EdTech Hub

Clear evidence, better decisions, more learning.

unicef for every child

Developing a Proof of Concept for a Regional Learning Hub for Eastern and Southern Africa

Part 3: Skills taxonomy

Date March 2022

Author Caspar Groeneveld

DOI 10.53832/edtechhub.0077

UKaid from the British people

THE WORLD BANK

#EdTechHub @GlobalEdTechHub edtechhub.org

About this document

Recommended citation

Groeneveld, C. (2022). *Developing a Proof of Concept for a Regional Learning Hub for Eastern and Southern Africa Part 3: Skills taxonomy*. EdTech Hub, UNICEF. https://doi.org/10.53832/edtechhub.0077. Available at https://docs.edtechhub.org/lib/VFV5SG9H. Available under Creative Commons Attribution 4.0 International, https://creativecommons.org/licenses/by/4.0/.

Notes

EdTech Hub is supported by UK aid (Foreign, Commonwealth and Development Office), Bill & Melinda Gates Foundation, UNICEF and the World Bank. The views expressed in this document do not necessarily reflect the views of UK aid (Foreign, Commonwealth and Development Office), Bill & Melinda Gates Foundation, UNICEF and the World Bank.

Acknowledgements

This report was commissioned by UNICEF and produced under UNICEF and EdTech Hub's global partnership. Many thanks to Asim Latif (INEE), Awol Endris (UNESCO), Jacqueline Strecker (UNHCR), Clara van Praag (UNHCR), Guillaume Michels (UNICEF) and Tom Kaye (EdTech Hub) for their support and input to develop this report.

Contents

Abbreviations and acronyms

ESARO	UNICEF Eastern and Southern Africa Regional Office
CBC	Competency-based curriculum
INEE	Inter-agency Network for Education in Emergencies
KICD	Kenyan Institute for Curriculum Development
NGO	Non-governmental organisation
RLH	Regional Learning Hub
STEM	Science, Technology, Engineering and Mathematics
UNHCR	United Nations High Commissioner for Refugees
UNESCO	United Nations Educational, Scientific and Cultural Organization

1. Background and purpose

In 2021 the UNICEF Eastern and Southern Africa Regional Office (ESARO), UNESCO, UNHCR, the Inter-agency Network for Education in Emergencies (INEE) and EdTech Hub (henceforth referred to as 'the partners') began collaborating to develop a Regional Learning Hub (RLH). In a collaborative project UNICEF, UNESCO, UNHCR, INEE and EdTech Hub have created a proof of concept for a Regional Learning Hub (RLH). The aim of the Regional Learning Hub (RLH) is to try to solve one particular problem in the process of implementing digital or remote learning solutions for governments in sub-Saharan Africa and other regions: the provision of enough content that is aligned with the respective curricula and that is appropriate to local contexts. The RLH is envisaged as a platform where digital learning content has been pre-aligned with national curricula to enable use by governments and education stakeholders to facilitate quick selection of content for educational use within their regions.

The proof of concept of the RLH is a learning exercise that delivers two short content modules with curriculum-aligned content. It also describes the processes used to deliver this and documents any observations on challenges and opportunities that are relevant to bring the RLH to scale. The proof of concept focuses on four countries: Kenya, South Africa, South Sudan, and Somalia, and on two small content modules (topics from Primary Level 2nd Grade Literacy and Secondary Level Biology). However, the ultimate aim of the RLH is to be useful for a large variety of countries and for a wide variety of grades and subjects.

Development of the proof of concept entailed five distinct activities that have all been thoroughly documented and which include recommendations for the next step in the development of the RLH (Final Report). The five reports documenting these activities are:

1. Inception report
2. User research
3. Skills taxonomy (this document)
4. Content curation
5. Final report

This document describes our observations during the third activity: the creation of a skills taxonomy. This skills taxonomy is a framework that details

the actual content which needs to be included in the proof of concept. This document is accompanied by a spreadsheet with the actual skills taxonomy.

1.1. A skills taxonomy

A skills taxonomy allows us to identify the content that needs to be included to create the content modules described in the Inception report. See EdTech Hub's document on content curation for a discussion on the skills taxonomy (↑Groeneveld et al., 2020).

The skills taxonomy describes the taxonomies for Primary Level Grade 2 Literacy ('language comprehension: listening and understanding) and Secondary Level Biology ('photosynthesis'). We have created these descriptions by analysing the content in the curricula. Since the learning outcomes or curriculum standards in curricula are not always defined in detail, we also analysed textbooks where they were available. We have used these skills to create an overarching taxonomy that identifies commonalities and differences between the curricula.

This overarching taxonomy is essential to the working of the RLH. Our vision for the RLH is based on the assumption that the curricula of different countries in the region will overlap. Clearly, the curricula will not overlap perfectly: different countries may offer exclusive skills and offer these skills at different points in the educational system. However, to reach scale, to allow for the RLH to be maintained centrally, and to prevent duplication of work, the RLH must have a mechanism whereby a range of resources can be mapped to different curricula.

1.2. A note on terminology

In this document, we use the term 'skills' and 'skills taxonomy'. However, the term 'skill' can also be read as 'curriculum standard'. We use the term 'skills taxonomy' to mean 'curriculum framework'. Our intention is to break down the curricula into small, teachable items and reflect this in the skills taxonomy.

By 'content' we mean *any digital learning resources that could be offered to education stakeholders through the RLH*. These may comprise resources that target learners directly, such as videos and HTML-5 resources; PDFs and resources aimed at teachers, such as lesson plans; resources aimed at education stakeholders, such as the original file used to render a video or create a PDF and which allows modification; or resources that are in digital

format but are intended for offline usage, such as the files that can be used to print textbooks.

2. Methodology

In this document we aim to address the key question:

To what extent are similar skills or learning outcomes interchangeable in different countries?

To find an answer, we considered several sources of information, namely:

1. **Curricula and textbooks**
   We gathered all the curricula and some textbooks from the four focus countries for our proof of concept and analysed what should be taught and how it is taught.

2. **Approaches of other organisations**
   We looked at or spoke to other organisations who work on problems similar to those we are trying to solve.

The curricula and experiences helped us to provide an analysis of the curricula of the four countries. This analysis is presented in Section 3. These results led us to make a number of concrete recommendations in Section 4. Finally, in Section 5, we outline next steps, including our considerations and questions relevant to bringing the RLH to scale.

2.1. Curricula and textbooks

For South Africa, curricula are available online on the government's website (↑Department of Basic Education, 2021). Kenya's Institute for Curriculum Development (KICD) offers the competency-based curricula (CBC) online (↑Kenya Institute of Curriculum Development, n.d.), but for the higher grades, which have not yet transitioned to the CBC, curricula or official syllabi can be found on non-governmental websites, such as Advance-Africa (↑KCSE, n.d.). Somalia's and South Sudan's curricula were collected as files through UNICEF's, UNESCO's, and UNHCR's contacts. Textbooks for Kenya were bought in the shop; Somalia's federal textbooks were delivered through partners; we have not been able to get copies of South Africa's and South Sudan's textbooks.

2.2. Approaches of other organisations

Two organisations working on creating curriculum frameworks, Learning Equality and War Child Holland, have shared their experiences and we have consulted the other sources listed below.

2.2.1. Learning Equality

Since 2018, Learning Equality, an NGO that created and maintains the learning platform Kolibri,[1] has worked on digitising curriculum standards to increase machine discovery of resources and automatically align them to curricula. Although their focus is on the automation of resource curation, the principles they identify apply to the RLH as well.

2.2.2. War Child Holland

Through their 'Can't Wait to Learn' initiative,[2] War Child Holland has worked on creating early grades literacy content for a variety of countries and languages. Their approach is comprehensive: they create a framework, develop content and offer the content in a gamified learning experience with assistance from teachers or facilitators.

2.2.3. USAID's Global Proficiency Framework for Reading

UNESCO developed a Global Proficiency Framework for Reading (GPF) in collaboration with USAID, UKAID, the Australian Council for Educational Research (ACER), the Bill & Melinda Gates Foundation, and the World Bank (↑UNESCO Institute for Statistics, 2020). Their framework includes reading, writing, and listening comprehension skills and organises them at conceptual levels, not unlike the Common Core (↑CCSSO & NGA, 2010), the standards set by the US government for mathematics and English language.

2.2.4. Learning Passport's Curriculum Framework

UNICEF and the University of Cambridge developed a curriculum framework (↑Cambridge Assessment, 2020) as a basis for materials design, with a special focus on refugees and displaced learners. As such, their framework does not aim to be comprehensive but to contain essential elements of the curriculum that can be built on further in a different setting and functions as a basis to develop core skills and knowledge.

[1] Available at kolibri.org

[2] Available at warchildholland.org/intervention-cwtl

3. Results

In this section we describe types of curricula and use that description to analyse the literacy and biology curricula that allowed us to organise our two content modules. We end with a description of and link to the overarching skills taxonomies for these modules.

3.1. Analysing types of curricula

The proof of concept aims to align content for two short content modules: primary level Grade 2 Literacy ('Listening') and secondary level biology ('Photosynthesis'). However, early grades literacy and secondary level biology have different dynamics. Learning Equality provides a helpful analysis of how these subjects are different and the implications of these differences (↑Savov, 2021).

Learning Equality differentiates between **content-based curricula**, **proficiency-based curricula,** and **competency-based curricula**. With content-based curricula, which apply in particular to mathematics and the sciences, content is organised in,

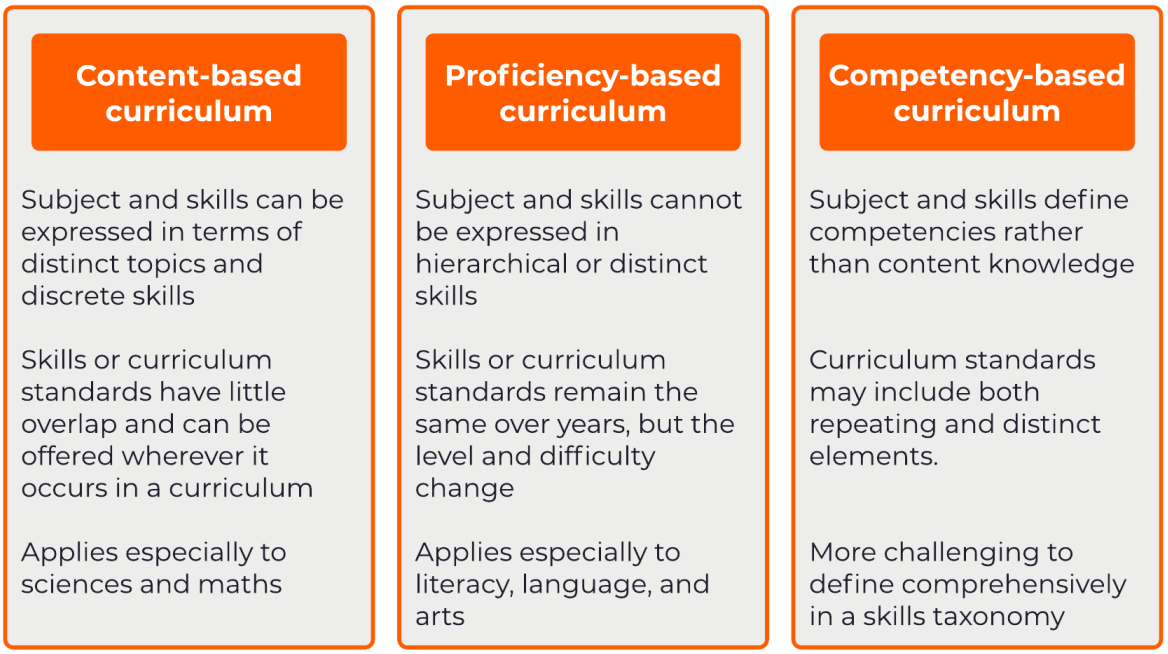
> *"distinct topics, subtopics, and concepts, which generally cover discrete content. Topics often have little overlap and can be arranged in a progression with a well-defined prerequisite structure between grade levels. Content-based curriculum frameworks are commonly found in math and science— subjects for which the 'building-block' model of learning is a useful analogy."* (↑Savov, 2021)

Proficiency-based curricula apply to subjects that cannot be expressed in such hierarchical organisation but where learners are expected to reach a higher level of proficiency on the same subject or curriculum standard. This applies especially to literacy, language, and arts. Finally, competency-based curricula define competencies rather than content knowledge. These can be subject-specific, cross-curricular, or general.

> *"Competency-based curricula can include aspects of proficiency-based curricula, and just like them, are not well represented in a grade level hierarchy since the competencies are equally relevant for 10-year-old learners (Grade 4) as they are for 30-year-old learners (continuing education)."* (↑Savov, 2021)

Figure 1 illustrates the differences between the three types of curricula.

Figure 1. *Three types of curricula as defined by Learning Equality.*



Learning Passport's Curriculum Framework makes a similar observation:

> *"In Maths and Science, the framework levels are not intended to be based on age and signify the development of concepts in sequence. By contrast, in Literacy, the relation between that of language development and fundamental cognitive development requires that organisation of the sequence be according to age [...]. Missing out on elements of linguistic development – for example through lack of exposure to certain language forms, or by low levels of linguistic interaction – can affect cognitive development."* (↑Cambridge Assessment, 2020)

This distinction is informative for mapping the RLH's two content modules. The biology skills can be identified as part of a content-based curriculum: the different skills can be offered as distinct units and in a different order in different curricula. Skills that are not relevant for a specific curriculum can be ignored. This approach works for all science, technology, engineering, and maths (STEM) subjects in late primary and secondary grades. Literacy skills, on the other hand, cannot be identified as distinct skills. Instead, the content will need to be at a specific level and age-appropriate, but cannot be defined in

terms of distinct learning outcomes. A formulation in South Sudan's literacy curriculum for Grades 1–3 is illustrative of this: each of the 13 units in each of the grades contains the phrase "They should listen to stories, poems, recite rhymes, and mime different situations with themes related to" the theme of that week.[3]

3.2. Literacy curricula

For the proof of concept, we have selected Grade 2 language comprehension content (language comprehension; 'listening'). The expectation was that it would allow us to find sufficient content, have sufficient overlap between the countries for content to be reused, and provide us with enough learning opportunities to further develop the RLH.

As a proficiency-based curriculum, literacy cannot be defined as clearly in terms of learning outcomes or skills as biology. Instead, for all levels, students can be expected to read or listen to and understand the text, with both the level of text and expected level of analysis slowly increasing over the years but learning objectives sometimes remaining the same. Some of the curricula used identify appropriate 'activities' for a specific age group.

3.2.1. The four countries' literacy curricula

Literacy standards are not defined in comparable terms in the four curricula. In some cases, the curriculum already defines the specific story that teachers work with (for example, 'Ahmed and his partner' in Somalia), themes of a specific unit (for example, 'games and sports' in South Sudan, or 'at school' in Kenya's Swahili curriculum), while in others, the curriculum focuses on more high-level standards (for example, South Africa's curriculum states that

> *"teachers select two themes that will allow them to introduce and recycle vocabulary, and cover the activities listed below. Note that the suggested themes/topics are simply suggestions. Teachers should choose their own appropriate themes depending on their context and the resources available."* (↑South Africa & Department of Basic Education, 2011)

For South Sudan and Somalia there is no listening strand. In South Sudan, each unit in the primary Grades 1 to 3 contains the phrase "They should listen to stories, poems, recite rhymes, and mime different situations with themes related to …" where the ellipsis is filled by the unit name and story name. For

[3] Resource is not publicly available, but was shared through our network.

Grade 2, there are 14 units with titles such as 'politeness', 'myself', 'games and sports', 'children's rights'. Similarly, Somalia's curriculum also includes specific stories, such as 'Ahmed and Hargeisa', 'Maize tree', or 'I had a vision'. However, Somalia's Somali curriculum or textbooks do not specify learning outcomes or other curriculum standards that can be identified as skills.

3.2.2. War Child Holland

War Child Holland creates content through their 'Can't Wait to Learn' implementation and learning games. Their content teaches the technical skill of reading and writing through phonics, frequently-used words, and simple texts which are offered progressively. The NGO creates this content based on research and local needs: their Arabic content for Jordan is very different from their Arabic content for Sudan. War Child Holland finds that creating content to teach reading and writing is more straightforward than creating content to help develop language comprehension. However, all content they create is unique to a country and very little of their content is reused or repurposed for different regions.

3.2.3. Assessment of literacy

Within the RLH, we aim to offer both learning content and resources that help teachers or caregivers to formatively assess progress and understanding of the skills. The four different countries have different suggestions for assessing literacy among second graders. South Africa has concrete suggestions for assessing listening, as presented in Table 1.

Table 1. *Literacy assessment questions from the South African curriculum, Grade 2, Term 1, 'Listening and speaking (oral)' (↑South Africa & Department of Basic Education, 2011).*

Week	Suggested assessment
1–5	■ Understands and responds to simple questions such as 'When ….?' 'Why ….? ■ Identifies an object from a simple oral description, for example, 'I am a very big animal. I have a very long neck. I can eat the leaves at the tops of trees. Who am I?'
6–10	■ Listens to a non-fiction text such as a factual recount or information report and answers comprehension questions orally

- Gives a simple oral summary of 3 or 4 sentences of a non-fiction text
- Demonstrates understanding of oral vocabulary by pointing to objects in the classroom or in a picture in response to questions / instructions from the teacher, for example, 'What's that?' 'Point to the elephant's tusks'

Kenya's literacy assessment suggestions for the strand are more succinct, with only the suggested assessment of "Question / answer; narration" (↑Kenya Institute of Curriculum Development, 2017). South Sudan's framework does not contain assessment suggestions. Somalia's curriculum contains a suggestion on weighing the different assessment methods but does not offer assessment standards.

In conclusion, the curricula and textbooks for literacy seem more disjunct for the different countries and for different languages within a country and are much more varied than is the case for biology curricula. For this reason, we expect the overarching taxonomy to be affected more by the content that we can find and curriculum experts intimately familiar with specific countries than is the case for the biology taxonomy.

3.3. Biology curricula

Since biology curricula are content-based, creating a skills taxonomy for the subject presents fewer difficulties.

The overarching taxonomy for the subject biology contains 25 different skills or curriculum standards that require content if we include both 'photosynthesis' and 'respiration'. Where there is overlap, skills have been mapped against each other. The separate taxonomies contain roughly 10 skills each, with Somalia's curriculum framework being an outlier with only 3 comprehensive skills (Kenya: 15; Somalia: 3; South Africa: 9; South Sudan: 11). These numbers have two implications for scale.

There is overlap between skills taught in different curricula. Some skills are unique to one curriculum while others are taught in several curricula. For that reason, with four curricula, we do not expect to identify four times the number of skills that we need for one curriculum. When mapping the content modules, we found that the overarching curriculum contains about 2.5 times the number of skills of a single curriculum.

We know from experience that we can estimate roughly 100 skills or curriculum standards — which are covered by content items — per science subject per grade. An estimated 100 skills or curriculum standards per science subject per grade in a given curriculum would amount to ~250 skills per science subject per grade for a taxonomy that covers four curricula. As the number of countries that are included in the RLH grows, this factor will likely go down since there is a higher likelihood of skills already being part of the RLH. The exact number of skills will be clear once the content curation phase has finished.

For the subject of biology, we are able to create one large, overarching taxonomy that contains separate taxonomies. Not all curricula have distinct codes for each skill or curriculum standard. For example, if we follow the chapter and paragraph numbers of Kenya's Biology syllabus to identify skills, then we can see that the Kenyan curriculum uses "6.2.2" for a curriculum standard that covers several skills. We have added a number to be able to distinguish between the different curriculum standards. Moreover, after ordering all the skills, we assigned our own codes. These codes ensure that all the skills have a unique identifier, which can be used for storing information on, organising, and mapping these skills.

An example of mapping multiple curricula can be seen in Table 2 below, including overlapping skills. Skill RLH8.1.01 occurs in both the South African and Kenyan curricula, but not in the Somali and South Sudanese ones. What is more, the curriculum standards in the Somali curriculum are broader — there are only two curriculum standards that cover photosynthesis — but these statements or skills are covered by at least three skills in our framework.

This framework allows a country to quickly filter, select, and order content that is relevant for them.

Table 2. *Example of mapping of multiple curricula in an overarching framework.*

Subtopic	RLH	South Sudan	South Africa	Kenya	Somalia	Skill / Statement
Photosynthesis	RLH8.1.01		8.1.1	6.2.1.1		Understand that interactions and interdependence in an ecosystem are driven by the need for energy to sustain life
Photosynthesis	RLH8.1.02	4.1.1		6.2.2.1	9.11.1	Understand why photosynthesis is important to plants
Photosynthesis	RLH8.1.03			6.2.2.2		Explain how the leaf is adapted to photosynthesis
Photosynthesis	RLH8.1.04			6.2.2.4	9.11.1	Describe the structure and function of chloroplast
Photosynthesis	RLH8.1.05		8.1.2			Understand that the sun is the important source providing this energy in the form of light and heat
Photosynthesis	RLH8.1.06	4.1.2	8.1.3	6.2.2.5	9.11.1	Describe the stages of photosynthetic reactions

Somalia officially teaches science subjects in English; however, the provided curriculum was in Somali and it is understood that the science classes are taught in Somali, not in English. For the proof of concept, we have limited the content to English — in line with the official curriculum. The books received for the Somali Federation and Somaliland were in English. Somaliland's Form 1 biology textbook includes photosynthesis and respiration, but the federal textbook for Form 1 does not (↑Ministry of Education & Higher Studies, no date; ↑Xafiiska Horumarinta Manaahijta, 2017).

3.4. Taxonomies

The taxonomies we created can be seen **here**. These taxonomies contain the skills for which content needs to be curated for biology and literacy. In the case of biology, it is not yet clear whether we should limit ourselves to photosynthesis or include respiration as a subtopic as well. If the effort to curate a sufficient amount of appropriate content for photosynthesis yields enough information to draw conclusions, then the topic of respiration will not be included.

For literacy skills, breaking down the curricula to create a taxonomy proved more challenging. Here, we expect the availability of content to help us refine the taxonomy.

4. Recommendations

Our approach has led to a number of conclusions for the design of our skills taxonomy. We need to:

1. Identify each skill or curriculum standard with a code
2. Differentiate content types for proficiency-based and content-based curricula
3. Curate literacy content
4. Curate biology content

4.1. Identify each skill or curriculum standard with a code

Syllabi and curricula in the four focus countries contain several skills or curriculum standards under one code or identifier. This is more straightforward for biology than for literacy. For example, Kenya's KCSE Biology Syllabus (↕KCSE, no date) identifies different aspects of photosynthesis under the code 6.2.2. Since different curriculum standards in the Kenya Syllabus align with different curriculum standards in other curricula, we need to modify the identifiers. We have done this by adding numbers to existing codes, for example, 6.2.2.1, 6.2.2.2.

Besides the adjusted codes to identify skills or curriculum standards within a curriculum, the overarching taxonomy will need its own identifiers. In this case, we have simply opted for codes such as RLH8.1.01, RLH8.1.0.2, etc., which suffice for the proof of concept. Table 2, above, contains an example with codes.

4.2. Differentiate content types for proficiency-based and content-based curricula

In the proof of concept, we have included two pieces of content: Primary Grade 2 Literacy ('Listening') and Secondary Level Biology ('Photosynthesis').

These two content types are very different. The biology content is knowledge content that does not require precise and specific previous knowledge and can be used at any point where the content is taught in the curriculum. Similarly, it is comparatively easy to assess the content knowledge. Besides content knowledge, most curricula include activities or experiments to

investigate specific concepts, such as an experiment to show that leaves produce starch.

The literacy content is very different. Whether it is 'listening to spoken text' or 'comprehension of written text', the name of the skill remains essentially the same for the entire period of basic education. The level of the texts and the levels of analysis, summary, and comprehension go up. This means that the content offered should be aligned to a reading and comprehension level of, roughly, Primary Grade 2. Defining that grade level difficulty is of a complexity that is beyond the scope of this project. For example, the content may include specific sentence lengths, a selection of vocabulary from predefined lists, or formulations and expressions.

4.3. Conclusions for literacy content curation

It is a challenge to map literacy skills between curricula and we expect it to be equally challenging to map digital learning resources to the literacy skills taxonomy. However, within the constraints and properties that we have observed above, we have several recommendations.

For curricula that do not include specific texts, texts for listening can be curated in **text format**, **audio format** and / or **video format**. These texts should be contextually relevant. For countries that do prescribe texts, such as South Sudan and Somalia, the challenge will be to find these texts in digital formats and obtain permission to share them. Besides the actual textual content, learners may require **workbooks** providing activities and exercises that refer to the content. Resources can be included that guide teachers and caregivers on how to facilitate a conversation on the material. These can be in the form of **lesson plans** or **teacher guides**. Finally, assessment should be formative, through teacher guidance and could be included in the lesson plans or teacher guides.

4.4. Conclusions for biology content curation

The nature of the biology skills make them more suitable for **interactive**, **illustrated**, **animated,** and **video content**. Nonetheless, including **textbooks** or matching textual files, if they exist, will be welcome.

The fact that curricula do not overlap completely means that content that can be used more or less as stand-alone material needs to be curated. Content that refers to other content (e.g., 'in the previous video…') may confuse more than it helps.

A property of the science content is the inclusion of **experiments** and **activities**. These may exist in the form of videos, workbooks, or **activity sheets,** or **interactive simulations**. Activities that include interaction with chemicals, a source of fire, or other potential hazards may be explicitly limited to being undertaken in person, by teachers, and exclude caregivers. Guidance for teachers in the form of **lesson plans** or **teacher guides** is desirable.

Finally, none of the curricula are explicit about the assessment of skills on the subject of biology.

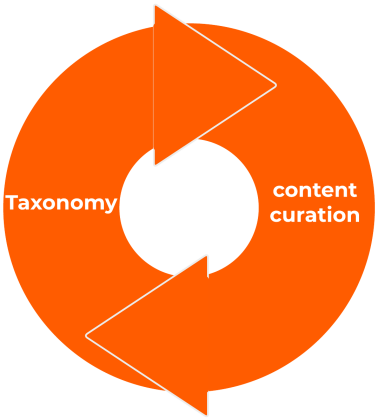
5. Next steps

This document describes the third step in the development of the proof of concept for the RLH. It is in itself a step in the development of the RLH, as it lays the foundations for content curation and provides observations and questions that are relevant as we prepare for scale.

5.1. From skills taxonomy to content curation

Creating the taxonomy is a first requirement before finding and selecting content. Once the taxonomy is in place, the challenge is to find and propose appropriate content items. However, based on the available content, the taxonomy can be adjusted to better reflect the existing content (Figure 2, below). For example, skills may be split, merged, or reformulated depending on the content available. Besides, depending on the content, there may be content items that cover multiple skills at once, making them suitable for some curricula, but not necessarily for others, which only contain one skill or explicitly exclude specific content. However, starting the curation process with a taxonomy allows for budgeting the required effort and for tracking progress on the actual curation process. Annex 2 provides a short example of the process for tracking progress.

Figure 2. *The skills taxonomy is a dynamic document and the nature of content available may lead to adjustments to the taxonomy.*



5.1.1. Presentation of skills — from taxonomy to content

There are different ways of presenting content. One option is to use a database, where education stakeholders can browse through the content and

make selections based on filters, tags, and their specific needs. Tables 3, 4, and 5 in Annex 1 offer a possible way of presenting skills and content. Please note that these are only examples being used to illustrate a possible presentation.

Table 3 contains an overview of all skills, including details showing which skills overlap and in which curriculum. A Kenyan stakeholder can make their own selection and limit the view to the skills represented in Table 4. Either directly from that view or from the next view, the stakeholder can then see which content has been curated for that skill, as for example, in Table 5.

5.1.2. Ambition level and feasibility

Table 5 presents a highly ambitious situation, with 16 types of content desired and 8 actually curated. In this example, with 11 skills for photosynthesis, we would aspire to have 176 resources for photosynthesis and we would have found 88 resources for this skill alone. It is highly questionable that such a high level of effort can be scaled to thousands of skills, let alone that such a repository can be sustained.

5.2. Preparing for scale

As we prepare for scale, it is a useful exercise to extrapolate and include more subjects and grades to make a calculation by way of example. Assuming that we have 100 skills per subject per content-based curriculum that we are going to include in an RLH with content for biology, physics, chemistry, and mathematics for four grades in high school, then we would need to select, propose, approve, and maintain 100×4×4 = 1,600 skills per curriculum. If the factor of 2.5 for four curricula holds, then our RLH will contain a database with 1,600×2.5=4,000 skills that require content.

This example does not address the question of the types of content that are necessary. If each skill is accompanied by learning content in any format, a form of assessment, a workbook and a lesson plan or teacher guide, the RLH's database balloons to 16,000 resources that would need to be maintained, updated, and managed in such a way that a change in any given resource is reflected in the country-specific curricula.

5.2.1. Questions

The proof of concept phase has been a learning exercise to inform further development of the RLH. The observations in this step of the process have inevitably led to further questions. These are listed below.

1. **Can we calculate a 'content factor'?**
   We have estimated that for biology content, offering digital resources for four countries requires 2.5 times the amount of resources needed for one country. The content curation process will confirm the accuracy of this number for the small amount of content curated in the proof of concept for two very different subjects. Next steps can show if such a number is consistent over larger amounts of content and different subjects.

2. **How does increasing the number of countries affect the 'content factor'?**
   If curating content for four countries has a 'content factor' of 2.5, then how does adding countries impact the 'content factor'? Does the law of increasing returns apply, as is expected, and can we quantify the work needed to add countries? For example, the 'content factor' for eight countries is expected to be less than 5.0, but a more precise estimation will inform the budget needed to expand the RLH to include resources for more countries.

3. **Which school subjects have proficiency-based curricula and will entail challenges similar to those we experienced with creating a taxonomy for literacy, and which subjects have content-based curricula?**
   Literacy and science are clearly proficiency-based and content-based, respectively. However, social sciences or history may fall somewhere in between.

4. **Is there a difference between countries in terms of the ease with which we can curate content?**
   It may be the case that appropriate content can be curated more easily for some countries than for others. Can we identify factors that will determine the ease or difficulty in curating content for particular countries?

5. **Is it possible to create an overarching curriculum framework for literacy?**
   There seems to be more variation in the way literacy is taught in the different countries than is the case for science. Some countries use a theme-based curriculum, which may constrain the content that can be curated or do not define substrands, such as listening.

6. **Do we need to treat competency-based curricula as fundamentally different or can we apply proficiency-based and content-based principles to these?**

Kenya started implementing a CBC five years ago. We have not treated Kenya's CBC differently to other curricula, but our next steps may help clarify if a CBC has practical consequences for the RLH and what these consequences are.

7. **If offering early grades literacy content proves more challenging than offering secondary grades science content, does the expected higher impact on learning justify the greater effort needed for it?** Teaching literacy in first languages is more effective than doing so in a national or second language, however, there may be a lack of content available to teach literacy in minority languages in the region. Besides, at this stage, mapping literacy content appears to be more challenging. However, the impact of early grades teaching is higher than the impact of secondary grades teaching, and this is another factor worthy of consideration.

Bibliography

This bibliography is available digitally in our evidence library at https://docs.edtechhub.org/lib/VFV5SG9H

CCSSO, & NGA. (2010). *Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects*. National Governors Association Center for Best Practices, Council of Chief State School Officers. http://www.corestandards.org/wp-content/uploads/ELA_Standards1.pdf. (details)

Cambridge Assessment. (2020). *The Learning Passport: Curriculum Framework (Maths, Science, Literacy)*. Cambridge Assessment. Available from https://www.learningpassport.org/media/331/file/Curriculum%20Framework%20(Maths,%20Science,%20Literacy).pdf. (details)

Department of Basic Education, & Department of Basic Education. (2011). *Curriculum and assessment policy statement English first additional language. Grade 1-3: Foundation phase Grade 1-3 : Foundation phase*. Available from https://www.education.gov.za/LinkClick.aspx?fileticket=BCaB_SnaASA%3d&tabid=571&portalid=0&mid=1561. (details)

Department of Basic Education. (2021). *Curriculum Assessment Policy Statements (CAPS)*. Available from https://www.education.gov.za/Curriculum/CurriculumAssessmentPolicyStatements(CAPS).aspx. (details)

Groeneveld, C. (2022). *Developing a Proof of Concept for a Regional Learning Hub for Eastern and Southern Africa Part 3: Skills taxonomy* (Technical Report No. 3). EdTech Hub. https://doi.org/10.53832/edtechhub.0077. Available from https://docs.edtechhub.org/lib/VFV5SG9H. Available under Creative Commons Attribution 4.0 International. (details)

Groeneveld, C. (2022). *Developing a Proof of Concept for a Regional Learning Hub for Eastern and Southern Africa Part 4: Content curation* (Technical Report No. 4). EdTech Hub. https://doi.org/10.53832/edtechhub.0078. Available from https://docs.edtechhub.org/lib/9VKXVKGI. Available under Creative Commons Attribution 4.0 International. (details)

Groeneveld, C., Kibga, E., & Kaye, T. (2020). *Deploying an e-learning Environment in Zanzibar: Digital Content Curation*. https://doi.org/10/gktg9h. Available from https://docs.edtechhub.org/lib/T2W7MU3K. Available under Creative Commons Attribution 4.0 International, Open Access. (details)

Groeneveld, C., Michels, G., & Kaye, T. (2022). *Developing a Proof of Concept for a Regional Learning Hub for Eastern and Southern Africa Part 1: Inception Report* (Technical Report No. 1). EdTech Hub. https://doi.org/10.53832/edtechhub.0075.

Available from https://docs.edtechhub.org/lib/EW94QPAA. Available under Creative Commons Attribution 4.0 International. (details)

Groeneveld, C., Michels, G., & Kaye, T. (2022). *Developing a Proof of Concept for a Regional Learning Hub for Eastern and Southern Africa Part 5: Final report* [Technical Report]. EdTech Hub. https://doi.org/10.53832/edtechhub.0079. Available from https://docs.edtechhub.org/lib/5XBMPDX6. Available under Creative Commons Attribution 4.0 International. (details)

KCSE. (n.d.). *KCSE Biology Syllabus 2022/2023*. https://www.advance-africa.com/Biology-Syllabus.html. (details)

Kenya Institute of Curriculum Development. (n.d.). *Curriculum Designs(PP1-Grade4)*. https://kicd.ac.ke/cbc-materials/curriculum-design/. (details)

Ministry of Education & Higher Studies. (n.d.). *Secondary Biology Form One: Student Book*. Republic of Somaliland. https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/5/1926/files/2016/02/Form-1-Biology-pnp5gl.pdf. (details)

Rahman, A., & Groeneveld, C. (2022). *Developing a Proof of Concept for a Regional Learning Hub for Eastern and Southern Africa Part 2: Insights from user research* (Technical Report No. 2). EdTech Hub. https://doi.org/10.53832/edtechhub.0076. Available from https://docs.edtechhub.org/lib/CI5UZ5R4. Available under Creative Commons Attribution 4.0 International. (details)

Savov, I. (2021). *Digitizing Curriculum Standards to Unlock the Potential of Open Educational Resources in a Global Context.* UNHCR, Vodafone Foundation, Google.org, and UNESCO. https://learningequality.org/r/digitizing-curriculum. (details)

UNESCO Institute for Statistics. (2020). *Global Proficiency Framework for Reading: Grades 1 to 9*. https://gaml.uis.unesco.org/wp-content/uploads/sites/2/2021/03/Global-Proficiency-Framework-Reading.pdf. (details)

Xafiiska Horumarinta Manaahijta. (2017). *Qaabdhismeedka Manhajka Waxbarashada Qaranka Soomaaliyeed*. Wasaaradda Waxbarashada, Hiddaha iyo Tacliinta Sare. (details)

Annex 1. Presentation of skills and content

Table 3. *Example of mapping of multiple curricula with curriculum standard numbers taken from the respective curricula.*

RLH Code	Subtopic	South Sudan	South Africa	Kenya	Somalia	Skill / Statement
RLH8.1.01	Photosynthesis		8.1.1	6.2.1.1		Understand that interactions and interdependence in an ecosystem are driven by the need for energy to sustain life
RLH8.1.02	Photosynthesis	4.1.1		6.2.2.1	9.11.1	Understand why photosynthesis is important to plants
RLH8.1.03	Photosynthesis			6.2.2.2		Explain how the leaf is adapted to photosynthesis
RLH8.1.04	Photosynthesis			6.2.2.4	9.11.1	Describe the structure and function of chloroplast
RLH8.1.05	Photosynthesis		8.1.2			Understand that the sun is the important source providing this energy in the form of light and heat
RLH8.1.06	Photosynthesis	4.1.2	8.1.3	6.2.2.5	9.11.1	Describe the stages of photosynthetic reactions
RLH8.1.07	Photosynthesis	4.1.3	8.1.4		9.11.1	Describe the stages of photosynthetic reactions in equations
RLH8.1.08	Photosynthesis		8.1.5			Explain how plants change glucose into starch cellulose and other chemical compounds to enable processes such as growth and reproduction

Table 4. *An overview of skills for one country.*

RLH Code	Subtopic	Form	Kenya	Skill / Statement
RLH8.1.01	Photosynthesis	I	6.2.1.1	Understand that interactions and interdependence in an ecosystem are driven by the need for energy to sustain life
RLH8.1.02	Photosynthesis	I	6.2.2.1	Understand why photosynthesis is important to plants
RLH8.1.03	Photosynthesis	I	6.2.2.2	Explain how the leaf is adapted to photosynthesis
RLH8.1.04	Photosynthesis	I	6.2.2.4	Describe the structure and function of chloroplast
RLH8.1.06	Photosynthesis	I	6.2.2.5	Describe the stages of photosynthetic reactions

Table 5. *Content sought per skill.*

Code RLH8.1.01 / 6.2.1.1 "Understand that interactions and interdependence in an ecosystem are driven by the need for energy to sustain life"									
	Low tech				**High tech**				
	TV	**Radio**	**Text (phone)**	**Audio (phone / IVR)**	**Video**	**Interactive (HTML5)**	**Illustrated text (PDF)**	**Plain text**	**Source files (per type)**
Workbook (student)							Download	Download	N/A
Learning content	N/A	N/A	N/A	N/A	Download	N/A	Download		N/A
Activity / experiment					Download	N/A	Download		N/A
Assessment			N/A			Download		N/A	N/A
Lesson plan (teacher)							Download		N/A

Annex 2. Monitoring and tracking examples

The tables below give a visual representation of examples of monitoring the process of content curation. Two small content modules have been curated in the proof of concept. However, going to scale requires a deliberate approach with proper tracking of the skills for which content will be needed and the skills for which sufficient content has already been curated. The tables below provide examples of such a monitoring exercise. Please note that all examples are only illustrative.

Table 6 shows the progress of curating different types of content for different skills in the overarching taxonomy. A person (or algorithm) could decide if there is a sufficient amount of content to consider the skill to be covered by digital resources. Such a table can feed into an overview, such as Table 7, showing progress and highlighting where challenges remain. As long as progress is maintained and tracked systematically, tracking progress or creating a dashboard for one country, one subject, one grade, one modality, or any combination thereof should be easily achievable.

Table 6. *Example of an overview of the types of content curated per skill.*

RLH Code	Subject	Topic	Subtopic	Skill		Sufficient content for skill	TV	Audio content	Video content	Lesson plan	Assessment
RLH8.1.01	Biology	Photosynthesis and respiration	Photosynthesis	RLH Skill 1	Learning content	Yes	Link		Link		Link
RLH8.1.02	Biology	Photosynthesis and respiration	Photosynthesis	RLH Skill 2	Learning content	Yes		Link			Link
RLH8.1.03	Biology	Photosynthesis and respiration	Photosynthesis	RLH Skill 3	Learning content	No		Link		Link	

RLH8.1.04	Biology	Photosynthesis and respiration	Photosynthesis	RLH Skill 4	Learning content	No			
RLH8.1.05	Biology	Photosynthesis and respiration	Photosynthesis	RLH Skill 5	Learning content	No		Link	
RLH8.1.06	Biology	Photosynthesis and respiration	Photosynthesis	RLH Skill 6	Learning content	Yes		Link	Link

Table 7. *Example of an overview of progress in content curation and degree to which the RLH contains the desired content.*

Subjects	# skills	# curated skills	Progress	February	March	April	May
Math	432	114	26%	15	26	28	45
English	460	73	16%	4	4	32	33
Biology	384	198	52%	18	30	68	82
Physics	392	227	58%	19	32	78	98
Chemistry	492	200	41%	5	25	86	84
ICT	232	69	30%	8	18	22	21
KiSwahili	344	38	11%	0	0	16	22
TOTAL	2736	919	34%	69	135	330	385