An educational game for children to learn English.

Optimized for OLPC-XO4 and smartphones. Deployable offline on a Raspberry Pi and ready to be deployable online on a web hosting server.

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Introduction

The harsh reality of the digital divide in developing countries holds true in Sarawak, Eastern Malaysia. For a large a number of rural areas, known as “Kampungs”, internet connectivity and technological knowledge is poor and oftentimes non-existent, with education being one of the areas suffering the consequences of this phenomenon. To add insult to injury, the Malaysian government is taking steps to convert the curriculum to English, which will only make matters more difficult for students that already have a hard time following along with the educational system in Malaysia.

There exist multiple educational platforms to help children learn and provide assistance with assignments and homework. However, the usual attribute that is shared between these platforms is that they require internet connection to access. Therefore, there is a need for offline solutions, such that usage by children in rural areas with low or no internet connection is possible. Moreover, these platforms commonly lie in the spectrum of gamification, which is making tasks that could be considered dull, exciting, by implementing reward based functionalities. In the context of education, it is not unusual to see quizzes or mini-games with satisfying visual and stimulating sounds, that try to engage children and make them enjoy the process of learning. Although, an inherent problem with these platforms, is that the content included has not been approved by the users - in this case, the children. Resulting in a rapid loss of interest in the content, as also verified by an interview with UNIMAS’ Dr. Cheah, who has been involved in research such as this in the past.

Following the ICT4D framework, an iterative and user-based approach to development, we have made an attempt to introduce a platform that solves both the problems of limited internet access and in addition provide interesting educational content that is validated and tested by children, by developing a web-application hosted in a Raspberry Pi, aimed to be accessed by OLPC XO-4’s, deployed firstly at the Kampung Pinggan Jaya, a village where internet access is extremely limited.

Context description

This project is conducted in Kuching, Sarawak in the Borneo island of Malaysia. The project aims to provide ICT solutions to problems taken from field analysis that will aid in the development local people. This project looks at education. In Malaysia the school system is very performance oriented. Schools that are getting good results get more funding from the government than schools that are performing worse. It is also a very common practice for parents that have enough money to send their children to so called tutors. They provide extra help to the children to help them in their educational career. Having mentioned this, intuitively, in rural and poor areas, the children will be sent to the lower-end schools and will not have access to the tutoring. This limits the development of the children.

Also, the school system changes very often. The government aims to teach most subjects in English, but for the kids that are

not doing well in school, this only limits their education even more. In courses like science and math, which are hard enough as they are, become even more difficult if the course material is in a language not mastered by the students.

Learning English is therefore of key importance for kids from a young age. It seems though, that the resources to do so offered in school do not suffice. This means that other methods should be available to develop their level in English. This leads to two other issues: connectivity and specificity. In rural areas there is no (consistent) internet access. This means that online content is not an option. Also, existing platforms are often not tailored to the syllabus used in school nor to culture and specific wishes of the end users. These platforms are very generic to be able to be used by as much people as possible, but not perfectly suited to any.

Project justification

The issue of connectivity has taken a toll on children's ability to follow along with homework and assignments. They are considered hard to complete by the children, who perform poorly in the English subject taught at school, because they do not have the privilege to get help online.

Pre-existing educational platforms such as "Frog", do not see usage, due to the absence of internet connections. UNIMAS' Dr Johari, has developed a platform named "Library in a Box", that is hosted on a Raspberry Pi and can be accessed by a laptop or smartphone and has expressed his plans for a possible gamification project at UNIMAS. Additionally, UNIMAS' Dr. Cheah, has been involved with educational projects and is experimenting with OLPC XO-4's, with students under his supervision creating content made for the devices. The combination of these two projects has given us the motivation to create an offline web application that delves into the spectrum of gamification aimed at teaching children to improve the reading and comprehension of English of children between age 10 and 12.

Use case description

0. Name

The name of the application is "Educomx", derived from educational comics.

Figure 1. Educomx Logo

1. Summary of key idea

The current situation is that children in the Kampung have difficulties doing their homework due to a lack of motivation and skill. Children also indicated that they found their English lessons difficult. Currently there is not much offline material available to stimulate children to engage in educational activities after school. Recently, some OLPC XO-4 laptops became available with some content on them, including the Library in a Box. The Library in a Box contains some games, videos and offline wikipedia pages. However, user testing showed that children lost their interest in these games quickly. Therefore, our goal is

to create a platform on the Library in a Box containing engaging content for children to learn English in a playful way. This platform should become a collection of different types of content related to improving English skills of young children. Examples of skills are learning basic words, grammar and reading comprehension.

As a starting application on this English learning platform, an application will be created containing comic books which are followed by a quiz. The goal for the children is to complete the quiz and get enough points to unlock the next comic book. Additionally, there are plans for a study corner to be built in the Kampung, an initiative which will be taken by UNIMAS and Dr. Cheah. This would provide an environment for the children where they experience less distractions while learning English.

The challenge is to make the application engaging, but also stay within the scope of the syllabus. Thanks to the interviews conducted in the Pinggan Jaya Kampung, where children were asked to draw their favorite superheroes and write down their hobbies and aspirations, inspiration for the artwork that will be used for the reading material has been given. As mentioned above, user testing made by UNIMAS professor Dr. Cheah, revealed that children quickly lose interest in existing applications and content provided by the “Sugar” environment in the OLPC XO-4. Therefore, it is essential to have a clear understanding of what is appealing to children, in order to ensure that the content matches that. This process has great significance in context analysis, and as taught by the ICT4D framework, user interviews and stories can be the deciding factors in the success of an application deployed in the field.

The Library in a Box will be installed in a study spot in the Kampung accessible from the OLPC XO-4 laptops that will be put there or from their mobile phones. The content can be accessed by connecting to the wireless connection on Raspberry Pi device and accessing the right address on a web browser.

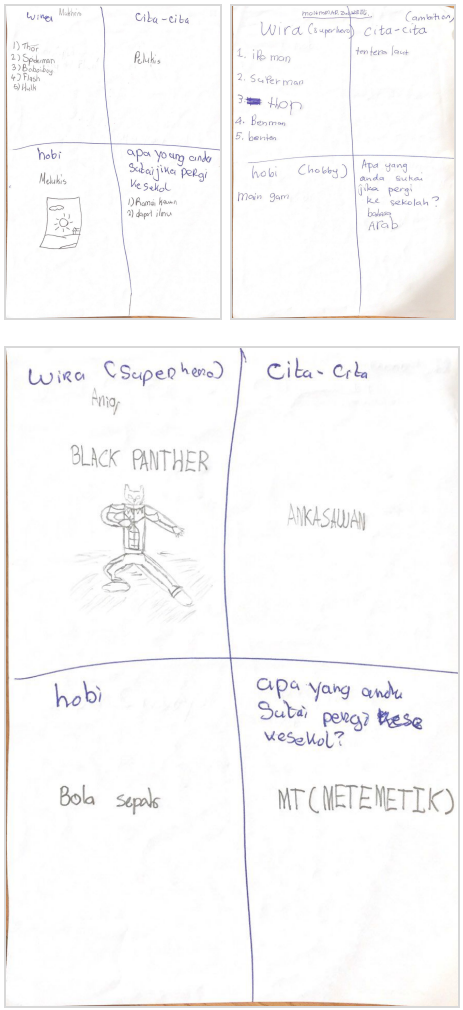

Figure 2. Children were asked to either draw or write down what their favourite superheroes are, as well as their hobbies, ambitions and favourite courses.

2. Actors and goals

Children. The children are obviously the most important stakeholders in this application. The children indicated that they have trouble learning English but nonetheless they are eager to learn. At the moment they do not have a desk or room to study at home. The children will benefit the most from this English learning platform since it will help them to improve their English.

Unimas. Unimas is working on providing OLPCs for the children in the kampung and creating a common study spot, where children will gather and do homework and educate themselves. At the moment about 5 OLPCs are available for the children to share and use. They are doing field research focussing on how to engage children to work on educational applications.

Women in the kampung. They want their children to have better education. The daughter of the kampung leader has show interest in the proposed idea by UNIMAS, which is to build a studyspot for children in order for them to have a stimulating environment to do their homework and learn in a playful way using the OLPCs. This will also allow children to stimulate and help each other when they work at the same time at the studyspot.

Government. The ministry of education wants to improve the English proficiency of the children and wants courses to be taught in English. The government is working on reforming the national educational system and started the Education Blueprint in 2013 with the main goal to ensure that every child enrols in education from preschool to upper secondary education. They want to achieve this by 2025. The government plays an important part in the deployment of the OLPCs in the Kampung, as they will have to subsidize for the costs.

3. Context and scope

School and homework

Some general facts gathered from the children interviews are that the walk to the school is thirty minutes and the children commonly walk to school on their own carrying bags around four kilograms in weight. Classes are from 7:30 to 13:15, excluding Friday, where classes end at 11:30. The curriculum involves following five subjects per day, with those being PE, Arabic, English, Science, Math and Malay. The curriculum is determined by the Malaysian government.

Children have different views on what subjects they find hard. The parents say that they score lowest for English (E's) and they find the ability to understand and communicate in English extremely valuable. The children themselves are eager to learn English.

During the user testing, we also interviewed two teachers who provide additional tutoring to the children in the Kampung Pinggan Jaya. One of them was Dayang Siti Nurshamira, who is a master student at unimas who is providing the English tutoring, and the other was Aisyah Zukipli, who teaches the children English. The tutoring takes place every Sunday. They teach the children English, math or other courses. The subject of the tutoring lessons

changes every week so that one week per month the children receive English tutoring. The next week of the month it is math etc. The tutoring lessons are provided by an organisation called Yayasan Sejahtera which is supported by volunteers such as Dayang Siti Nurshamira and Aisyah Zukipli. The aim of this organisation is to eradicate poverty in rural villages. Dayang told us that her main focus is to get the children to a level of basic conversational English since other courses like for example science and math are taught in English. She does reading, writing and speaking exercises with them to boost their confidence in speaking English.

We would also have liked to speak to the school principal of the children but since it was a school holiday it was difficult to get into contact with him.

4. Use case scenario script

Unimas and the head of the Kampung are relevant to this use case diagram, because in order for the idea of the study spot to be realised, a study corner must be subsidized in every session, while UNIMAS must provide the OLPC's for the session to start. The children can gather scores by completing quizzes and reading the content, while practicing English, and the contributor can add/update content and quizzes (see figure 3).

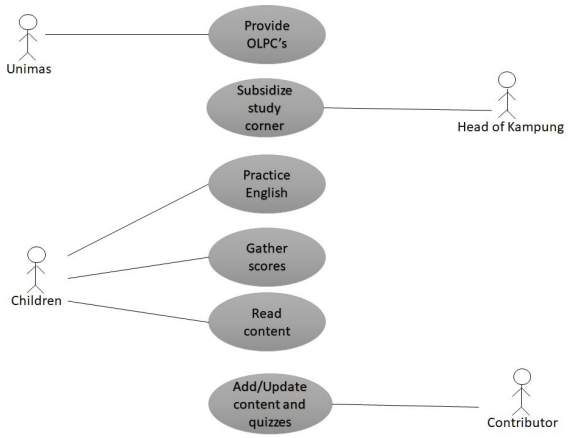

Figure 3. User interaction diagram Educomx.

5. Interaction and communication

Figure 4 shows the interactions between the user and the system and the flow in the application. In order for the children to have their own user account and store their obtained scores, first they will have to login entering their username. The system will then check whether this is an existing name, and, if this is the case, will retrieve the scores of the user which is stored the database. If the user does not yet exist, a new user will be created in the database. Now, the user will enter the landing page (figure 10) where the user can choose a chapter to read. New users will have to start at chapter 1. While reading the chapter, the user will answer questions about the read content. If the user has answered all questions correctly, the next chapter will be unlocked. The user can now decide to either read the chapter again, read the next chapter (if enough points are obtained), or log out and end this session.

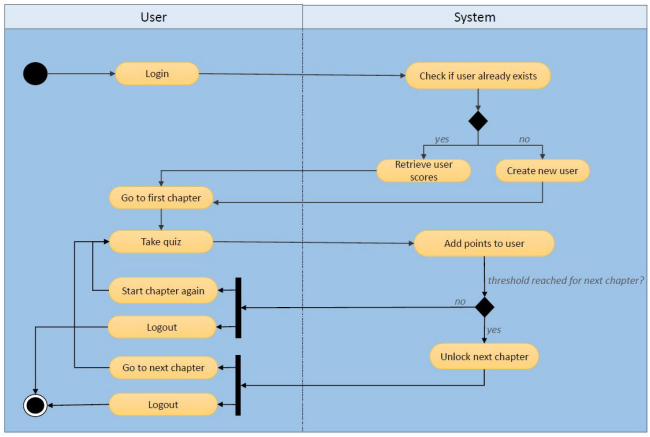

Figure 4. Activity diagram of Educomx

6. Information concepts

Figure 5 demonstrates the information that is stored in order for the application to run. These static data structures are the same as the database structures more extensively explained in the 'prototype description' section.

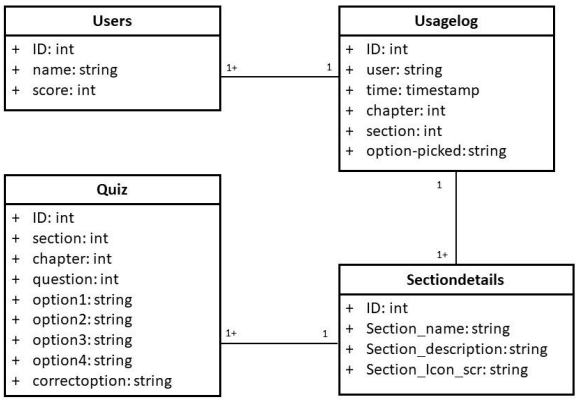

Figure 5. Class diagram of Educomx

7. Technology Infrastructure

The web application and the database is hosted in the Raspberry Pi. The children will primarily be using the OLPC XO's that will be provided to them, but it is important to point out that by using any device, one can connect to the Raspberry Pi and access the content using a browser. Further instructions on how to connect are included below.

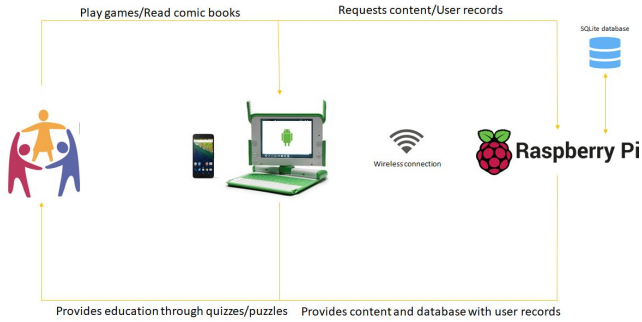

Figure 6. Technology infrastructure of Educomx

8. Cost considerations

For this application to run, there are very few resources required that cost money. When deployed on a Raspberry Pi, the only cost is the purchase price of the device. This should be paid by the people that want to run it. This is not a cost that is directly related to the application. The application is developed and ready to be deployed. It would cost the developers money if it were to be hosted online. The cost would than be the price to host the application. This cost is fixed and normally ranged between 40 and 80 euros per year.

Of course, the user needs a device to access the application. This however, is not a cost for the development team.

9. Feasibility and sustainability

Technical feasibility

The technical implementation of the system should not give too much reason for problems. All that is required for the local implementation, which will be in the study spot, is a Raspberry Pi with the Library in A Box platform installed. Additionally, any device can connect to it and access the application using a web browser and the details mentioned in the user manual in the appendix.

Economic sustainability and feasibility

A key element of projects in the field of ICT4D projects is a sustainability analysis. Many projects have unnecessarily failed because of a lack of proper analysis. Those projects focussed mainly on the period from the beginning of creating a system till the system was finished. However, when a system or application is created, this is the point that it starts for the user. In this section multiple scenarios will be discussed regarding the sustainability of this application. First a typical commercial scenario will be sketched, followed by non-commercial scenarios. The e^3-value model was used to describe these scenarios. This is an E-business modelling tool created by Jaap Gordijn, which was created to take into account the economical sustainability of all stakeholders and to see which parties gain profits.

Often, when an application is created the costs are covered by selling user data to big companies. These companies then sell this data to other companies or use it for their own marketing strategies. However, one must be careful in sharing this data especially regarding children. Since the goals of the companies are only to make profit they do not take into account the ethical considerations of using this data of users. We strongly disagree with this method of covering expenses and feel that we should protect these children from companies that want to use their data. In the figure below, one such a scenario is described with the use of an e^3-value model. Three stakeholders are shown in this model, the customer, which are the children using Educomx, the data broker companies, which collect data of the users of the application and an administrator, which can be anyone who takes care of and pays for hosting the domain for Educomx. For providing this service, the administrator will need to get some compensation. Therefore, a transaction of values takes place between the administrator and data broker companies. These companies would then buy user data in exchange for money. This leads to an indirect transaction between the data broker companies and the customer (the children), since its their data they ‘pay’ with, in order to get access to Educomx.

Since this is a scenario we do not want, other scenarios must be explored as well. Since the data broker companies will be left out of our business model, compensation for hosting Educomx will have to come from another source. This leaves two most likely solutions: one is that the kampung pays a

small fee in order to have access to the application. Since a study spot is most likely to be build in the near future, the application can be a good addition for the children to educate themselves. This transaction is shown in figure 8.
However, the dean of Unimas talked about the possibility of assisting us in hosting Educomx. This would be a suitable solution since Unimas is most likely going to continue to work with this application after this project has finished.

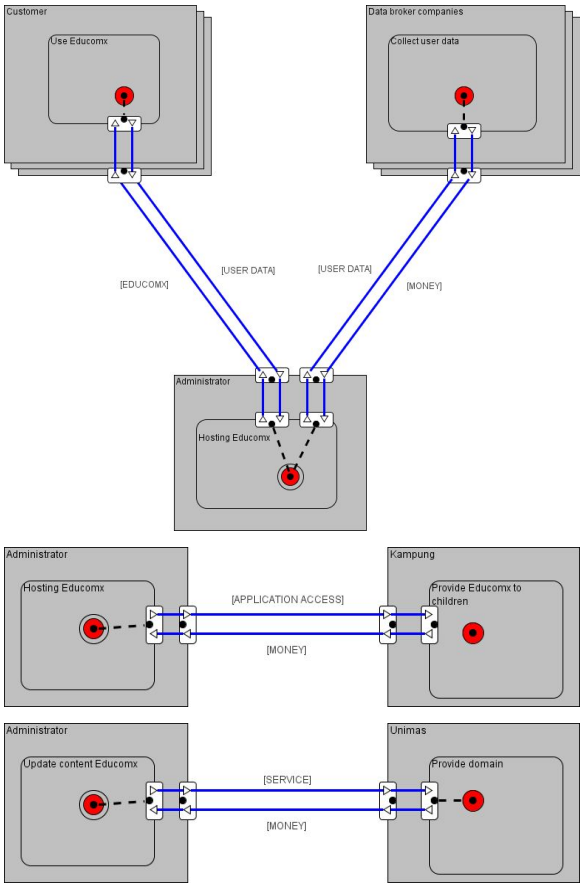

Figure 7. e^3-value models

Technical sustainability
Some the technical risks that exist are that the application will need new content in order to keep it interesting for the children to keep using it. We tried to limit the technical obstacles of adding new content to a minimum. For example a database was created where new questions for the quiz can be added easily, which means that it is not too difficult for someone else to modify the application.

Dependencies and conditions for deployment and continuation

Now that the application has been tested and a final prototype is presented that is ready to be deployed, it must be questioned how the project will continue. The success of the implementation is dependant on other parties deploying the application. If the application is not accessible to end users, the project will not be used. There are two possible deployment methods: on the Raspberry Pi (more specifically the ‘Library in a Box’ platform) or via an online web hosting service.

UNIMAS is the most straightforward option for deployment and continuation of this project. They continuously do projects with Kampungs. They are the ones that plan to implement the study spot in Kampung Pinggan Jaya and would just need to find a place where the Raspberry Pi can run continuously. The application is already set-up on a device that is owned by UNIMAS. Also, students from UNIMAS were involved in the project.

UNIMAS would also be the most logical party for deployment and further development. They have indicated that they have the resources to host applications online. They offered to provide us with a VPS where the application files and

database can be hosted. That would mean that the application can be accessed by anyone that has access to a mobile device that has connection to internet and a web browser.

Even though the dependency on other parties is there, it should not be regarded as a major concern. UNIMAS was closely involved in the process and they should therefore have enough incentive to make this work.

10. Key requirements

In this section, the key requirements will be further elaborated based on the MoSCoW list of requirements.

Must have	**Should have**	**Could have**	**Won't have**
Educational English content	Rewards	Content based on syllabus or the CEFR	Advertisements
Content based on children's preferences	Gamification aspects - sounds and visuals	Personalised profile items such as avatars.	In-game purchases
Database for storing user data and questions.	Easy methods to manage and add new content	Option to add images to database to be displayed in sections/chapters	Videos in chapters

Table 1. MoSCoW list of requirements.

Report of user testing

User testing - Cycle 1

In order to do the user testing for the first prototype, we went to the Kampung Pinggan Jaya and showed the application to a group of children in the style of a "living lab", where children are able to freely play with the application.

The age range of the children was between 10 and 12 years old. A few kids were a lot younger (age 5) and it was not surprising that they found the application too difficult to understand. They seemed to like to watch the older children playing with the application. The other children however seemed to like the concept of the comic books. They started to read the sentences in the comics aloud so it was good to see their reading skills. The questions at the end were a bit difficult for them. Also we noticed that there were too many pages before the quiz started so after some pages they were having a hard time concentrating on reading. Also, 4 or 5 children were behind each laptop so they did not take too much time to read, because other children wanted to move on to the next page. One of the children however managed to answer all three questions correctly on the first try. The children seemed to enjoy unlocking new chapters and were really motivated to get all questions correct. They started to share their answers with other children to help them unlock new chapters as well. They also liked the sound effects of answering the questions correctly. Another thing we noticed was that when they wanted to return to the homepage, the logout button was immediately behind it at the home page so a lot of times they would accidentally logout.

As mentioned in the interview section, we spoke to Dayang Siti Nurshamira who is tutoring the children in English. Her reaction to the application was positive, she mentioned that she liked the aspect of needing to answer the questions correctly in

order for the children to continue to the next chapter since it really motivated them to (read) the chapter again. She noticed as well that the children had difficulties understanding the content of the comics, even though they could read and pronounce the sentences. She liked the fact that the images supported the text so the children could understand better what the text was saying. She also mentioned that in her classes the children read at most the length of a paragraph after which she ask the children to tell her what they read.

Figure 8. User testing in Kampung Pinggan Jaya.

Improvements - Cycle 2

After the completion of cycle 1 following the user testing at Kampung Pinggan Jaya, several adjustments were made to match the requirements revealed from this process. After going through the chapter pages and reaching the quiz part, the children had figured out that the order of the answers to the questions remained the same and did not think twice before choosing the option that they had memorised as correct. In this cycle, we implemented a solution that shuffles the order of the questions, in order to encourage effort in understanding the text in the pages and furthermore make the children pay attention to the choice they are selecting, rather than remembering in what position the correct answer had been.

Regarding content design decisions, we had initially made each chapter ten to fifteen pages, which was found to be too long, given that the children had formed groups of four-five, with each child taking different times to read and comprehend the text, resulting in either them skipping the pages, or taking too long to go through the text. When reaching the quiz part of each chapter, if the children did not get the answers correct, it felt overwhelming to them to return to the start and go through the pages again.

Nevertheless, the children were thrilled both by the comic book artwork that we had selected, but also with the quiz part, with the assumption that we had made about the generation of a sound whenever a correct answer is chosen being pleasing proven correct. They spent a lot of time making sure to explore every chapter and try to get all the answers correct.

The change that we have implemented in this cycle, solves this problem, while staying true to the positive feedback received from

the user testing. Chapters are now called **sections.** Each **section** has four chapters, all 3 pages long. The length of the text appears shorter, and the quizzes appear more frequently, giving a solution to the overwhelming amount of text, while still keeping the elements that gave the children satisfaction.

Final prototype description

For the use case that was previously described, an application prototype was developed for children in Kampungs to learning English in a playful way. The application is optimized for smartphones and the OLPC-XO4, but could run on any device that has access to a wireless connection and a web-browser.

The application is named EduComX. The basic concept is that children can read chapters of their favourite comic books, and answer questions about the text. This will contribute to the reading comprehension skills and increasing the children's vocabulary in English.

The current prototype is highly editable to fit context or needs. It is possible to change the content of the chapters and the questions and answers on quizzes. We have delivered the foundation for an educational platform that can be expanded and modified according to local requirements in different Kampungs. The overall result is that the project has an easy deployment, followed by a freedom to modify, which is sure to attract many contributors with interdisciplinary expertise that work on similar projects.

Design decisions

Image slider and quiz

For the comic book reading, an open source image slider has been used. The repository can be found at[2]. We have used this image slider, because it is easy to change the content included in the chapters, the comic book pages. Additionally, using built-in functions written by the original developer, one can implement functionalities for when the pages are initialised, after changing a page and before changing a page. Moreover, this image slider runs smoothly on the OLPCs and pages can be changed by swiping on the touch screen of mobile devices.

Regarding the quizzes, we have used an open source quiz found at[3], and edited it to fit the scope of our application. We have added a cheerful sound for when a correct answer is chosen and have altered the colours of the answer buttons.

Generally, the html pages follow an open source template available freely online [4]. The template uses jquery and bootstrap making front-end development faster and easier. Bootstrap also changes how the web pages are displayed according to the device width and length making deployment to mobile devices easier.

Database structures and storage

In order for the application to dynamically load all the content, and personalize this content, a database was set-up to store information about the user's progression and activities as well as storing the content of the quiz and content reader that are loaded into the application when needed.

Four tables are used in the database. Quiz, Sectiondetails, usagelog and users.

Quiz:

The quiz database table stores the question, options and correct answer for each chapter in each section. The tables gets accessed when the user enters the quiz. When the form is filled in to add new content, the table is updated with the new questions and answers.

Sectiondetails:

The sectiondetails table keeps an overview of all the sections in the application. In the landing page, the information is used to load all the sections with the correct titles, descriptions, images and sounds. When the form is filled in to add new content, the table is updated with the the correct information.

Usagelog:

The usage-log table keeps track of the quiz activity of users. When a user selects an option in the quiz, the decision is tied to the user and accompanied by the time the activity was conducted. This table will allow to keep track of the usage of the system, which questions users have the most difficulty with or which are too easy.

Users:

The users table stores users by the name they enter when they start the application. When the name is recognized, their scores and progress are retrieved from this table. Everytime the users progresses through the chapters and sections, their score gets updated. When the users return later and enter the same name, they can continue on their personal profile.

Dynamic content loading

The image slider and quiz were only used a basis for the application. A lot of components were developed to make it into the current prototype.

When entering the first page of the application, the user is asked to enter their name. This name is validated with the 'users' database table. If the user is recognized, its personal content is loaded. This includes which chapters they have already completed.

The original files from the image-slider and quiz were static HTML pages. Since we want to be able to easily add content, dynamically loading the content from the database was the best option. This required to re-write the static HTML files into PHP files where the right content is retrieved at the right time. Another big advantage of this design decision is the fact that we limit the number of files. Before, for each new chapter and each quiz needed to have a new file created. This also meant that all links needed to be manually created in all files to keep everything consistent. Right now, only 1 quiz file and 1 content reader file is needed. By keeping track of the

sections and chapters, the right content will always be loaded.

Gamification aspects

To make this application more fun, gamification methods were used. The idea behind this is that it shouldn't feel like a learning application, but like a game that unconsciously helps you improve your level in English. First of all, the design of the application was intended to look playful. This includes animations, sounds, fun colors and images. Then, a scoring system is implemented. Children need to continue though chapters that feel like levels, which they have to complete successfully in order continue to the next one. There are status bars that show your progress and scores. From the user testing it showed that the kids really liked these aspects. They reacted positively to sounds, and wanted to continue through the chapters to complete the game.

Maintainability

It is of primary importance, that we develop the application in a way that it can be edited by contributors, since the project will be an open source release. The php files can be edited to change the layout and structure of the application. They can be retrieved from the GitHub repository by anyone. Comments and a readme file will make sure the code is understandable for potential contributors. To add new chapters and sections, an interface was created where a form can be filled in. When the form is filled in and the steps required were followed, the new content will be stored in the database and will be visible when you refresh the application. In the appendix, a more extensive technical description is provided on how this works and how this can be accessed.

Interfaces and demo

The following screenshots aim to give an overview of the application interfaces on an (Android) smartphone and an OLPC-XO4. FIgure 9 shows the login page, Figure 10 shows the landing page, Figure 11 shows the content reader and Figure 12 shows the content reader

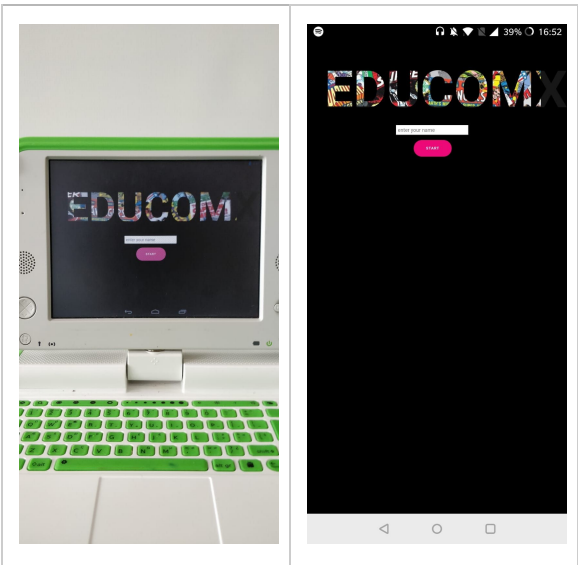

Figure 9. Login page

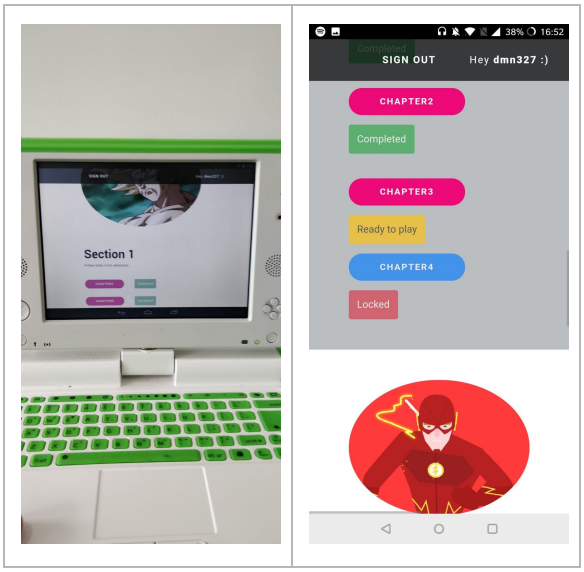

Figure 10. Landing page

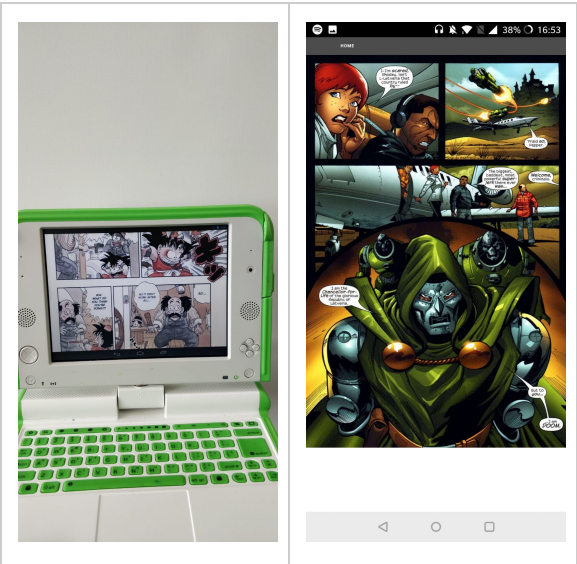

Figure 11. Content reader

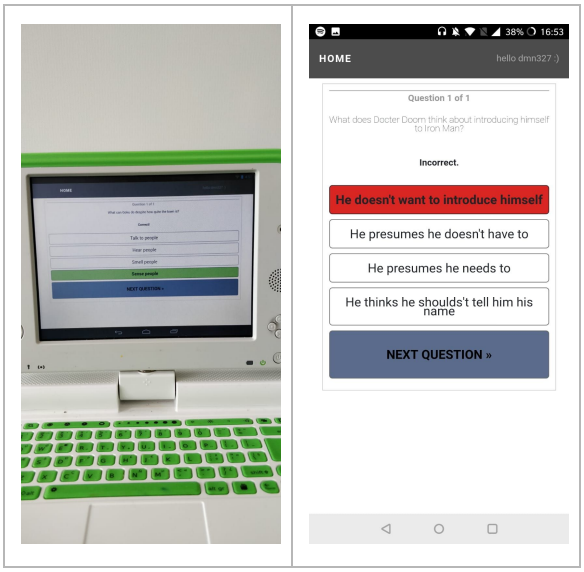

Figure 12. Quiz

Demo videos:

The following links provide a user demo of the application as a user would see it and of an example of adding new content:

- https://www.youtube.com/watch?v=O8Gj52CvN8o&feature=youtu.be
- https://www.youtube.com/watch?v=Lze9aZJNeMI&feature=youtu.be

Error handling

In the user testing section, most issues were discussed and resolved in the next iteration. There are still a few potential errors that can cause the application to be disrupted:

- **Different people that enter the same name to enter the application**: In most applications, a user account is created using a username, email address and password. Since we are working with young children and the low severity of the consequences of people entering each other's accounts, it was decided that only a

username would suffice. If this turns out that this is a problem, a password could be added. Right now the problem of people using similar usernames is tried to be limited by recommending the user to enter an original username for their profile.

- **Wrong content being added or old content that needs to be removed**: With the current approach, where contributors can add questions and add new content manually, there is a risk that the wrong content is submitted. Content can always be edited by using a database manager like PHPmyadmin, but when the user doesn't know how to do this, the content will still be displayed on the application. In the timespan we have, a full user interface to edit all content is not realistic. If it turns out that problems occur, this is a potential project to work on. This will be mentioned in the future work section. Right now, error handling is done by checking input fields when submitting the form. Not on content quality, but on presence of.

- **Connecting to the application via the Raspberry Pi**: On the OLPC-XO4, the application should be pre-installed and available on the home screen accessible by pressing the icon. When the kids want to access it on their personal devices, they need to take some steps which need to be properly executed. They need to connect to the wifi network of the Raspberry Pi, and than access the correct URL on their web-browser. Ideally, they should save the application to their home-screen once they accessed the correct application. But this might not be a realistic assumption for children to follow. This problem should be tried to be avoided by providing a physical instructions guide in the place where the Raspberry Pi is placed.

- Technical issues on the Raspberry Pi causing disconnections: It can always happen that the Raspberry Pi has technological issues. A problem with the wireless connection for example, or a complete soft- or hardware breakdown. When no people are around to fix these problems, the application won't be accessible. This error should be resolved by the people that deployed the Raspberry Pi in the field.

Discussion and reflection

Based on the user tests of the application, we feel this project has delivered a useful and interesting prototype that allows for easy implementation, maintenance and further development by other parties like UNIMAS. With careful context analysis and information that was gathered, a solution was created that is personalized for the target user group. The success of this approach was observable in the prototype demo session with the children in Pinggan Jaya.

By having created an application that unconsciously improves the user's English using the things that children like such as video games and comic books, we have attempted to solve both the issue of content being deemed undesirable by children, while improving the current situation of poor performances in English subject.

It is important to point out, that the maintainability of this application largely depends on future contributors. Since this application is divided in sections, at a certain point, users will have completed them, and there will be a need for an addition of further content. This project will be released as open source, with the aspiration that UNIMAS and other contributors will assist in further improving the application.

Finally, we believe the the large success of the first test phase, can be accredited to the interview-focused requirement gathering that is fundamental in ICT4D. Understanding what children like and learning about their daily lives, had a massive influence in our design decisions.

Limitations

There were a few factors that limited the outcomes of this project. First and foremost, the short timeframe of the project. Additionally, there was lack of knowledge on the right format and right way to approach the composure of educational material. As this project was conducted by students of the master courses: Computer science, Artificial Intelligence and Information Sciences, the ability to provide the system with the correct content, while still remaining in the scope of the children's syllabus was hard. Nevertheless, since our project is an open source release, using the the user manuals provided in the Appendix, it can easily be updated to include content that matches the children's syllabus and the CEFR.

There was one testing phase, and while it gave us a large amount of information and feedback on the direction the project should go towards, additional cycles may have revealed other errors and challenged assumptions that we had wrongly made, which would only help us to further improve the project.

Future research

The application has been successfully deployed on the Raspberry Pi, as part of the Library in A Box platform. However, online hosting must also be considered. There are plans to host the application on the web, so it can be accessed by children with internet access in other Kampungs as well.

Having the content match the CEFR(Common European Framework), is also of critical importance. Thus, there is a need for a plan, that includes the addition of content with the approval of education professionals, that is along the lines of the CEFR, in order for the skills obtained by using the application to be used in completing assignments and performing well on written examinations.

Appendix

Interview summaries

Interviews with teachers, women in the Kampung Pinggan Jaya, UNIMAS faculty and children, were deemed crucial in paving the way for the development of the right system. Interviewing children, who are our end-users, allowed us to develop a fundamental understanding of what they would enjoy in an educational platform. By

asking them to draw or write down their favorite superheroes, aspirations for the future, and hobbies, was critical to our context analysis, which is much needed in ICT4D. The UNIMAS faculty interviews and discussions, gave us an insight on what is already being developed by them, and as a result, giving us the idea for our project. In particular, Dr. Johari, with his “Library in the box” demonstration, and Dr. Cheah, with his past research on children’s education and valuable information on the OLPC XO’s, were the principal discussions that led to the formulation of our idea.

Children

The interviews with the children were conducted in three different groups. All groups consisted of around 5 children. 2 groups were of children between the age of 10 and 12 and the third group consisted of children between 7 and 9. The following section will provide a summary of the findings that were taken from the talks with the children. Each section has a subheader to structure the findings. In order to conduct our context analysis in a productive manner, we had to interview the children concerning aspects of their daily lives, and in hand understand what challenges they are facing, in order to understand what the scope of our application would be. The talks focussed on their hobbies, school problems and technology usage.

Hobbies

The children stated that a common pastime for them is outside activities such as hide and seek, climbing on trees and in general playing with friends, which is something that parents stated they find valuable. As far as technological usage, they watch cartoons and play games on smartphones. During the interview, the children were asked to draw pictures, or write down their favorite fictional characters, hobbies, aspirations for their future. The children drew and wrote down famous superheroes, which was helpful to us, because the characters came to be the inspiration for the artwork and content included in the application.

Smartphone access and usage

Smartphone and technological usage had to also be assessed. It was found most children have access to smartphones and many of them borrow them from parents or siblings, while a few claimed they had their own. Using the smartphones, the children watch youtube videos with local cartoons (e.g BoBoiBoy), which is not in English. They also use it to play games, such as puzzles or “MineCraft”, while also finding chatbots(e.g MyAngela) fascinating. An interesting side note that was gathered was that they have never heard of Google.

Teachers - School visit

A lot of background information was given by children, the kampung leader’s daughter, and UNIMAS faculty. However, in order to truly evaluate the technological availability, connectivity, and usage in the school, a visit was pivotal.

The general consensus of the discussions, was that there is a limited amount of computers in the school(three-four), something that was found to be false, as there are forty-one notebooks for the children to use, and an additional eight

desktop computers in the lab. The internet speed test conducted in a lab computer using speedtest.net, as shown in Figure X, shows that the download speed is not fast.

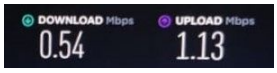

Figure 13. Results of internet speed test at the children's school (speedtest.net, conducted at 27/06/2018)

Concerning the education platform "Frog", which was created by a company in the United Kingdom[1], it appeared that it is not used at all. This conclusion was made, after login credentials were given to us, so that we can access and review the Frog platform. In the "Frog" account that was accessed, an account with administrator privileges, it was discovered that no content is uploaded in any of the subsections. These include books, audio files and assignments.

Dr. Cheah and Kampung Leader's Daughter

The plan is to create a study spot in the Kampung leader's house. Requests to extend the house have been submitted. In the study spot, a number of OLPC XO-4 laptops will be situated. The kids will be able to use the laptops to learn different skills. They will be able to learn how to use a computer or laptop, since they rarely have access to one at home. They can learn valuable skills such as text editing and presentation making. The idea is to install a Raspberry PI with the Library in a Box system on it, for the kids to be able to access the content on there. A mention was made by Dr. Cheah, regarding a possible request to the government of Australia, for one thousand OLPC's, as an unwarranted amount was purchased, which now remains unused.

The Kampung leader's daughter, continuously expressed her wishes for children to be better at understanding and communicating in English.

User Manual

This section will document the details and steps needed to continue on this project. This is an addition to the documentation on GitHub and will contain more sensible information like log-in credentials and setting up the system on a Raspberry Pi. The github repository and code can be found in [5].

Deployment on the Raspberry Pi

When the application is planned to be accessible from a Raspberry Pi: more specifically on the 'Library In a Box' platform, the application files need to be placed in the right directory, and a link should be provided from the landing page on the 'Library in a Box'.

Adding content:

On the raspberryPI, the files can be added to the following directory:

/var/www/html/educomx

Pull all the files from Github and place them in this folder. Than, update the index.php file in the var/www/html and add a link to the index.php file of the educomx directory: educomx/proto/index.php

When deployed on the library in a box, a database needs to be set-up on the device. More details on this will be covered in 2 sections from here: 'Database setup and access'.

Potential deployment on the web

When this project is wanted to be deployed on a web hosting server, not too much extra effort is required. A hosting package with a database is needed. That, downloading the source files and placing them on the server via FTP should make the application accessible on the domain name URL that it is planned to be deployed on. The somewhat more tricky part is the database set-up, which will be discussed now.

Database setup and access

Since the content of the quizzes and content reader are dynamically loaded, the database needs to be properly set-up and connected to the application. On the Raspberry Pi where the application is currently installed on, the following credentials are used:

credentials:

Server:	localhost
User:	root
Password:	kasadaka
Table:	users

To access the database for changing, copying or retrieving data or information structures, PHPmyadmin installed on the Pi can be used.

On the Raspberry Pi:
1. Open a web browser
2. Go to the URL: localhost/phpmyadmin
3. Login with the following credentials:
   user= root
   password= kasadaka
4. you can access the database tables and their respective contents from here.

On an external device:
1. connect to the raspberry pi wifi
2. open a web browser
3. Go to the URL: http://172.24.1.1/phpmyadmin/
4. Login with the following credentials:
   user= root
   password= kasadaka
5. you can access the database tables and their respective contents from here.

How to access the Library in a box and included content on any device:

1. Connect to the Raspberry Pi using the Library in a Box 2 network.
2. Login using password: 12345678
3. Open a browser. Note: Application was tested on Chrome version 67.0.3396.87.
4. Go to the URL: http://172.24.1.1/

Database installment on the Raspberry Pi can be done by following a tutorial[1].

EduComX content adding

To add content to the EduComX platform, the following steps need to be followed:
For 1 new section:

- Collect 12 pages of comic books (4 sets of 3 pages)

[1]https://randomnerdtutorials.com/how-to-install-phpliteadmin-database-in-a-raspberry-pi/

- Create a question for each set of pages (4 questions total)
- For each question, 4 possible answers should be provided, of which 1 being the correct answer.
- An eye catching gif or image for the section.
- A sound that gets played when the pages are loaded.

How to make the section show up on the platform:

- Upload the comic book pages in the following way:
    - Go to the directory within the application: .../proto/contentreader/images/
    - Create a new directory that should be named the highest number in the folder, + 1 (so if the highest number is now 4, create a directory named 5).
    - Name the image files: page1.jpg up and to page12.jpg.
    - Upload a gif or image that will serve as an eye-catching icon for your section.
    - Upload an entry sound when your pages are loaded: name it: sound.mp3.

- Enter the questions to the database:
    - Go to the following page on a web browser: <location of application>/proto/CreateSection.php
    - Fill in the form completely and correctly.
    - As the validation code, insert: ‘kasadaka’.

References

[1] https://frogasia.com/en/1bestarinet/
[2]https://github.com/Codeinwp/Ideal-Image-Slider-JS
[3] https://github.com/jrue/JavaScript-Quiz
[4] https://github.com/BlackrockDigital/startbootstrap-one-page-wonder
[5] https://github.com/ludwigHoon/educomx.