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Influence of Cambridge International Education on environmental content in seven African syllabi

Cambridge International Education (CIE) presents a Western science based generic syllabus for use in foreign countries. Amid calls to decolonise the curriculum, this study investigated the extent to which seven African countries have decolonised the ecological and environmental content of their biology syllabi by departing from CIE. A decolonised syllabus may reduce the alienation students experience when they encounter Western science by infusing African epistemology into the syllabus, incorporating Indigenous knowledge, and using relevant familiar examples to illustrate scientific concepts. The seven African biology syllabi presented a Western science perspective, with five syllabi exhibiting CIE influence, ranging from very close similarity (Namibia and Lesotho) through some similarity (Rwanda and Botswana) to mostly dissimilar (Malawi). Uganda and South Africa displayed little CIE influence and incorporated more relevant content than other countries. Countries other than Botswana, Uganda and South Africa chose inappropriate examples to illustrate concepts and neglected the local environment and local Indigenous knowledge. Although all seven countries developed their own syllabi, sometimes in collaboration with CIE, not all have decolonised or contextualised their biology syllabi.

Significance:

This paper shows that seven African countries have adopted Western science epistemology for the ecology and environment sections of their biology syllabi. Five syllabi follow CIE syllabi to some extent, and few include Indigenous knowledge and content relevant to local context. I conclude that few of the seven countries have decolonised their syllabi.

Introduction

This study was precipitated by my experience as an author of secondary school biology textbooks in African countries, which required close engagement with the official national syllabus for each country. Many of these syllabi resembled Cambridge International Education (CIE) syllabi for biology. Amid calls from African university students to decolonise the curriculum, I asked: To what extent have African biology syllabi been decolonised from Western science and CIE? I also looked at how relevant African biology syllabi are to local ecosystems and environmental issues.

Cambridge International Education

CIE originated from the University of Cambridge Local Examinations Syndicate, which administered examinations in British colonies from 1864.[1] After attaining political independence, many previous colonies continued to offer imported qualifications such as the Cambridge Overseas School Certificate, Cambridge Overseas Higher School Certificate, International O-Level and International A-Level.[2,3]

Many African countries later opted to develop national curricula for their public schools with or without assistance from agencies such as the Cambridge Assessment Group.[2,3] 'Public schools' exclude 'international schools' which offer qualifications emanating from the Global North, including CIE.[4] The University of Cambridge Local Examinations Syndicate offered an advisory service to ex-colonies to run their own examinations following the Cambridge model. The West African Examinations Council, established in 1952, was the first of such partnerships.[5] Cambridge Partnership for Education aims to partner with governments to transform societies through quality education. It assists countries to design, establish and implement curricula and assessments that will work best for the country.[6]

Curriculum design can take one of three forms: a bespoke curriculum designed by CIE; co-development of a curriculum by CIE with curriculum developers from the commissioning country; or adaption of a Cambridge curriculum to suit the country's context.[6] The Learning Passport provides guidance for adaption using five principles[7] which apply in any situation where local experts are developing a national curriculum.[8] The adaption guidance principles are[7,8]:

1. Take account of the country's curriculum and education policies.
2. Select an appropriate language of instruction.
3. Frame selected content so that it is culturally relevant.
4. Incorporate Indigenous knowledge.
5. Support learner well-being, inclusion and success.[7,8]

Guidance principles 3 and 4 provide the framework on which the present study is based. Guidance principle 3 includes choosing content and examples relevant to students, such as local plants and animals, ecosystems and environmental issues.[8] Culturally relevant content equips students with skills that are useful in their everyday lives and accommodates the worldview prevailing in the target community.[3,9,10] Guidance principle 4 recommends including local Indigenous knowledge (IK) in the curriculum, thereby affirming people's traditional knowledge of their environment and promoting students' interest and motivation.[8,11]

Guidance principles 1–5 enable CIE and its partners to adapt their generic curricula to different contexts.[7] The present study investigated the extent to which CIE influences biology syllabi in seven African ex-colonies and seeks evidence of decolonisation by inclusion of African epistemology, locally relevant content and IK in the syllabi.

Worldviews, IK and decolonising the curriculum

Western science is believed to occupy a privileged status above the worldviews of non-dominant groups in current science curricula.[10,12,13] African IK and its worldviews are defined as "culturally specific knowledge systems that relate to the knowledge of Africa, their oral culture and traditional ecological knowledge, as affected by their worldview; the knowledge that incorporates their social and natural wellbeing, their cosmos and their spiritual world"[3(p.28)]. An indigenous worldview is a way of understanding the natural world, as distinct from IK, which is local, traditional knowledge that informs actions in everyday life. African indigenous worldviews hold that a vital force connects all natural phenomena into a unity of being. All living and non-living things possess spiritual powers which emanate from God and exist in decreasing amounts through the ancestors, living people, animals, plants, rocks and soil, mountains, streams and the earth itself. Knowledge is collectively owned and transmitted from the ancestors through the elders by means of story-telling, games, songs, rituals and cultural practices.[9,14]

Worldwide, Indigenous groups share a worldview of spirits interconnecting all of nature and all humanity, creating a pluriverse of onto-epistemologies. Such worldviews make communities responsible and accountable for their actions in the natural environment, centring community goals over individual and economic gains.[12,15] Indigenous worldviews and IK have been infused into school science curricula in nations such as Canada, New Zealand, Australia, some jurisdictions in the USA[16] and some Central American and Latin American countries[17]. IK offers rich, relevant and authentic contexts for science learning, particularly about the environment and the sustainable use thereof. It also provides opportunities for students to develop more balanced and holistic worldviews characteristic of Indigenous knowledge systems (IKS) but not Western science.[15]

African scholars support calls to recognise IK in school science curriculum but acknowledge that Western science and technology benefit society and the ecological environment. Science curriculum should be relevant to students' "cultural attitudes towards, and local knowledge about, their environment"[14(p.17)], including knowledge of local ecosystems and its sustainable use for survival[3,18]. While African students need to learn about their IKS and IK for their identity formation, some scholars recommend that they learn Western science in a hybrid subject integrating IK and Western science.[3,19,20] Hybrid science improves student interest and motivation[16,20] and could lead to improved performance in science, although evidence supporting this is limited[10,11,13]. It is a 'two-eyed seeing' model which uses IK to illustrate Western scientific concepts[10], thereby reducing the alienation felt by African students in science classes[3,13].

An alternative to hybrid science is to use overlaps between IKS and Western science, one of which is a commitment to careful description and observation.[21] One can then combine IK for descriptive and observational studies with Western scientific explanations of the observed phenomena.[21] Hybrid science is rejected by some authors on the grounds that it sterilises diversity of worldviews by 'scientising' IK which emerges from non-scientific worldviews.[22] True decolonisation requires accommodating interpretations of reality and knowledge criteria that pertain to non-science worldviews such as IKS.[22] The socio-cultural context of the knower is important in both IK, which pertains to a specific context, and Western science, which is confined to a scientist's situated cognitive domain rather than being unbiased.[21,22] Knower awareness enables students to realise that the motivations of the knower are important[22]: for IK practitioners, the motivation may be relevance to everyday life, while for Western scientists, the motivation may be to advance understanding of a theory.

Violent student protests on South African university campuses in 2015–2016 included calls for decolonisation of curricula, citing alienation, exclusion and racism experienced by (mostly) black students in universities dominated by (mostly) white academics.[19] The protests revealed that university staff were unaware of the lived experiences of students and their cultural knowledge was not legitimised.[19] To overcome the perceived alienation, Jegede[14] recommended that science teaching in Africa should begin with the traditional worldviews of students and progress towards imbibing scientific culture. Induction of African students into Western science is best achieved by using a conceptual ecocultural paradigm in which an individual's perception of knowledge grows and develops from their sociocultural environment.[14] Relevance is of primary importance in Jegede's argument for African science.[14]

Researchers who promote the concept of powerful knowledge[23] which best prepares students for future life[24] oppose including IKS and IK in the curriculum. Science has an impressive track record of successfully explaining many natural phenomena and using the explanations for technological development.[22] Powerful knowledge inducts students into conceptual organisation of isolated facts into generalisable principles.[23] A curriculum constructed around students' life experiences does not develop their human powers of reasoning nor prepare them for a technological future as Western science does.[14,23,24] Most powerful scientific knowledge is counterintuitive and generic, unlike IK. Proponents of powerful knowledge may agree that IK can set the context for scientific knowledge, but they reject appeals for African students to learn only things that are important for everyday life and living.[23,24]

Philosophers of science regard faith-based or spiritual worldviews as incompatible with science. Western scientists seek rational explanations for natural phenomena, excluding spiritual or supernatural causes.[25] Science presupposes that natural mechanisms and entities explain or potentially can explain all natural phenomena. Science does not rule out supernatural intervention but separates supernatural from natural explanations because it is concerned with material objects of study that obey natural laws and are open to scrutiny.[25,26]

Caution is urged to avoid romanticising Indigenous epistemologies and IK.[27] Indigenous peoples do not all live in harmony with nature, respecting the living and non-living world and behaving for the good of the community.[15,16] For example, trade in medicinal plants has become a competitive business to the detriment of traditional practices of sustainable harvesting.[28] Africa's environmental challenges include air pollution, unsustainable land management practices, waste and littering, overpopulation and rapid urbanisation.[29] The continent's rich biodiversity faces threats from illegal trade in plants and animals, mono-cropping, deforestation, climate change and invasive alien species.[18] These realities contradict claims of harmonious coexistence for Indigenous communities.[15,16]

Influence of CIE and relevance to local contexts

CIE syllabi present a generic Western science oriented worldview. Where a country has collaborated with CIE to develop its own curriculum, one expects to find content that is locally relevant, includes local IK and acknowledges indigenous worldviews. Even if formal collaboration did not take place, CIE's influence may be revealed through similar content selection and wording of learning outcomes. The first research question investigates the influence of CIE on African syllabi through two avenues:

1. Do seven African biology syllabi select similar content to equivalent CIE syllabi?
2. Does the wording of content units match the wording of CIE outcomes?

The second research question investigates adaption of generic ecological and environmental content to African IKS, IK about local ecosystems and local environmental concerns.[19] Questions asked here are:

1. What proportion of each syllabus is locally relevant?
2. What opportunities to contextualise the syllabus have been missed?

Seven African countries were selected based on curriculum documents available to me. Countries previously colonised by Great Britain and their years of attaining independence were South Africa (self-governing dominion until 1961), Uganda (1962), Malawi (1964), Botswana (1966)

and Lesotho (1966). Rwanda obtained independence from Belgium in 1962. Namibia was governed by South Africa from 1915 until independence in 1990.[30]

Methods

Constructing a reference list

I used CIE Biology syllabi 0970 for IGCSE[31] and 9700 for AS and A Level[32] to construct a reference list of generic content related to ecology and environmental issues, using both core and supplement learning outcomes from IGCSE Topic 19 (Organisms and their environment) and Topic 21 (Human influences on ecosystems)[31], supplemented with a few relevant outcomes from AS & A Level Topic 18 (Classification, biodiversity and conservation)[32]. The final reference list had two topics, eight sub-topics and 71 learning outcomes[31,32], shown in Table 1.

Some CIE learning outcomes were subdivided but were counted as a single outcome. For example, an outcome relating to the nitrogen cycle has eight subdivisions, but it is counted as one outcome.

Matching African syllabi with CIE reference list

Documents analysed and the years of study to which they apply are shown in Table 2.

Table 1: Cambridge International Education reference list for Topics 19 and 21

	Number of learning outcomes
Topic 19: Organisms and their environment	
19.1 Energy flow	2
19.2 Food chains and food webs	21
19.3 Nutrient cycles	5
19.4 Population size (includes definitions of communities and ecosystems)	10
Topic 21: Human influences on ecosystems	
21.1 Food supply	5
21.2 Habitat destruction	4
21.3 Pollution	9
21.4 Conservation (includes sustainability)	15

Namibia[33], Lesotho[35] and Uganda[38] acknowledge assistance from CIE in their curriculum development.

Identifying content in African syllabi

Content organisation differed among the African syllabi. Headings from which content was extracted were 'Ecology' in Botswana[37(p.25–26)]; 'Relationships of organisms with one another and with their environment' in Namibia[33(p.31–34)] and Lesotho[35(p.6–11)]; 'Environment' in Malawi[39(p.19–25)]; 'Environmental Studies' in South Africa[36(p.33–34,51–55)]; 'Soil'[38(p.22–23)] and 'Interrelationships' in Uganda[38(p.45–48)]; and 'Ecology and conservation' in Rwanda[34(p.51–52,82–90)]. Statements in each syllabus were grouped to form conceptually coherent units, which were counted only once if they recurred elsewhere in the syllabus. For example, five statements listed in Rwanda's Unit 5 were repeated from Unit 4 and were not counted as new units. The complete spreadsheet showing reference list outcomes and units from each syllabus is available as supplementary material.

CIE influence on content selection

Content units from African syllabi were assigned to matching reference list outcomes. Many units matched more than one reference outcome, meaning that the number of matches could exceed the number of content units in a syllabus.

Similarity in the wording of the content units provided further evidence of CIE influence. Similarity was coded on a scale of 1–3, using the following descriptors:

1 = similar idea, but wording does not match reference list

2 = similar idea, wording somewhat matches reference list

3 = wording closely matches reference list

Table 3 shows an example of coding for similarity.

Coding for relevance to each country's context

Three aspects derived from CIE adaption guidelines[7,8] indicate that a syllabus was relevant to a country:

1. Including African worldviews pertaining to ecology and environmental issues[3,19]
2. Referencing local IK
3. Referencing local ecosystems and environmental issues

The list of units in each African syllabus was scrutinised for mention of African IKS and coded for whether it was generic or relevant to the local context. To qualify as relevant, a unit had to specify a national/local ecosystem, issue or IK.

Table 4 summarises how coding was carried out, as well as the terms used throughout this paper.

Table 2: Countries and syllabus documents analysed in this study

Country	Syllabus	Years of schooling	Qualification	Years in which ecology and environmental issues are taught
Namibia	Namibia Senior Secondary Certificate (NSSC)[33]	9–11	NSSC O-Level	10 and 11
Rwanda	Rwanda O-Level[34]	7–9	Ordinary Level	8 and 9
Lesotho	Lesotho GCSE[35]	10–11	Cambridge GCE O-Level	10 and 11
South Africa	National Curriculum Statement[36]	10–12	National Senior Certificate	10 and 11
Botswana	Botswana General Certificate of Secondary Education[37]	11–12	Botswana GCSE	11 and 12
Uganda	Uganda Lower Secondary[38]	8–11	O-Level	9 and 11
Malawi	Malawi School Certificate of Education (MSCE)[39]	9–12	MSCE	11 and 12

Findings

Influence of CIE on content selection

There were 13 content units in Botswana, 15 in Malawi, 21 in Uganda, 23 in South Africa, 38 in Lesotho, 46 in Namibia, 50 in Rwanda, and 71 outcomes in the reference list. Many units in African syllabi matched more than one CIE outcome. The proportion of the reference list matched varied from a high of 62% in Rwanda and 61% in Namibia to lows of 23% in Uganda and 20% in Malawi (Table 5). The percentage match indicates that Namibia and Rwanda were most like CIE in terms of broad content selected.

All seven African syllabi matched both topics in the reference list. Namibia's syllabus matched 68% of the outcomes in Topic 19, while Botswana's matched only 18%. Botswana omitted population size in Topic 19, while Malawi, South Africa and Uganda omitted energy flow. Rwanda's syllabus matched 64% of the outcomes in Topic 21, while Malawi's matched only 12%. Lesotho, Malawi, and Uganda omitted food supply and Malawi omitted conservation. Apart from those omissions, every reference subtopic was represented by at least one unit in each syllabus.

Non-matching content indicates independence from CIE. A total of 57% of Ugandan units did not match the reference list, followed by 52% in South Africa, 40% in Malawi and 39% in Rwanda. Botswana, Namibia, and Lesotho had very few units that departed from the reference list.

Rwanda and South Africa added the biosphere and biomes, while Rwanda, South Africa, Uganda and Malawi included interspecific interactions such as predator–prey relations, competition and commensalism. CIE syllabi omit the abiotic factors of an ecosystem which are present in the Rwandan, South African, Ugandan and Malawian syllabi. Uganda emphasised the structure of soil, its importance in the environment

Table 3: Example of coding for similarity between Cambridge International Education (CIE) reference list and matching units from African syllabi

CIE reference list	19.4 Identify and state the factors affecting the rate of population growth for a population of an organism, limited to food supply, predation and disease.[31(p.40)]	
Syllabus	**Matching outcomes/units**	**Similarity code**
Lesotho and Rwanda	State the factors affecting the rate of population growth for a population of an organism (limited to food supply, predation and disease), and describe their importance[32(p.84),34(p.23)]	3
Namibia	State the factors affecting the rate of population growth for a range of living organisms.[30(p.32)]	2
South Africa	Population size: immigration, emigration, mortality, births; fluctuations. Limiting factors and carrying capacity.[35(p.49)]	1

Table 4: Example of coding and terminology used in the study. Highlighted text shows where matches were made.

Content unit from an African syllabus	**Number of units**	**Number of matches**	**Similarity index**	**Generic / relevant**
Discuss how poor agricultural methods result in destruction of the ecosystem, e.g. monoculture, excessive use of fertilisers and pesticides, overstocking, deforestation.[36,(p.26)]	1	4		Generic
Matching outcomes from reference list				
21.1.1 State how modern technology has resulted in increased food production in terms of: …chemical fertilisers to improve yields; insecticides to improve quality and yield; herbicides to reduce competition with weeds……			1	
21.1.2 Describe the negative impacts to an ecosystem of large-scale monocultures of crop plants			2	
21.1.3 Describe the negative impacts of intensive livestock production.			1	
21.2.4 Explain the undesirable effects of deforestation on the environment.			1	

Table 5: Number and percentage of matches between seven African syllabi and the Cambridge International Education reference list

	Namibia	**Rwanda**	**Lesotho**	**South Africa**	**Botswana**	**Uganda**	**Malawi**
Total matches ($n = 71$ outcomes)							
Number of matches	43	44	39	35	21	16	14
% of reference list matched	61%	62%	54%	49%	30%	23%	20%
Topic 19: Organisms and their environment ($n = 38$ outcomes)							
Number of matches	26	23	27	18	7	9	10
% of reference list matched	68%	58%	34%	47%	18%	24%	26%
Topic 21: Human influences on ecosystems ($n = 33$ outcomes)							
Number of matches	17	21	12	17	14	7	4
% of reference list matched	52%	64%	36%	52%	42%	21%	12%

and its conservation. Actions to promote conservation are included in six syllabi, the exception being Lesotho. Other non-matching units are diverse.

Similarity in the wording of units is a strong indicator of CIE influence on African syllabi. The percentage of matches scored at similarity levels 1, 2 and 3 are presented in Figure 1.

High proportions of matches at similarity levels 2 and 3 indicate CIE influence. The Namibian syllabus showed the most similarity, followed by Lesotho, Rwanda and Botswana. High proportions of Level 2 matches in Malawi and Botswana indicate an attempt to re-word CIE outcomes, but the units were still recognisably derived from CIE. The proportion of matches at level 1 indicate independence from CIE, which is highest in Uganda and South Africa.

Inclusion of African worldviews, IK and relevant content

All the African syllabi presented a Western science perspective without mentioning African worldviews. Local IK is specifically mentioned only once in the South African syllabus.

Figure 2 shows the percentage of units in each syllabus that are generic or relevant to the country. Clearly, South Africa and Uganda prioritised relevant content, where other countries had more generic than locally relevant content. Namibia, Lesotho and Malawi rarely mentioned local context, while Rwanda and Botswana had more than a quarter of their units relevant to the local context.

Table 6 explores the proportion of generic and relevant content by topic. All units in Topic 19 were generic in Namibia, Lesotho and Botswana, while Malawi and Rwanda had more generic than relevant units. Uganda had half generic units and half relevant, while South Africa had more relevant units than generic. In topic 21, Malawi had only generic units, while Namibia and Lesotho had mostly generic units. Rwanda had somewhat more generic than relevant units, while Botswana had half of its units generic and half relevant. Uganda and South Africa had far more relevant than generic units.

Two examples of how units were generic or relevant to local context are shown below.

Example 1:

Reference list outcome 19.4.6 "Define ecosystem as a unit containing the community of organisms and their environment, interacting together, e.g. a decomposing log, or a lake".[31]

Namibia[33] and Lesotho[35] closely matched the wording of outcome 19.4.6, including the decomposing log and lake as examples of ecosystems.

Uganda contextualised the concept as: "Look at a map showing the main physical features of East Africa and identify at least five ecosystems; stating their distinguishing features"[38(p.45)] and "Investigate an ecosystem close to the school"[38(p.33)].

Example 2:

Two reference list outcomes mention discarded waste:

- Outcome 21.3.2: "State the sources and effects of pollution of water (rivers, lakes and the sea) by chemical waste, discarded rubbish, untreated sewage and fertilisers."
- Outcome 21.3.4*:* "Discuss the effects of non-biodegradable plastics in the environment, in both aquatic and terrestrial ecosystems.*"*

Botswana re-phrased outcome 21.3.2 generically as "Describe the undesirable effects of water pollution by sewage and inorganic waste."[37(p. 26)]

South Africa contextualised water pollution, eutrophication, the effect of mining on water quality and thermal pollution by requiring students to observe an example of human influence on the local environment.[36(p.51)]

Missed opportunities and inappropriate examples

There are numerous missed opportunities in the African syllabi as well as inappropriate examples. The decomposing log and lake are inappropriate examples of ecosystems for Namibia and Lesotho, both of which have interesting and unique local ecosystems. Neither Rwanda nor Malawi

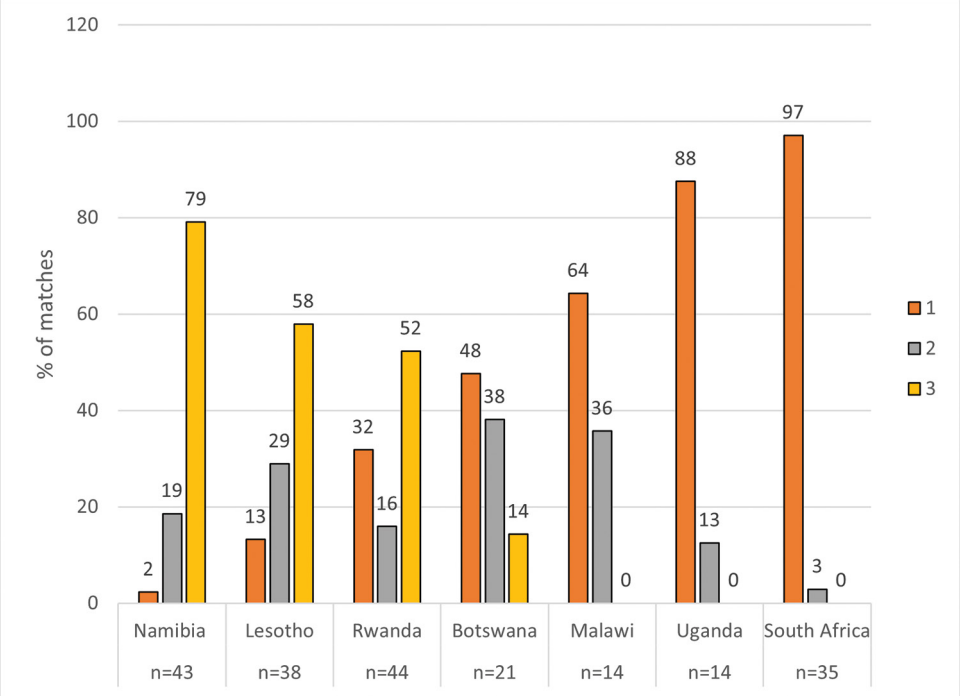

Figure 1: Percentage of matches between CIE outcomes and units in African syllabi at similarity levels 1–3. 1 = dissimilar, 2 = somewhat similar, 3 = closely similar.

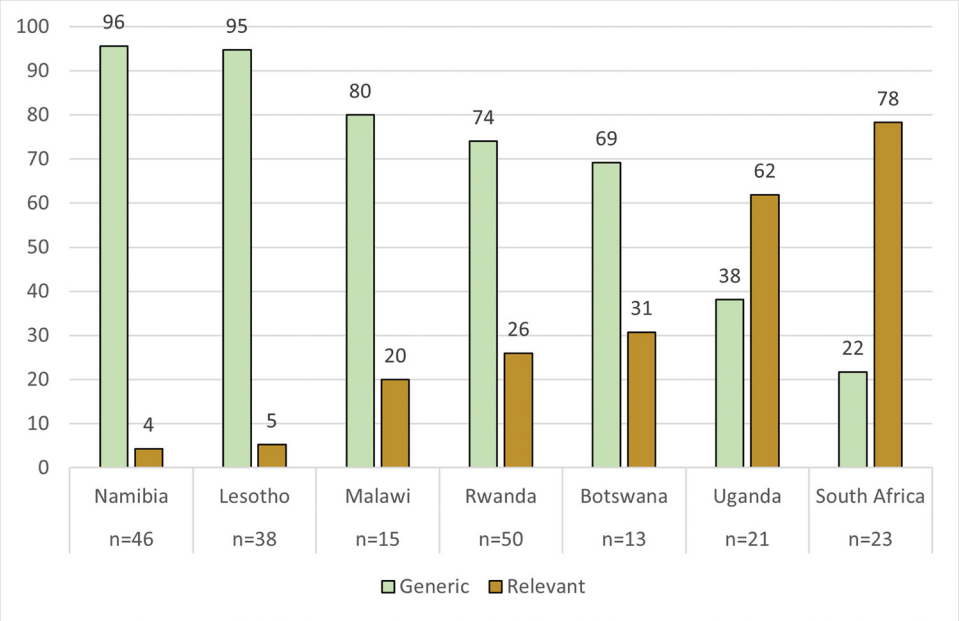

Figure 2: Percentage of generic and relevant content units in seven African syllabi (n = number of units).

Table 6: Number and percentage of generic and relevant units per topic and country

	Namibia	Lesotho	Malawi	Rwanda	Botswana	Uganda	South Africa
Total number of units	46	38	15	50	13	21	23
Topic 19: Organisms and their environment							
Generic	27 (100%)	25 (100%)	7 (70%)	27 (82%)	5 (100%)	7 (47%)	5 (36%)
Relevant	0	0	3 (30%)	6 (18%)	0	8 (53%)	9 (64%)
Topic 21: Human influences on ecosystems							
Generic	17 (85%)	11 (79%)	5 (100%)	10 (59%)	4 (50%)	1 (17%)	0
Relevant	2 (10%)	2 (14%)	0	7 (41%)	4 (50%)	5 (83%)	9 (100%)

prescribed study of a local ecosystem. South Africa and Uganda provided opportunities to investigate biomes and/or local ecosystems in their countries. Malawi chose non-local camels, polar bears and sharks to illustrate adaptations to various environments rather than local species. No country prescribed the identification of food chains and food webs in their local environment.

Pollution by waste and littering is identified as an environmental problem in southern African countries.[29] Lesotho and Botswana did not contextualise the outcome, while Namibia, Uganda and South Africa did so through activities.

The subtopic 'conservation' provides opportunities to highlight endangered plants and animals and efforts to protect them in each country. Lesotho and Malawi did not identify endangered species in their own countries, while Rwanda prescribed that students research endangered species in Africa broadly. Botswana contextualised the concept by suggesting that students investigate local threatened species and the need to conserve them. Both Rwanda and Uganda omitted the threatened mountain gorilla populations in their countries, a missed opportunity for this charismatic species. Namibia and South Africa used local contexts by suggesting that students investigate rhinoceros poaching in their countries and South Africa listed elephants in the Kruger National Park as an example of culling. Sustainable harvesting of food, building materials and traditional medicines was absent from all syllabi.

IK was rarely mentioned in any of the African syllabi. South Africa listed IK related to sustainable use of plants in the local environment, while Botswana asked students to "Find out from the local community which plants and animals have become scarce and why."[37(p.25)] Uganda did not mention indigenous or traditional knowledge specifically but required students to "discuss what steps farmers and gardeners in their locality take to maintain the fertility of their soils"[38(p.23)]. Malawi asked students to: "Identify organisms using local and scientific names."[39(p.22)] Omitting IK is a missed opportunity to include traditional knowledge about the sustainable use of natural resources.

Discussion

The findings lead to the following interpretations of the influence of CIE on African curricula:

- The syllabi of Namibia and Lesotho were strongly influenced by CIE, as indicated by a high proportion of close matches with the reference list, and a small number of non-matching units. Both countries had a few units that were relevant to their context. They have reduced the breadth of CIE syllabi. The syllabi were co-developed with CIE[6] but very little adaption has taken place.
- Rwanda's syllabus matched CIE's content selection and used similar wording to CIE outcomes in many of its units. Departure from CIE is indicated by the large number of non-matching units. About a quarter of its units were relevant to the context, particularly the human influence topic. Rwanda has adapted the CIE syllabi to its context[6], but it also departs from CIE with additional units.
- Botswana has a much narrower syllabus than CIE, but most of its units matched CIE outcomes with only one non-matching

unit, indicating a strong CIE influence on the selection of content. It re-worded CIE outcomes and contextualised a significant proportion of the human influences topic. Botswana has adapted the CIE syllabus to its local context.[6]

- Malawi has a much narrower syllabus than CIE syllabi with 40% of its units not matching the reference list. Nevertheless, 36% of its matches are at level 2, indicating some CIE influence. Most of its syllabus is generic. It has not adapted CIE syllabi, nor added content that is relevant to the local context.
- Uganda has 57% of its units not matching the reference list and very few close matches with CIE wording. Its content is mostly relevant to its context. Its syllabus appears independent of CIE influence, yet it acknowledges assistance from Cambridge Education and Curriculum Foundation.[38] It is consistent with co-development between CIE consultants and local curriculum developers.
- South Africa matches almost half of the reference list, indicating a similar selection of content to CIE. Wording of matching units differs from CIE outcomes, and South Africa adds a significant proportion of non-matching units. Most of its units are relevant to the country's context. South Africa's syllabus is independent of CIE influence.

None of the syllabi mentions Indigenous ways of understanding ecosystems.[9,14,19] All seven syllabi have adopted Western scientific epistemology and generic scientific content. The continued influence of CIE in some African syllabi might be interpreted as neocolonialism[4] or a device to perpetuate cultural imperialism[40] and the privileged status of Western science[3,10,13]. 'Neocolonial mind-snatching'[40] and 'curriculum epistemicide'[41] describe subtle processes which cause Indigenous peoples to devalue their own epistemologies in favour of Western science. The 'ghost of colonialism past' could account for CIE's influence in countries which followed Cambridge syllabi after independence (e.g. Lesotho and Botswana), but does not account for CIE's influence in non-British colonies such as Rwanda and Namibia, nor departure from CIE in Uganda and Malawi.

Each syllabus included in this study was locally constructed by curriculum developers with or without assistance from CIE or other organisations from the Global North. CIE cannot be assumed to have promoted Western science at the expense of African epistemologies as its adaption principles promote relevance, meaningfulness, respect and responsiveness to students' culture and worldviews.[8] It is more likely that African countries recognise the incompatibility between Western scientific worldviews and IKS[22] and the value of powerful knowledge[23,24]. The silence regarding African epistemologies does not assist African students who claim to feel alienated from Western science.[3,19]

Guidance principle 4 recommends including local IK in the curriculum.[7] Relevant IK could equip students with knowledge and appreciation of their natural environments, and the skills and attitudes to appreciate and improve the sustainable use thereof.[15] However, there are very few examples of local IK in the African syllabi studied here. Difficulties with prescribing African IK include its local, culturally specific and orally transmitted nature[3], and its inaccessibility due to lack of written documents. Rapid urbanisation, modern medicines, materials and foods, the mingling of different cultures[27] and exponential advances in information technology have detached many African students from their traditional roots, rendering local IK obsolete in modern contexts[14]. Scientific research and technological development underpin future prosperity and quality living in African countries, and Western science is recognised as the vehicle to achieve economic development.[3,10,14]

Guidance principle 3 advises that syllabi should include locally relevant examples.[6,8] Five of the seven African syllabi gave more attention to generic than to local contexts. South Africa and Uganda showed how local, relevant examples can illustrate ecology and environmental issues. It is most unfortunate that so few countries teach students about their local environment.

None of the seven countries has decolonised their Biology syllabus by incorporating African worldviews. Four syllabi show close affinity with CIE, supporting continued CIE influence in their curriculum development. Five syllabi mostly failed to heed Jegede's[14] call to teach science that is relevant to the sociocultural environment of the student. Learning about local contexts would encourage students to take informed custodianship of their natural environment and address the environmental issues that threaten African countries.[18] It makes no sense for students to study non-local ecosystems when their own unique ecosystems are vulnerable, nor for students to study foreign plants and animals instead of threatened species in their own countries. Uganda and South Africa provide examples of how a locally relevant syllabus for ecology and the environment might be constructed.

Data availability

The data supporting the results of this study are available upon request to the author.

Declarations

I have no competing interests to declare. I have no AI or LLM use to declare.

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