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IREX
Make a Better World

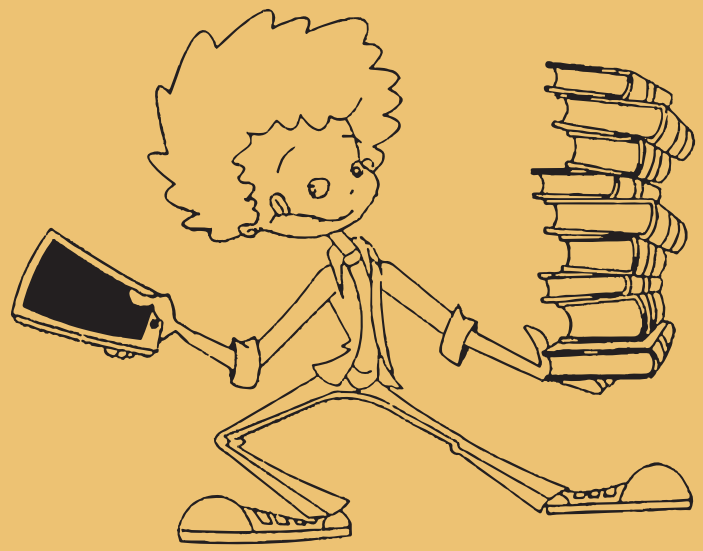
Hacking Literacy

How to engage local developers, content creators and libraries to improve reading outcomes

A Beyond Access Guide

Introduction

This guide is based on IREX's 10+ years of effectively linking technology and communities through libraries. We created this guide after realizing that local technology communities could be much better integrated into early reading efforts through careful planning and engagement. The Hacking Literacy guide is a valuable resource that is rooted in lessons learned implementing technology for development and community mobilization for early reading programs. If you are interested in learning more or partnering with IREX to conduct a hackathon or use technology to increase literacy, please contact us at beyondaccess@irex.org.



Contents

The Challenges

Children's literacy is a priority in many countries, but schools are overwhelmed and can't meet the needs on their own. Often, school reading methodology fails to associate reading with enjoyment. Textbooks are the main tool for teaching reading, and supplementary materials are scarce. As a result, children learn to associate reading with memorization and exams, rather than pleasure.

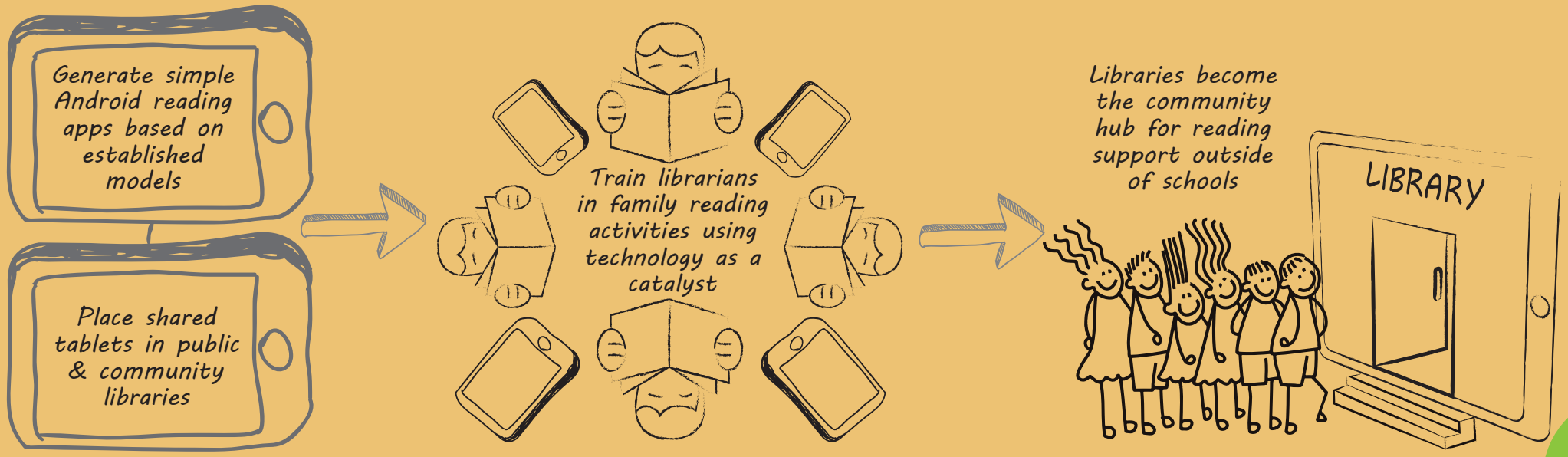
Parental engagement in learning to read is critical.[1] The amount of time spent by children reading with their caregivers is a key indicator of reading achievement. Schools typically struggle to engage, guide and support parents sufficiently.

Reading materials are scarce, particularly in non-dominant languages. Even countries dedicating significant resources to literacy programs are unable to print enough books to make them available to everyone who needs them.

[1] United States Agency for International Development (USAID). (2011). Education opportunity through learning. Washington, DC: USAID.

The Response

The IREX "Hacking Literacy" Approach



Hacking Literacy leverages existing public libraries as the hub from which to attack these challenges. Equipping libraries with content and tools, as well as the right methods to reach families in their communities leads to a new resource in the community that fosters early grade reading abilities.

Where does technology fit into the picture?

Reading apps with specific early-learning functionality can be an integral part of the picture. Installed on inexpensive tablets in the shared, community space of the library, apps are particularly useful for the following reasons:

For children and their parents

Engagement. While skilled teachers and facilitators can turn any book into a set of engaging activities, such efforts require planning time and supplementary resources beyond what is usually available. Well-designed apps create games out of reading skills, enticing children to learn while they think they are playing. Installed on a tablet located at a public library, they are then available any time, not only when a teacher can make class time.

Association with enjoyment. Teaching to state exams, teachers often struggle to make reading an enjoyable activity. Reading apps can forge a connection in children's minds between fun and reading - essential if a child is going to become a strong reader.

Repetition. Tablet apps make it engaging and fun for children to repeat learning activities until they have mastered new skills. Rather than dull and ineffectual memorization, children are empowered to direct learning for themselves. Children enjoy repeating familiar tasks, particularly when they receive visual rewards (such as stars or 'great job!'), and tablets have an unlimited tolerance for repetition, unlike adults who become fatigued far more quickly.

For education systems

Lower costs at scale. Lack of resources is usually the main reason for lack of reading materials in local languages. On the current market, a device costing less than $200, with free apps installed on it, can provide more content than printed materials purchased for the same costs. With the quantity of electronic content increasing, the cost-benefit ratio will be increasingly in favor of electronic devices.

Scalability of new materials. New materials are constantly being developed but their printing and deployment nation-wide usually requires significant investments. With tablet apps downloadable from a free Android platform, this process is simpler, faster and cheaper.

Content requires devices. Which ones?

IREX's experience has shown that 10-inch tablets are the ideal tool for activating the benefits of technology in a shared setting, for the following reasons:

Tablets are far more cost-effective than desktop or laptop computers. In 2014-15, the average price of tablets libraries have procured has been between US$200-300, about half the cost of a desktop or less.

Tablets require far less, and less-reliable, electricity than computers. In most developing countries, power access and stability are problems. Tablets can typically be plugged in overnight, when electricity loads are lighter and more reliable, and will be ready the next morning for a full day of use. In places where power is unavailable, cheap solar chargers can fill the gap.

Once content is created, through shared devices in libraries, it can reach more people faster than an effort to print books. A vibrant educational app ecosystem can continuously update materials much more dynamically than relying on distribution of printed books.

Tablets have a far lower maintenance cost than other forms of technology. Mid-range tablets (such as the Samsung Galaxy Tab 4) are fairly rugged and, when fitted with a case, tough to break with regular shared daily use. After a year of use in 55 libraries throughout Myanmar, small drops and shared active use among many children have not resulted in any tablet loss. Software-wise, though tablet data storage can fill up fast, they can be easily reset to factory settings should performance decline. SD cards are a cheap way to expand storage if necessary.

10-inch tablets are the right size for group usage. At the same size as a typical children's book, a librarian can hold up the screen in front of a group, and images will be visible to all. In a small group of 3-5 children, all will be able to see and touch the screen. The screen is also the ideal size for sharing between a parent and one or two children sitting next to each other.

The value of tablets is minimal, however, without the right content. In many countries that content either does not exist for early grade reading, or is of very poor quality.

For this reason, efforts to leverage technology by employing tablets in libraries must be accompanied by a concerted effort to create appropriate apps. Central to the Hacking Literacy model is the Literacy Hackathon.

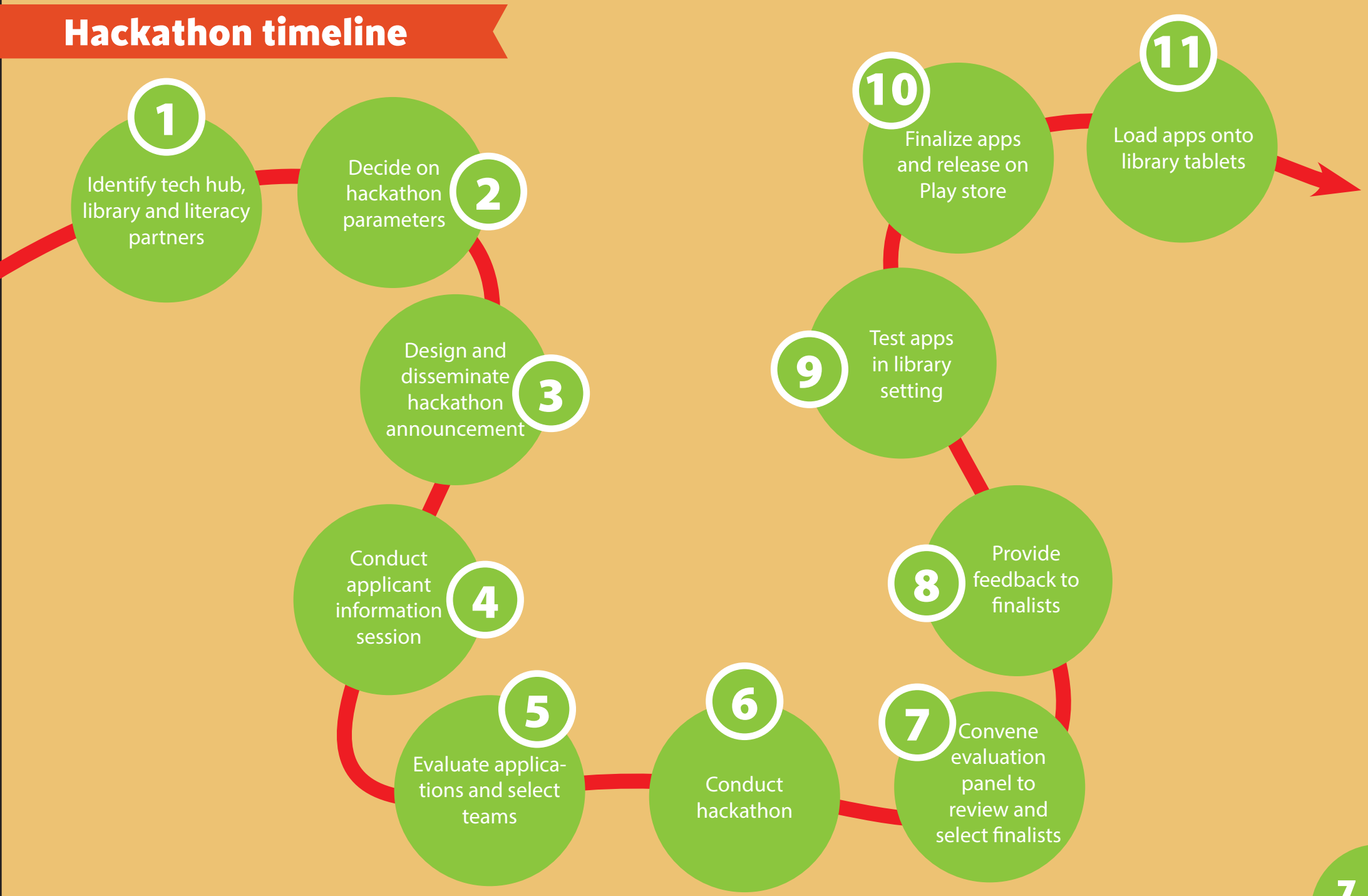
A Literacy Hackathon

1. Activates the country's coder community for the production of useful, engaging, pedagogically valid Android apps targeted at early-grade readers in languages commercial markets cannot currently support.

2. Brings together coders designers, the library community, government and literacy program implementers in a coordinated way to address barriers to engaging communities and parents in the early childhood reading experience.

3. Produces apps that are meant to be used in a shared setting and by children together with caregivers.

Hackathon timeline



Hackathon Components

Partners

Technology hub. Local co-working hubs or innovation spaces serve as the connection to the local tech community. In Ethiopia, IREX partnered with iceAddis, who recruited coder teams and hosted the event.

Library community. So that apps will be designed with a shared setting in mind, input from local library staff and leaders is crucial for contextualizing the apps during the development stage.

Literacy experts. Since app developers are not literacy experts, they'll need grounding and guidance to make sure the app design and functionality are in line with literacy concepts.

Hackathon parameters

Based on local conditions, the partners will need to decide on answers to the following questions:

Which app types should be created? Decisions should be made in response to identified shortcomings in reading achievement – from an EGRA, for example. Give guidance that is as explicit as possible, keeping in mind that programmers will not have pedagogical training in reading instruction. This guide contains explanations of three common types of apps that are useful for reading activities in libraries.

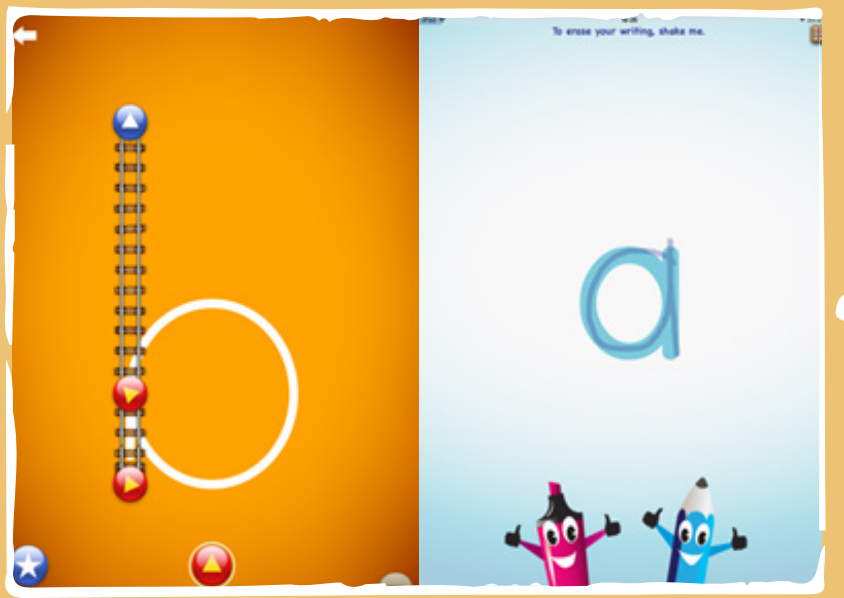
What should the prize levels be in each category? Based on the level of difficulty, different prize amounts can be awarded in different app categories, but the prize amounts will affect the number of applications in each category. IREX has found it's best to keep prize amounts relatively even, so that teams are not overly incentivized to all compete in the same category.

How long should the hackathon last? Three days appears to be the right duration for a successful hackathon that maintains momentum. By the end of three days, most coder teams are able to produce a functional prototype of their app.

What are the criteria for evaluating apps? Based on reading priorities, what are the most important features which must be present in the apps, and therefore, what factors have the greatest priority in evaluation. Some suggestions are noted on page 17 of this guide.

App types

An app package in any new language must start simply, with the basic apps most likely to both strengthen specific literacy skills and be engaging enough to associate reading with enjoyment. Simple reading apps feed a child's curiosity and desire to interact. Apps that provide visual rewards for accomplishing a reading achievement motivate children to continue progress. IREX recommends the following **three** app types, each of which addresses specific early grade literacy skills, as recognized by international literacy experts and EGRA methodology. [1]

1 App category	Functions	Examples
Introduction to letters: Improves the skill of recognizing letters of the alphabet. These apps introduce letters to children in a playful, repetitive way.	Child: ➛ Hears letter names ➛ Hears letter sounds ➛ Repeats sounds ➛ Recognizes letters and names them them aloud ➛ Identifies letter from sound ➛ Follows letter outline and guidance to draw letter themselves Some also teach similar skills with numbers.	

[1] https://www.eddataglobal.org/reading/index.cfm

2 App category	Functions	Examples
Increasing vocabulary: Improves the skill of reading words. These apps connect printed words to pictures and help children learn to match the two.	Teaches new words, breaks words into syllables, builds syllables up to words. Children: ➛ Child reads them aloud ➛ Child repeats words ➛ Child matches between pictures and correct words ➛ App reads them aloud, asks child to repeat	 

3 App category	Functions	Examples
Book apps: Improve the skills of understanding sentences and paragraphs, and listening with comprehension. These apps use a complete story to improve reading skills and comprehension.	➔ App reads a story to the child, matched with pictures and occasionally animation. ➔ Child reads story themselves, can tap individual words to hear them.	 

A useful guide for app user experience has been developed by Sesame Workshop and it is helpful to provide this as background to programmer participants: http://www.sesameworkshop.org/our-blog/2012/12/17/sesames-best-practices-guide-for-childrens-app-development/

Special Note

Acknowledging the criticism of hackathons

Hackathons have a pretty problematic reputation in the development field, for good reasons. In the past, they have been used as ways to incorporate 'technology' into a program, without broad consideration of all the necessary steps and implications. They've been one-off events that result in apps or products without further support or any usage case beyond the donor. Results are discouraging, as products are soon forgotten.

IREX has been deeply involved in the progression of technology in the development field for the last two decades and has closely followed this debate. We settled on the approach described in this guide because it meets the following criteria:

Having decided apps are needed to address a specific problem, we have recognized that single-app development led by an NGO is a long, costly and resultantly unrealistic approach. It is far more efficient to involve the energy and talent of local experts in a competition format.

Reading apps in the formats described herein are not complicated and do not require advanced programming skills. Functionality is already prescribed and models are readily available. Replicating and adapting these into new languages, therefore, is a perfect opportunity for young programmers just embarking on professional careers.

The intellectual property issue is settled beforehand, as contest winners are awarded commercial contracts to produce final versions of their apps. Once released on the Google Play store, the apps are free for anyone to use.

The process does not finish with the announcement of a successful weekend event. Apps are tied into training for librarians and then disseminated through a ready network of institutions to be used by a specific audience as part of a national literacy program.

Applicant information session

With the announcement circulating, it is critical to inform programmers about expectations. Key messages include:

Teams with winning apps will be paid a flat fee prize, but apps must be uploaded to the Google Play store as free apps permanently. Teams may update them once they are posted, but this is not required.

Apps will be used in a shared setting. This means personalization settings need not be prioritized

Design apps for 10-inch tablets. Apps should be customized for tablet screen space, not phones.

App content expectations, for example:

- Introduction to letters: all letters/letter combinations in alphabet included
- Increasing vocabulary: 250 sight words included
- Book apps: a 15-page story, using 200 words total

Apps must be intuitive for children aged 4-8. Functions should be easy to understand and navigate, including rewarding sounds and images.

Applicant selection process

Programmer teams are requested to submit a concept note as part of their registration applications. This document is meant to encourage them to put some initial thought into app functionality and consider the look and feel. The note below illustrates these ideas. For those selected, it allows a running start – they come prepared with a specific set of tasks to accomplish in order to create a working prototype, and organizers are able to provide early feedback to ensure selected teams are headed in the right direction.

A Gamified Amharic Letter Learning App for Kids

[redacted] is a cross platform smart phone app that teaches letters of Amharic in a funny way to preschoolers. It provides hands-on interactive games, match letter and word drawings.

The app is intended to be usable by kids of all learning styles:

For Visual Learners: Who learn by reading or seeing pictures

The app helps the kids to associate a letter with a familiar image. A great care will be taken to select the associated image to facilitate learning. For example, a picture of **glass (መነጽር)** will be used to associate with letter **መ** than a picture of **car (መኪና)** because glass has similar shape with letter **መ**.

For Auditory Learners: Who learn by hearing and listening

The app should be able to read and teach the kid audibly. Furthermore, the app will have a feature that asks the kid to say a letter; it, then mimics and says the kid's voice back using a chipmunk sound; and this will be fun for the kid.

For Tactile Learners: Who learn by touching and doing

The app need to have an interactive gesture detector that allows to trace letters (following a guiding direction.) It will give feedback on success/failure. Many of meaningful touches will have a charming feedback.

In addition, the app incorporates "Catch the Fish" game which is a fun way for kids to practice recognizing the letters. This part contains slowly swimming fishes with a letter label. The challenge is to catch fishes based on the sound of letter heard or based on associated image shown (eg, glass image).

The app doesn't need to contain every Amharic letters. It, off course, will omit some letters lest they may introduce ambiguity in the brain of a toddler.

The application will be developed using Java Programming Language incorporating LibGdx game library. The app can be exported to iOS devices with small extra work.

The Hackathon

This is a sample agenda for the event:

Day 1

Time	Topic	Activity
9:00-10:30	Welcome, Introduction and Briefing	• Registration of participants • Icebreaker activity • Presentation by the organizers, covering goals of the literacy program • Review of hackathon format and agenda • Presentation of app categories, expected functionalities and user experience • Definition of outcomes and review of evaluation criteria • Q&A with participants
10:30-12:30	Group work session	Organizers circulate to review app ideas and answer individual questions
12:30-13:30	Lunch	
13:30-16:30	Group work session	
16:30-17:00	Feedback session	Group question and answer session
17:00-19:30	Group work - optional	Some teams may want to stay into evening to continue work

Day 2

Time	Topic	Activity
9:00-10:30	Welcome, Introduction and Briefing	• Registration of participants • Icebreaker activity • Presentation by the organizers, covering goals of the literacy program • Review of hackathon format and agenda • Presentation of app categories, expected functionalities and user experience • Definition of outcomes and review of evaluation criteria • Q&A with participants
10:30-12:30	Group work session	Organizers circulate to review app ideas and answer individual questions
12:30-13:30	Lunch	
13:30-16:30	Group work session	
16:30-17:00	Feedback session	Group question and answer session
17:00-19:30	Group work - optional	Some teams may want to stay into evening to continue work

Day 3

Time	Topic	Activity
9:00-10:30	Welcome, Introduction and Briefing	• Registration of participants • Icebreaker activity • Presentation by the organizers, covering goals of the literacy program • Review of hackathon format and agenda • Presentation of app categories, expected functionalities and user experience • Definition of outcomes and review of evaluation criteria • Q&A with participants
10:30-12:30	Group work session	Organizers circulate to review app ideas and answer individual questions
12:30-13:30	Lunch	
13:30-16:30	Group work session	
16:30-17:00	Feedback session	Group question and answer session
17:00-19:30	Group work - optional	Some teams may want to stay into evening to continue work

Presentation of app prototypes

By the last day of the hackathon, each app team should be prepared to present the full range of functions of their app. App teams are not expected to present a polished and finalized app; rather, the app should perform a basic breadth of functions to give the selection committee a glimpse of the apps' features, design, usability, and feasibility.

App evaluation

Apps are evaluated on the basis of four key criteria:

Functionality

This is considered the most important category when scoring apps presented by candidate teams. App functions should receive more weight when scoring compared to the other evaluation criteria. App functions are listed in the 'functions' column of the App Types table above.

Usability

The app must be age appropriate and intuitive. Icons should be easily recognizable and highly visible. As these apps are designed for early grade learners, emphasis should be placed on intuitive, guiding images over written instructions. Navigation should emphasize swiping functions and users should be able to easily return to previous pages without being routed to the landing or home screen.

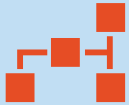
Feasibility

The app should be built to perform in resource-constrained environments. The app should execute all functions offline and require minimal system updates and bug fixes. The app should take up as little hard drive space as possible.

Design

The app should have an attractive, age-appropriate user interface including animations and a wide range of colors. This category evaluates the consistency and the quality of the following:

Graphics: High quality images, minimal pixilation



Color Scheme: Consistent and quality color scheme throughout app

Fonts: Consistent use

Layout: Intuitive and appealing structure of images throughout app

Tabulation/Selection of Winning Teams

This is a sample spreadsheet that can be used to track evaluation scores.

	Markos					Florian					Matej					Joel					Composite
	Function	Design	Usability	Feasibility	Total	Function	Design	Usability	Feasibility	Total	Function	Design	Usability	Feasibility	Total	Function	Design	Usability	Feasibility	Total	
	1.5	1.5	1	1		1.5	1.5	1	1		1.5	1.5	1	1		1.5	1.5	1	1		
App 1																					
Hohey	6	4.5	2	3	15.5	6	6	3	3	18	6	4.5	2	3	15.5	6	4.5	2	3	15.5	64.5
Yeneta	6	6	3	3	18	6	7.5	4	4	21.5	4.5	6	3	3	16.5	6	6	3	3	18	**74**
Hahu	4.5	3	2	4	13.5	3	3	3	3	12	3	3	3	3	12	4.5	4.5	2	3	14	51.5
App 2																				0	
Let's Code	3	4.5	2	3	12.5					0	4.5	4.5	4	4	17	4.5	3	2	3	12.5	42
Zur Hackers	3	3	2	2	10					0	4.5	3	2	2	11.5	3	3	3	2	11	32.5
Hawe	4.5	6	3	3	16.5					0	6	6	4	3	19	6	6	3	4	19	**54.5**
App 3																				0	
iSoft	3	1.5	2	2	8.5					0	4.5	3	3	3	13.5	4.5	4.5	3	3	15	37
FocusLabs	1.5	4.5	3	2	11					0	1.5	3	3	2	9.5	3	7.5	2	3	15.5	36
Birana	6	3	3	3	15					0	6	6	4	4	20	6	4.5	3	4	17.5	**52.5**

Selection Committee

The literacy app hackathon selection committee should consist of technical experts in IT (mobile application design, development, usability) and in early grade reading and literacy. While each member of the selection committee will evaluate the apps under the same criteria, literacy experts will focus their evaluation on the app's functions, determining the extent to which the functions contribute current accepted principles in early grade reading. IT experts will lend insights into the usability, feasibility, and design aspects of the apps.

Sample scoring sheet for literacy experts

Sample scoring sheet for app development experts

Judges convene either on the final day of the hackathon, or the following day in order to test apps and record their evaluations. Scores are tabulated and winning teams chosen. Often, those who aren't selected as winners in any of the categories are still in the process of producing worthwhile apps. Should resources allow, organizers can offer smaller prizes to other teams whose work may turn out worthwhile.

Providing app feedback

Typically, the prototype will demonstrate functionality only for a limited number of letters, words or pages. The expectation for all teams is that the final app will include full content. However, based on the prototype, detailed commentary should be provided to each team, setting expectations for how they should finalize the app before the prize will be awarded.

Categories to address include:

- the clarity and accuracy of instructions provided within the app
- the appearance of learning content, such as how letters and words change in appearance and sound when a user taps or otherwise uses them
- consistency of styles, colors, fonts, graphics and page layouts
- the intuitiveness of movement between the app's different components
- functionality, such as :
  - the use of typing, tapping, holding and swiping to activate different functions
  - the shape, size, color and use of different buttons
  - the speed with which different app functions work
- sound and graphics quality

Experience has demonstrated the following common mistakes in initial app prototypes:

MISTAKES

- Design is too complicated for such a young audience. Too many arrows between pages as opposed to sliding, which is more intuitive.
- Too much graphical, "fancy" noise. Sometimes leaner, easier design is more appropriate.
- Needs explicit guidance on what user should be doing. Considering the audience, games need a clear demonstration of what players are expected to do. This can best be done with an engaging character that leads the user through the app – someone with whom children can bond.

Here is a sample of feedback provided to one programmer team. This document should be provided to the programmer team along with the contract award. It becomes part of the scope of work for delivering the app and thereby being awarded the prize money.

- App Category 1
  - English:
    - ✓ The previous version of the screen (all icons on the page, instead of sliding menu) was better, please bring it back
  - Menu screen:
    - ✓ The previous version of the screen (all icons on the page, instead of sliding menu) was better, please bring it back
    - ✓ On the opening screen, there is no need for English language option, delete it.
  - Letter naming screen:
    - ✓ NEW: not all the letters are present in the menu
  - Letter drawing screen:
    - ✓ Not all the letters are represented
  - Matching letters screen:
    - ✓ On the rewards pop-up, there seems to be 3 stars awarded. Do those stars accumulate somewhere? Would be good to have, for example, a bigger reward (verbal, by the character) once the child guesses right the letter three times in a row.
  - New game with row of letters down, and the sound plays when you click on them
    - ✓ Add more letters

Organizers may also want to request separate English translations of all app content to provide explanations of the app to an international audience, and to inform training design.

Testing the apps

Before apps are released, they should be tested in a focus group setting at a small number of local libraries. Librarians recruit 10-15 participants to sit with the apps for 30-60 minutes and provide feedback. A suggested breakdown of participants includes:

- **4 children aged 4-5 (with beginner or no reading skills)**
- **4 children aged 6-8 (with intermediate reading skills)**
- **4 parents**
- **3 teachers and librarians**

At the event, provide a very brief introduction to each app. Avoid explaining the apps in detail, as part of the observation should be the degree to which apps are intuitive for the children and parents.

Divide the participants into groups. Some children can be placed in groups of 2-4 on their own. Some parents should be placed with 1-2 children and a tablet. Give the groups about 15-20 minutes with each app. Ensure that all children in the groups get a chance to play.

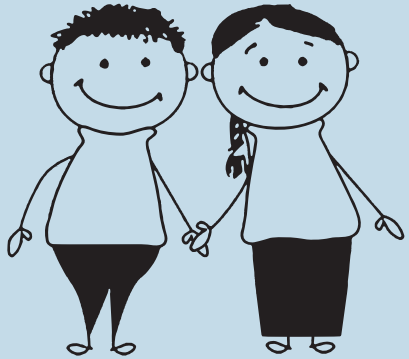
Questions for focus group discussion:

For all

- What was your favorite part of the game?
- What didn't you like about it?
- Was there anything you didn't understand?
- What would make it more fun?

For adults

- Would you be comfortable with your children/students playing this game?
- Do you think it would help them learn to read? What about each game did you find most useful?



Summaries of the feedback should be provided to the programmer teams to inform final revisions.

App dissemination and training

When finalized, apps should be uploaded by the programmer teams to the Google Play store as a free app.

Training for librarians should be conducted as part of the Beyond Access "Libraries, Literacy and Technology" module. Activity cards should be designed for each app that provide explicit instructions on using the app in a shared library setting, accompanied by other suitable literacy activities.

Measurement

IREX recommends the following indicators for performance and impact measurement

- **# of app downloads**
- **# of libraries using apps**
- **# of activities conducted using apps**
- **# of participants in library activities using apps (child/adult)**

These figures may be reviewed monthly and quarterly to gauge usage and tailor training for librarians.

Since there is no convenient way to isolate the improvement of a child in reading assessments due to the presence of technology in a library, IREX recommends assessing before and after among a select group of children:

- **change in time spent reading outside of school**

as the key indicator suggesting whether library activities are contributing to factors which are known to influence reading advancement

About us

IREX: IREX is a non-profit international development and education organization based in Washington, DC and working in more than 120 countries. IREX programs develop leaders, promote quality education and access to information, and strengthen communities and institutions that advance positive change.

Beyond Access: Through Beyond Access, IREX works with local partners to promote sustainable, inclusive access to information and technology for those who need it most. That access is delivered through trusted community institutions that already have funding and trained staff in place: public libraries. More than 230,000 public libraries — 73% of the world's total — are located in developing and transitioning countries.

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