a context for learning science (Zidny et al., 2020). However, given the pressure on teachers and students to prepare for high-stakes examinations (Vavrus & Bartlett, 2012), there is little hope that it will happen. Thus, integrating indigenous science content in the science curriculum remains a promising path. There is a need to identify indigenous science knowledge in Tanzania and to research the best way to integrate it into the school curriculum. Several models for integrating indigenous science have been proposed elsewhere. For instance, the science education for sustainability model (Zidny et al., 2020). Likewise, Handayani et al. (2018) describe a four-step model used to integrate indigenous knowledge into the science curriculum in Japan.

### *5.3 Decolonising the Curriculum Using Critical Pedagogy*

The dominance of white-male Western scientists in the school curriculum is, according to critical pedagogy, very disempowering and is nothing less than the continuation of Western domination in every sphere of life. In particular, students from other races, as well as women, may pick up a negative message about who is capable of producing scientific knowledge. Critical pedagogy calls for analysing how the production of scientific knowledge is linked to Western supremacy. Further, learning that only white-male Western scientists are capable of discovering scientific knowledge serves as a hidden curriculum that may lower the self-efficacy of science among non-white and female students. Indeed, the hidden curriculum is as powerful as the formal curriculum and should be taken seriously (Alsubaie, 2015). There comes the need for critical pedagogy in science classrooms in Tanzania. Critical pedagogy can help teachers offset the impacts of the hidden curriculum associated with the dominance of Western scientific knowledge in the curriculum.

A science classroom should be a place where students are aware of how scientific knowledge is constructed, including the historical contexts that surround its construction. Students should be taught that science is far from universal; rather, scientific knowledge is theory-laden and a product of a particular culture. Thus, students should engage in active dialogue to challenge power relations that are associated with the construction of scientific knowledge.

DeJong-Lambert (2004) has suggested that students should be exposed to the biographies of scientists so that they can learn science in relation to the contexts that surrounded its discovery. Further, students should be aware of notable scientific discoveries which took place in their communities (Abonyi et al., 2014) to enhance their sense of belongingness to science. According to Anderson (2002), science is both a body of knowledge and a way of thinking and the two are intertwined. Seen from this light, depending on Western science as the sole body of scientific knowledge has the effect of instilling in students a sense of Western scientific thinking, thus further reproducing a generation which does not value native ways of thinking about the natural world. Critical theorists view this overreliance on Western science as a serious mistake because it results in the maintenance of the Western colonial legacy.

### *5.4 De-globalisation As an Opportunity to Adopt Indigenous Science in Tanzania*

This discussion treats geopolitical shifts instrumentally, not as determinants of curriculum reform, but as contextual developments that challenge assumptions about the universality of Western scientific authority. As discussed earlier, the shift from the age of liberal optimism, when the West assumed moral legitimacy, to the era of populism and the rise of China offers an opportunity to adopt indigenous science and its associated knowledge systems. As noted earlier, the 1990s marked a period of intensified globalisation and liberal optimism. Pillars such as the global free market, democracy and prosperity, and the moral legitimacy of the West led in convergence in many spheres of life, including the best practices for advancing science and technology. However, the 2000s saw rapid shifts that almost refuted many of the 1990s' pillars. These shifts have fuelled the rise of Southern and Eastern epistemologies (Voda & Havlík, 2021). In the same vein, they offer an opportunity for Tanzania and other developing countries to reform their science curricula by adopting indigenous science. First, the 2008 economic crisis resulted in many challenges to the global economic order. The crisis had a tremendous impact on many Western economies, many of which have entered a period of stagnation.

Second, 2014 marked the rise of populism (DeHanas & Shterin, 2018). This era has been marked by many people, including those in the West, questioning the moral legitimacy of the West to engage in humanitarian intervention. Indeed, the rise of Donald Trump and Brexit in the UK in 2016 marked a shift towards nationalism and ushered in an era that prioritises the interests of the national state over globalisation (DeHanas & Shterin, 2018). This era can be considered a period of de-globalisation that restores the power of the nation-state and is

fuelled by nationalist sentiment. Indeed, it is a great opportunity to consider adopting indigenous science. Furthermore, the negative effects of military intervention in countries such as Iraq began to surface, thereby challenging the idea of humanitarian intervention. Third, the rise of China as an economic superpower has not only challenged the global order but also challenged the superiority of the West. The fact that China has risen without turning to a liberal democracy has also challenged most of the 1990s pillars. Indeed, a bipolar world is emerging that offers opportunities for national states to rethink their development strategies, including educational policies.

Finally, the rise of autocracy in countries such as Turkey, India, China, Brazil, and Russia has led to diminished trust in the free-market global order. Thus, populism can, in a way, be a decolonisation and disruptive approach that advances the postcolonial indigenisation educational programs in Tanzania and Africa in general. The rise of populism and alternative development models, particularly China's state-led approach to science and innovation, challenges the assumption that Western epistemologies are the sole pathway to scientific legitimacy, thereby enabling national education systems to assert greater epistemic autonomy. Ultimately, the integration of indigenous science in Tanzanian education remains a matter of local curricular agency, shaped by national policy frameworks, educational priorities, and classroom realities rather than by external geopolitical alignments.

## 6. Summary and Conclusion

The arguments presented in this paper offer a framework for rethinking science education in Tanzania. While the paper does not provide details on specific strategies for integrating indigenous science in the science curriculum, it raises important questions about why that integration has not happened in the first place. Furthermore, the paper highlights that the current curriculum is a complete representation of Western science worldviews, which has the effect of separating students from their native environment. The paper also notes a lack of coherence among the national vision, policy documents, and the science curriculum regarding decolonising the curriculum, which needs to be addressed. An argument is given that integrating indigenous science in science curricula can serve at least three roles. First, it will enhance students' learning of science according to research in cognitive science. Second, it will promote sustainable development, given that indigenous science is associated with a sustainability culture. Finally, it is going to empower the students, and indeed the country, by valuing science knowledge which is rooted in their native environment.

Indeed, in Africa, the learning spaces for indigenous knowledges have always been the socio-cultural and physical/natural environments. Meanwhile, efforts to integrate indigenous knowledge in the science curriculum have shown promising results in countries such as Nigeria (Abonyi et al., 2014) and Japan (Handayani et al., 2018). In these countries, indigenous science integration has targeted three aspects of knowledge, attitudes, and skills. Further, integration did not take a radical shift approach. Instead, it was done incrementally following rigorous research. In Japan, for instance, integrating indigenous science in science curricula involved four distinct phases/steps (Handayani et al., 2018). More importantly, the geopolitical shift discussed in this paper has expanded learning spaces beyond the four walls of a classroom, thus creating the possibility of shifting the indigenous agenda into these spaces. Specifically, advances in information and communication technologies, notably social media and journalism, provide new and powerful learning spaces. Another possibility would be to emphasise the critical component in higher education programs, a stage at which students are mature enough to engage in a more advanced geopolitical debate. Therefore, the study recommends contextual integration of indigenous science within existing curricula and targeted teacher preparation to support epistemic mediation in science classrooms. Integrating indigenous science in schools' science curricula can be adopted in Tanzania. It is time to build, to improve deteriorating science performance, and to decolonise the school curriculum.

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