

onecourse

handbook



one**course** handbook

by onebillion

onebillion learners is a registered charity in England and Wales N° 1159480

onebillion.org

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01

executive
summary



Welcome to onecourse!

One app for reading, writing and numeracy. By non-profit onebillion.

onecourse is comprehensive. It is designed to enable children to achieve basic literacy and numeracy in their own language, whether in or out of school.

onecourse is child-friendly and engaging. A little teacher figure guides the child through our wide range of learning activities, with their clean and simple graphic style.

onecourse is modular in structure. This makes it easy to personalise, add further content, and scale to other languages. Our numeracy content is already in use around the world, in 50 languages. Our literacy content is in English, Swahili, and Chichewa.

onecourse is born of experience. We have a wealth of experience in delivering education through software, over many years. The data and observations we collect have fed into the course design.

onecourse is inspired by our vision. Our goal is to empower one billion marginalised children around the world, through education. We work with partners to help us achieve this goal.

onecourse has evidence of impact. Our numeracy material has been evaluated by University of Nottingham (UK) and University of Malawi. Formal trials showed significant positive results. Our reading/writing material had a short trial in Dar es Salaam, with promising results, and is now the subject of a larger, longer trial in Malawi.

onecourse is for sharing. Our learning activities can easily be added to other developers' solutions, if we are an XPRISE finalist. We will add the best of other finalists' solutions to **onecourse**, to help ensure the best possible outcome for the child.

onecourse will soon be complete. It is now around 70% complete. Much of the remaining material will be released by August 2017, with the remainder by September 2018. We plan 3000 learning units in total.

Our onecourse submission

Our **onecourse** submission has four parts.

1. onecourse demo app for the judges, on Pixel C

This is for you, and not for children. It contains:

- over 50 sample units from the course, for reading, writing and numeracy, in both Swahili and English.
- a video showing how the child's daily access will be structured, when the course is complete.
- video clips of children using the material, filmed in Tanzania, the UK, Malawi, and Uganda.

The two language buttons allow you to switch between English and Swahili, for the sample units.

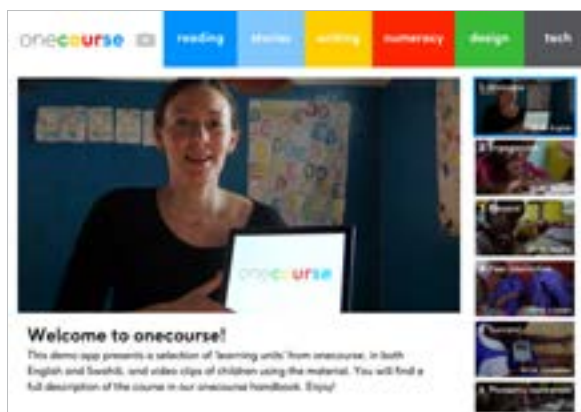
2. onecourse Swahili app for children, on Pixel C

Here you can experience the **onecourse** material as children in Tanzania would experience it.

3. onecourse English app for children

Our **onecourse** English entry is on our XPRIZE repository, but not on a tablet. The XPRIZE team has agreed to verify the content.

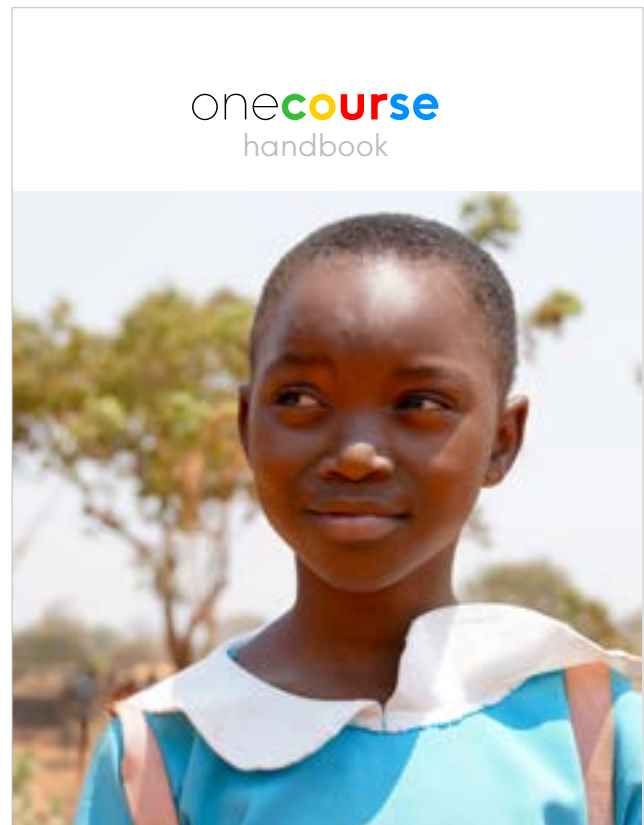
Please contact the XPRIZE team if you'd like to find out whether **onecourse** English could be installed on a tablet for you.



4. onecourse handbook

You are reading it now! It contains:

- an overview of **onecourse**.
- colour-coded sections on Reading, Writing, Numeracy, Design, and Technology, corresponding to the tabs in your demo app.
- a summary of evidence from trials and pilot tests which were carried out in several countries, to evaluate the efficacy of **onecourse**.
- information about **onebillion** – the non-profit organisation which produced **onecourse** – and the work we do.
- a set of appendices with further details about the course, our research, the software, and the schedule to completion.



Note!

As you saw on page 5, **onecourse** is well on the way – but not yet complete.

- The completed course will have both a Study Zone and a Play Zone. The units on your tablets are from the Study Zone.
- Activities for the Play Zone, and further activities for the Study Zone, are in development. You will see screen shots for them later in this handbook.
- [Appendices A and B](#) in the handbook outline the full course content, in Swahili and English. [Appendix G](#) has our schedule for completing the course.
- The completed course will have 3000 learning units in the Study Zone, across ten levels, as well as many different Play Zone activities.

Enjoy your exploration of **onecourse**!

A close-up photograph of a young girl with dark skin and short hair, wearing a blue and white school uniform. She is smiling broadly and has her right hand raised high in the air. In the background, other children are visible, including one in a pink shirt and another in a blue shirt, all looking towards the camera.

02

an overview
of onecourse

An overview of onecourse

onecourse is our response to the Global Learning XPRIZE challenge: to devise an approach, and software, which will enable children with no access to quality education to achieve basic literacy and numeracy, anywhere in the world.

Two key features

Let's start with two key features of **onecourse**, which underlie its structure:

- The child's daily access is time-limited. (This feature has been disabled in our submitted apps for logistical reasons, as discussed with the XPRIZE team. It will be enabled if we become a finalist.) Our rationale for limiting daily access is given on page 53.
- At the heart of **onecourse** is our little teacher figure Anna. She appears in person, or as a pointing hand. She guides the child through the learning material. She provides encouragement and continuity, and helps to make the course a coherent whole.

The course structure

The **onecourse** material falls into two areas:

- the Study Zone, where the main learning takes place.
- the Play Zone, where the child can interact with and compete against other children, and create material to show others.

The zones are not completely independent. What is learned in the Study Zone will be used in many of the Play Zone activities. Access to both zones is time-limited.

In addition to these two zones, we also provide a set of bedtime stories.

The Study Zone

The child begins each day in the Study Zone.

The material in the Study Zone is divided into ten levels, 1 to 10. An outline of the content for each level for Swahili is given in [Appendix A](#), and for English in [Appendix B](#).

Within each level, the work on numeracy, reading, and writing is presented in short learning units. The child must complete a level before moving on to the next one. The child receives a trophy at the end of each level.

The completed Study Zone will have 3000 learning units. The number of units per level will increase with level.

The child's tenth trophy marks the end of the course. However, the child can still access the activities in the Play Zone, and the growing library of books.

The approach in the Study Zone

We use a direct teaching approach in the Study Zone, to help the child learn as efficiently and effectively as possible. Our reasons are these:

- Our target children may spend little or no time in school – and if in school, education may be of low quality. They are falling behind. Time is precious.
- Not all children will benefit from indirect teaching, for example through discovery learning, or games.
- Some children may already be learning English or another second language in school. Achieving fluent reading in their own language as early as possible will help them. (In particular it has been shown that fluency in a consistently spelled local language helps children achieve fluency in a less transparent one.)

We deliver the direct teaching with the help of Anna, our teacher figure.

Repetition and spaced practice are essential in achieving numeracy and literacy. Key learning units will be brought back time after time in the Study Zone. They include for example units on counting, letter recognition, and word building.

We can also track the occurrence of each grapheme, syllable, and word, in the literacy material. We re-present them frequently within different activities. The goal is automatic word recognition, which will in turn facilitate fluency and comprehension.



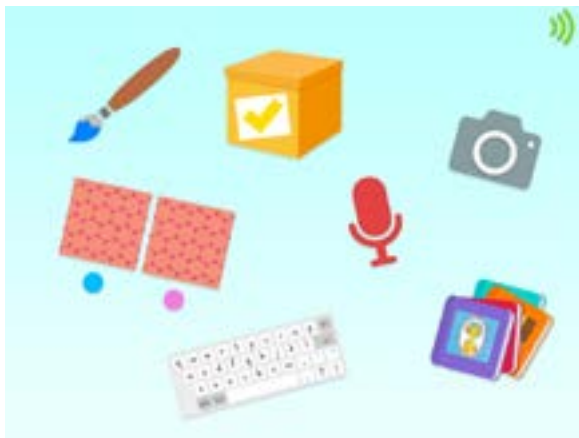
Anna, our little teacher. She explains 'how to'.

The Play Zone

Once time is up in the Study Zone, the child gains timed access to the Play Zone. Here the child can choose from a wide range of activities, which include playful practice of concepts met in the Study Zone, as well as creative and collaborative activities.

The Play Zone has no levels. A child can abandon an activity at any time by pressing the back-to-the-menu arrow.

The activities will include games for one or more players, painting, creating a photo album, writing and typing stories, recording audio and video – for example of the child's own songs and stories – and reading books from the library.



Some of the activities on offer in the Play Zone. See Appendix G for the implementation schedule for the Play Zone. (The box is for 'My saved things'.)



Recording in the Play Zone. Recordings can be saved by touching the yellow tick. They go into the 'My saved things' box.

The approach in the Play Zone

The Play Zone offers discovery learning. There will be minimal instruction, unlike in the Study Zone. Children must work out how to use each component, and this is likely to foster peer interaction.

The Play Zone will also foster interaction with the local community. For example the child can create a photo album of local events, and record people telling traditional stories. The created material can be saved and shown around.



The painting package in the Play Zone. It gives the child the chance to be creative. Paintings can be saved too.



One of the games being developed for the Play Zone. This one is for two players, and is based on 'Snap'. The player who hits the button first on spotting a match wins a point.



Children can type their own stories in the Play Zone, using a keyboard appropriate for the language. The stories can be saved and read out later.

The bedtime stories

After the child is timed-out of the course for the day, we still have a further treat to offer: a bedtime story. We believe this will enhance the child's engagement with the tablet, and can be enjoyed by the rest of the family too. We are developing a set of appropriate and imaginative stories in audio only.

The course structure: a summary

This flow chart summarises the structure of **onecourse** as experienced by the child:

The Study Zone

10 levels of learning units which cover Reading, Writing and Numeracy

Built-in stories

A teacher figure

Time-limited daily access



The Play Zone

Playful and creative activities which can be shared

The full library of stories

No teacher figure, no levels

Time-limited daily access



The Bedtime Story

A treat every evening

03

learning

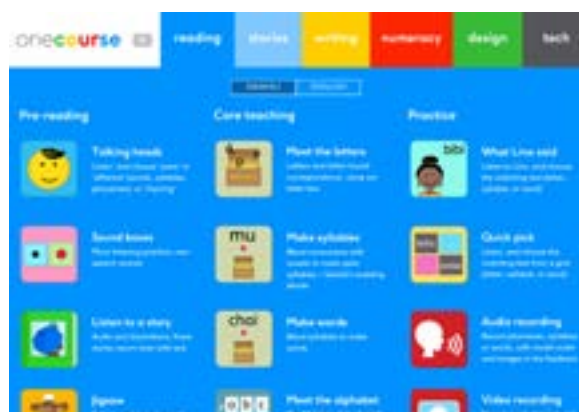
reading



Reading

The main learning for reading, writing and numeracy takes place in the Study Zone. The child works through an ordered set of learning units.

Sample units in both English and Swahili are available at the blue tab in your onecourse demo app.



Pedagogy

A grasp of letter/sound correspondence is key in learning to read. Children will quickly start to recognise some words by sight, but they need the tools to decode unknown words. This is important in English, and equally so in Swahili, which – although a more ‘transparent’ language – is considerably more agglutinative. Words of 8 and more letters are common in even the lowest-level Swahili readers on the market. In terms of instant word recognition, these present a challenge.

So phonics plays an important part in **onecourse**. Letters and their sounds are introduced one by one, systematically, with reasonable intervals between them. We introduce them in an order which allows us to build simple words as soon as possible, through blending.

However, phonics is only a means to an end. Enabling the child to read automatically, and acquire a love of reading, are our goals.

This is where our stories come into play. The child meets stories from the first day. Initially they are read to the child, with only the story title in text. Gradually we move through different story modes, until finally the child can read alone.

We also spend time on morphology – word structure – for example looking at how tenses are formed. This will be helpful in English, but even more so in Swahili, to enable the child to break long agglutinate words into meaningful chunks.

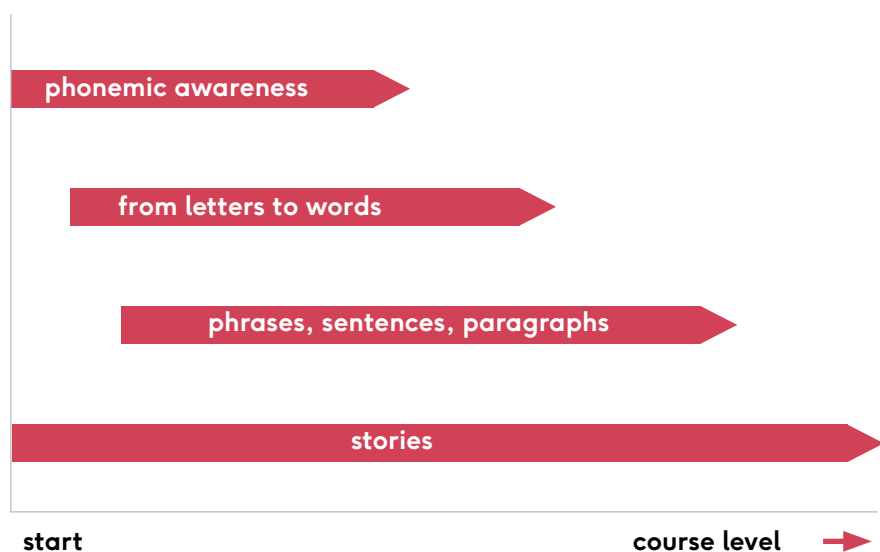
Structure and content

The reading material has four strands:

1. Phonemic awareness.
2. From letters to words.
3. Phrases, sentences, and paragraphs.
4. Stories.

These strands run in parallel for most of the course, as shown below:

Reading: our four strands



Now we will look at each strand in turn.

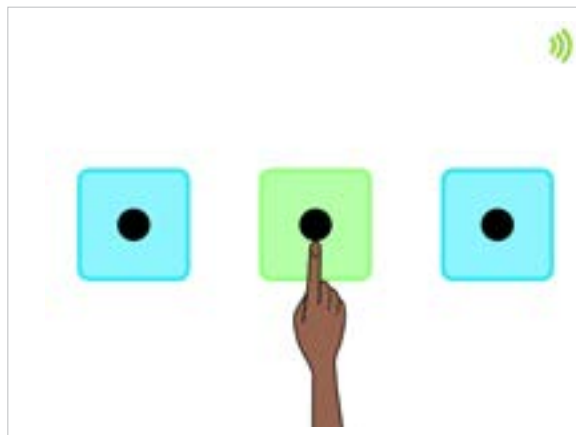
1. Phonemic awareness

The ability to distinguish between sounds is critical in learning to read.

The 'phonemic awareness' strand features most prominently in Level 1 of the course, but carries on through several levels. The child identifies 'same' and 'different' sounds, and picks out objects whose names start with, end with, or contain, specific phonemes.



We use the smiley yellow faces to say 'same' and 'different' spoken sounds.



The sound boxes play all kinds of other sounds, including animal noises.

In identifying 'same' and 'different' spoken sounds, we start with words, move on to syllables (mainly in Swahili), and finish with individual phonemes. This mirrors the order in which young children begin to grasp spoken language.

The work can be quite challenging. For example all three smiley faces may say different words, and the child must pick the two which said words with the same initial phoneme.

2. From letters to words

This strand consists of core lessons, followed by practice using a range of activities.

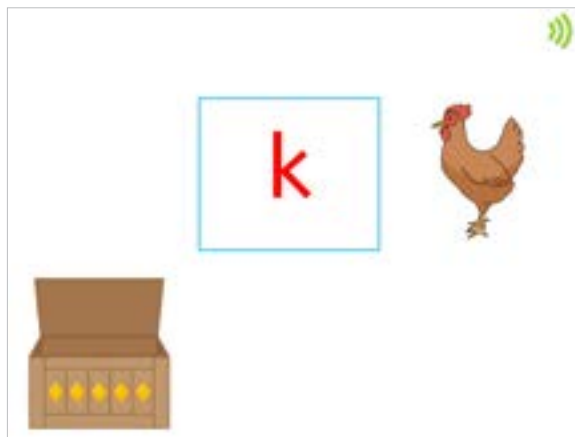
Core lessons

These are: *Meet the letters*, *Make syllables*, *Make words*, and *The alphabet*. The first three are based on our letter box.

Meet the letters

The child meets the letters and their sounds, in an order which depends on the language. The letters fly out of the letter box.

- In Swahili, we present the vowels first – since almost all of its syllables end in vowels – and then the consonants in order of frequency of occurrence. We used textual analysis to determine this.
- In English, we present the letters in the order recommended in the **UK's National Literacy Strategy**¹. The first six letters are **s,a,t,n,i,p**.



From single letters, we move on to graphemes with two or more letters. Later we deal with common non-phoneme consonant pairs and clusters, for example **mb** and **nj** in Swahili. Again we present them in order of frequency, so as to use them in common words as soon as we can. Our approach is pragmatic: to accustom the child to permissible letter combinations.

Make syllables

- In Swahili, with vowels met, we quickly move to making syllables for each new consonant. From now on, the focus is on syllables. These will become the building blocks for words.
- In English, we leave syllables until the child has had plenty of practice with monosyllabic words. We can then build compound words such as **cobweb**, **sunset**, and **seaside**, and move on to longer words.



The screen above right shows how we build the syllable **pa** in Swahili. The red 'listening button' jumps from letter to letter. The child touches it to hear the letter sounds. Then the letters blend, and the child can hear the syllable.

¹ <https://www.gov.uk/government/publications/national-curriculum-in-england-english-programmes-of-study>

Make words

Because of the order in which we present letters, the child can start making and reading words long before all the letters have been met. For example:

- In Swahili, once **n**, **m**, **k**, and their syllables have been met, the child can make and read words such as **kaka** (brother), **kina** (monkey), **kuku** (chicken), **kuni** (firewood), **kukua** (to grow), **mama** (mum), **maua** (flowers), **nane** (eight), and **neni** (word).
- In English, once the first six letters have been met, the child can make, and read, a range of two- to four-letter words, including **at**, **an**, **in**, **as**, **ant**, **sat**, **nip**, **sip**, **tap**, and **pant**.



Making a word by blending syllables in Swahili.



Making a word by blending letters in English.

The alphabet

We introduce the alphabet – the list of letters by name – after the work on letter/sound correspondence. The alphabet is presented in a grid which is adaptable for any language.



The Swahili alphabet: 24 letters.



The English alphabet: 26 letters.

Practice activities

We use a variety of activities to put the core lessons into practice. They approach the work from different angles. They allow us to re-present target letters, syllables and words time after time in different contexts.

Build syllables or words by choosing from a grid

Children build syllables or words in response to audio, by selecting letters or syllables from a grid.



Make the word you hear

Children make the word they hear, by dragging its letters or syllables into place in the right order. (This is a precursor of spelling.)



Segment and blend

At the touch of a button, a word appears, with its corresponding image. The word segments and blends, synched to audio. For English, it will segment to graphemes.



Match what Lisa said

Children choose the letter, syllable or word which matches what the talking head said.

When the activity is about words, the word is segmented into its syllables (in Swahili) or letters (in English) as part of the feedback.



Record yourself in audio or video

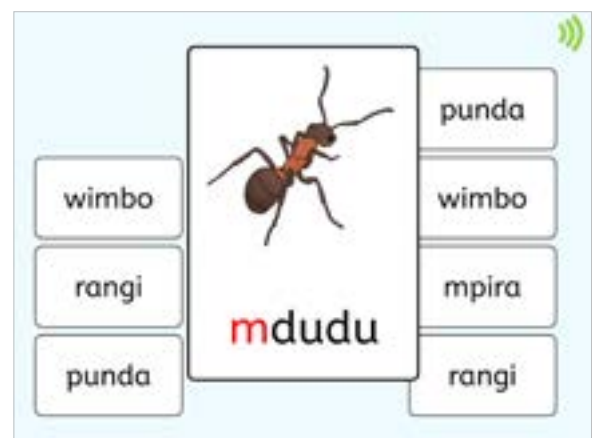
Children record themselves reading text, in audio or video. Their recording is played back, followed by model audio. A word may be segmented and blended as part of the feedback.

For audio recording, the image for the word appears as part of the feedback.



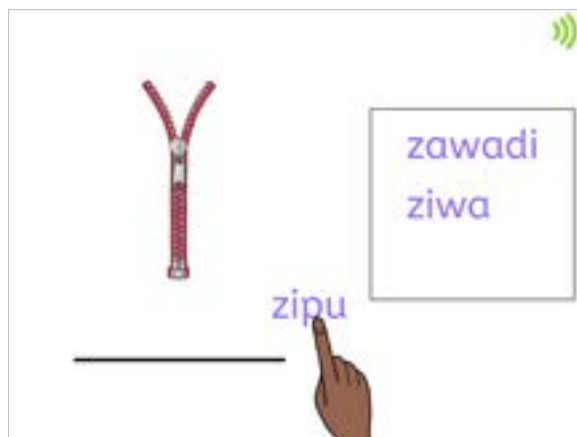
Match word cards

Children find two word cards that match. The cards merge and the image appears. Segmenting and blending is part of the feedback.



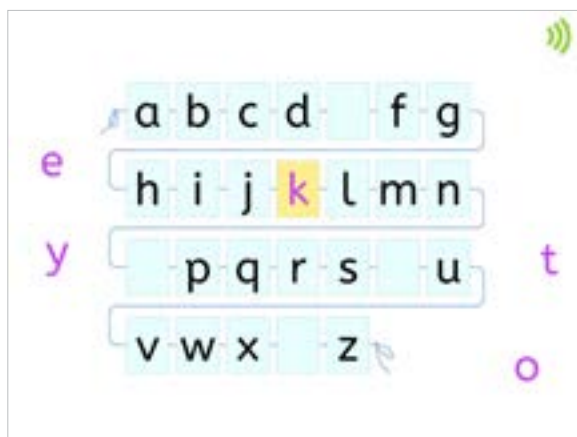
Drag the label

Children drag the correct label to an object, with no audio until feedback. This tests ability to decode.



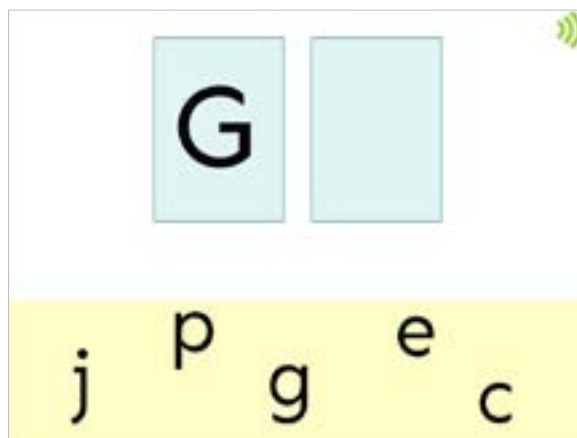
Complete the alphabet

This is revision of the alphabet. In the final feedback, the letters are named in order.



Match upper and lowercase letters

Children will drag the matching lowercase letter to the blank card.



Quick pick

Children pick out graphemes, syllables or words to match audio, from a random arrangement in a grid. This activity can also be presented as a race against the clock, with a score.

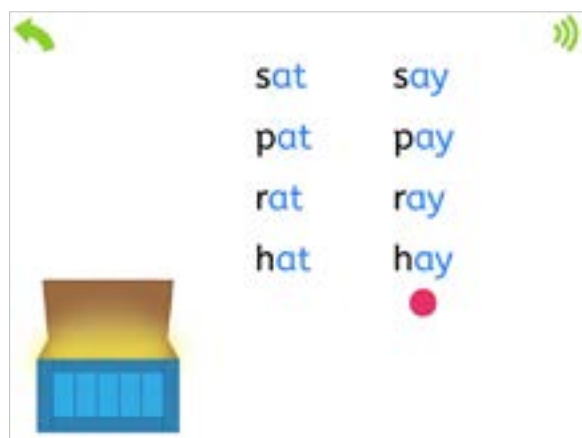


Addressing the special difficulties of English

Swahili is a consistently-spelled language, with words written as they are pronounced. English is much less transparent. For example:

- Individual letters in English may be pronounced in different ways. Compare **c** in **cat** and **cent**, **g** in **got** and **gem**, and **y** in **yes** and **very**.
- Spelling bears little relation to pronunciation in many high-frequency words. These tricky words include **go**, **he**, **she**, **are**, **was**, **some**, **their**, **they**, and **could**.
- The final **e** affects the pronunciation of the first letter in a split digraph. Compare **mat** and **mate**, **fat** and **fate**.
- A combination of vowels may be pronounced in different ways. Consider **ou** in the words **four**, **sour**, **cough**, and **tough**.

Therefore, although most of our activities work equally well for both Swahili and English, we are designing some to specifically address the special difficulties of English. They include onset-and-rime, and activities to familiarise the child with the tricky words. The aim at all times is to facilitate instant recognition. Below are examples.



One of our onset-and-rime activities, using our 'word' box. We will do the opposite too: show words with the same starting letter group, and different endings.



An activity on different pronunciations for a letter group. We bring these 'tricky' words back very frequently to facilitate automatic recognition.

3. Phrases, sentences and paragraphs

This strand is the bridge between single words and stories. The material will be specially written for the target language, and begin at a very simple level.

In this strand the child will:

- learn about reading from left to right, and from the first line down.
- learn the function of capital letters, and punctuation.
- assemble phrases and sentences from words, to match audio.
- practise high-frequency words for that language in context – including, in English, words such as **the, he, she, they** which have limited letter/sound correspondence.
- develop morphological awareness, for example about how tenses and plurals are formed.

The work on morphology is important in English. It is even more important in Swahili, where different noun classes form different plurals, and where verb stems can add on up to four markers (for subject, negative, temporal/ conditional, and object).

It is important to encourage the child to read with comprehension. Lack of comprehension can be a big issue, even for children who can readily decode. So this strand will also provide comprehension activities, from an early stage. For example, the child will fill in the blanks in a sentence or paragraph by choosing appropriate words. We will also provide mini stories, no longer than a paragraph, and ask comprehension questions about them in audio.



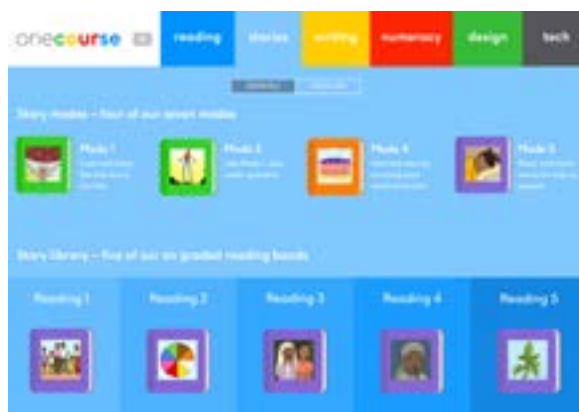
Building a phrase to match audio, in Swahili.



A unit about sentences, which focuses on the use of initial capital letters, and full stops.

4. Stories

Four story modes, and sample stories in both English and Swahili, are available at the light blue tab in your onecourse demo app.



Our goal is to enable children to read fluently, with comprehension. All the work on reading leads to the stories. We currently have 80 stories, with many more to come. See [Appendix J](#) for a list of the stories available now. Our aim is 150+ stories by September 2017.

The stories are graded into reading bands, and each story can be presented in up to seven different story modes.

Some stories are specially written, to bring in familiar situations from everyday life. In Swahili these feature the Moyo family and friends. We plan a parallel family for English.

The others are Creative Commons stories from [African Storybook](#)¹ (African), [StoryWeaver](#)² (Indian) and [Book Dash](#)³ (African) which we have edited. Most are heavily illustrated.

We plan to add non-fiction to the library too, on a wide range of topics.

See [Appendix G](#) for the implementation schedule.

¹ africanstorybook.org

² storyweaver.org.in

³ bookdash.org

The reading bands

The stories are divided into reading bands **R1 – R6**, as shown in the table below. They generally increase in complexity with length, while font size decreases overall.

Band	Pages	Sentences per page	Font size
R1	8	1	large
R2	8-10	1-2	large
R3	10-12	2	medium
R4	12-14	2-3	medium
R5	14-16	3 upwards	small
R6	16 upwards	as fits	smaller

The story modes

Children love listening to stories. They also benefit from hearing, and reading, the same story several times. So each story can appear in up to seven modes:

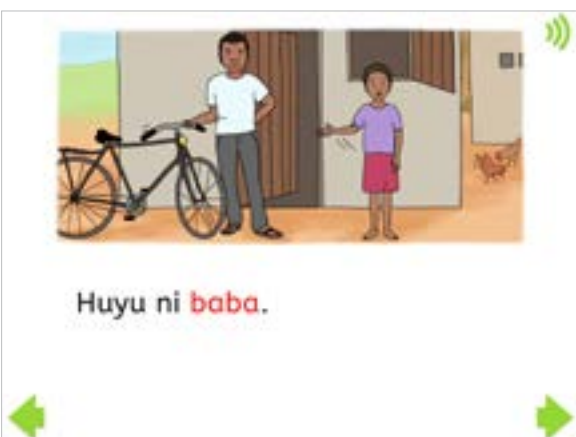
Mode	Description
1	Read to me; the only text on display is the story title.
2	As for Mode 1, but with in-page comprehension questions in audio.
3	Read to me: all text is shown; the words highlight in synch to audio, which helps to confirm that reading is from left to right, and from line 1 down.
4	Touch all the words: the child touches the words in order, and hears the audio for each word; this prepares the child for touching unfamiliar words in mode 5.
5	Read by myself; now the child is reading alone – but with scaffolding; for reading bands R1 – R5, the child can touch any word to get help, and will hear it spoken; for R1 and R2 stories, the child receives syllable breakdown too, which is particularly relevant in Swahili.
6	As for Mode 5, but followed by comprehension questions in both audio and text.
7	Record myself; children can record themselves reading the story in audio, and hear their recording, followed by the model audio.



A screen from a story in Mode 1, 'Read to me'.
The textless story is read aloud.



In Mode 2, Anna asks questions to check comprehension. Here the child touches a button to answer a binary-choice question.



In Mode 3, the words in a story highlight one by one, while the story is read out.



In Mode 5, when a child touches a word in the story it jumps up, highlights, and its audio plays.

Making the most of each story

The story modes allow us to make the most of each story, reusing it at different levels in the course. Until the child has done key work on phrases and sentences, the stories are presented in Modes 1 and 2: they are read to the child. A smaller number of stories then appear in Mode 3, followed by Mode 4. Thereafter, Modes 5–7 are the most common.

Even after children have begun reading by themselves, we will still include stories in Mode 1 at intervals, as a treat.

Reading with comprehension: the ultimate goal

Our goal is to enable the child to read with fluency and comprehension. The child's working memory is key to this – and the working memory is limited in capacity.

To understand text, the child must decode the words, and then make links with areas of memory where meaning is stored. We help the child with this complex task in several ways.

We:

- present target words very frequently across learning units, to enable automatic recognition, and hence free up capacity in the working memory.
- extend the child's vocabulary across the course, with images to give meaning.
- start work on comprehension early, in the 'Phrases, sentences and paragraphs' strand.

Within the stories themselves, we:

- use short sentences, and repeated words and phrases, in lower-level stories.
- provide audio help at the touch of a word.
- provide illustrations on every page, for most stories.
- allow the child to page back through the story.
- repeat a story several times and in different modes – initially in audio only.
- focus specifically on comprehension in story modes 2 and 6. In Mode 6, the child can turn back to the relevant text and look at it again, in order to answer a question.



writing

Writing

The work on writing is similar for both Swahili and English.

Sample units in both English and Swahili are available at the yellow tab in your onecourse demo app.



Pedagogy

Familiarity with letter shapes is a prerequisite for decoding. So we display each new letter in a large font size, and repeatedly show how it is formed. Only then do we move to tracing. Tracing with the final familiar shape in mind is more effective.

After tracing, the child has the chance to write letters freehand. Once several letters have been met, the child can write simple words. Writing now becomes more meaningful.

In early writing, we build the letters stroke by stroke in the correct sequence, rather than in one continuous movement. This helps to establish the motor plan in the child's mind. Later in the course, we introduce continuous strokes.

When the child has moved from sounding out letters to using their names, we also introduce a keyboard – initially small groups of keys containing the target letters and distractors, and later a full keyboard, as appropriate for the target language. At this stage, the focus has moved to spelling.

Structure and content

We are interpreting 'writing' widely, to include numerals as well as letters and words. This is because many of the activities we have designed for writing letters will work just as well for numerals.

We are including spelling too. At a certain point, when writing letters becomes automatic, the ability to spell becomes key.

The child will:

- begin with pattern work for lines and curves in Level 1, as preparation for writing letters and numerals.
- initiate animations where perfect letters form, to increase familiarity with their shapes.
- trace letters, digraphs, and numerals, and then write them freehand.
- trace short words, supported by audio and an image.
- write words, and numbers, in response to audio only (hints available).
- write words in response to images only (hints available).
- practise writing with continuous strokes.
- practise spelling by typing words, phrases and sentences in response to audio and images – using a partial keyboard first, then a full keyboard.



Showing how the letter e is formed.



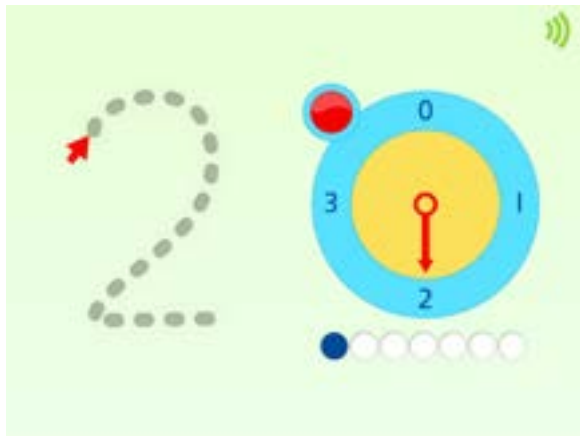
Tracing the letter p. Next we will show the child's tracing with the grey 'model' letter removed.



Writing a simple word in onecourse English. The child can rub out with the duster.



We gradually build up to using a full keyboard, and eventually to typing sentences. The letters q and x will be blanked out for Swahili.



We will use our blackboard for writing numbers too. The child will also trace numbers, as shown here, in the numeracy section.



numeracy

Numeracy

Sample units in both English and Swahili are available at the red tab in your onecourse demo app.



Pedagogy

To achieve basic numeracy, children must first learn to count concrete objects in words, and then match the words to numerals. They must become familiar with the numerals. They must grasp the numerosity of the numbers they represent—that 31 is a larger number than 29, for example—which in turn requires an understanding of place value. Finally, they must recognize the abstract nature of numbers, for describing any quantity of any thing, which allows us to carry out number operations.

For everyday situations that require numeracy, children must understand addition and subtraction, and the related symbols. Multiplication will be very useful too. Most importantly, they must be able to apply what they have learned.

These concepts and skills build on each other, with the level of difficulty steadily increasing. It is harder to count to 20 than to 10. It is harder to find the answer to $47 + 12$ than to $5 + 2$. It is harder to multiply than to add.

Enabling children to achieve basic numeracy on their own is a big challenge. Our response is to build up the work very slowly and carefully. Even counting to 10 is tackled in three stages. We use images of concrete objects for counting, and later, for introducing the number operations. We also offer different approaches: for example a number line as another way to do addition and subtraction.

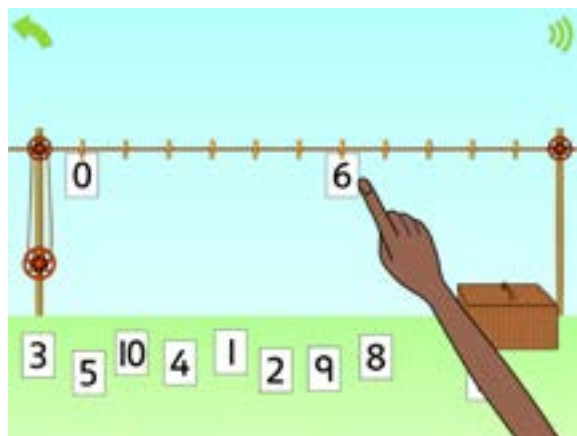
The work on shape recognition is different. It can begin in early pattern work, since it is independent of numbers at this level.

Content and approach

The numeracy content of Global Learning XPRIZE is valid for basic numeracy everywhere. Here we look in more detail at different aspects of the content, and our approach to it.

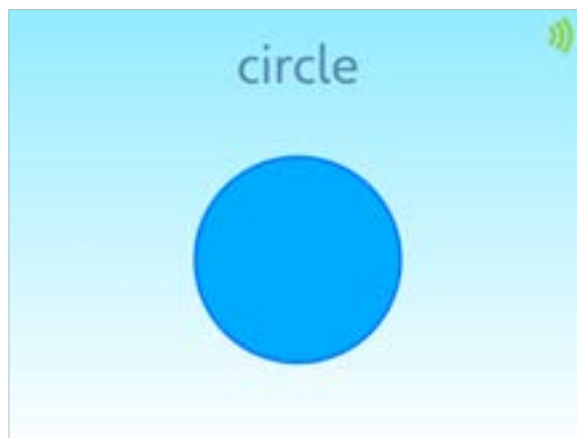
Direct instruction

As elsewhere in the Study Zone, Anna shows the child 'how to' at the start of each numeracy learning unit.



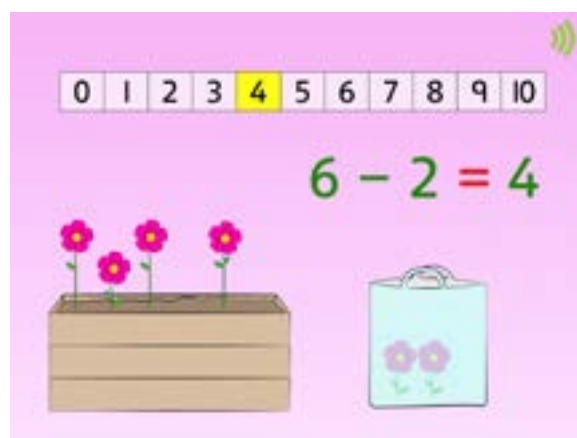
No reliance on reading

For most of the numeracy work, we show no text on the screen, so reading ability is not an issue. Instructions are in audio. The infrequent text is restricted to labelling. At higher levels we will introduce more text, and specifically in word problems, but we will keep it very short and simple.



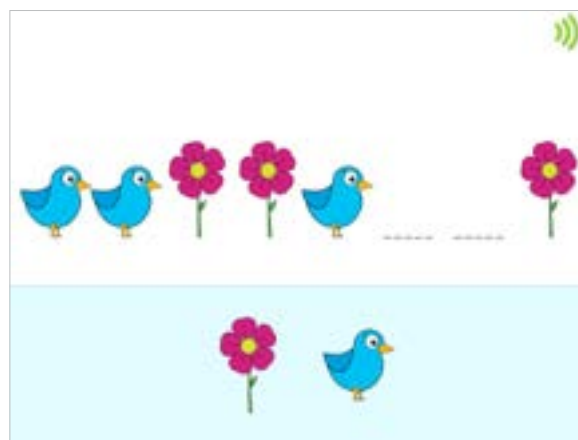
From concrete to abstract

As far as possible, we use objects for establishing concepts. For example children count, and add, and take away, apples and insects and fish. At higher levels, we move to manipulation of abstract numbers.

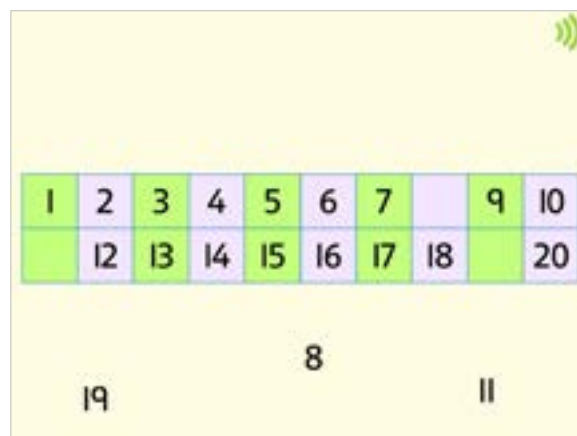


Establishing patterns

Mathematics is based on patterns. So the preparatory work in Level 1 includes filling in missing items in patterns, and colouring in patterns, and completing patterns, as well as sorting and matching objects.

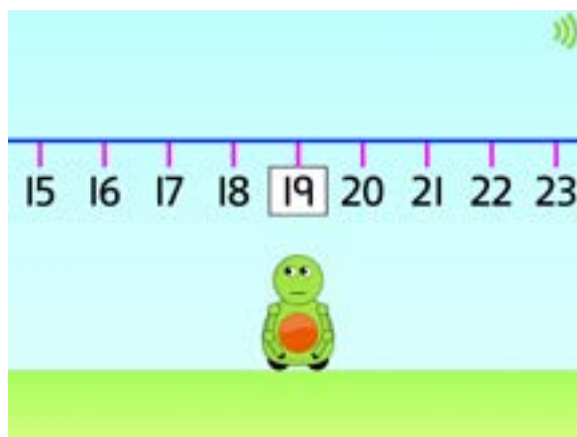


Later, the child works on number patterns, for example by putting numbers in the correct sequence, filling in the missing numbers in a sequence, and identifying patterns in the 1–100 number grid.



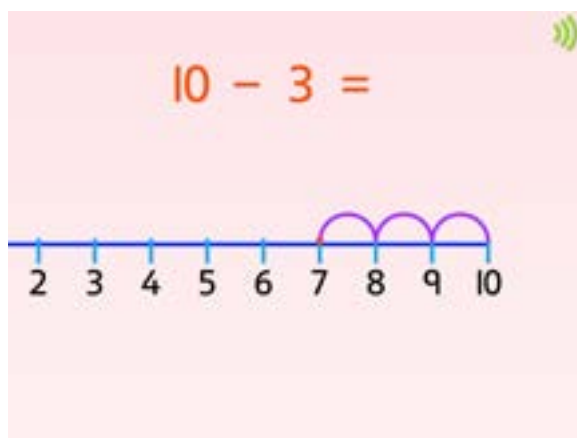
Using number lines

We include number lines because they are such a useful tool. They can be used for number recognition, number sequencing, establishing numerosity, and skip counting, as well as for addition and subtraction.



Gradual progression

We build up gradually in difficulty. For example by the time children meet vertical (columnar) addition and subtraction, they will already have done a lot of work with linear expressions ($8 + 4 = 12$), and added and subtracted using number lines. They will also have done the appropriate work on place value.



In the same way, we approach multiplication gradually, via counting in multiples of 10, 5, and 2, and by adding 'the same again'. Once the concept of multiplication has been firmly established, we will move on to multiplication tables, which are essential for rapid multiplication in everyday situations.



The concept of place value

To match numbers to their names (for example 29 and 239), and discriminate between numbers (201 is larger than 189), and carry out number operations (addition and subtraction involving numbers >10), an understanding of place value is essential.

We use different strategies to help the child grasp this concept. For example in the activity shown on the right, the child places objects on the screen using a '10' button and a '1' button, to match a given number.



Rote learning and spaced practice

Rote learning plays an important part in numeracy.

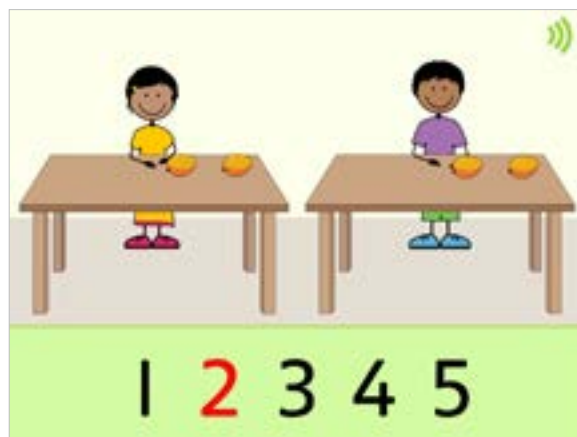
For example by the end of **onecourse**, the child should be able to count dependably to over 1000, at least. So we bring counting units back many times, at intervals.

We repeat other key units too, for example on addition and subtraction, to provide spaced practice.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

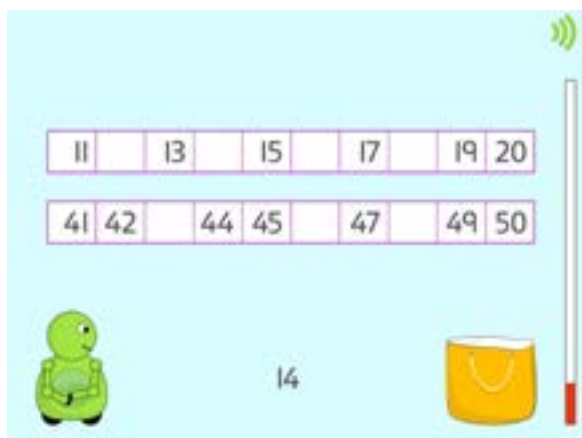
Word problems

Children often have difficulty in transferring learning to other situations. We plan to introduce word problems throughout the course, beginning in Level 1.

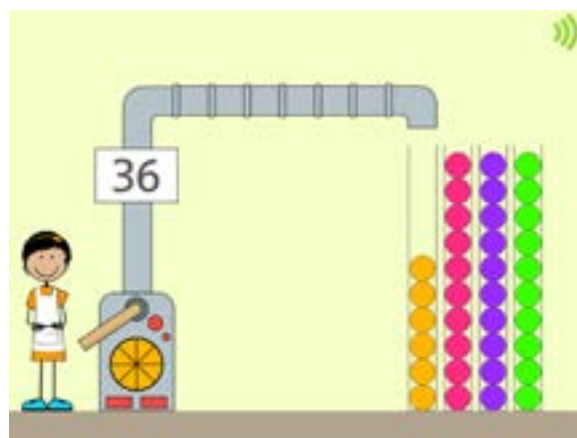


Engagement and fun

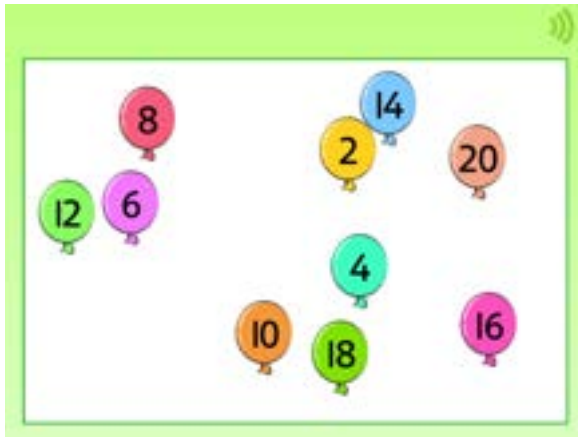
Throughout numeracy, as elsewhere in the Study Zone, we have worked hard to engage the child. We use playful activities to establish concepts. We have colouring-in, and games. Our 'stick children' add to the appeal.



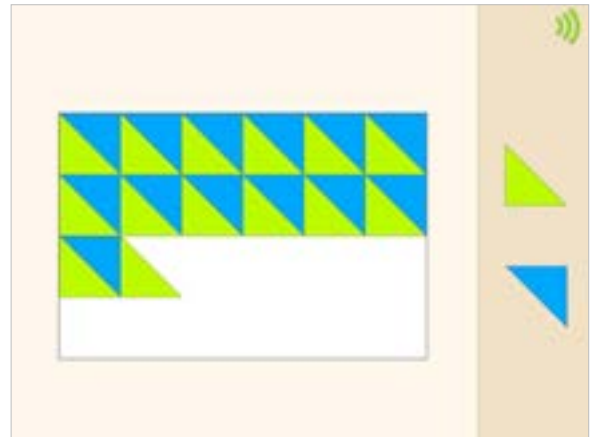
Completing number sequences: the robot coughs out a number and the child decides whether it goes in a sequence, or in the bag.



Introducing counting to 100: a new 'tube' fills in for each new set of ten.



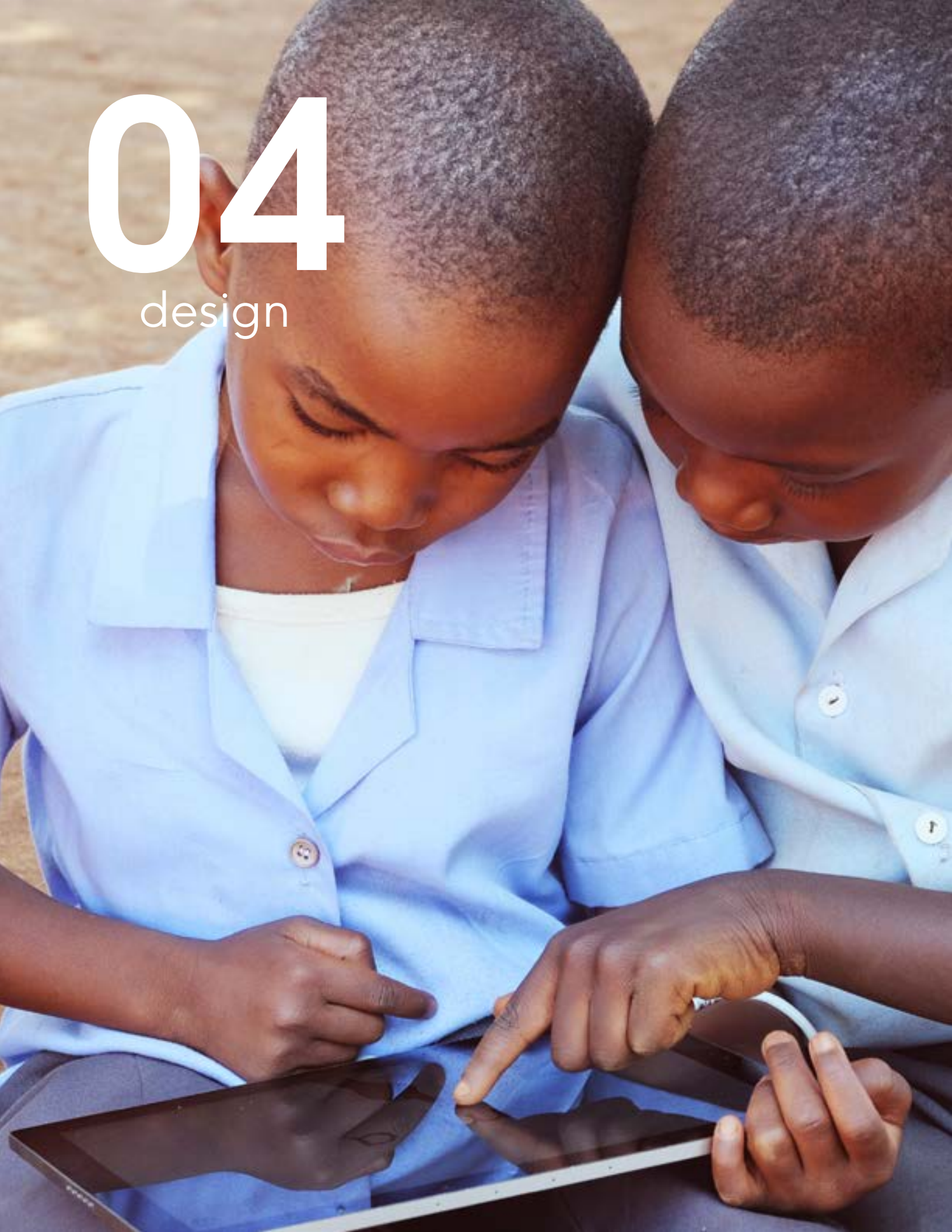
Counting in twos: the floating balloons must be popped in numerical order.



2-D shapes: making a tessellation of triangles

04

design



Design

onecourse is designed to be child-friendly, effective, and easily localised. In this chapter we focus on its design, under these headings: Usability, Engagement, Personalisation, and Localisation.

Sample units in both English and Swahili are available at the green tab in your onecourse demo app.



Usability

The child will essentially work alone, in the Study Zone, and may have no access to help from peers or adults. We have taken steps to ensure that the child does not get confused, overwhelmed, or 'stuck' for any reason.

Clarity of instruction

The child must always know what to do next.

Guidance from Anna

Our little teacher figure, Anna, guides the child every step of the way. She appears on screen herself, or as a pointing hand. For each new activity, she shows 'how to'. Her instructions are short, simple, and clear.

Repeat instructions

If the child fails to respond within a certain time, an instruction is repeated. The child can also press the 'Repeat audio' button to hear the instruction again.



*Anna guides the child at each step.
(In Swahili she is called Mahira.)*



Anna points out the 'Repeat audio' button.

Clear feedback

Response to the child's input is immediate, and clear. An incorrect answer receives a 'negative' sound effect, and the child is asked to try again. A correct answer receives a 'positive' sound effect and a tick, then we move to the next item.

Ease of input

We make it easy to input an answer.

A starter lesson

onecourse will probably be the child's first experience of using a touch-based device. So the first unit introduces the two main gestures needed for working through the course: lightly tapping on the screen to make choices, and sliding a finger around the screen to drag items. We also introduce the two main buttons: the 'repeat audio' button, and the forward arrow.

Generous hot areas

To ensure that selecting is easy, the 'hot' area for an item (the area of the screen that responds to touch) is larger than the item being selected. So chubby fingers can touch and pick up even small items.

Allowing for poor motor control

Some children may have difficulty with longer continuous movements, for example when tracing. So we allow tracing to be completed in stages. If the child's finger is lifted close to the end, the tracing completes automatically.

Likewise, when dragging an item, the child may drop it short of the target destination. We provide a generous hot area for the destination. If the item is dropped too soon, but overlapping the hot area, it will automatically slide into place.

Child-friendly screens

Cluttered screens, illegible typefaces, and small font sizes can leave a child overwhelmed. In effect, the software may be unusable for that child. We have looked carefully at all aspects of screen design.

Typography

We have developed two child-friendly typefaces: **onebillion reader** and **onebillion writer**. Both will become open-source under the SIL licence if we become a finalist.

onebillion reader is based on an existing open-source typeface. We use it for all the reading matter. The characters are rounded and friendly, and these features further enhance legibility:

- relatively long ascenders and descenders, easy to spot
- clear distinction between capital **i** and lowercase **l**
- single-storey **a** and **g**.

Each new letter is introduced in **onebillion reader**. But children get practice in recognising letter shapes in other typefaces too.

onebillion reader

ABCDEFGHIJKLMNOPQRSTUVWXYZ

abcdefghijklmnopqrstuvwxyz

1234567890

onebillion reader typeface.

onebillion writer is our own typeface, for use where the child forms and traces letter shapes. It has:

- very clear, simple, letters
- clear joins between constituent parts of a letter, indicating the separate strokes.

onebillion writer

ABCDEFGHIJKLMNOPQRSTUVWXYZ

abcdefghijklmnopqrstuvwxyz

1234567890

onebillion writer typeface.

Screen layout

Our style is to keep screens uncluttered, with no unnecessary graphic elements, to help the child focus on the learning. In the numeracy units, objects to be counted and numbers to be manipulated are carefully sized and positioned. In the reading units, we avoid dense text: the fontsize, leading, and quantity of text are all carefully controlled.

In particular, the story editors follow guidelines about fontsize, layout, and number and length of sentences per page, for each reading band. Pages can be rapidly previewed in our online 'story mock-up' tool.



The 'story mock-up' tool is accessible on onebillion.org/ting/story/

Use of colour

We use colours in a consistent way throughout the course. Red is the highlighting colour. The tick for 'correct' is always yellow. Colours are generally lively, but not brash. We take care to ensure that colour combinations work for children who are colour-blind.

In the reading units, we use a white background to enhance the uncluttered look, and increase contrast with text. It is widely held that pastel backgrounds, rather than white, help children with dyslexia – but recent research does not support this view.¹ However, changing the background colour is simple if our trials suggest that it would be beneficial.

Technical safeguards

A child might get 'stuck' for technical reasons – for example, because of corrupted assets. In effect, the app becomes unusable. Technical safeguards have been designed in, to prevent this from happening.

Steps have also been taken to prevent the child from tampering with system settings, or receiving error messages. If the tablet battery needs charging, the child will receive a simple audio message in the local language.

See pages 67-68 in the Technology section for more information about the technical safeguards.

¹ Creavin, A., Lingham, R., Steer, C. & Williams, C., (2015). Ophthalmic Abnormalities and Reading Impairment, *Pediatrics* 135, Issue 6, 105–1065.

Engagement

We want the child to return to **onecourse** eagerly day after day, and stick with it to the end. We have designed in many features to enhance engagement.

Anna, an engaging teacher

Anna, our little teacher, is the friendly face of **onecourse**. She provides continuity, and a form of social interaction, for the child working alone. Her cute appearance and animation set a playful tone. She has many friendly functions in addition to instruction. She:

- welcomes the child each day ... *“Welcome back! Let’s see what we have for today.”*
- gives praise ... *“Very good. You practised counting to fifty!”*
- indicates progress ... *“Ten stars! Excellent! You have reached the end of Level Three!”*
- indicates when time is up ... *“That’s enough for today! See you tomorrow!”*
- introduces a new bedtime story each evening.

To enhance the child’s engagement with Anna, we choose voice-over artists carefully, with easily-understood accents and pleasant tones. Anna’s appearance can also be localised: her skin tone can change, depending on the language she speaks.



This Malawian girl has just heard Anna speaking to her in Chichewa for the first time.

Engaging activities

We offer a wide variety of activities for the child. Taken together, they are multi-sensory: they involve listening, looking, speaking, touching, and dragging items. They are generally short, to keep the child stimulated and engaged.

Games are engaging, so a number of practice activities in both numeracy and reading have elements of gaming. The Play Zone will also contain fully-fledged games.

A wealth of imagery

We have a large and growing library of single images, in addition to the plentiful illustrations in the stories. Images are in themselves engaging, and enliven the course, but we also use them for pedagogical reasons:

- The child may have a very limited vocabulary, and be unfamiliar with words we use. The corresponding images will aid understanding, and help to extend vocabulary.
- Associating a word with an image will later aid comprehension in reading.
- In numeracy, it is essential to begin work on counting and number manipulation using images of real and familiar objects.

The images in the image bank are drawn in a fairly realistic style, to help children unused to interpreting cartoons. The illustrations in the stories, however, have a range of styles.



A small selection of images from our image bank.

Motivating feedback and rewards

Feedback and rewards help to engage and motivate. So do visible signs of progress. We want children to know where they are in the course, but without creating anxiety around slow progress, or the amount left to do. We do not want the course to become a burden.

So the child receives encouraging feedback throughout the course, and rewards which lightly signal progress. The child receives:

- ticks and positive sound effects after correct answers in a learning unit.
- a shooting-star finale at the end of each learning unit; it follows a very short summary of what has been learned or practised.
- stars at key points within each level in the Study Zone.
- a trophy at the end of each level in the Study Zone.



The child gets big yellow ticks within a unit, and a 'shooting star' finale at the end of the unit.



Anna awarding a trophy at the end of Level 1.



When a new trophy is in place, we briefly show the empty trophy slots, to give a sense of progress.

Wider engagement with the community

We want children to be highly engaged with the tablet. We believe that they can engage with their families and local community through the tablet too, to everyone's benefit and enjoyment. We foster this wider engagement in several ways:

- The Play Zone will offer the full library of books; these can be read with friends and family.
- In the Play Zone, the child will be able to photograph local places and events, and record local people in audio and video – for example telling stories, playing instruments, and singing. These items can all be saved and shown around.
- The Play Zone will also offer game-based activities for two or more players. For example, our own versions of Snap, Snakes and Ladders, and Ludo.
- The bedtime stories which Anna offers in the evenings can be shared with family members.



Posing for a photo in the Play Zone. Captions can be written, and photos saved in the photo album. This is held in the child's 'My saved things' box.

Personalisation

Ideally, a learning app will adapt to what the child knows already, and the child's subsequent progress. There are also other ways to personalise the child's relationship with the tablet, both across the day and throughout the course.

Assigning the child to a track

The children in the Global Learning XPRIZE target group are aged 7–10. Some may have attended school for a number of years. So we carry out a diagnostic assessment at the start of the course, to assess how much a child knows already.

Depending on the score, the child will be assigned to one of three tracks:

Track	Score in diagnostic assessment*	Course material offered
1	> 0 and $< x$	All topics and all learning units.
2	$> x$ and $< y$	All topics, with some in revision mode; some learning units will be skipped.
3	$> y$	All topics, with a larger number in revision mode; more learning units will be skipped.

* x and y to be specified.

We expect most children to be on track 1. But some will be on track 2 or 3, allowing them to speed through early levels in revision mode, skipping some learning units.

The diagnostic assessment will also be valuable if a tablet is lost or damaged, and the child has to start on a new tablet. If the child is assigned to track 2 or 3, there will be less repetition of material learnt already.

The diagnostic assessment is in development. See the schedule in [Appendix G](#).

Responding to in-track progress

The journey through **onecourse** also adapts to the child's performance. Progress is continually monitored. If the child is working through a unit very slowly, or struggling to answer questions correctly, the unit will be re-presented on one or more subsequent days.

Limiting daily access to the tablet

In **onecourse**, we limit how long a child can spend on the tablet each day. (Note that this feature has been disabled in the submitted apps, as discussed with the XPRIZE team. It will be enabled if we become a finalist.) Limited daily access will help to personalise the child's relationship with the tablet. However, our reasons for imposing time limits are more fundamental:

1. The learning in the Study Zone is highly focused. We want to prevent overload, and a subsequent loss of enthusiasm, and allow the child time to process what has been learned.
2. Letter/sound correspondence is at the heart of learning to read. It is widely accepted that letters should not be taught too fast, to avoid confusion: ideally no more than one a day, with revision days at intervals.^{1,2}
3. There are concerns around the world about the length of time children spend looking at screens. Screen time has been linked to a range of physical and mental issues, including obesity, attention disorders, and addictive behaviour.³

How the time-limited access is structured

The child begins each new day in the Study Zone, with a welcome from Anna, our little teacher. Access to this zone, when enabled, is currently limited to two hours. When time is up, Anna will move the child to the Play Zone. Access here will be time-limited too.

Children can spread their access time across the day. Then in the evening, as a treat, Anna introduces a bedtime story.

For a set period during the night, **onecourse** sleeps. If the tablet is activated, the image of a night sky will appear, then fade away. The image will show the correct phase of the moon for that geographic location, and that point in the lunar cycle.

¹ Abadzi, H. (2013). Literacy for All in 100 Days? A research-based strategy for fast progress in low-income countries, *Global Partnership for Education, GPE Working Paper Series on Learning No. 7*, 5

² Department for Education and Skills, UK (2007). Letters and Sounds: Principles and Practice of High Quality Phonics, *Primary National Strategy*, 49 - 50

³ Sigman, A., (2012). Time for a view on screen time, *Arch Dis Child*, 97 (11), 935 – 943

Our timings for daily access are informed by data and observations gathered during trials with children in Malawi and Tanzania. Timings can easily be adjusted.

Personalisation in the Play Zone

In the Play Zone, children can interact with whoever they choose – child or adult – in effect creating a personal play space. They can also create and save a range of items, from drawings to recordings and ‘typed’ stories.

Saved items are stored in the ‘My saved things’ box, and can be accessed whenever the Play Zone is open. This box becomes a personal treasure chest. Each child’s treasure will be different.

We expect that the Play Zone itself, and the ‘My saved things’ box, will create a strong bond between the child and the tablet.

Localisation

The Global Learning XPRIZE demands software that can be easily adapted to different languages and cultures.

Efficient, streamlined localisation is a function of:

- the underlying architecture of the software
- the design of the learning activities
- the localisation process itself.

The underlying architecture of the software

onecourse is designed so that the language pack – which contains the database of words, phrases, sentences, paragraphs and stories, and their audio – is completely separate from the learning activities. The translated material for a new language is then simply plugged into each activity.

For more about the software architecture, see page 62 in the Technology section.

The design of the learning activities

Most of the learning activities in **onecourse** are designed with different **modes**. For example, in an activity for building words, Mode 1 allows word-building from graphemes, and Mode 2 allows word-building from syllables.

When localising for a new language, we can quickly select the appropriate mode. For example in Swahili, children build their first words from syllables, so we select Mode 2 for that activity. For first words in English, we select Mode 1. We then plug in appropriate data from the language pack.

For more about the design of learning activities, see page 61 in the Technology section.

The localisation process itself

onebillion grew out of language-learning company **EuroTalk**¹, where we gained experience of localising material into over 120 languages. As a consequence, we have a streamlined localisation process.

¹ eurotalk.com

The localisation process is a balancing act of automating as much as possible, while allowing for linguistic and cultural adjustments. We go through these stages, working with local experts at each stage:

1. Analyse the target language, and build a clear description of it, to include:
 - the linguistic structure
 - the alphabet used
 - the phonetic structure
 - the order of frequency of graphemes and consonant clusters (determined by textual analysis); we are likely to follow this order when presenting them, in particular for open-syllable languages like Swahili
 - a list of high-frequency words
 - a set of common first names and surnames.
2. Check the description of the language against our learning activities. If new components or modes would benefit the child, develop these.
3. Select appropriate stories from the extensive library, and write further stories as required (for example, similar to the Moyo family stories in Swahili).
4. Translate:
 - the database of words
 - Anna's script for the activities
 - the stories
 - the numeracy learning units.
5. Write, in the target language, simple phrases, sentences, and paragraphs (for strand 3 of Reading).
6. Create any new images required.
7. Record all of the audio material, using several voice artists. (Anna does not herself read out stories, or deliver model audio.)
8. Finally, with all assets prepared, build the child's **onecourse**.

Translations can be done remotely. For our numeracy software, we use an online translation platform, and a largely automated workflow. Adapting the reading material is more involved, so we use Word templates to give our local experts more flexibility.

Audio is usually recorded in our in-house studio (but we have also done some recording abroad). With advice from our local experts, we choose the voice-over artists carefully, with attention to accent, clarity of diction, and tone of voice.



Brighton and Sarah recording Swahili audio for our stories and Anna. Sarah recording English.

Adapting to different cultures

We take care to ensure that the database of words, and the corresponding images, are culturally appropriate for the target language.



A girl reading the 'Moon and the cap' story.

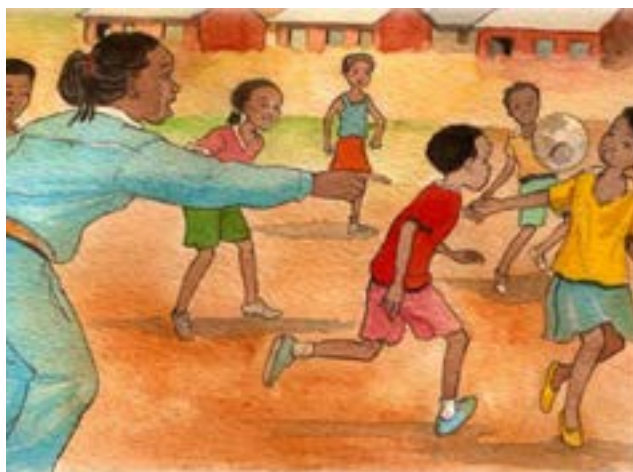
The stories in **onecourse** will come from many cultures. Specially-written stories featuring situations familiar to the child are mixed with stories from other cultures, to fuel the child's imagination.

We make extensive use of Creative Commons stories to offer a diverse and interesting library. We edit the stories to ensure they match our reading bands, and work for a wide audience. The modular design of **onecourse** means stories can be taken out or added, as appropriate, for every new language.

Empowerment through stories

Stories are a powerful tool for empowerment and change. Working with local experts, we will build in empowering and motivating stories for all children – and particularly for girls. We will have stories with strong female role models. We have a number of these in production.

We will also work with local experts on stories about specific local issues, if they think appropriate. The attitude to albinism is one example.



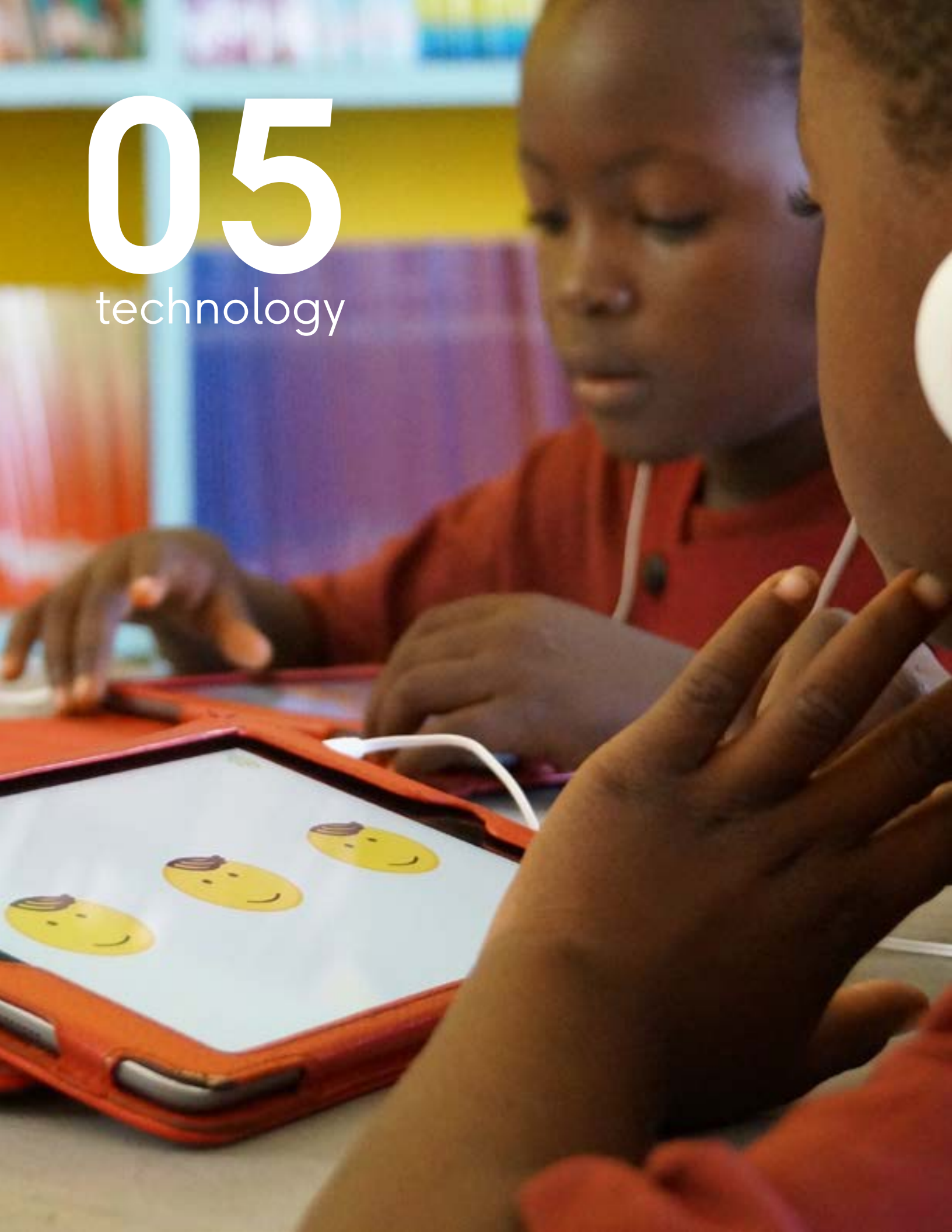
A woman coaching the football team.



An albino radio presenter.

05

technology



Technology

The XPRIZE challenge is to develop open-source software which will enable children anywhere, in any situation, to learn. For this to work, customisability, device/OS portability, code transparency and resiliency are of critical importance. This chapter covers these and other technical aspects of **onecourse**.

Sample units in both English and Swahili are available at the grey tab in your onecourse demo app.



Software architecture

The software is being developed in the Java programming language and targets the Android SDK. It is rendered to the screen using OpenGL ES.

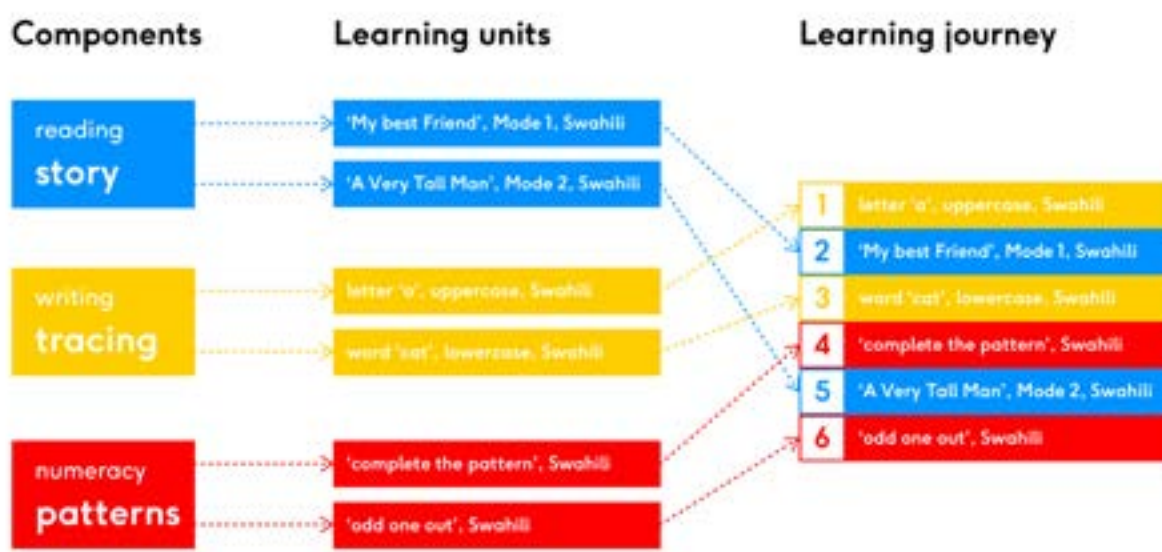
Components and learning units

Conceptually, **onecourse** consists of a set of learning activities or **components** for numeracy, reading and writing. A component may offer different **modes**. For example, a component for segmenting and blending has one mode for segmenting into syllables, and another for segmenting into graphemes. For stories we offer seven different modes (page 26). A component may also offer options, for example 'demo on/off' or 'pictures on/off'.

When the parameters for the component are specified (e.g. language, mode, word list), and options chosen, the result is a **learning unit**. Each learning unit retrieves data from the underlying language pack, as well as visual, audio, or configuration assets.

The learning journey

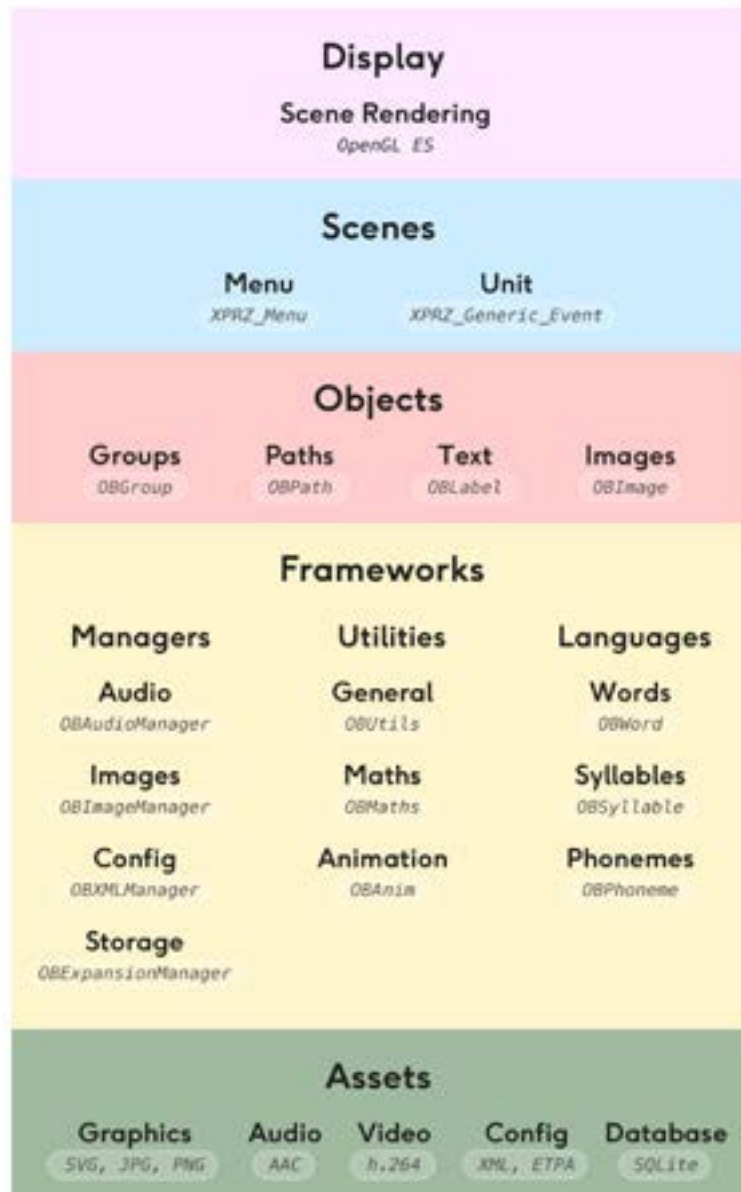
The child's **learning journey** is an ordered set of learning units to be worked through. These can easily be reordered if required. Look at the model:



A child's learning journey is made of a set of units, themselves derived from a set of components.

Technical architecture

Architecturally, **onecourse** consists of five key blocks sitting atop one another.



- **Display** - rendering to the screen.
- **Scenes** - the behavioural logic of learning units and menus.
- **Objects** - the elements that constitute a scene.
- **Frameworks** - abstraction and loading of assets, helper utilities.
- **Assets** - audio, video, images; localisation, configuration and user databases.

Customisability

The software design of **onecourse** makes it easy to customise. The course can be adapted to the needs of any target audience. New components are easily added. Shared use of tablets is catered for too.

Customising to different locales

A locale is a pairing of a language and a location (e.g. Tanzanian Swahili, British English). In **onecourse**, the language pack is completely separate from the components, which means the course can be readily customised to different locales. The numeracy learning units have so far been versioned into 50 different locales, including several English variants (American English, Australian English, British English). Literacy units have been versioned into Tanzanian Swahili, British English, and Chichewa for Malawi.

Language packs

The language pack for a particular locale consists of four elements:

1. an XML representation of the individual characters that constitute the language's alphabet.
2. an XML representation of the key phonemes, consonant clusters and syllables present in the language. It also contains a database of high-frequency and culturally specific words, as well as phrases and sentences.
3. a set of audio files recorded by native speakers.
4. localised versions of the stories that form the graded library.

The technical specification for the language pack format can be found in [Appendix E](#).

Customising the learning journey

The learning journey can be customised for different target audiences and purposes, even within the same locale. For example we could provide only reading units, or only stories, or only numeracy units, if required.

The journey can also be personalised to suit the individual child's needs. The diagnostic assessment at the start of the course will assign the child to a specific track. A younger child may need a 'slower' track than an older child who has spent several years at school.

The structural format of the learning journey for the Study Zone can be found in [Appendix F](#).

Adding new components

onecourse is designed to be easily extendable by adding new components, from **onebillion** or third parties, to enable further customisation. For example they could be components to deal with the specific difficulties of a particular language. Third parties can use as much or little of the **onecourse** frameworks as they choose, but there is considerable benefit in 'porting' content for greater integration. We intend to publish a third-party integration specification in late 2017.

Device sharing

onecourse allows for both standalone and multi-user device scenarios.

Progress data can be stored on a child's own tablet, as planned for the XPRIZE field test. Alternatively, where a device is used by many children, data can be stored on either a local or remote network server. In our [Unlocking Talent](#) (page 79) initiative in Malawian schools, for example, up to 10 different children use a single tablet every day. Their progress data is stored locally. (No internet connection is required.)

Improving the customisation process

We are working on supportive tools to automate significant parts of the process of creating both language packs and learning journeys. This will mean that **onecourse** can be customised efficiently and correctly by local language experts into different locales.

We have optimised our own translation and recording system to get the highest-quality localisations (although it is possible to use other standard translation tools and recording facilities to localise **onecourse** content). The audio recording system uses custom-developed tablet software that allows a sound engineer to check each recording as it is spoken by the voice artist, as well as to demark the sounds/syllables within a word where necessary. Audio analysis algorithms automatically trim the silence from the beginning and end of each recording. We intend these translation and recording systems to be used remotely in the future, so that localisations can be done in-country.

Improving on existing technology

Performance and energy consumption

We have paid great attention to two critical issues: performance and energy consumption.

The experience of using the tablet must be as smooth as possible (no lagging or stuttering). The child must receive instant audio or visual feedback on interacting with the device. Making **onecourse** as performant as possible has the added benefit of minimising energy use, and maximising the tablet's battery life. This is important where power may be erratic, or access to it difficult.

OS integration and modifications

For **onecourse**, we have carried out some modifications to the underlying Android system, to make it as child-friendly and child-proof as possible. Specifically:

- Android is locked to **onecourse**, which becomes the default 'launcher' app. This means children cannot tinker with system settings, or delete the app itself.
- Android system notifications and navigation (the status bar, back and home buttons) are all either hidden or intercepted by **onecourse**. For example, instead of a 'battery low' system notification, children will receive an audio message in their own language telling them to plug the tablet in to charge.

Device / OS portability

Operating system

onecourse was prototyped on iOS in Objective-C, and then ported - by the same developers - to Android. As a consequence of this approach, all core functionality has minimal dependency on system libraries. In fact, the port to Android has been accelerated through custom source-to-source transpilation.

Form factor

onecourse is designed to work seamlessly across touch devices with different physical screen sizes and resolutions. This is achieved through:

- rendering to the screen using a device's 3D hardware, using OpenGL ES 2 and a set of short fragment shaders.
- adapting the placing of elements on screen to the ratio of the display dimensions. This means **onecourse** displays just as well on widescreen devices as on squarer ones. We plan to customise the view layer for display on smaller devices such as smartphones, where screen space is at a premium.
- providing most graphical assets in the SVG (Scaleable Vector Graphics) format. This results in the sharpest possible image. There are also benefits in terms of file size, and the ability to work with layers. We have written a custom SVG render to enable frame-based animation of SVG graphics, which allows us to change colours and shapes on-the-fly. For example, rather than having three PNG files of a ball, each coloured differently, we can use a single SVG and make it any colour we wish.

Code transparency

For software which will be added to and widely customised by **onebillion** – and made open-source if we are an XPRIZE finalist – code transparency is of critical importance.

The way we work guarantees code transparency. The technological design of **onecourse** is based on four key principles:

1. **Modularity** - encapsulating the idea of components.
2. **Reusability** - abstraction of shared elements allows them to be re-used across different components.
3. **Simplicity** - **onecourse** is not bloated, and does not suffer from excessive abstraction.
4. **Clarity** - the codebase is well-documented, with a clear and natural hierarchy.

Our developers have experience of working with open source software (OSS). In order to produce software that is performant, extendable and reliable, they work in an extremely collaborative fashion. This is aided by the use of distributed version control (git) not only for source control, but also for bug reporting and documentation. Interfaces between frameworks are well-defined, and inheritance is used liberally in defining the logic of components.

It is our intention that **onecourse** will be easy to contribute to, be that through additional features, bug fixes or underlying technological improvements.

Resiliency

It would be very unfortunate if the children's tablets stopped working. We take very seriously the ability of **onecourse** to recover from unknown states.

Self-healing

The single biggest concern is corruption of the child's progress database. We will implement consistency checking and database rollbacks, should corruption occur. In the most extreme circumstances, the database will automatically reset. We will achieve this by using a background watchdog to carry out scheduled health checks, and recover the app if it is not functioning correctly.

Resilient

Missing or corrupted assets are also potential causes of failure, causing the child to get 'stuck' in a unit. **onecourse** is designed to cope with this scenario. It will simply move the child beyond the malfunctioning unit. Exceptions are handled silently, and the child receives no error messages.

Debuggable

At the code level, and since it is a standard Java application, it is fully debuggable using the standard Android Studio debugger. This is aided by the addition of a collection of useful logging functions. During testing, **onecourse** features a debug interface for the testers. This allows them to see an overview of the child's learning journey, skip to specific units, repeat units, and test the time-based functionality of **onecourse**.

Tested

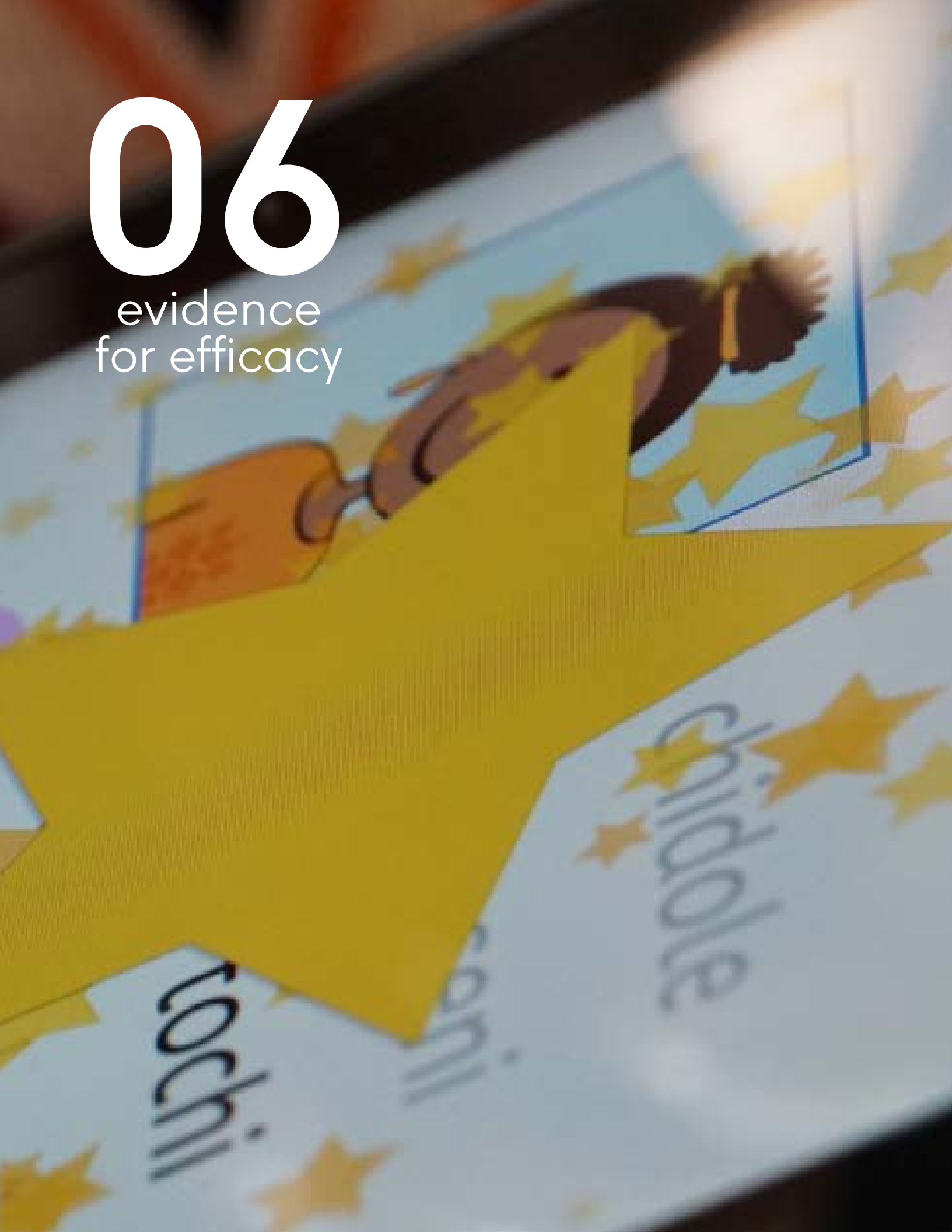
onecourse has been fully tested by our highly experienced QA (Quality Assurance) team, and by in-country testers. We use Github's issue-tracking system to report, assign and keep track of both functionality and content bugs. Each phase of testing is against a defined milestone.

The numeracy units have been tested by thousands of children in Malawi and Uganda as part of the Unlocking Talent initiative. We also have a 'testing by teachers' scheme running in Malawi whereby each new software iteration is tested for localisation issues.

We plan to develop methodologies for automated user interface testing to further improve quality assurance.

06

evidence
for efficacy



Evidence for efficacy

onebillion is committed to producing the best possible software to enable children to learn. We are also committed to working with partners to deliver it effectively.

How do we measure our success? We look for evidence – through formal evaluations, pilot tests, and informal observation. The feedback we obtain leads to continual improvement, and we gain invaluable experience.

Efficacy of onecourse

Do children learn from **onecourse**? To answer that question, the software has been, is being, and will be, widely trialled.

Our numeracy software, which is now part of **onecourse**, was developed some time ago. It has been more extensively trialled than the reading/writing software, which is more recent. We have plans to redress the balance.

Numeracy

In 2013, a randomised controlled trial (RCT) and a pilot study of our numeracy software were carried out in Malawi and the UK respectively, led by Dr Nicola Pitchford of the University of Nottingham, UK.

In Malawi, the trial involved 283 children in Standards 1–3, in Biwi Primary School in Lilongwe. It lasted for eight weeks.

After just 8 weeks of using the intervention children tripled their specific maths curriculum knowledge, with Standard 2-3 children raising attainment levels to a higher level than the average shown by Standard 4 with normal pedagogical practice.

Dr Nicola Pitchford, University of Nottingham

In the UK, the pilot study involved 26 children in Dunkirk Primary School in Nottingham. It lasted for six weeks.

Results showed foundation pupils' learning gains made in curriculum knowledge were equivalent to 18 months of standard pedagogical practice.

Laura Outhwaite, University of Nottingham

A larger evaluation with 389 children has recently been completed in the UK. The intervention ran for 12 weeks and the learning gains were comparable to those for the children in the Malawi RCT of 2013.



A child being registered by Dr Pitchford before pre-testing at Biwi School.



An intervention group using the numeracy apps.

Reading/writing

Trials of the reading/writing software have focused on Tanzania and Malawi.

In August 2016, the University of Dar es Salaam, in partnership with the University of Nottingham, conducted a small-scale trial of the reading/writing software from **onecourse** Swahili at Msasani Primary School in Dar es Salaam. The trial ran for five weeks. 38 kindergarten children were involved, aged 4–7.

The report concluded:

*There is evidence for the app's effectiveness. Results showed children using the tablets & app improved by more than those receiving normal practice for these two sub-tests: syllables and **onebillion** key words. The findings warrant further research over a longer period of time, with a larger group of children, preferably in the first year of formal schooling in Tanzania.*

Dr Nicola Pitchford, University of Nottingham

This small-scale trial provided data and observations which have already been fed back into **onecourse**.

In Malawi, an RCT for the reading/writing software in Chichewa began in two primary schools in January 2017. The results are expected in June 2017.

For more detail on trials, see [Appendix D](#).



A child in the intervention group at Msasani School in Dar es Salaam listening to a story.



Another child being post-tested by Edith Lyimo of the University of Dar es Salaam.

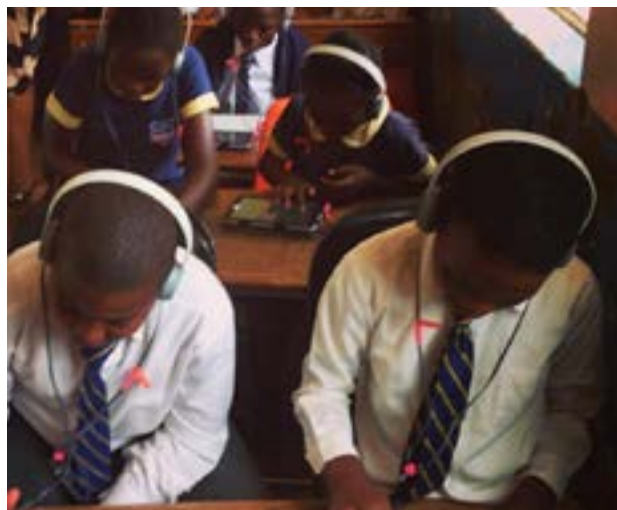
Effectiveness of scaling

When the XPRIZE competition is over, the focus will switch to delivering the winning software solutions to children everywhere – and that means scaling.

We already have substantial experience of scaling, and the challenges involved. In Malawi, we partner with VSO (Voluntary Service Overseas)¹, in an initiative called Unlocking Talent. (See page 79.) This initiative has now reached over 19,000 learners in 62 schools, and is still growing. There will be 127 Unlocking Talent schools by the end of 2017. The children use our numeracy software. Access to all of **onecourse** will follow from 2017.

Three universities – University of Malawi, University of Nottingham, and Lamar University (Texas) – are currently collaborating to assess the effectiveness of the Unlocking Talent initiative. They are running a clustered RCT, involving an intervention in seven schools in seven different educational districts. To date 1,200 children have taken part in the trial. We expect to obtain a great deal of valuable information.

In addition, pilot tests by organisations in South Africa, Lesotho and Canada are providing us with evidence on both the effectiveness of our numeracy software and the form of intervention. These pilot tests are usually carried out with a view to scaling. There is more information about them in Appendix D.



Special needs children using our numeracy apps in South Africa.

¹ vsointernational.org/fighting-poverty/where-we-fight-poverty/malawi

Informal observation

Informal observation is very useful for trialling new activities, and for identifying difficulties for specific groups of children, such as children with special needs.

In Malawi, we can get feedback on new activities within 24 hours, thanks to our volunteer Nadia. We push an app from London onto Nadia's tablet. Nadia tries out the activity with children, and immediately reports back to us. We then modify the software if needed.

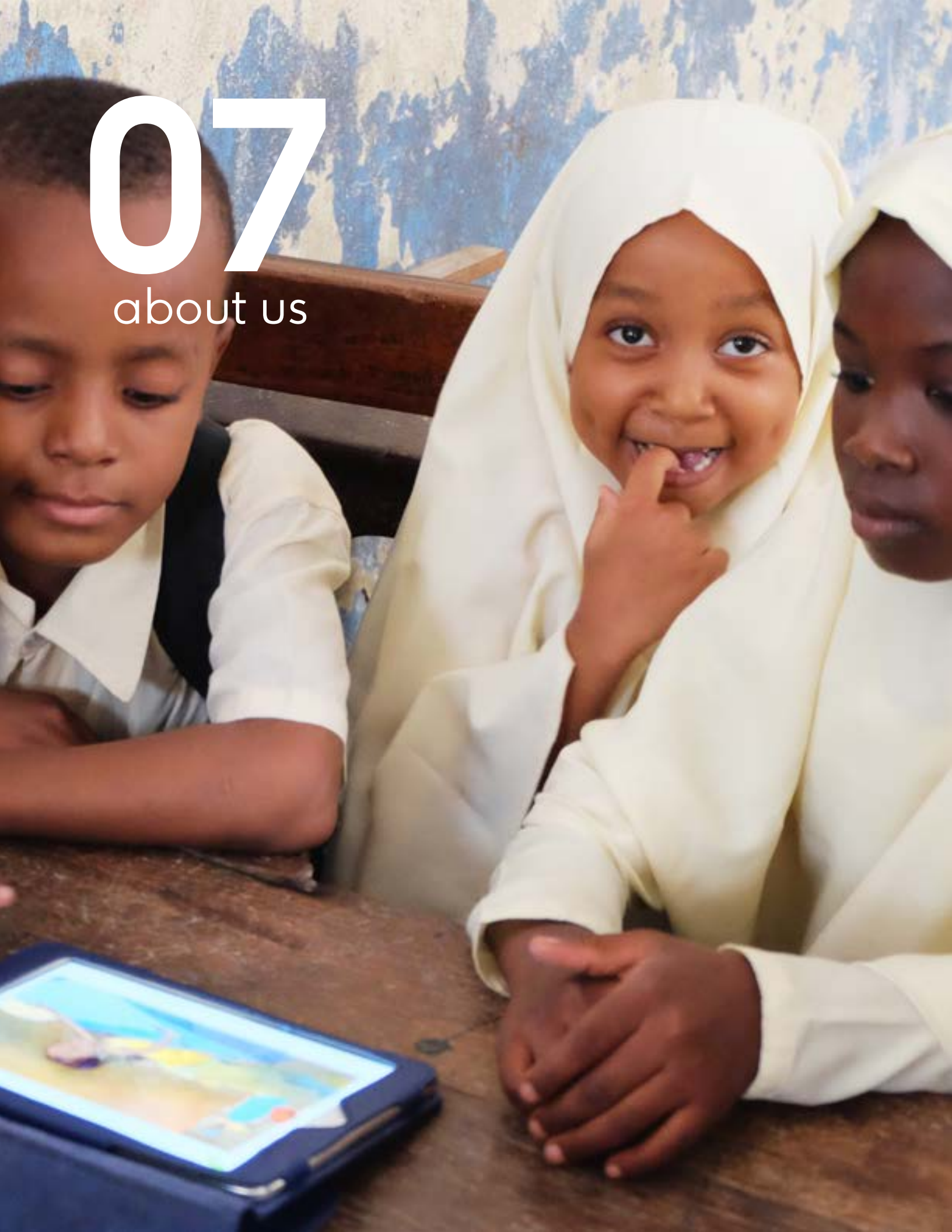


Volunteer Nadia trials a new activity with children at Biwi School, Malawi.

Through VSO in Malawi we have gained a better understanding of how children with special needs interact with the tablets, and what challenges they face. VSO has organised learning groups for students who struggle with fine motor skills. These children are incredibly engaged, and determined to complete activities, in spite of their difficulty in touching the screen lightly.

07

about us



About us

Mission & vision

onebillion is a non-profit publisher of educational software, with an ambitious mission and vision.

We believe that achieving basic literacy and numeracy is transformational for every child. Our mission is to be a catalyst for this transformation, by creating quality material that delivers learning to even the most marginalised children. To this end, we work with a global network of partners.

Our vision is to empower one billion marginalised children, by helping them achieve basic literacy and numeracy in their own language.

The team

Our team consists of the members in our offices in London, and our local experts in different countries. In London, we are 10 people of 8 different nationalities:

London team

- **RoseMarie** - Lead author
- **Matt** - Operations and finance
- **Zane** - Design and illustration
- **Rosanna** - Localisation
- **Judith** - Communications
- **Pedro** - Framework architect
- **Alan** - Senior developer
- **Michal** - Developer
- **Andrew** - CEO
- **Jamie** - CTO

The English audio content has been recorded with the help of:

- **Sarah** - voice-over for our little teacher
- **Nat** - voice-over for model audio
- **Deborah** - voice-over for **onebillion** stories
- **Simon and Bill** - voice-over for Creative Commons stories

Swahili team

Our local experts provide linguistic advice, write material, translate content, review, conduct research, and lend their voices to record audio.

- **Yussuf** – University of Cambridge, linguistic advice, new material, and translations
- **Professor Mutembei** - University of Dar es Salaam, linguistic advice
- **Zena** - voice-over for our little teacher
- **Sarah** - voice-over for model audio
- **Lilian** - voice-over for **onebillion** stories
- **Brighton** - voice-over for Creative Commons stories
- **Robin, Pakii, Haula** and **Pras** - volunteers facilitating the **onecourse** trial with children in Tanzania

Other help

- **Nadia** in Malawi – rapid trialling of new activities with small groups of children; for this purpose, the material is translated into Chichewa
- **Frank, Sylvia,** and **Jo** – our primary-school teaching advisors in the UK

We also get help from a network of partner organisations who support us in countless ways, including through travel logistics and funding. In particular, we are grateful to VSO, our partner organisation in Malawi, who are implementing the Unlocking Talent initiative and providing us with invaluable feedback.

Our history

Originally part of language-learning publisher **EuroTalk**¹, we at **onebillion** have more than 30 years' experience in producing educational software.

We also have wide experience in delivering our software to its target audience, using different technologies. We worked with interactive video on laserdiscs in the 1980s. We experimented with interactive DVDs in India in 2000. We developed custom-built interactive video players for Malawi in 2006. We trialled our solar-powered projector in Uganda in 2015.



Interactive DVD lessons in India - 2000, Handheld video players in Malawi - 2007, Tablets in Malawi - 2010, Solar powered Projector in Uganda - 2015.

Our approach

Our focus is on designing software from which children can learn with minimal adult support. We worked on software for language learning, health, and geography in the past. We are now focused on the core competencies of numeracy, reading and writing. These are the fundamental building blocks for any child's education.

We have observed and listened to children using our software. What we learned has informed the way **onecourse** is designed. The most important thing we have learned is that software must be clear and simple for children working on their own. Achieving simplicity is hard – but it is the key to the child learning.

¹ eurotalk.com

The Unlocking Talent initiative

Developing **onecourse** is not enough. We want to ensure that it is delivered to the children who need it.

In Malawi, we support our implementing partner, the international NGO **Voluntary Services Overseas (VSO)**¹, in rolling out the **Unlocking Talent** initiative.

Through this initiative, our numeracy software – which is now part of **onecourse** – is being used by children in over 60 schools across the country. Standard 1 and 2 children attend half-hour sessions in their solar-powered learning centres, which are equipped with sets of tablets. From 2017, the children will have access to the **onecourse** reading/writing software too.



oneclass at Kwababwa School Lilongwe, Teachers registering students, Children at Biwi school learning numeracy during a oneclass session, Charging the tablets by solar power.

Each child is registered in the learning centre. Data on progress is saved, so children can continue from where they ended the previous session. Progress is monitored on the teacher's tablet.

Find out more about the **Unlocking Talent** initiative in these reports from the BBC:

- **Malawi app 'teaches UK pupils 18 months of maths in six weeks'**².
- **The technology helping to teach Malawi's children**³.

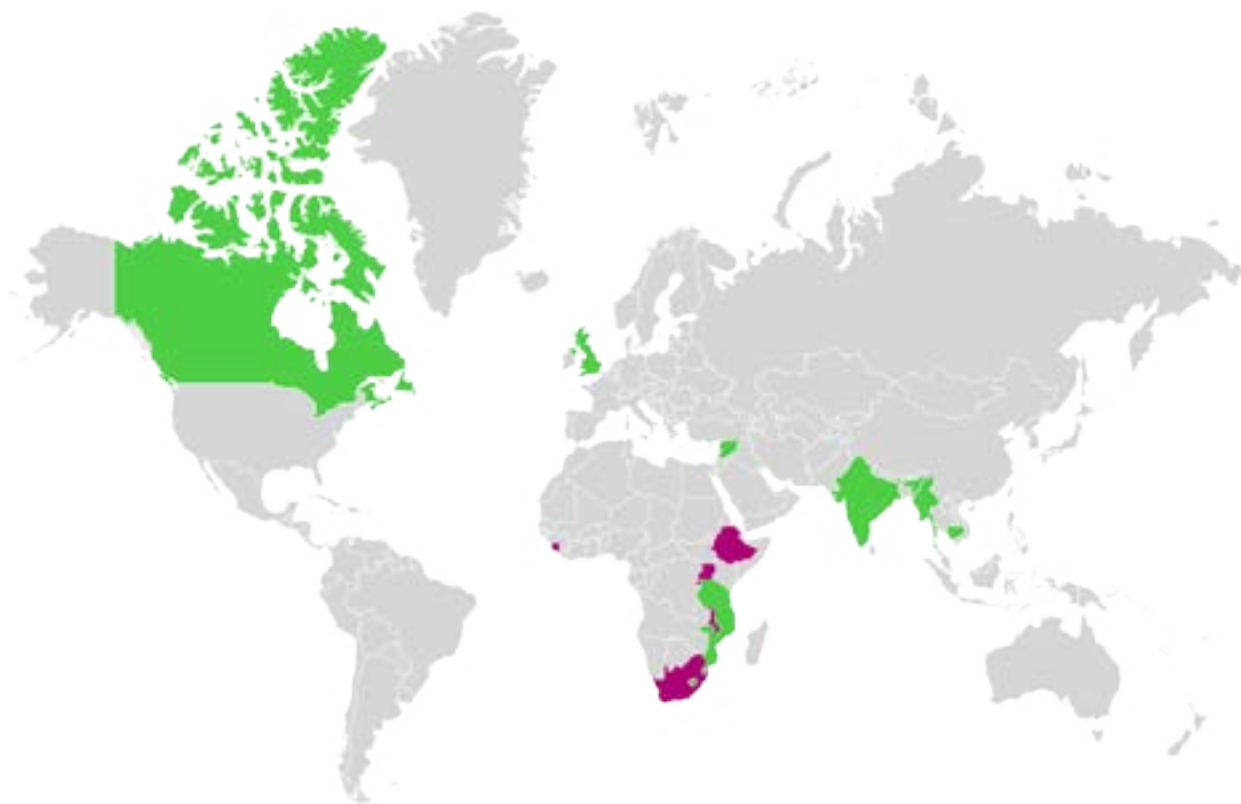
¹ vsointernational.org/fighting-poverty/where-we-fight-poverty/malawi

² bbc.co.uk/news/technology-29063614

³ bbc.com/news/technology-36024060

Future initiatives

Once **onecourse** is completed in Chichewa, Swahili and English, we will work with VSO and other partners around the world to implement further initiatives.



- *current trials of our numeracy software.*
- *Unlocking Talent scaling (both underway and planned).*

Our numeracy software is currently being piloted or trialled in more than 15 countries. We are working with local governments in Malawi, Sierra Leone and South Africa for this, and with local non-profit organisations in Uganda, Canada, Brazil, Ethiopia, Cambodia and Myanmar.

From 2017, we will begin scaling in those countries where trials show significant results. We will localise all of **onecourse** into the respective languages.

Our name, and future plans, reflect our vision: one billion marginalised children around the world empowered by education.

Finance and funding

Business model

We are a registered charity in the UK, and being non-profit, we rely on donors to provide financial support. To date, we have received over £650,000 from private donors and grant-making organisations. A further £275,000 has been committed up to 2018.

We also receive income from the sale of our maths apps on the iTunes and Google Play stores. Since 2011, our free maths apps with in-app purchase have been downloaded over 2 million times by customers in 150 countries.

Investment to date

To date we have invested over £1.5M in developing **onecourse**. We have also helped to secure over \$8M from the Norwegian Embassy, Scottish Government, Comic Relief and UNICEF for the roll-out and implementation of **Unlocking Talent** in Malawi.

We see this submission as the start of our XPRIZE journey. If chosen as a finalist, we will spend a further £1M on improving and expanding **onecourse**.



Norwegian Embassy



Donor organisations.

08

appendices



Appendices

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A. Swahili onecourse outline

The completed course will consist of ten levels. The content of each level is shown below.

Level	Numeracy	Reading	Writing (numbers and text)
1	sort and match; continue/complete patterns; count to 10; word problems	phonemic awareness activities; meet the vowels (lower case); listen to stories	familiarisation with the new letters; trace and write the numbers and letters
2	add and take away within range 0–10; count to 20; missing numbers; ordinal numbers; more than, less than; word problems	first six consonants in order of frequency in Swahili (n,m,k,w,t,l); make their syllables; make words from letters and syllables met so far; listen to stories including with oral comprehension questions	as above; also trace simple words and write them freehand
3	skip count in twos to 20; addition and subtraction; number bonds to 5 and 10; doubling; word problems	next six consonants (s,y,b,g,r,d); make their syllables; make words; listen to stories including with oral comprehension questions	as above; also write numbers in response to audio
4	count in tens and fives; practise with multiples of 10 and 5; $a + b = b + a$; more than, less than; word problems	remaining consonants (h,p,z,j,f,v) + digraph ch; make syllables and words; work with phrases; listen to stories including with oral comprehension questions	as above
5	count to 50 and 100; patterns in 1–50 and 1–100 grid; more than, less than; missing numbers; word problems	consonant pairs ng, nd, mb, sh, ny, kw; make syllables and words; capital letters; alphabet; work with sentences and paragraphs; the mechanics of reading; guided reading of stories	familiarisation with capital letters; trace and write them freehand
6	2-D shapes; number lines; add, subtract, and identify numbers using number lines; $a + b = c$ and $c - b = a$; word problems	consonant pairs mw, nj, bw, mz, tw, dh; syllables and words; work with sentences and paragraphs, including work on comprehension; read-by-myself stories	continuous-stroke writing; trace and write words and numbers freehand
7	place value to two places; vertical addition and subtraction; 3-D shapes; word problems	further consonant pairs and clusters; make words; work with sentences and paragraphs; read-by-myself stories including comprehension questions in audio and text	as above; also begin spelling using letter names
8	count to 1000; place value to three places; more than, less than; word problems	morphology, including tenses and plurals; read-by-myself stories including comprehension questions	spelling; type words including filling in the gaps, in response to audio and images
9	multiply single digit numbers; multiplication tables; word problems	further morphology; read-by-myself stories and non-fiction, including comprehension questions	spelling; type words, phrases, and simple sentences
10	multiply two-digit numbers; word problems	further morphology; read-by-myself stories and non-fiction, with more taxing comprehension questions	spelling; type words, phrases, and sentences

Note that key concepts, content, and practice activities from one level will be revisited in later levels, giving spaced practice. This is in addition to the new material for each level.

See [Appendix G](#) for the implementation schedule for the remaining content.

B. English onecourse outline

The completed course will consist of ten levels. The content of each level is shown below.

Level	Numeracy	Reading	Writing (numbers and text)
1	sort and match; continue/complete patterns; count to 10; word problems	phonemic awareness activities; meet six lowercase letters (s,a,t,p,i,n); make words from them; listen to stories	familiarisation with the new letters; trace and write the numbers and letters
2	add and take away within range 0–10; count to 20; missing numbers; ordinal numbers; more than, less than; word problems	letters m,d,g,o,c,k,e and the digraph ck; make words from the letters met so far; listen to stories including with oral comprehension questions	as above; also trace simple words and write them freehand
3	skip count in twos to 20; addition and subtraction; number bonds to 5 and 10; doubling; word problems	six letters + three digraphs (u,r,h,b,f,l,ff,ll,ss); make words; tricky words; work with phrases; listen to stories including with oral comprehension questions	as above; also write numbers in response to audio
4	count in tens and fives; practise with multiples of 10 and 5; $a + b = b + a$; more than, less than; word problems	remaining seven letters + further digraphs; make words; tricky words; work with phrases; listen to stories including with oral comprehension questions	as above
5	count to 50 and 100; patterns in 1–50 and 1–100 grid; more than, less than; missing numbers; word problems	revision; capital letters; alphabet; tricky words; work with sentences and paragraphs; the mechanics of reading; guided reading of stories	familiarisation with capital letters; trace and write them freehand
6	2-D shapes; number lines; add, subtract, and identify numbers using number lines; $a + b = c$ and $c - b = a$; word problems	further digraphs and trigraphs; alternative spellings for phonemes; build two-syllable words; work with sentences and paragraphs, including work on comprehension; read-by-myself stories	continuous-stroke writing; trace and write words and numbers freehand
7	place value to two places; vertical addition and subtraction; 3-D shapes; word problems	further alternative spellings for phonemes; build three-syllable words; read-by-myself stories including comprehension questions in audio and text	as above; also begin spelling using letter names
8	count to 1000; place value to three places; more than, less than; word problems	morphology, including tenses and plurals; read-by-myself stories, including comprehension questions	spelling: type words including filling in the gaps, in response to audio and images
9	multiply single digit numbers; multiplication tables; word problems	further morphology; read-by-myself stories and non-fiction, including comprehension questions	spelling; type words, phrases, and simple sentences
10	multiply two-digit numbers; word problems	further morphology; read-by-myself stories and non-fiction, including more taxing comprehension questions	spelling; type words, phrases and sentences

Note that key concepts, content, and practice activities from one level will be revisited in later levels, giving spaced practice. This is in addition to the new material for each level.

See [Appendix G](#) for the implementation schedule for the remaining content.

C. Statements of support

1. Kumbali Kindergarten, Lilongwe, Malawi

onebillion numeracy software has been used in this kindergarten since 2012.

Kumbali Kindergarten
P. O. BOX
30420 Lilongwe 3
Malawi
Phone: +265 (0) 995931975
Email: mwales22@yahoo.com
www.kumbali-kindergarten.de

15 Sep 2016

Greetings to all in the onebillion lovely team.

I write to express my gratitude and offer my encouragement to you and the entire team, for the commitment and support you have offered to Kumbali Kindergarten since 2012.

From 2012 to this day you have not ceased in supplying us with learning gadgets and programs that have helped hundreds of children at the Kindergarten and the surrounding area to have their minds and world opened in masamu (maths) and letter writing.

The programs are very friendly to the learning of the child as it is self directory, easy for the child to follow and understand and offers the solution to shortages of teachers, since the child only need minimum supervision and guidance; moreover it is learners' friendly and enjoyable, that even my 1 year 10 months daughter was able to use it her own.

All children that have attended our kindergarten have proven to be intelligent having used the gadgets with the programs. We follow them since they left the kindergarten for primary school and every term we record good grades from them, the reason being the foundation that was laid by using the programs from onebillion. This year we have released 18 children to go to primary school. These are big brains selected.

If you compare children in our Kindergarten that use the gadgets, with other children that are not you are able to tell which ones are standing a better chance of producing great results in life. This is a great opportunity to children who live in the poorest of nations. The Kindergarten has served over 300 children since its establishment in 2012 and all of them had and some still having access to the programs.

With the soon to be released reading and writing program, my excitement is that it will enable children to develop reading skills at a very good age thereby opening a great opportunity for their future; since the program comes in the language they understand better. These are programs set to the best of understanding where no teacher can be able to reach, according to my point of view; they are the best! And i wish all the world should come behind onebillion in support of this.

Children and the world, need the best for their foundation; and you have the best that they need. I can testify!

Please receive my thanks & gratitude on behalf of the teachers {who find their job easier now}, the parents committee, and my wife who is also the coordinator.

Greetings to the Great “onebillion” family!

Yours with gratitude and Love,

Sai Mwale

Saili Mwale

Project Cordinator- Kumbali Kindergarten, Malawi AFRICA.



VSO

17th November 2016

Unlocking Talent with onecourse.

I am Global Lead for Unlocking Talent - an initiative that is supported by partners including The Royal Norwegian Embassy, Comic Relief, The Scottish Government, iSchool Africa, UNICEF, Airtel (the largest Africa mobile Phone service provider), Cisco, DFID and others.

We work closely with the Education Ministries in Malawi, Sierra Leone and Tanzania.

A key partner to Unlocking Talent is the London based developer onebillion. onebillion have created the comprehensive course that we use to deliver the key skills needed in primary education.

We have used the Numeracy component of onecourse for 2 years in Malawi (now used by more than 19,000 children in 62 schools) and have seen real change in the children.

On 15th November 2016 in Lilongwe we launched onecourse Chichewa - This added Reading and Writing to Unlocking Talent. The Honourable Emmanuel Fabiano, Minister of Education, welcomed this significant resource to Malawi.

I believe that onecourse is the highest quality interactive content we have ever seen. It is changing lives in Malawi and beyond, and I commend it to you.

Best wishes



Dario Gentili

VSO Country Director Malawi
Global Lead - Unlocking Talent



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www.vsointernational.org

Voluntary Service Overseas is a company limited
by guarantee, registered in London number: 703529
Registered charity number: England and Wales 103757
Scotland SC039117

3. Comic Relief

Comic Relief is a major British charity. It has been following our work closely, and recently granted GBP 417,000 (2016 – 2018) to build six Unlocking Talent Learning Centres in Phalombe district, Malawi.

From: Teresa Sguazzin <T.Sguazzin@comicrelief.com>
Subject: Your Masamu work in Malawi
Date: 12 September 2014 at 17:31:00 BST
To: "andrew@onebillion.org.uk" <andrew@onebillion.org.uk>,
 "jamie@onebillion.org.uk" <jamie@onebillion.org.uk>



Hi Andrew and Jamie

I manage Comic Relief's international education programme. Comic Relief aims to tackle both access and quality with a special focus on reducing inequality of educational opportunities, and all of our education projects are in sub-Saharan Africa.

I read the BBC report on the Masamu work with interest – and then the University of Nottingham evaluation. I'm particularly interested because the maths work seems to use the opportunity technology affords and take fresh approaches to teach mathematical concepts.

So many of the proposals we get use tablets simply as a means of delivering content, so it's really refreshing to see something that uses technology to find new and better ways of learning. I was also pleased to see that issues of access to power had been properly considered.

I'd be really interested in talking to you with a view to seeing if there was some way we could support you. This could be through support to your work in Malawi, or perhaps exploring the potential to link you to grantees in other low resource settings who might offer the opportunity to move into new places and new languages. We're very supportive of mother tongue approaches, so it was good to see that the app was in Chichewa.

Let me know if you'd be interested in chatting. It'd be good to open up some space to explore what might be possible.

I see you've a London address. Comic Relief's offices are in Vauxhall, so we could have a face-to-face meeting. But you may be in Malawi – in which case Skype or phone would work just as well.

Best regards
 Teresa

Teresa Sguazzin
 International Grants Programme Manager - Education

D. Evidence for onecourse

The material in **onecourse** has been, and is being, widely trialled, to evaluate its effectiveness. The numeracy software has been trialled separately from the reading/writing software, which was developed more recently.

The numeracy and reading/writing software is now combined in **onecourse**, to meet XPRIZE requirements. Hence the trial findings apply to **onecourse** too.

1. A summary of key findings

The key findings of the trials conducted by the University of Nottingham are summarised below.



A. Malawi: the numeracy software

2013

Proof that onebillion's numeracy software is effective was obtained in an RCT (randomised control trial) with 283 children from Standards 1 – 3 in Biwi Primary School in Lilongwe. Use of the numeracy apps for 8 weeks significantly raised learning outcomes compared to standard practice, with children's maths ability extended by up to 18 months. Low achievers made the most gains. Girls responded to the numeracy apps just as well as boys did.

2015 – 17

An efficacy trial is currently being conducted in Malawi through a cluster RCT. It covers fourteen schools across the country, in seven districts, with one intervention school and one control school per district. To date over 1200 Standard 1 and 2 children have taken part, with the intervention applied to half of this sample for between 1 and 3 months. Low-achieving pupils receiving the intervention have made significant learning gains, compared to low achievers receiving standard practice.

The trial forms part of a holistic evaluation taking place in Malawi. To date 68 schools are involved in the evaluation. We have conducted interviews with pupils, teachers, school leaders, and primary education advisors, and plan to interview government officials, in order to identify and understand the barriers to implementing digital technology in primary schools in Malawi.

B. Malawi: the reading/writing software

2017

Starting in January 2017, an RCT is being conducted in two primary schools in Malawi to evaluate the effectiveness of the reading/writing software in Chichewa. Results are expected in June 2017.

C. UK: the numeracy software

2013 – 2016

Pilot studies have been conducted with over 150 primary schools in the UK. These studies have demonstrated that the numeracy apps are effective in raising early maths skills, especially for low-achieving pupils. Children with poor memory skills made the highest learning gains.

2016¹

An RCT with 389 foundation pupils (aged 4–5) has recently been completed. The intervention ran for 12 weeks. Results showed that children exposed to the numeracy apps made greater gains over that period than children receiving standard practice. This result was strongest with low-achieving pupils. In particular, the apps supported conceptual and reasoning skills. The gains were comparable to those for the children in the Malawi RCT of 2013.

D. Tanzania: the reading/writing software

2016

A small pilot study was conducted in Tanzania with 38 pupils aged 4 – 7, to investigate the effectiveness of the reading/writing software in Swahili. 19 pupils received the app for 5 weeks, and 19 received standard practice. The former showed significant gains in reading aloud key words taken from the app, compared with those who received standard practice. The study indicated that the app could be effective in developing literacy skills, if implemented over a longer period of time.

¹ The full report of the first pilot study (2013) is available at: onebillion.org/downloads/dunkirk-primary-final-report.pdf

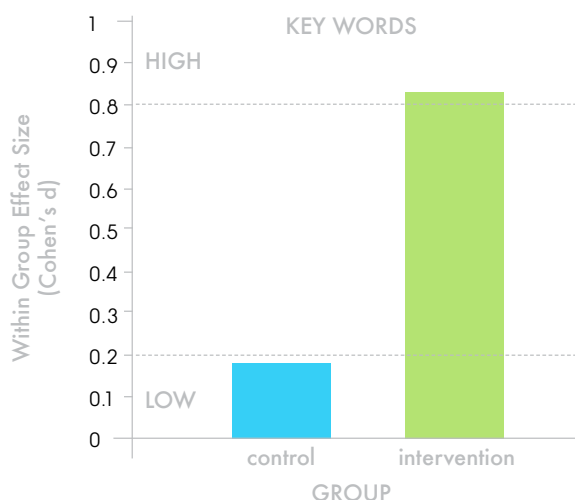
Raising learning outcomes

READING

Tanzania

- small pilot study
- 38 children, aged 4-7 years
- treatment & control groups
- teacher-led implementation
- 5 weeks, beta software

- apps improved recognition of syllables and key words more than normal practice



From presentation by Dr Nicola Pichford at the mEducation Alliance Symposium in Washington DC, October 2016: onecourse Swahili – Literacy Trial outcomes.

E. South Africa: the numeracy software


2016

In a collaboration with onebillion and VSO, iSchool Africa introduced the onebillion numeracy apps, in English, in 32 schools in South Africa through 2016. Baseline assessments were carried out, with follow-up assessments in 16 of the schools 4 – 7 months later.

The impact of the apps on numeracy skills was encouraging. In addition, teachers reported many other positive impacts on the children, including increased confidence and increased engagement in classroom activities.

2. The numeracy RCT in Malawi, 2013

The 2013 RCT for the numeracy software was reported in the journal *Frontiers in Psychology* in 2015. Below is an extract from the report.



ORIGINAL RESEARCH
published: 23 April 2015
doi: 10.3389/fpsyg.2015.00485

Development of early mathematical skills with a tablet intervention: a randomized control trial in Malawi

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Evaluation of educational interventions is necessary prior to wide-scale rollout. Yet very few rigorous studies have been conducted on the effectiveness of tablet-based interventions, especially in the early years and in developing countries. This study reports a randomized control trial to evaluate the effectiveness of a tablet intervention for supporting the development of early mathematical skills in primary school children in Malawi. A total sample of 318 children, spanning Standards 1–3, attending a medium-sized urban primary school, were randomized to one of three groups: maths tablet intervention, non-maths tablet control, and standard face-to-face practice. Children were pre-tested using tablets at the start of the school year on two tests of mathematical knowledge and a range of basic skills related to scholastic progression. Class teachers then delivered the intervention over an 8-weeks period, for the equivalent of 30-min per day. Technical support was provided from the local Voluntary Service Overseas (VSO). Children were then post-tested on the same assessments as given at pre-test. A final sample of 283 children, from Standards 1–3, present at both pre- and post-test, was analyzed to investigate the effectiveness of the maths tablet intervention. Significant effects of the maths tablet intervention over and above standard face-to-face practice or using tablets without the maths software were found in Standards 2 and 3. In Standard 3 the greater learning gains shown by the maths tablet intervention group compared to both of the control groups on the tablet-based assessments transferred to paper and pencil format, illustrating generalization of knowledge gained. Thus, tablet technology can effectively support early years mathematical skills in developing countries if the software is carefully designed to engage the child in the learning process and the content is grounded in a solid well-constructed curriculum appropriate for the child's developmental stage.

Keywords: tablets, technology, primary school, mathematics, intervention, evaluation, randomized control trial

Introduction

Research with digital educational software has shown increased motivation (Rosas et al., 2003) and promotion of positive attitudes (Ke, 2008) toward mathematics in primary school children. However, a recent study has concluded that although technology is used in many classrooms in the West, its potential to support learning is often underutilized due to limitations in its design and content (Yelland and Kilderry, 2010). Consequently, findings regarding the attainment benefits of

Frontiers in Psychology | www.frontiersin.org

1

April 2015 | Volume 6 | Article 485

The full report is available at <http://journal.frontiersin.org/article/10.3389/fpsyg.2015.00485/full>

3. The reading/writing trial in Tanzania, 2016

An evaluation of the reading/writing software from **onecourse** Swahili was carried out by the University of Nottingham and University of Dar es Salaam. (The software is referred to as 'the literacy app' in this report.)



The trial was conducted by

University of Nottingham

Dr. Nicola Pitchford - Associate Professor, School of Psychology

Dr. Paula Hubber - Postdoctoral Researcher, School of Psychology

University of Dar es Salaam

Dr Ernesta E. Mosha - Director, Institute of Kiswahili Studies

Dr Edith B. Lyimo - Head, Department of Literature

Prof Aldin Mutembei - Associate Professor

Summary

This study evaluated the tablet-based Swahili Literacy app, developed by onebillion, in supporting the acquisition of literacy skills in young children in Tanzania.

A matched-sample study was conducted in a kindergarten in the urban Msasani area of Tanzania. 40 children were allocated to one of three intervention groups, based on pre-test literacy levels: a normal practice group; a group which received the intervention for one 45-minute session each day; and a group which received the intervention for two 45-minute sessions each day, with a short break between.

The children were pre-tested using six subtests from the Early Grade Reading Assessment for Kiswahili (EGRA) and an additional subtest designed by onebillion to test the ability to read key words which feature in the app. The intervention was delivered for 5 weeks and 2 days by classroom teachers at the school, with support from Voluntary Service Overseas (VSO). Children were post-tested using the same assessment as the pre-test.

A matched sample of 38 children was analysed to investigate the effectiveness of the onebillion Swahili Literacy app, and to evaluate whether two 45-minute sessions each day were more beneficial than one 45-minute session.

Results showed that children using the app improved by more than those receiving normal practice for two of the subtests: Syllables and onebillion Key Words. These results support theories of language and literacy acquisition.

There was also evidence that the longer time using the app led to improved performance on the Syllables and onebillion Key Words subtests.

The findings of this study warrant further investigation over a longer period of time, and with a larger sample size.

NO Pitchford

Dr. Nicola Pitchford

Bnulle

Dr. Paula Hubber

School of Psychology
University of Nottingham



The full report is available at
<https://onebillion.org/downloads/evaluation-of-onebillion-kiswahili-literacy-app.pdf>

4. The iSchool Africa report, 2016

The details below are from a report by iSchool Africa in November 2016.

Some teacher feedback

“The learners have improved academic results, learners are enjoying school. Even those who generally struggle feel cared for, despite their own issues.”

Harold Nxele, Edendale PS

“My children were so engrossed in what they were doing, they didn’t want to stop. It was the first time I have ever seen my whole class completely focussed on the task. Absolutely wonderful for education.”

Dolores Koopman Grade 2

Assessment results

Baseline assessments in 8 of the 32 schools were carried out in May 2016 with the support of University of Nottingham. Follow-up assessments in October 2016 showed encouraging results:

School	Grade	Baseline - Date	Baseline test %	Follow up test - date	Follow - up test %	Increase
Nomnekane PS, GP	3	May 2016	73	October 2016	87	14
Mkhambeni PS, EC	3	May 2016	48	October 2016	86	38
Tabase PS, EC	3	May 2016	58	October 2016	83	25
Lugongozo PS, EC	3	May 2016	76	October 2016	84	8
Dysselsdorp PS, WC	3	May 2016	78	October 2016	85	7
PJ Badenhorst PS, WC	3	May 2016	79	October 2016	92	13
St Konrad PS, WC	3	May 2016	82	October 2016	90	8
Muyexe PS, LP	3	May 2016	70	October 2016	76	6

Learner impact

The report listed these impacts on the children who used the apps.

- **Increased numeracy skills** – consolidation of the basic numeracy skills needed to catch up with actual grade requirements.
- **Increased tech literacy** – learners are able to navigate through the apps easily.
- **Increased confidence** – learners gained confidence as they grasped concepts not understood before. The one-to-one engagement with the content, immediate feedback, and constant encouragement and praise built into the app, affirms to the learner that he/she is capable of doing more than he/she had ever realised.
- **Increased engagement in classroom activities** – as the learners gain confidence they're more willing to take part in class activities and contribute to class discussions.
- **Improved concentration** – learners with concentration problems are able to channel their energy when they concentrate on the app and use the headphones. It helps them to focus and not get distracted by other learners and influences.
- **Improvement in overall attitude and behaviour** – teachers have noticed an improvement in the overall attitude towards learning, and classroom behaviour.
- **Love for learning** – using technology helps learners experience learning in a non-threatening way. The one-to-one engagement helps learners to concentrate on their own learning experience in a fun way, which cultivates a new love for learning.

E. Language pack documentation

Language packs

A locale is a **pairing of a language and an optional region** (e.g. Tanzanian Swahili, British English). A locale is represented using abbreviated codes, so Swahili would be `sw_TZ` and British English `en_GB`. Each localised version of **onecourse** requires a language pack for that locale, and a localised learning journey. The language pack consists of four elements:

1. The alphabet

The file `letters.xml` defines the individual letters that constitute the language's alphabet. Each `letter` has a unique `id` and an optional set of `tags`. The values for the tag attribute vary across language families, with `vowel` being used in both English and Swahili. The letters **a**, **b** and **d** are represented like this:

```
<letters>
  <letter id="a" tags="vowel">
  <letter id="b"></letter>
  <letter id="d"></letter>
</letter>
```

2. Phonemes, syllables and words

The file `wordcomponents.xml` defines the key phonemes, consonant clusters and syllables present in the language. It also contains a set of high-frequency and culturally specific words for that locale.

Each phoneme has a unique `id` with the prefix `is`. In Swahili, the phonemes **a**, **th** and **ng'** are represented like this:

```
<phonemes>
  <phoneme id="is_a">a</phoneme>
  <phoneme id="is_th">th</phoneme>
  <phoneme id="is_ng_apost_">ng'</phoneme>
</phonemes>
```

Next come syllables. Each `syllable` is made from one or more `phoneme` and has a unique `id` with the prefix `isyl`. The individual phonemes in each syllable are delimited by `/`. In Swahili, the syllables **ju** and **nye** are represented like this:

```
<syllables>
  <syllable id="isyl_ju">j/u</syllable>
  <syllable id="isyl_nye">ny/e</syllable>
</syllables>
```

Finally, the set of `words`. Each word is made from one or more `phonemes` or `syllables` and has a unique `id` with the prefix `fc`. The phonemes or syllables in each word are delimited by `/`. In Swahili, the words **paka** and **rafiki** are represented like this:

```
<words>
  <word id="fc_cat">pa/ka</word>
  <word id="fc_friend">ra/fi/ki</word>
</words>
```

3. Audio and images

Each letter, phoneme, syllable, consonant cluster (if appropriate), and word is recorded by a native speaker and an aac compressed version is stored in an `.m4a` file, named by its `id`. In Swahili, the words **nywele**, **jani** and **kima** exist as recorded audio files: `fc_hair.m4a`, `fc_leaf.m4a` and `fc_monkey.m4a`.

Where a word is broken down into `syllables`, the recording has an accompanying `.epta` file which specifies the start time of each syllable in the audio file.

For each word, an optional `.png` image exists. In Swahili, the words **mbu**, **kiazi** and **shule** have image files: `fc_mosquito.png`, `fc_potato.png` and `fc_school.png`.

4. Stories

Localised stories each have an `id`, and are defined in a corresponding `.xml` file.

Presentational aspects of the story are defined in the `book` element. Each `page` contains one or more localised `para`. A `page` can have an optional `picjustify` attribute to specify the page layout.

In lower-level stories, there is a syllable breakdown for each word, delimited by `/`. The title and first page of the story *A Lot of Cats* are represented in Swahili like this:

```
<book id="xr-alotofcatsSW" indent="N" lineheight="1.5" paraheight="1.33"
      letterspacing="1" fontsize="58" noparas="true">
  <page pageno="0">
    <para>Pa/ka we/ngi</para>
  </page>
  <page pageno="1">
    <para>Mi/mi ni/na m/bwa. Ji/na la/ke ni Si/mba, la/ki/ni si m/ka/li sa/na.</para>
  </page>
</book>
```

Every `para` has a corresponding `.m4a` audio file and an accompanying `.etpa` file which specifies the start time of each word in the audio file.

Each word within a `para` is also individually recorded, along with a version split into syllables for lower-level stories. (These audio files will be played when the child touches words for help.)

F. Learning journey documentation

The child's learning journey is an ordered set of learning units to be worked through. A learning unit is a component with parameters assigned from the underlying language pack as well as any required visual, audio or configuration assets. It is specific to a particular locale.

An example from the **onecourse** Swahili learning journey is shown below. The first unit is an introduction to using the tablet, the second a listening activity focusing on initial phonemes.

```
<level id="1">
  <unit id="0002.OC_SectionIT"
    target="OC_SectionIT"
    params="eventit"
    config="oc-introduction"
    lang="sw"
    targetDuration="120"
    passThreshold="0.5"
    catAudio="-1"
    awardStar="-1"
    icon="icon_0002"/>
  <unit id="0003.OC_Sm2"
    target="OC_Sm2"
    params="sm2/
      demo=true/
      demotype=a1/
      noscenes=8/
      words=fc_prize,fc_animals,fc_sugar,fc_donkey,fc_pineapple,
      fc_glasses,fc_shorts,fc_minibus,fc_address,fc_basin,
      fc_cooking_pot,fc_sister,fc_mango,fc_hoe,fc_button,fc_drum,
      fc_pump_for_well,fc_friends,fc_rabbit,fc_soil,fc_children,fc_heron"
    config="oc-lettersandsounds"
    lang="sw"
    targetDuration="120"
    passThreshold="0.5"
    catAudio="2"
    awardStar="-1"
    icon="icon_0003"/>
```

Levels

The learning units in the child's learning journey are divided into levels, reflecting the progression in content. In **onecourse** Swahili and **onecourse** English we have opted for 10 levels, with Level 1 the simplest. A level typically contains between 100 and 400 learning units.

Learning units

A learning unit has the following parameters:

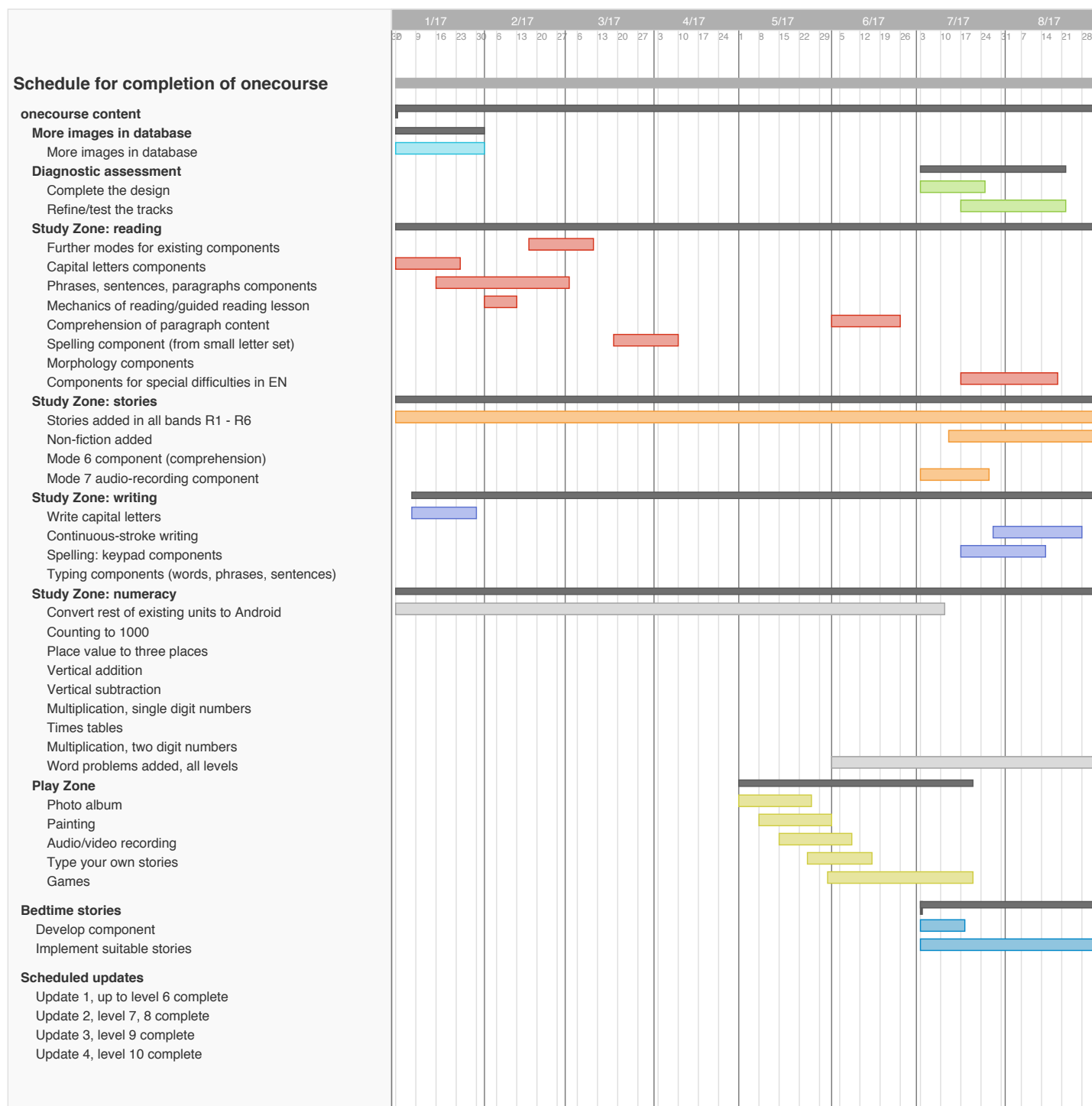
- `id` unique identifier.
- `target` component the unit is using.
- `param` list of component-specific parameters in `key=value` form, each delimited by `/`.
- `config` configuration directory for audio and video assets used by the component.
- `lang` language pack to be used.
- `targetDuration` reflects the time it should take an average child to complete the unit .
- `passThreshold` the ratio of correct:incorrect answers which constitute the child *passing* the unit successfully.
- `catAudio` introduction given by the on-screen teacher.
- `awardstar` whether the child is awarded a star upon completion of the unit.
- `icon` the image shown to the child before beginning the unit.

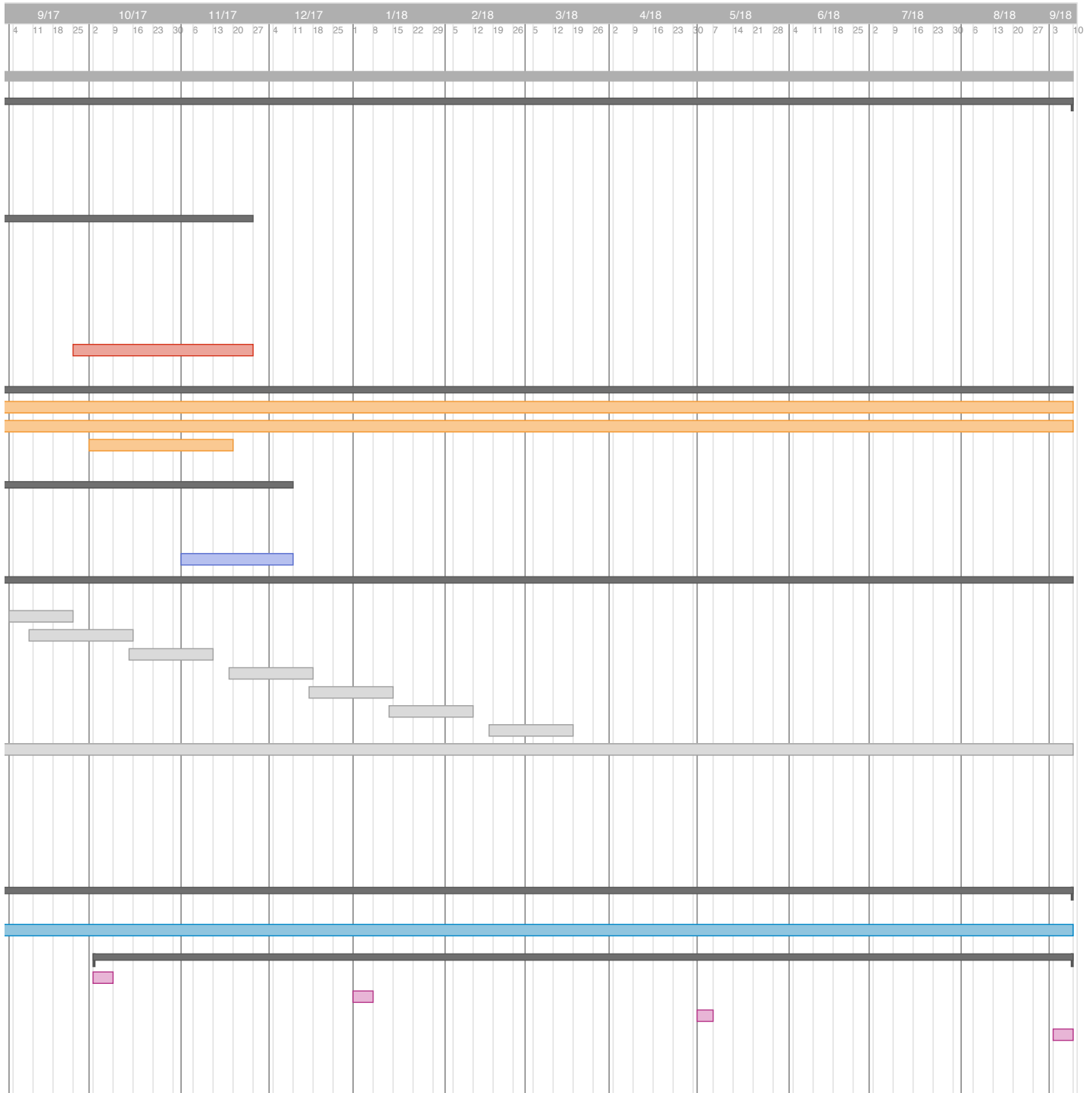
In the following example, the letter tracing component OC_LetterTrace is being used. The params indicate:

- lt= single letter mode.
- intro=false no introductory audio.
- letter=i use the letter i from the Swahili language pack.
- notraces=4 the letter is to be traced 4 times.

```
<unit id="0052.OC_LetterTrace"  
  target="OC_LetterTrace"  
  params="lt/intro=false/letter=i/notraces=4"  
  config="oc-lettersandsounds"  
  lang="sw"  
  targetDuration="120"  
  passThreshold="0.5"  
  catAudio="1"  
  awardStar="-1"  
  icon="icon_0052"  
</>
```


G. Schedule for completion of onecourse





H. Background research

We are grateful to the authors of the following material, for valuable insights gained during our research phase. These insights are reflected in the course design.

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I. Glossary

Component	A programmed activity in onecourse , designed to achieve a specific learning objective. When parameters are fed in, the component becomes a learning unit.
Diagnostic assessment	An assessment to find out what a person knows and can do before a learning programme starts. In onecourse , the results of this assessment will be used to assign the child to one of three tracks.
EGMA	Early Grade Math Assessment is an oral assessment designed to measure basic numeracy skills of students in early grades.
EGRA	Early Grade Reading Assessment is an oral assessment designed to measure basic literacy skills of students in early grades.
Grapheme	A letter or group of letters representing a single sound (phoneme) in a language.
Learning unit	In onecourse Study Zone, the material is presented as an ordered set of learning units. Each focuses on a specific objective.
Numerosity	The ability to discriminate between numbers in terms of the quantity of objects they represent; 31 is a larger number than 29.
Phoneme	The smallest unit of sound in a language; the word 'dog' is made up of three phonemes.
Randomised Controlled Trial (RCT)	A study in which people are allocated at random to receive one of several interventions. One intervention is designated as the standard of comparison, or 'control'. (The control may be 'carry on as usual'.)

Unlocking Talent (UT)

Unlocking Talent is an initiative by Voluntary Service Overseas (VSO) in partnership with onebillion, to improve the quality of primary school education through Digital Education Technology.

Voluntary Service Overseas (VSO)

VSO is an international development charity. It was founded in the UK in 1958.

J. onecourse library

onecourse contains a growing library of graded stories, from which we will select for localisation. It comprises:

- **onebillion stories** - written by our author, illustrated by our graphic designer.
- **Creative Commons stories** - text and illustrations carefully edited by us.

Here are the current stories arranged by reading band, from R1 to R6, with R1 the simplest. More stories, and non-fiction titles, are on the way for all bands.



My red ball



Someone like me



A very tall man



My dog Max



Laughing with mum



Our family



My best friend



The lost shoe



Little Sock gets lost



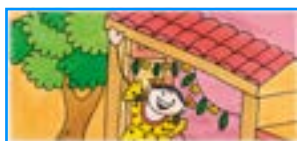
Where is Max?



Mrs Tembo's umbrella



My friends



My home



Millipede's boots



Our clothes



The game



Pendo the cow



In the market



Teeth



Rain





Where is the cake?



Maloo and Kaloo



I like to read



The lost cows



Our day at the zoo



Rani's first day at school



Jadav plants a forest



Let us cook together



Vina and Vinay have fun with paint



Football!



The colours of the rainbow



The man who sneezed very loudly



A new house for Mouse



The lost key



I am not afraid



Colours



Ant and Dove



A lot of cats



Amazing Daisy



A very busy day



Busy



The penguins' new home



The moon and the cap



Hide and seek



Count the animals



Dalitso's dream



Always be fair when you share



Fatima's forest friends





Our favourite friend



How Ant saved Dove




Hippo wants to dance



Rabbit's ears



The loose tooth 



Simon saves the day



Maguru gives out legs



I love the rain!



Lory Dory



No problem!




A great birthday surprise



Zama is a star



Chifundo and Adila get a fright 



Anna's new shoes



Little Ant has a clever plan



Avani and the pea plant




The bus to town



Samir's box of things



What is Chifundo making? 



The red raincoat



Holidays with grandma




Keeper looks after the animals



Helping grandma



Grandma tells a story 



Amina's mat



What Dalitso found 




Chikondi and the chickens



The flying T-shirt 



Grow, grow, grow 



Important jobs



Grandma's bananas



Fruit



GLOBAL
LEARNING **XPRIZE**

