DOCUMENTATION REPORT

Part of the BACHELOR DISSERTATION

How can individual learning paths consisting of open educational resources be offered in primary education in disadvantaged contexts?

Empowering Education: Bridging Gaps with Open Learning Resources in Disadvantaged Primary Schools

Bachelor	Applied Computer Science
Elective track Graduation	Software Engineer
Academic year	2023 - 2024
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howest.be

Availability for consultation

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Foreword

My bachelor's thesis “How can individual learning paths consisting of open educational resources be offered in primary education in disadvantaged contexts?” was written in fulfillment of my bachelor's degree in applied computer science at Howest college in Bruges. I conducted this research and wrote this bachelor thesis from February 2024 to May 2024.

This research was conducted during my internship for Kaffie, both founders are volunteers for Afrodidact, a non-profit with the goal of providing school administration services in The Gambia, for whom this research is intended.

My research question was formulated together with my internship mentor Yentl Jacobs and internship supervisor Olivier Sourie.

I would like to thank Mr. Sourie and the staff of our faculty for their guidance and help during my research and internship. I would also like to thank Shane Deconinck from our faculty research team for supporting and guiding me through this research.

To team Afrodidact, thank you for the confidence in my ability.

To Simon Bronders, thank you for taking me out of my comfort zone and making it clear how proud I can be of my work.

To Yentl Jacobs, thank you for being my intern mentor and welcoming me with open arms, trusting me, guiding me, supporting me and helping me along the way.

To my fellow interns (Carol-Jane De Baets, Lukas Vanhee and Chloé Perraux) at Kaffie, thank you for helping me when I asked for it and for brightening the sometimes more difficult moments with your presence.

To my friends and family, you kept me motivated and believed in me at every moment.

I wish you much reading pleasure.

Tuur Delacroix

Bruges, February 15, 2024

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1 Introduction

1.1 Company presentation (KUBO and Afrodidact)

KUBO, an organization dedicated to enhancing education in developing countries, collaborates with Afrodidact, which offers a pedagogical framework for nursery and primary education.

The Swallow, a research and education center in The Gambia, applies and examines Afrodidact's methods, providing education up to grade 6. KUBO aids The Swallow by delivering a school administrative platform to alleviate their administrative burdens, streamlining operations and focusing on educational quality.

KUBO operates on three core principles:

- **Bold (Think Big, Not Small):** KUBO aims to create significant impact by thinking big and not limiting its vision to small-scale changes.
- **Inclusive:** As detailed in section 1.2, KUBO strives to empower both teachers and students, ensuring that educational advancements are accessible to all.
- **Outreaching:** KUBO actively seeks to collaborate with other partners, recognizing the value of working together and avoiding the reinvention of the wheel.

1.2 What is KUBO[1]

KUBO is a solution designed to enhance the educational experience in developing countries' nursery and primary schools. It aims to empower teachers and students by minimizing administrative tasks. The system includes a Raspberry Pi server equipped with the KUBO software platform, which simplifies school management and provides valuable insights into student performance, thereby streamlining educational processes and fostering a more effective learning environment.

1.3 Background of KUBO[2]

KUBO was founded in the early summer of 2017. It is a project that grew out of a Proof of Concept created during the internship of a former student named Shane Deconinck. The main motivation for starting KUBO was to reduce the administrative burden at The Swallow. Shane saw an opportunity to do this using affordable hardware combined with easy-to-use software.

The PoC that was delivered consisted of a software platform on a raspberry pi that allowed teachers to record student grades and students to improve their skills with additional exercises

[1] Jacobs, "KUBO – the Open School Platform."
[2] Deconinck, "A Case Study in Serrekunda, The Gambia."

tailored to their needs. From here, Yentl Jacobs, another former student, started his internship. He effectively created the first version of the KUBO platform.

The next idea was to develop an educational platform where students use open educational resources to individually process their learning.

1.4 Motivation for this research

Based on previous research and the current system, KUBO has been segmented into two main components due to its potential to evolve into a comprehensive software suite. The administrative component, already fully functional, manages school administrative tasks like student registration and grading.

When talking to Yentl about what I could do during my internship he mentioned an idea that my bachelor thesis will explore, the innovative component, aimed at providing educational content tailored to students' needs, enhancing the platform's user-friendliness and ensuring it grows incrementally while aligning with user feedback.

1.5 KUBO roadmap

The KUBO journey has unfolded a significant timeline:

During Shane's internship, a PoC was developed and deployed at The Swallow in Gambia. Post-deployment analysis revealed that the PoC was not a robust foundation for our administrative platform.

Yentl's additional contributions led to the launch of KUBO Alpha, after which Robby Goetinck, a later intern, took the helm for further evaluation and implementation.

Following a pause, during which there was continuous development in terms of hardware and software but no significant innovation, a period of reflection and analysis initiated a new chapter for KUBO. This new phase focused on shifting towards innovative and impactful solutions to meet the evolving educational needs in disadvantaged contexts, particularly by emphasizing personalized educational materials.

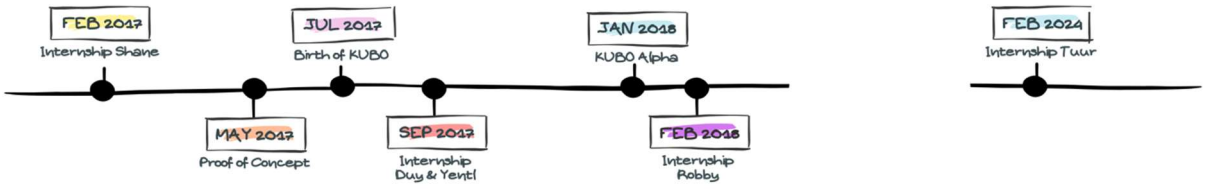


Figure 1: Timeline of KUBO

1.6 Problem statement

This thesis addresses the specific problem of limited access to quality education in disadvantaged regions, particularly in countries such as The Gambia and Uganda. The core issue is the limited availability and accessibility of open educational resources, compounded by challenges such as insufficient infrastructure, lack of reliable internet connectivity, and socio-oeconomic disparities. In many of these regions, internet access is sporadic or non-existent, making it difficult for students and teachers to access digital educational materials and online learning platforms.

Specifically, the problem statement focuses on the need to develop and implement a digital education solution, the KUBO - Student Platform, to bridge this gap and provide personalized learning paths consisting of open educational resources in primary education settings within disadvantaged contexts. This aligns with the main question and sub-questions outlined in the problem definition.

In this context, Kaffie is involved in the implementation of KUBO for Afrodidact, an initiative that provides pedagogical models for nursery and primary education and supports The Swallow Research Center for Emancipating Education in The Gambia, which investigates and disseminates the educational model of Afrodidact. My engagement with this problem emerged during my internship at Kaffie, where I decided to take on a significant wish of Afrodidact and initiate the research, focusing on enhancing access to quality education through the current KUBO Platform.

2 Research question and objectives

2.1 Main question

How can individual learning paths consisting of open educational resources be offered in primary education in disadvantaged contexts?

2.2 Sub-questions

1. What are the current available distribution channels for offering educational materials digitally?
2. What open educational resources are currently available and suitable for implementation in primary education settings?
3. How can individualized learning paths be tailored to meet the diverse needs and abilities of students in disadvantaged contexts?

3 Literature review and theoretical framework

3.1 Overview of ICT4D

While ICT has great potential to significantly enhance the educational sector in developing countries, numerous challenges must be critically managed to realize this potential. Many ICT initiatives have been found to be futile due to reasons such as insufficient infrastructure and lack of trained personnel. For example, the One Laptop per Child (OLPC)[3] initiative struggled with maintenance issues and underutilization, while the Hole-in-the-Wall project[4] faced challenges with hardware durability and contextual relevance. These examples highlight how such factors can lead to the failure of well-intended ICT projects, resulting in wasted resources and unmet educational goals.

Building on the extensive research of Shane in ICT4D and Yentl in the field of user experience, this study focuses on the sustainability of technologies that have been proven to work well in similar contexts. By examining these sustainable technologies, the study aims to identify how they can be effectively integrated into new educational solutions tailored to our specific needs. In this view, we always consider the insights drawn from our previous studies to ensure a comprehensive and effective approach.

3.2 Current solutions and their applications

In today's rapidly advancing technological landscape, numerous ICT4D solutions have emerged to tackle educational challenges in developing countries. Exploring these solutions in depth allows us to understand their implementation, effectiveness, and scalability. The primary reason for this exploration is to gain insights into various successful methodologies and identify best practices. Additionally, this knowledge facilitates the introduction of Afrodidact and Kubo to these organizations, promoting collaboration, knowledge exchange, and the development of more effective and sustainable educational technologies tailored to our needs.

3.2.1 Kolibri

Kolibri, created by Learning Equality, is the successor to KA Lite, which Shane used for his PoC. Designed to facilitate education in regions with limited or no internet access, Kolibri enables users to download, organize and share a wide range of educational content for offline use. This evolution signifies a substantial advancement in providing equal

Figure 2: Logo Kolibri

[3] OLPC, "One Laptop per Child."
[4] NIIT, "Hole-in-the-Wall Project."

education access globally, building on KA Lite's initial foundation to reach more learners in resource-constrained environments as described in 3.1.

3.2.2 Kiwix

Kiwix is a program that allows downloading and compressing entire websites into a single file with an extension, ".zim". These files can be stored on mobile phones, computers, or inexpensive hotspots. Kiwix functions like a regular browser, but it accesses local copies instead of online content, enabling people with limited or no internet access to enjoy a browsing experience like others.

Figure 3: Logo Kiwix

Reaching out to organisation

I've managed to have a meeting with Stéphane Coillet-Matillon, CEO, to introduce both the organizations to each other.

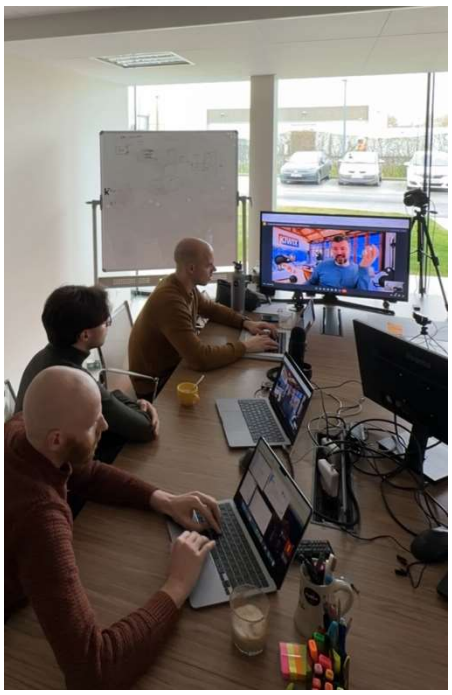


Figure 4: Call with Kiwix CEO

This technology offered a powerful solution for storing and delivering offline content. We delved deeper, exploring the possibility of transitioning to a Kiwix server and learned about their alliance with Learning Quality.

While our initial conversation with Learning Quality happened later, these discussions, though not highlighting a fundamental mismatch, revealed that they primarily offer a methodology without a distribution solution for these educational resources. This made it clear that their offering was not exactly what we needed. However, these discussions ultimately proved invaluable as we gained crucial insights into the ZIM format and Kiwix's partnership with Learning Quality, shaping our platform's development for the better.

This experience underscores the importance of adaptability and ongoing communication in the educational technology landscape.

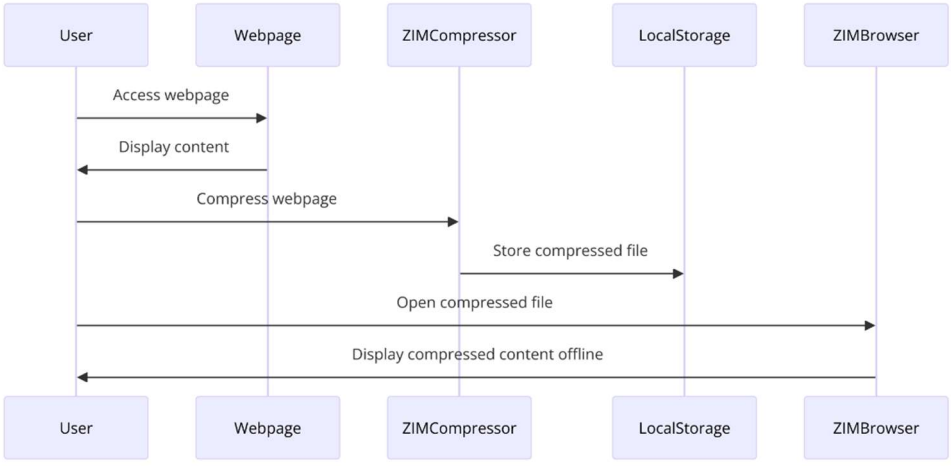


Figure 5: Zim Compression Diagram

3.2.3 Moodle

Figure 6: Logo Moodle

Moodle is an open-source learning platform designed to provide educators, administrators, and learners with a single robust, secure, and integrated system to create personalized learning environments. It is widely used for distance education, e-learning projects, and blended learning programs. With features that support creating courses, handling enrollments, posting assignments, and providing resources, Moodle facilitates interactive learning experiences. It also supports a range of plugins for additional functionalities, making it adaptable to various educational needs and contexts.

4 Methodology

4.1 Research design

This research employs a mixed-methods approach to collect both qualitative and quantitative data, providing a comprehensive understanding of the impacts and usability of different educational technology solutions. The methods are designed to gather insights from various stakeholders including educators, students, and technology experts.

Additionally, there will be an in-depth investigation into existing solutions, examining their functionality, effectiveness, and user-friendliness. This will help identify the best practices and potential areas for improvement.

4.2 Data collections methods

4.2.1 Qualitative research and analysis

- Conduct semi-structured interviews and focus groups with teachers, students, and stakeholders active in this type of research to gather in-depth insights into their experiences, perceptions, and challenges regarding the use of open educational resources (OERs) and individual learning paths.

4.2.2 Quantitative research and analysis

- Surveys will be administered to gather quantitative data on aspects such as teacher satisfaction[5], student engagement and so on.

[5] SurveyMonkey, "Likert Scale."

4.3 Risk analysis and research conditions

Funding: equipment, costs related to data collection, potential project implementation, potential travel expenses.

Information: access to relevant literature, data, and information related to the research topic is essential.

Time: sufficient time for planning, data collection, analysis, and reporting is crucial.

Materials: depending on the nature of the research, materials such as computers, software, etc., may be necessary.

Consent: obtaining informed consent from Users, including schools, teachers, and students, is essential to ensure ethical standards are met and to protect the rights and privacy of individuals involved in the research.

Collaboration(s): establishing partnerships and collaboration with relevant stakeholders, such as educational institutions, government agencies may be necessary to gain access to research locations, recruit Users, and facilitate project implementation.

4.4 Technical and environmental considerations for the solution

4.4.1 Infrastructure limitations

Electricity	Frequent power outages can disrupt the use of technology and internet services. Any technological solution must be able to operate effectively with intermittent power supplies.
Internet Access	There is limited internet connectivity, which can restrict the use of online platforms and resources. Solutions that require minimal or no internet connectivity for functionality, or can function offline, may be necessary.
Bandwith & Streaming	Limited bandwidth can hinder the ability to stream large amounts of data, which is critical for accessing educational content. Solutions should be optimized for low-bandwidth environments, offering compressed or pre-downloaded content to ensure smooth functionality.

4.4.2 Hardware accessibility

Availability of devices	There is limited access to computers and other technological devices. Solutions may need to utilize low-cost, low-power computing devices like Raspberry Pi, which can serve as an affordable and practical option for educational settings.
Durability and maintenance	Devices need to be durable and easy to maintain due to the harsh environmental conditions and limited technical support.

4.4.3 Software and content

Local Relevance	Educational content needs to be culturally relevant and in local languages to be effective. It should align with the national curriculum and local educational standards.
User-Friendliness	Interfaces must be simple and intuitive to accommodate users with limited technological experience.

4.4.4 Economic

Cost-Effectiveness	Any solution implemented must be financially sustainable given the economic challenges in the region. Solutions should leverage existing resources and infrastructure where possible to minimize costs.

4.4.5 Training and support

Capacity Building	There is a need for training and ongoing support for educators and students to effectively use technology. This includes both technical training and pedagogical support to integrate technology into teaching and learning processes.

4.4.6 Regulatory and policy

Alignment with Educational Policies	Any introduced technology must comply with local educational policies and regulations, which might affect deployment and scaling.

4.5 Evaluation of alternatives

Considering the complex requirements of our project and the unique needs of the Gambian context, a comprehensive evaluation of various technological pathways is crucial.

This section delves into the feasibility of multiple potential solutions. We'll be dissecting each option through the lens of its technical viability, adaptability to the Gambian environment, and potential impact.

Buckle up as we explore a diverse toolbox of solutions, each with its own set of pros and cons, to identify the optimal fit for our project in Gambia.

4.5.1 Path 1: In-house development

Building the platform in-house would allow for a high degree of customization to the specific educational and cultural needs of students and schools in The Gambia. Imagine a platform that seamlessly integrates with the Gambian curriculum and leverages local languages for optimal student engagement. However, this approach presents significant challenges for a non-profit organization.

In-house development would require several months and additional staff members, posing a significant strain on our limited resources. Moreover, continuous technical support is essential for long-term scalability and maintenance, which is currently beyond our internal capacity.

Given these substantial challenges, internal development is not a feasible option for us.

4.5.2 Path 2: Collaborating with Learning Equality on Kolibri

Given the resource limitations of internal development, partnering with Learning Equality to utilize the Kolibri platform presents a compelling alternative. Kolibri offers a strategic advantage: it's a proven and robust educational framework specifically designed for resource-constrained environments.

Learning Equality is a large organization with financial resources and a dedicated development team, making it an ideal partner for our project. This collaboration ensures that we can leverage their expertise, extensive support network, and ongoing platform development, which addresses many of the challenges we would face with in-house development.

This pathway will go over all the faced elements.

To explore this potential partnership, we reached out to Learning Equality to discuss how we could collaborate and integrate Kolibri into our project.

Contact with Learning Equality

Thanks to an old blog post[6] from 2017 by Shane we were able to reconnect with Laura, Head of Global Engagement at LE. We discussed our progress, findings, and new objectives, and how we can support each other.

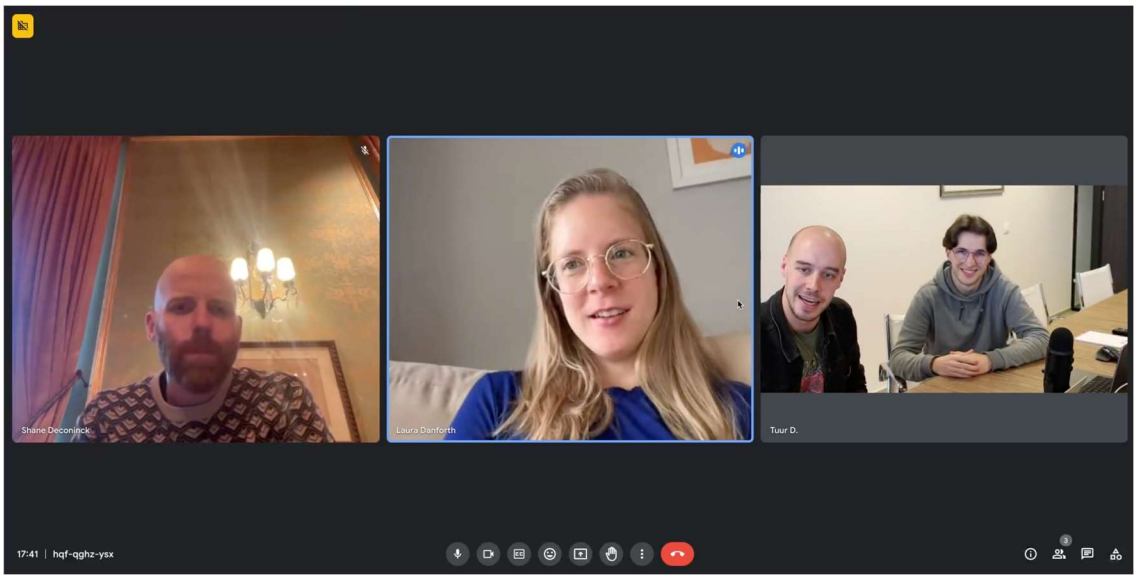


Figure 7: Videocall with Laura from Learning Equality

Several key points were discussed regarding the use of the Kolibri platform:

1. Technical Resources and Support:
   - Laura highlighted the availability of the Kolibri EdTech Toolkit[7], which includes resources for Training of Trainers (ToT) and implementing blended learning with Kolibri.
   - A one-pager for getting started with Kolibri Studio[8] was mentioned, useful for uploading your own educational materials to the platform.
2. Custom Development:
   - I inquired about the possibility of forking the Kolibri codebase for custom development. Laura provided details about the tech stack used by Kolibri, which includes Python and Django (1.11) for the backend and VueJS 2.6 for the frontend.
   - While forking the codebase is possible, Laura strongly recommended considering the development of custom plugins instead. This approach allows for targeted functionality enhancements without losing the ability to benefit from mainstream updates and bug fixes.
3. Plugin Development:

[6] Deconinck, "Blog Post Shane LE."
[7] Learning Equality, "Kolibri EdTech Toolkit."
[8] Learning Equality, "Kolibri Studio Instructions."

- Laura suggested looking at existing plugins on their GitHub repository as examples of how functionalities can be extended or modified.
- The conversation also touched on the idea of updating the UI through plugin modification, which would enable you to tailor the frontend while maintaining compatibility with the core Kolibri updates.

4. Collaboration and Open Licensing:
   - Learning Equality appreciates any efforts to make plugins openly licensed, supporting the broader community.
   - Laura expressed a desire to stay in touch to follow up on your user testing and any insights you gather during the implementation and use of the platform.

This call was very productive in setting the stage for my custom developments with Kolibri and highlighted the supportive resources available through Learning Equality's community forum. Laura's encouragement to use the plugin system for modifications points towards a flexible yet sustainable approach to customizing the learning experience.

She also mentioned the following: "*I'd also love to stay in touch generally in the coming weeks and months to hear how the user testing goes and anything you learn.*"

Technical Architecture

Learning Environment: Client & Server

The learning environment of Kolibri consists of three primary components: a client application, a server, and learning content.

The **client application** is available in various formats, including Android and iOS apps, as well as a web app. This application enables users to download, view, and utilize learning content, even when an internet connection is unavailable.

The **server**, powered by Python and Django REST framework, serves as the central repository for learning content and provides an API for communication with the client application. The server can be installed on local hardware or in the cloud, offering flexibility and scalability.

Learning content within Kolibri can range from HTML, CSS, and JavaScript to videos (MP4), audio (MP3), and images (PNG, JPG). This content can be structured into learning modules and paths, allowing users to build a personalized learning experience.

Distribution and Synchronization

Kolibri offers two primary options for distributing learning content:

- **Kolibri Server:** Learning content and the API are hosted on a central server, which can be installed locally or in the cloud. Devices download the required content from the server.
- **Kolibri Learn:** Devices can download learning content directly from other devices via USB or Wi-Fi, which is beneficial in environments with limited internet connectivity.

In addition to distribution, Kolibri also provides **synchronization capabilities**. Over-the-air updates ensure that learning content and the application remain up to date, while local synchronization enables content sharing between devices.

Kolibri Server

The Kolibri server forms the heart of the Kolibri learning platform, where learning content is hosted, managed, and distributed to client devices. To harness the power of Kolibri in Gambia using KUBO Servers (Raspberry Pi's) as servers and client devices, understanding the technical aspects and scalability is crucial.

Server Hardware

The performance of the Kolibri server depends on the hardware it runs on. The requirements are:

Range of concurrent client devices	RAM	CPU	SSD (Server)
1-10	1GB	RPI 3+	Max 180GB[9]
10-20	1GB	RPI 3+	Max 180GB
25-30	4GB	RPI 3+	Max 180GB
30+	8GB	Intel Core 5	Max 180GB

Figure 8: Hardware requirements Kolibri Server

Contribution to Kolibri

Making our own additions to the codebase.

Unfortunately, we are currently unable to directly contribute to the Kolibri codebase due to a few factors:

- **Required Skills**: Development for Kolibri requires a high level of expertise in Python, Django, and Vue.js. This level of skill is not currently available within our team.
- **Time Investment**: Making significant contributions to the codebase would require a substantial time investment from one or more team members. This would limit our capacity for other critical tasks.

[9] Depends on the size needed.

Creating a plugin

Kolibri's plugin architecture empowers developers to extend and tailor the platform's functionality to meet specific requirements. This is highly relevant for our project as it allows us to customize Kolibri to better fit the unique educational needs of students in The Gambia. By developing plugins, we can add targeted functionalities without modifying the core system, ensuring we benefit from ongoing updates and support from Learning Equality.

We plan to develop plugins that will enhance user experience, integrate local educational content, and provide additional features necessary for our context. This approach ensures that our customizations are sustainable and maintain compatibility with future Kolibri updates.

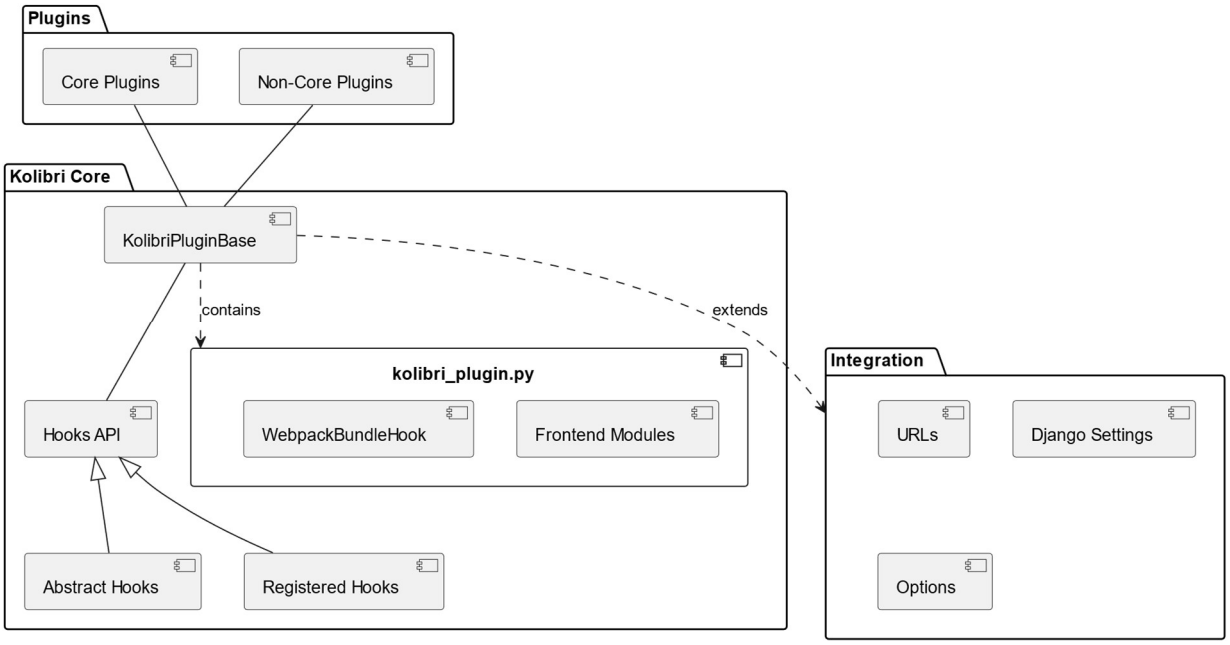


Figure 9: Plugin Creation Diagram

4.5.3 Path 3: Transfer to BEEKEE

How it works

Beekee[10] offers a transformative solution for learning environments through two primary devices: the Beekee Box and the Beekee Hub. These standalone devices are engineered to deliver a comprehensive online learning experience entirely offline, addressing the infrastructural challenges such as lack of internet access and frequent power outages that many educational settings face.

Beekee Box: Dubbed the 'Instant Pocket Digital Classroom,' the Beekee Box functions as a portable mini-computer. It is a plug-and-play solution that requires no additional apps and runs directly from a browser. Designed to be energy efficient, it is compatible with solar power, making it ideal for use in areas with unreliable electricity. This device makes educational content and apps for active learning accessible anywhere, anytime.

Beekee Hub: This device acts as a server, transforming any space into a robust, digital, offline-first campus. It operates primarily offline but utilizes available connectivity to perform functions such as video calls, access to specific online services, and syncing learner progress through Beekee's efficient synchronization technology. The Beekee Hub supports remote access and automatic updates, enhancing its utility in diverse educational settings.

Both devices support a variety of learning applications that facilitate interactive, collaborative, and gamified learning experiences. These applications are compatible with any device that has a browser, making Beekee a versatile and user-friendly option for educational institutions. The system integrates well with Moodle to offer structured e-learning pathways and allows for the import and creation of courses. Additionally, it includes a library of curated educational resources through Kolibri, supporting self-paced learning and small class environments.

Product specifications

For this I would like to refer to the official documentation[11] of BEEKEE.

[10] Beekee.ch, "BEEKEE Website."
[11] Beekee.ch, "BEEKEE Documentation."

Contact with BEEKEE

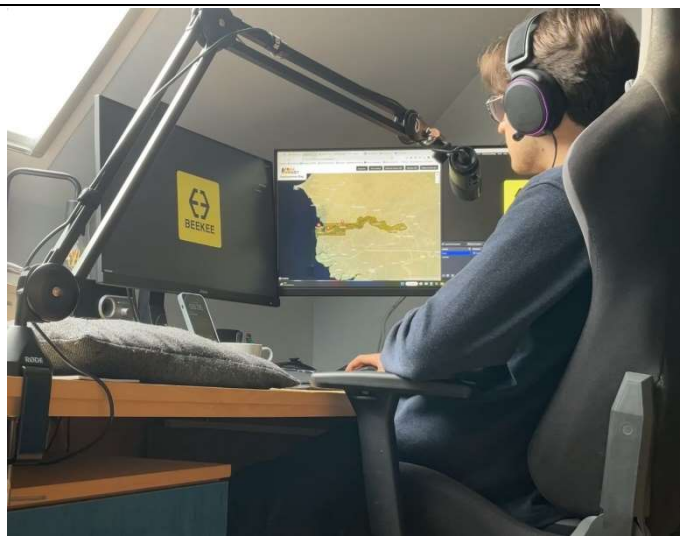


Figure 10: Zoom Call With BEEKEE

Vlad Daniluc, a Learning Solutions Consultant from Beekee, met with me for a 28-minute Zoom conversation. The discussion focused on KUBO's work and how Beekee's products and services could align with our goals.

Vlad was interested in understanding KUBO's unique ecosystem, which is entirely volunteer-driven. He also inquired about KUBO's existing partnerships with other organizations. While KUBO currently operates independently, they have established relationships with Learning Equality and Kiwix, and they are open to exploring further collaborations.

The primary focus of the meeting was on potential collaboration between KUBO and Beekee. KUBO is particularly interested in how their scalable software, KUBO, could be integrated with Beekee's platform.

Vlad explored several aspects of Beekee's offerings during the conversation. He inquired about their reseller/label partner model, the possibility of acquiring Beekee hardware with KUBO's software, and the availability of Beekee's development team for external projects.

Beekee doesn't have a formal reseller program, but they pointed out that many organizations like KUBO often transition to Beekee in the long run due to the high quality of their hardware. Beekee is open to discussing the possibility of KUBO purchasing their hardware with KUBO's own software pre-installed, but they require more specifics from KUBO before moving forward. Beekee's development team is currently focused on internal projects and is not available to work on external projects for other organizations.

Vlad also inquired about Beekee's pricing structure. Beekee explained that their pricing is highly customizable and depends on factors such as the number of users, location, synchronization needs, and content requirements.

An interesting feature discussed was Beekee Cockpit[12], a remote management tool that allows users to manage multiple Beekee hubs and boxes from a single location. This tool requires an internet connection but can function with ethernet, a SIM card, or even a dongle. Beekee Cockpit offers functionalities like connecting to hardware, accessing applications, and monitoring resource usage (energy, storage, internet).

[12] Beekee.ch, "BEEKEE Cockpit."

Future

Following this initial conversation, KUBO and Beekee should continue discussions to explore potential collaboration opportunities, particularly focusing on how KUBO's software can be integrated with Beekee's platform. To facilitate further discussions, KUBO needs to provide Beekee with more specific information about their requirements and proposals. This will allow Beekee to provide more accurate information on pricing and feasibility.

Conclusion of path evaluation

After thoroughly evaluating the three potential solutions, it is clear that partnering with Learning Equality to utilize the Kolibri platform (Path 2) is the most viable option for our project. This conclusion is based on several key factors:

1. **Resource Efficiency:** In-house development (Path 1) would require significant time, financial resources, and technical expertise that our non-profit organization currently lacks. The development and ongoing support for a custom solution would strain our limited resources and is not feasible.
2. **Technical Viability and Support:** Collaborating with Beekee (Path 3) offers robust offline solutions, but integrating their hardware with our existing infrastructure presents complexities. While Beekee provides excellent offline-first technology, their systems are not as tailored to educational content delivery as Kolibri.
3. **Established Infrastructure and Expertise:** Learning Equality's Kolibri platform (Path 2) is specifically designed for resource-constrained environments like The Gambia. Learning Equality is a well-established organization with significant financial resources and a dedicated development team. This ensures continuous support, regular updates, and the ability to customize the platform through plugins, which aligns perfectly with our needs.
4. **Alignment with Educational Goals:** Kolibri's focus on delivering educational content and its ability to function offline addresses our primary challenges of limited internet connectivity and infrastructure. Additionally, the platform's existing use in similar contexts provides a proven track record of success, reducing the risk associated with its implementation.

Therefore, Path 2 not only meets our initial parameters of technical viability, adaptability, and impact but also leverages a partnership that maximizes our resources and aligns with our strategic goals. This makes partnering with Learning Equality and utilizing Kolibri the preferred path for our project.

5 Experiments and analysis

5.1 General approach

In this section of this dissertation, I will conduct multiple experiments to explore various aspects of the research question. Each experiment, although focused on different aspects, will adhere to a consistent structure to ensure clarity and coherence in the presentation and analysis of the findings..

The array of potential outcomes from this approach is diverse:

- We might swiftly identify an existing tool that meets our needs.
- It could lead us to develop our own personalized solution.
- Alternatively, we may recognize that we are not able to offer an optimal solution immediately, due to unforeseen hurdles.

5.2 Experiment 1: Kolibri user testing

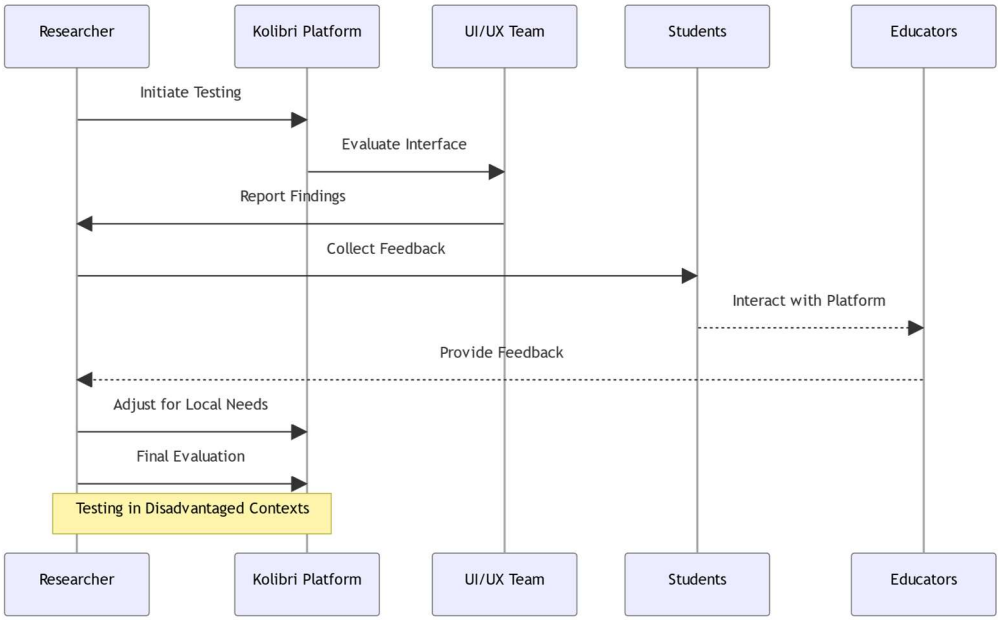


Figure 11: Kolibri User Testing Strategy Diagram

5.2.1 Reason and goals

Testing objective

This study aims to assess the effectiveness of Kolibri as a platform for delivering Open Educational Resources (OERs) in disadvantaged contexts, specifically focusing on its suitability for students in Gambia. Successful implementation of Kolibri has the potential to revolutionize access to quality education for Gambian students, empowering them to learn regardless of resource limitations.

However, a crucial aspect of this evaluation involves understanding how well Kolibri caters to users with limited technological exposure. Our initial exploration revealed a wealth of functionalities within Kolibri, which while powerful, might present a challenge for students unfamiliar with complex interfaces. Therefore, this testing aims to evaluate how effectively Kolibri can be simplified for immediate use and potentially adapted for future needs to meet the requirements of students with limited technological experience in Gambia. By analyzing user interaction and learning outcomes, we can determine if Kolibri can truly bridge the digital divide and empower students in disadvantaged contexts.

User interface and experience

A critical focus of our evaluation is the platform's User Interface (UI) and User Experience (UX). This segment prioritizes the experience for students in Gambia, many of whom may have limited prior experience with technology. Our goal is to determine whether the UI/UX is intuitive and straightforward for these users who may be encountering such systems for the first time.

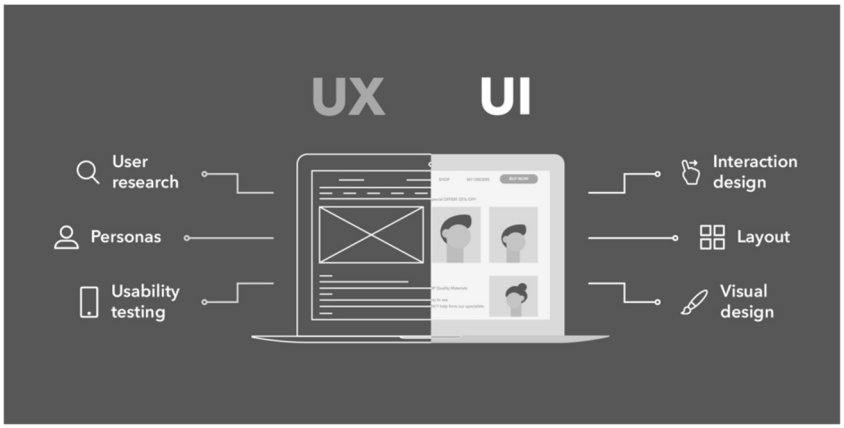


Figure 12: Difference between UX and UI

By pinpointing UI/UX ambiguities and errors through a combination of user observation and direct interaction testing, we can propose improvements that ensure Kolibri is intuitive and accessible for all learners in Gambia, regardless of their technological background. This

comprehensive report will be systematically conveyed to Learning Equality through direct contact with Laura, allowing them to refine Kolibri for wider adoption in disadvantaged contexts.

Platform functionality and feedback

Our evaluation goes beyond UI/UX. We are also interested in assessing whether Kolibri meets the specific educational needs outlined by Afrodidact. This involves evaluating functionalities like content creation tools, assessment features, and the ability to create personalized learning pathways that align with Afrodidact's curriculum.

To gain a well-rounded perspective, we will also gather overall feedback on the platform from students and teachers within the formal Belgian educational system. We will tailor our feedback mechanisms through surveys and focus groups, specifically catering to the needs and experiences of educators and students non-familiar with Kolibri within a formal learning environment.

This valuable user feedback, particularly the insights gleaned from "mistakes" and shortcomings observed in Belgium, will play a crucial role in guiding enhancements for Kolibri's implementation in Gambia. By leveraging these lessons learned, we can ensure a more optimized platform that better serves the educational needs of Gambian students and educators. In essence, this approach allows us to learn from the Belgian experience to create a more successful deployment in Gambia.

5.2.2 Setup and execution

Testing environment configuration

Initially, it was crucial to establish a suitable testing environment to ensure accurate and comprehensive observations. The setup included:

- Sony Camera: Positioned to capture a wide angle of the tester, including hand movements and body language.
- Lenovo Laptop: Pre-configured with the Kolibri platform to facilitate the test execution.
- Macbook Laptop: Utilized for audio recording in conjunction with the Sony camera.
- Blue Yeti Microphone: Employed to record the conversations between the tester and the test host.
- iiyama Monitor: To monitor the tester's actions live, ensuring real-time feedback and interaction.
- Open Broadcaster Software 9.: Software used to record the hardware and to capture both the screen interactions and the body language of the tester.

The five-act interview method

Adopted from Google Ventures[13], I used the five-act interview method. This structured yet natural approach includes:

1. **Introduction**: A friendly welcome to set a positive tone for the session.
2. **Getting to Know the User**: Asking general questions to understand the user better and create a relaxed atmosphere.
3. **Prototype Introduction**: Presenting the Kolibri platform, explaining its functionalities, and setting the stage for testing.
4. **Execution of Test Scenarios**: Testers interact with the platform using the prepared scenarios to explore its usability and functionality.
5. **Debriefing**: Concluding the session with a debrief to gather initial impressions and feedback, followed by a heartfelt thank you to the participant.

This methodological approach not only aimed to gather valuable feedback but also to ensure a pleasant and engaging experience for all Users, thereby enhancing the quality of data collected.

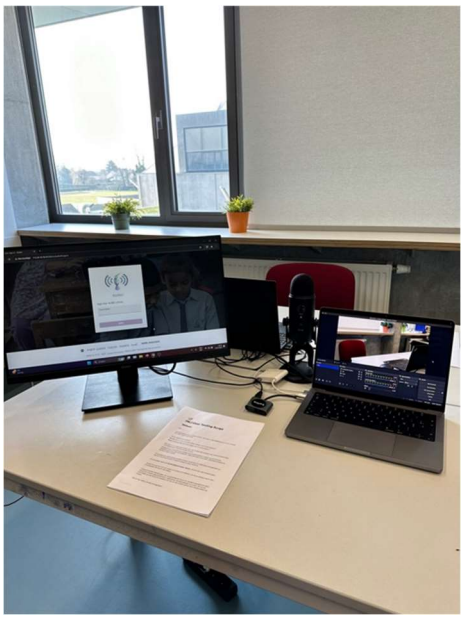


Figure 13: Complete desksetup

Figure 14: Setup from camera pov

Recruitment of test audience

[13] *From 'Sprint': The Five-Act Interview.*

Thanks to my alumni connections at two secondary schools, the Ensorinstituut and Athena both in Ostend, I was able to recruit a test audience. This allowed us to gather diverse user feedback essential for evaluating the usability of the Kolibri platform.

Documentation and testing materials

For the execution of the tests, I prepared several documents to guide the testing process and provide ample information:

- **User Test Scripts**[14]: Available in both Dutch and English, these scripts outline general information to be communicated before testing begins.
- **Test Cases**[15]: Detailed scenarios in Dutch and English that the testers were asked to perform, simulating real-world usage.
- **User Credentials and Helping Resources**[16]: Papers handed to each tester to assist them during the testing process and ensure they could perform tasks independently.

[14] Delacroix, "Afrodidact - Kolibri - User Test Script (NL)"; Delacroix, "Afrodidact - Kolibri - User Test Script (EN)."
[15] Delacroix, "Afrodidact - Kolibri - User Test Cases (EN)"; Delacroix, "Afrodidact - Kolibri - User Test Cases (NL)."
[16] Delacroix, "Afrodidact - Kolibri - User Test Helping Resources"; Delacroix, "Afrodidact - Kolibri - User Test Credentials."

5.2.3 Results

Introduction

User experience is crucial for the success of educational platforms in resource-constrained environments like Gambia. These platforms must be not only feature-rich but also intuitive and accessible to users with varying levels of technological experience. This segment of the thesis delves into the comprehensive user testing conducted on the Kolibri platform. The goal of this testing was to evaluate how well Kolibri meets the needs of educators and learners in these challenging contexts, ensuring it can deliver quality education effectively.

Through meticulous user testing sessions involving educators, administrators, and students in Gambia, I gleaned invaluable insights regarding Kolibri's usability and user interface design. Each interaction illuminated areas of strength and weakness, providing a roadmap for refinement and enhancement.

This segment thoroughly examines the user testing findings, dissecting each identified issue and proposing tailored solutions to address them. By combining qualitative feedback with quantitative data, this analysis seeks to bridge the gap between user expectations and platform functionality, ultimately fostering a more enriching and seamless learning experience for all stakeholders within the Gambian educational landscape.

Issue overview

Issue	Occurrences
Misalignment of Coaches when Linking to Classes	3
Lack of Clarity in Lesson Planning via “Plan” Feature	2
Ambiguity in Linking Lesson Materials	2
Confusion with Search Functionality	2
Non-Intuitive Naming Conventions	2
Lack of Clarity in Quiz Exercises	2
Unclear Overview of Plans and Compound Quizzes	2
Confusion Caused by Khan Academy Resource Channel	2
Lack of Visibility for Selected Materials in Lesson & Quiz Planning	3
Management of Groups in Incorrect Position	3
Overcrowding and Clutter in Class Home Environment	4
Lack of Clarity in Reviewing Exercises (non-student)	4
Unclear Navigation and Naming	7
Localization Not Always Clear	7
Underutilized Lesson Summaries and Filter Methods	7
Lack of Differentiation between “Class Page” and “Home”	5
Lack of Filter and Search Functionality	3
Inability to View Entered Password	3
Quiz Planner Layout is Very Poor, Unclear	4

Issue possible solutions

For all possible solutions I tried to align them as much as possible with the Kolibri Design System[17].

Here I will only go over the ones with a high occurency, I've made a collection[18] with all the changes.

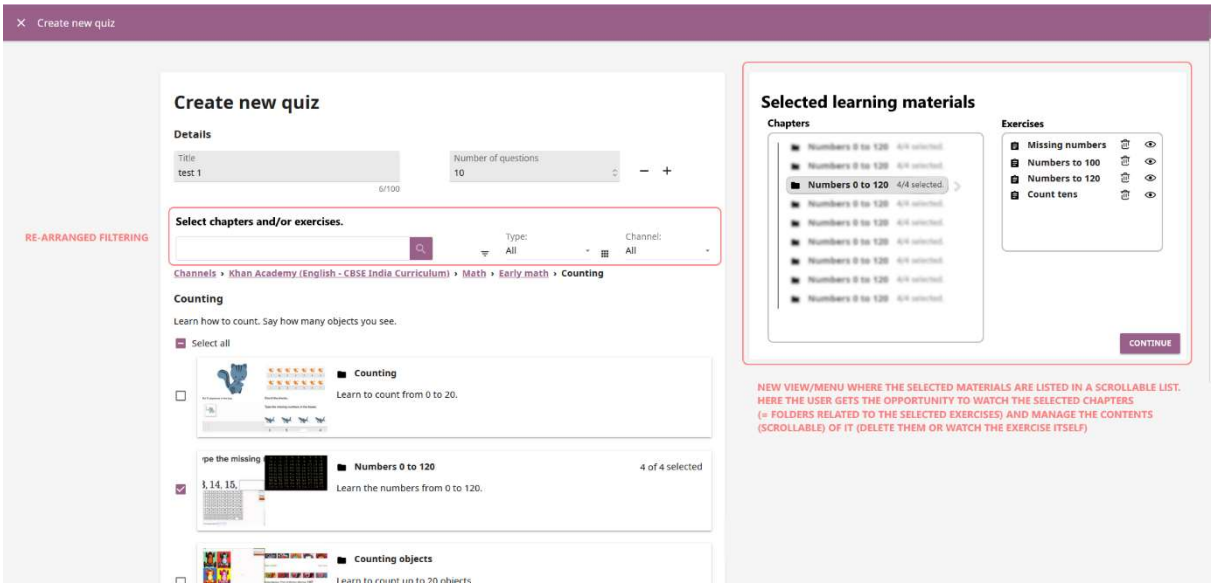
Issue: Lack of Visibility for Selected Materials in Lesson & Quiz Planning

Occurences: 3

Description: Users reported difficulty in viewing selected materials quickly or obtaining an overview during lesson and quiz planning.

Solution: Improve the interface to provide better visibility and access to selected materials during the planning process.

Visual Aid:



[17] Learning Equality, "Kolibri Design System."
[18] Delacroix, "Visual Aids Collection."

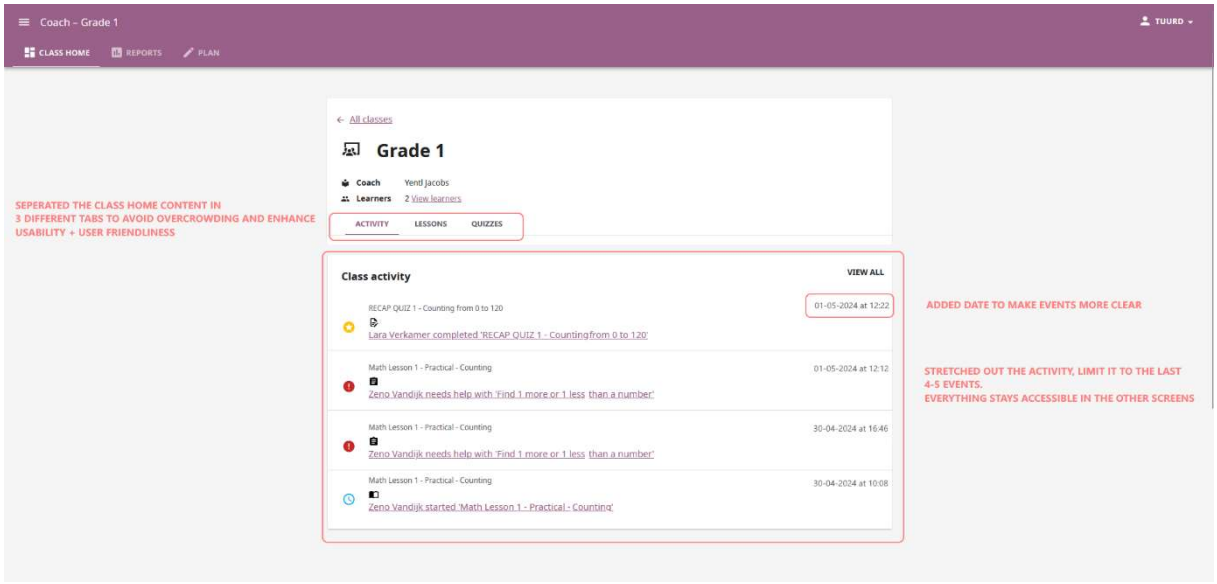
Issue: Overcrowding and Clutter in Class Home Environment

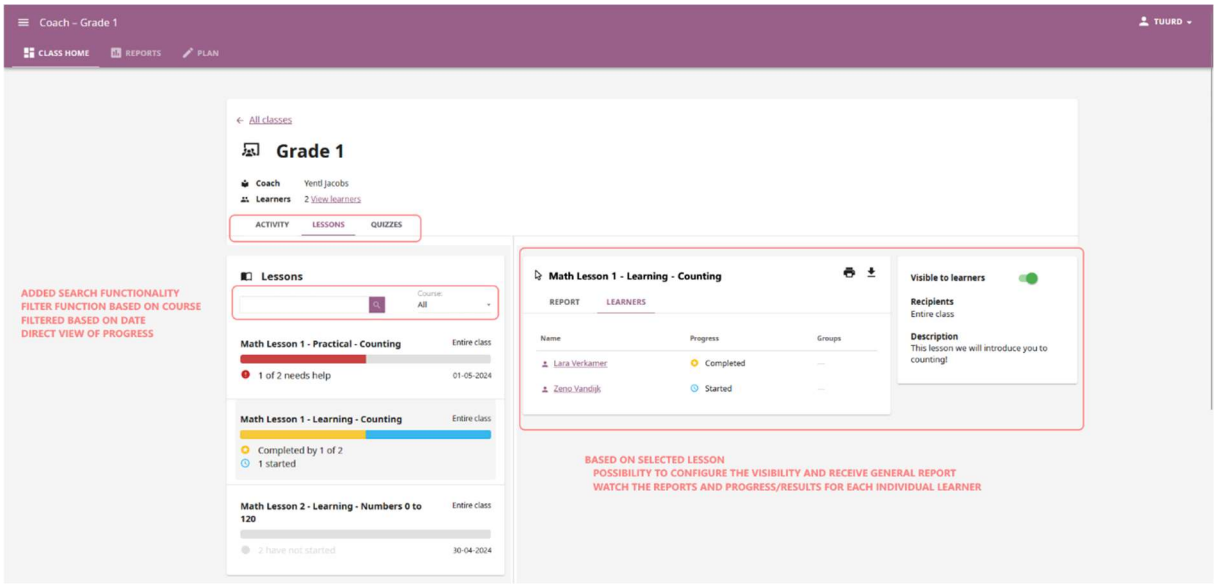
Occurences: 4

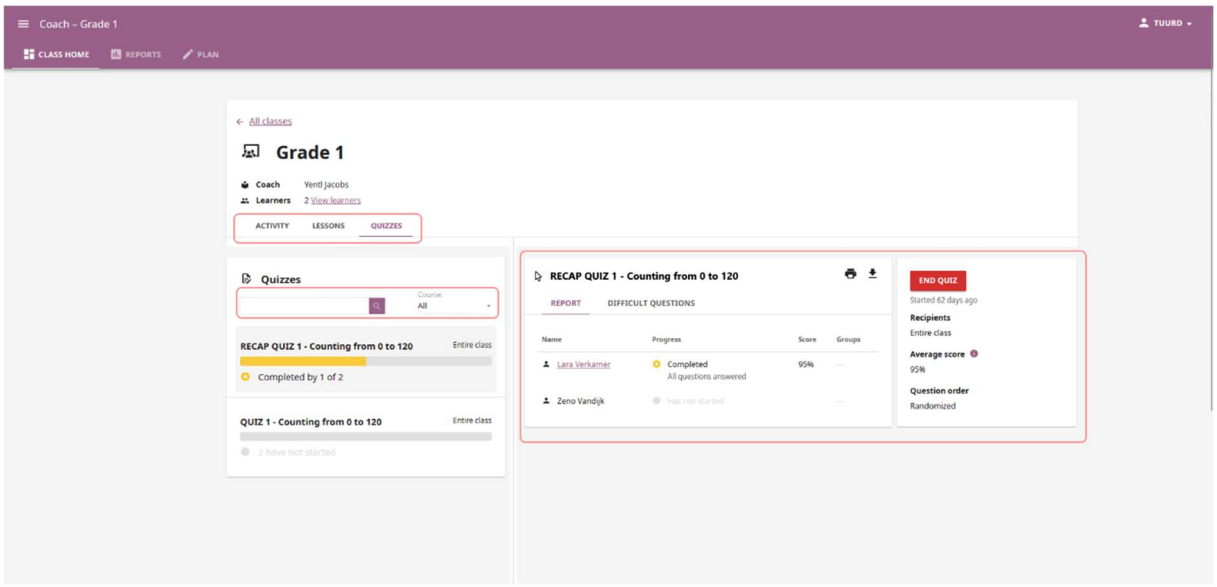
Description: Users expressed concers about the overcrowding and clutter in the "Class Home" environment, particularly with many students, class activity, lessons and quizes.

Solution: Implement features or design elements to mitigate overcrowding and organize information more effectively, such as adding tabs to split the information.

Visual Aid:







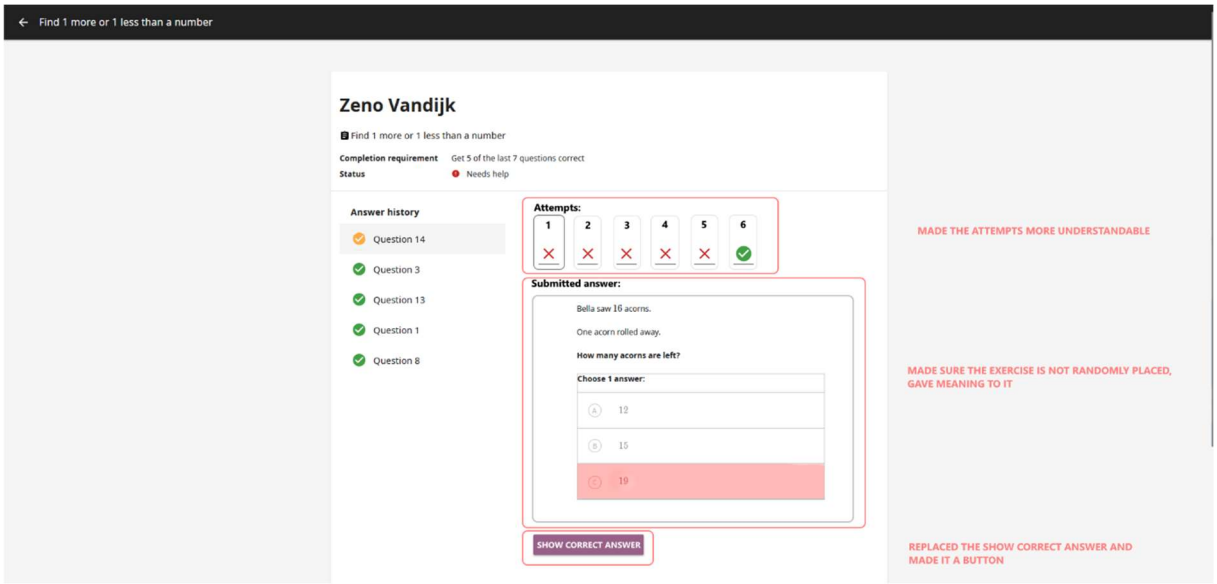
Issue: Lack of Clarity in Reviewing Exercises (non student)

Occurences: 4

Description: Users found it unclear to differentiate between incorrect and correct answers in exercises.

Solution: Enhance the interface to provide clearer distinctions between incorrect and correct answers, improving user comprehension.

Visual Aid:



Issue: Unclear Navigation and Naming

Occurences: 7

Description: Users encountered difficulties in navigation and found certain naming conventions non-intuitive.

Solution: Revise navigation paths and naming conventions paths and propose redesigns with clearer labels and intuitive pathways.

Visual Aid: /

Issue: Localization not always Clear

Occurences: 7

Description: Users found localization within the application to be unclear and not always straightforward.

Solution: Review localization methods and interface design to ensure clarity and ease of use for users of all roles.

Visual Aid: /

Make sure each page has its title and avoid using total new pages for by example watching the contents of an exercise, keep the headers and breadcrumb navigations as long as possible. This will avoid users getting lost in the application.

Issue: Underutilized Lesson Summaries and Filter Methods

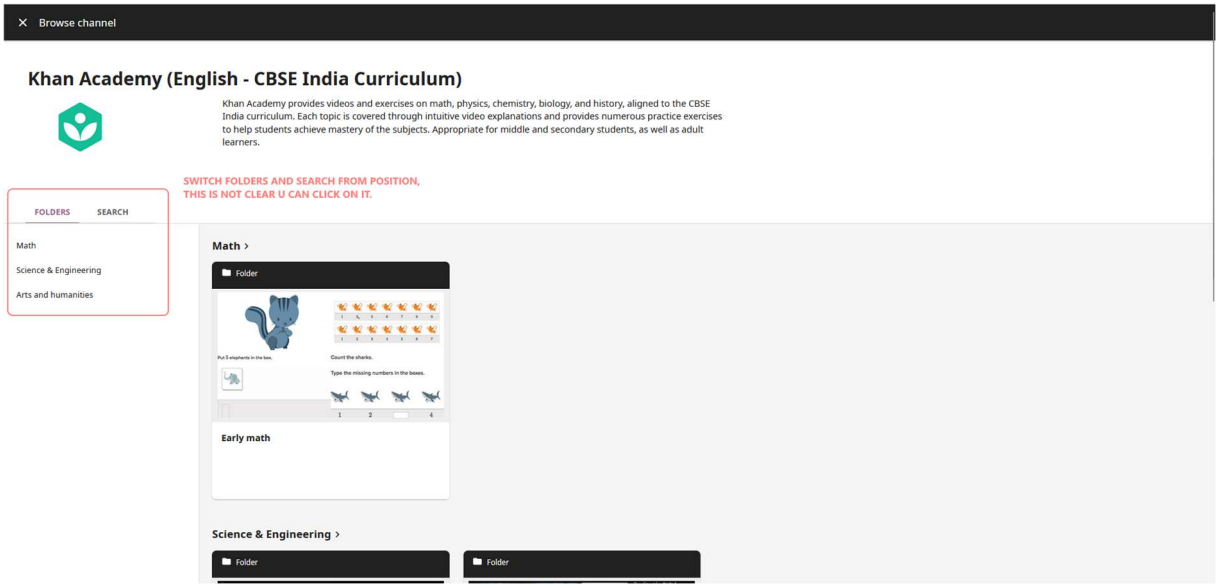
Occurences: 7

Description: Users noted that lesson summaries in "Recent/Your lessons" were not sufficiently utilized and did not adequately describe content. Also all places where users need to navigate through "Resources", are the "Folders", "Search" (Library) not sufficiently utilized. (Mostly they don't know the existance or functionality behind it)

Solution: Enhance the utilization of lesson summaries and navigation functionalities to provide more informative and descriptive content for users.

Visual Aid: /

Make it more inviting or clear to use the "Folders" tab or "Search" functionalities.



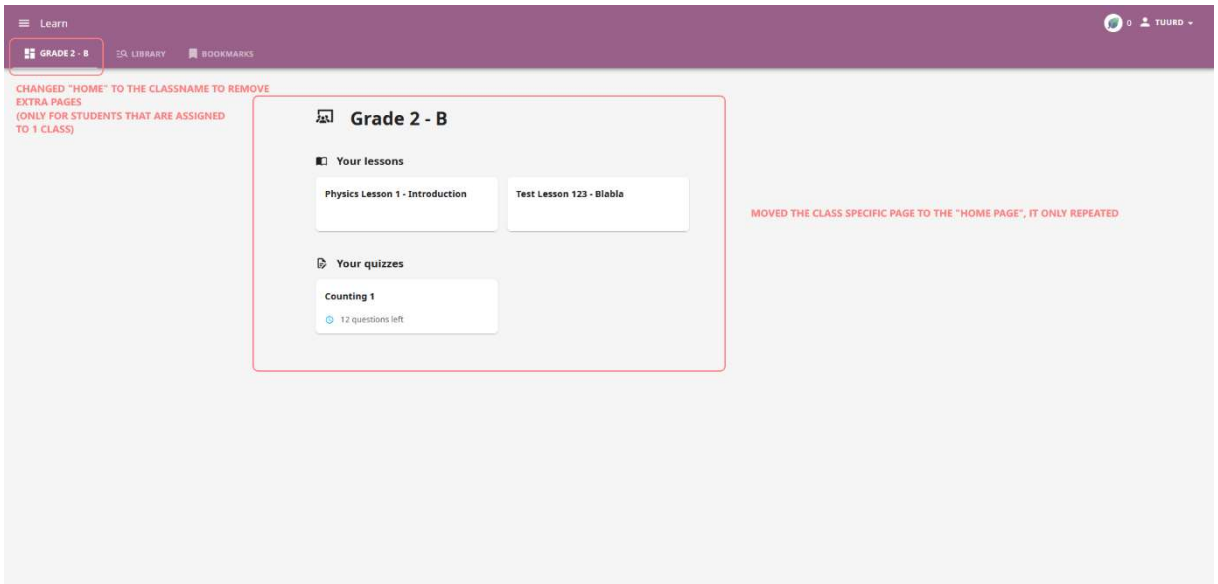
Issue: Lack of Differentiation between "Class page" and "Home"

Occurences: 5

Description: Users found it unclear to differentiate between the class page and the general home page, leading to confusion.

Solution: Remove the multi-pages and combine them into one clear overview.

Visual Aid:



5.2.4 Analysis and application

All the following results are based on the recordings of the 2 editions.[19]

Analysis

The analysis focuses on identifying time lost due to inefficiencies in the user interface (UI) and user experience (UX). To accurately measure time lost, a baseline or acceptable time for task completion is essential. This baseline allows us to calculate the actual time loss by comparing the time taken by users to complete tasks against this predefined limit.

Establishing a baseline for time Loss

To establish a baseline, we define the acceptable time for completing specific tasks on the platform. An acceptable time might is **32 seconds***. Any time taken beyond this limit is considered time loss.

**This is the time I used when trying this task on a slow pace without knowing the solution.*

Time lost calculation

While evaluating the user interface and user experience (UI/UX) issues encountered within the system, a detailed time tracking was conducted to identify the exact durations users were impeded by specific UI/UX challenges. Below is a table summarizing these interruptions:

Sidenote: This was only measured for 1 specific task; 'Find the chapter Counting from 0 to 20'. The time measurement was carried out by reviewing the recordings and timing each session to the second. The timing started the moment the participant received the task and ended when they verbally confirmed or demonstrated that they had successfully navigated to the correct page.

[19] *Playlist User Testing*.

By analyzing the recorded user sessions, we can determine how much time users spent on each task and identify instances where they exceeded the baseline. Here is a table summarizing the time consumed during the testing, highlighting where users exceeded the baseline:

Start Time	End Time	Duration (seconds)	Time Exceeded Baseline (seconds)
17:48	21:01	**193**	**161**
21:11	22:20	**69**	**37**
22:45	23:19	**34**	**2**
3:20	7:23	**243**	**211**
5:40	9:10	**210**	**178**
2:58	5:44	**166**	**134**
4:00	6:11	**131**	**99**
2:53	5:19	**146**	**114**
5:48	7:09	**81**	**49**
1:19	2:05	**46**	**14**
4:59	7:03	**124**	**92**
4:10	4:47	**37**	**5**
9:18	10:11	**53**	**21**
3:24	5:12	**108**	**76**

Figure 15: Time lost table

Total Time Lost: 1,193 seconds (approximately 19 minutes and 53 seconds).

This quantifies the significant impact of the identified UI/UX problems on user efficiency and overall system performance.

Acceptable time loss vs. inefficiency

For our context, a time loss of up to 32 seconds per task can be considered acceptable. This accounts for minor lapses in concentration, occasional connectivity issues, and the natural learning curve associated with using new technology. However, time loss exceeding 32 seconds indicates inefficiencies that can significantly hinder user experience, especially in resource-constrained environments where every second counts.

Analysis of time loss

Critical Disclaimers:

1. The data is based on a specific task and a limited sample size. Larger-scale studies may yield different results, but the trend of cumulative time loss is a critical indicator.
2. The purpose of this measurement is to highlight how minor inefficiencies in UI/UX can lead to significant cumulative effects, especially in educational environments where every minute counts.
3. As developers, it is our responsibility to ensure that we do not burden users, especially those in disadvantaged contexts, with difficult-to-use systems. The goal is to create intuitive and efficient platforms that enhance, rather than hinder, the educational experience.

Scenario analysis for expanded educational environment

To predict the potential impact on a larger scale with more users, consider the following scenario:

Scenario: The scenario involves scaling the system usage to include **4 schools**, with a total of **10.000 students** all using the KUBO system in a way they face **5 of these UI/UX issues**.

Assumptions for Scaling:

1. The frequency and severity of UI/UX issues are consistent across different user types and increase linearly with the number of users.
2. The initial data presumably covers a smaller group, estimated at about 10 students, providing a baseline for average time lost per user.

Calculations:

- **Average Time Lost per User for one UX/UI issue**:

  Total time loss: 1,193 seconds

  Number of users: 14

  Average time loss per user: 1,193 seconds / 14 users ≈ **85.2 seconds per user** (1 minute and 25 seconds)

- **Now, let's calculate the total estimated time lost for 10.000 students across 4 schools with 5 UI/UX problems:**
  - Totale time lost for all students: 10.000 x 85.2 seconds x 5 problems ≈ **4.260.000 seconds.**

Conclusion:
The analysis predicts, based on a rough estimate for the first time, that the UI/UX issues, if not addressed, could lead to a significant cumulative loss of approximately **49 days, 6 hours, and 40 minutes** when scaled up to a simulation (like our current target audience = reality).

This projection underlines the urgent need for UI/UX improvements to enhance both educational efficiency and the overall user experience in larger settings. These figures show that even small inefficiencies in UI/UX in educational systems can add up significantly, especially when scaled to larger groups such as multiple schools.

While 1 minute and 25 seconds might seem insignificant, let's consider the impact it can have:

1 minute and 25 seconds is roughly the time it takes to read a page of a textbook or solve a basic math problem. These seemingly small delays can accumulate over time, hindering your grasp of crucial concepts and slowing down your academic progress.

In many developing communities, fetching water for daily needs is a time-consuming task. In **1 minute and 25 seconds**, you could make 7,1% of the trip to the well (average is 20minutes). Now imagine encountering similar delays every time you interact with a system – it can become quite frustrating!

However, it's important to note that we cannot assume that individual seconds saved will necessarily result in noticeable performance improvements. The real-world impact of time saved can vary widely depending on the context and the specific tasks being performed. While reducing delays is generally beneficial, the cumulative effect on overall performance and efficiency depends on how these saved seconds are utilized and the broader context in which the system operates.

Every minute lost can be seen as a missed opportunity for educational progress and personal development.
- Tuur Delacroix

User Feedback and Average Usability Score

In evaluating the user interface and user experience (UI/UX) of our educational platform, I compiled feedback from a diverse group of users, including students, teachers, and administrators. Each participant rated the system, and their comments provide valuable insights into both strengths and areas for improvement.

Average Usability Score

The average usability score across all users is approximately **7.85** out of 10. This score is based on the general scores given by each user after their session. It reflects a generally positive reception but also indicates significant room for enhancement. An average score closer to 8 suggests that while the system is functional and meets many user needs, there are notable deficiencies impacting overall satisfaction.

General Feedback Themes

Positive aspects:

- **Clarity in Navigation**: Many users found the system relatively easy to navigate, appreciating clear overviews and straightforward processes for tasks such as class creation and student enrollment.
- **Efficient Group Management**: Features like group work and class management were highlighted as efficient and user-friendly, aiding in administrative and teaching tasks.

Areas for improvement:

- **Resource Management and Access:** Users frequently noted difficulties in managing and accessing resources. Issues included unclear labeling, confusing resource categorization and a cumbersome process for adding and organizing teaching materials.
- **Intuitive Design:** There is a need for more intuitive design elements, especially in areas like lesson planning and quiz management. Users expressed confusion over various icons and commands, suggesting that a more intuitive layout could significantly enhance usability.
- **Feedback Mechanisms:** Several users pointed out that the feedback mechanisms for exercises and quizzes were not sufficiently clear or informative, hindering both teaching and learning processes.

User Experience Concerns

- **Navigational Confusion:** Users often felt lost within the application, unsure of where to find specific features or how to return to previously visited pages.
- **Inconsistent Terminology:** The use of inconsistent terminology across different sections of the platform caused confusion, particularly for new users who are not yet familiar with the system's layout.

Conclusion and Recommendations

The average score of **7.85** is a call to action. It underscores the necessity to address UI/UX issues that could be obstructing a more streamlined and engaging educational experience.

Recommendations based on the feedback include:

1. **Enhance Resource Accessibility:** Simplify the process of adding and organizing resources. Clearer labels and a more logical structure in the resource section could mitigate confusion and save time.

   Example: Currently, teachers find it difficult to locate specific educational materials quickly. By simplifying the process of adding and organizing resources, such as implementing drag-and-drop functionality and categorizing resources by subject or grade level, we can reduce confusion and save time. Clearer labels and a more logical structure in the resource section will help users find what they need more efficiently.

2. **Improve Navigational Clarity:** Redesign the UI to make navigation more intuitive. This includes consistent terminology, clearer icons, and possibly a more guided experience for new users.

   Example: Students often struggle to navigate between different sections of the platform, such as moving from their lesson plans to the assignment submission page. Redesigning the UI to include a consistent layout with familiar icons and consistent terminology can make navigation more intuitive. Additionally, providing a guided tutorial for new users can help them understand the platform more quickly.

3. **Refine Feedback Systems:** Develop more descriptive and helpful feedback mechanisms for exercises and quizzes to enhance both teaching effectiveness and student learning.

   Example: After completing quizzes, students receive generic feedback that does not help them understand their mistakes. Developing more descriptive and helpful feedback mechanisms, such as detailed explanations for incorrect answers and suggestions for further study, can enhance both teaching effectiveness and student learning. For instance, if a student answers a math problem incorrectly, the system could provide a step-by-step solution to help them learn from their mistake.

6 Results and discussion

6.1 Choice of path

Based on a thorough analysis of the available options, I have chosen to make use of Kolibri. This decision was influenced by several factors:

- Resource Efficiency: My analysis indicated that developing a platform in-house would demand substantial resources, including time, expertise, and financial investment, which are beyond our current capabilities. In contrast, Kolibri is already a robust and proven platform tailored for low-resource settings, offering a ready-to-deploy solution with comprehensive support structures.

- Technical Compatibility: Kolibri's flexible architecture allows for significant customization through plugins, making it possible to tailor the platform to meet the specific educational needs of The Gambia without the need for extensive coding from scratch. This plug-and-play functionality aligns well with our technical constraints and project goals.

- Community and Support: Learning Equality offers an active community and support network, providing resources, training, and continuous updates. This community will be invaluable as we adapt and scale the platform to suit our needs.

- Sustainability and Scalability: Choosing an existing, widely used platform ensures sustainability. Kolibri is designed with scalability in mind, capable of expanding to accommodate the growing needs of educational institutions in The Gambia.

- Proven Track Record: Kolibri has been successfully implemented in various similar contexts globally, which reassures us of its applicability and effectiveness in achieving our educational goals

6.2 Analysis of findings

Our experimental results reinforce the suitability of Kolibri for our context. User testing highlighted the platform's strengths and weaknesses and accessibility, even for users with limited technological experience. Additionally, the ability to function offline is crucial in The Gambia, where internet access is inconsistent.

The analysis also emphasized the importance of community involvement in the content creation process, suggesting that empowering local educators to tailor and create content directly within Kolibri could enhance engagement and relevance.

6.3 Discussion on impact and relevance

Implementing Kolibri is expected to have a significant positive impact on education in The Gambia. It addresses critical barriers such as lack of access to quality educational resources and supports personalized learning paths which are crucial in diverse educational settings.

By implementing these personalized learning paths, we can potentially leapfrog Western education systems, offering tailored educational experiences that cater to individual student needs and learning paces.

Moreover, this approach aligns with broader educational goals of inclusivity and accessibility, aiming to provide equitable educational opportunities. By leveraging open educational resources, we are also fostering a culture of sharing and continuous learning.

7 Conclusion

This research investigated how individual learning paths built with open educational resources (OERs) can be offered in disadvantaged primary education contexts, specifically in The Gambia. Through comprehensive research, including evaluations of various educational technology solutions and user testing of the Kolibri platform, the study identified a viable pathway for implementing personalized education effectively and sustainably.

Findings revealed that Kolibri, supported by Learning Equality, is the most suitable platform due to its adaptability to low-resource environments, offline capabilities, and strong support community. These features perfectly align with the needs of The Gambia's educational landscape.

The research demonstrates that integrating Kolibri into primary education settings can significantly enhance accessibility and educational quality. The platform offers scalable, customizable learning experiences that are user-friendly and resource-efficient. Notably, its offline functionality is crucial in regions with unreliable internet access, ensuring uninterrupted and consistently available learning.

In conclusion, the adoption of the Kolibri platform represents a transformative approach to learning in disadvantaged educational settings within The Gambia. This approach ensures that every child has the opportunity to access quality education tailored to their individual needs and circumstances.

By embracing Kolibri, we pave the way for a future where quality education is a universal reality, not a privilege.

8 Recommendations

8.1 Contribution to the field

This thesis makes a significant contribution to the field by demonstrating the transformative potential of the Kolibri platform in expanding educational access within disadvantaged contexts. It highlights how technology can move beyond simply supplementing traditional education and instead fundamentally reshape how learning is delivered. This transformation is achieved through personalized learning pathways empowered by open educational resources.

8.2 Recommendations for future research and practical applications

1. Structured Training and Implementation Framework: Establish a comprehensive framework that includes detailed educator training using the Kolibri EdTech Toolkit. This should be supported by pilot testing in a controlled setting to refine training methodologies based on educator feedback.
2. Sustainable Partnership with Learning Equality: Solidify a long-term collaboration with Learning Equality to ensure ongoing platform support and development, including regular updates and custom plugin development that meets the specific educational needs of The Gambia.
3. Engagement with Global Educational Technology Organizations: Strengthen ties with organizations like offline-internet.org to enhance resource sharing, advocacy, and technical support, amplifying the project's impact and reach.
4. Longitudinal Impact Studies: Conduct long-term studies to assess the educational impacts of the Kolibri platform implementation in The Gambia, focusing on learning gains and academic achievement over an extended period.

9 Future perspectives

9.1 Future developments for KUBO

Looking ahead, I'm committed to enhancing Kolibri's impact in The Gambia. A key initiative is developing a custom KUBO plugin that seamlessly integrates with the platform. This plugin will streamline the connection between student assessments and report generation within KUBO, boosting efficiency and effectiveness.

To ensure the plugin meets both technical and user needs, we'll follow a two-pronged approach:

- Technical Alignment: We'll adhere to Learning Equality's standards, guaranteeing compatibility with future Kolibri updates and access to their robust support structure.
- User-Centric Design: We'll incorporate feedback from Gambian educators to tailor the plugin to their specific requirements and maximize its practical value.

Through this collaborative development process with Learning Equality, we aim to create a valuable addition to the Kolibri ecosystem, ultimately empowering educators and improving learning outcomes in The Gambia.

9.2 Practical implementation

A crucial aspect of the integration will be user management. KUBO accounts will be linked directly with Kolibri accounts, eliminating the need for users to create new accounts. This unified login system will streamline the user experience and ensure seamless data sharing between platforms.

1. Aligning Platforms for Feedback Integration: We will integrate Kolibri's student assessment data with KUBO using APIs to fetch data on student performance in assignments, tests, and exams. This data will be utilized within KUBO to generate detailed reports that reflect individual student progress, strengths, and areas needing improvement.
2. Personalized Learning Paths: With the assessment data integrated, we can analyze it within KUBO to identify learning gaps. This analysis will provide feedback to Kolibri, enabling it to present students with customized sets of exercises. Depending on the feedback, Kolibri will offer students easier or more challenging exercises tailored to their learning needs. This ensures that each student receives a personalized learning experience that supports their educational growth.

3. **Continuous Improvement and Feedback Loop:** Using the KUBO-generated reports, we can continually refine and enhance the learning materials on Kolibri. Teachers' feedback on the effectiveness of the exercises will inform future content updates. Regular updates and improvements will maintain alignment with Kolibri's updates and educator feedback, ensuring the system evolves with user needs.

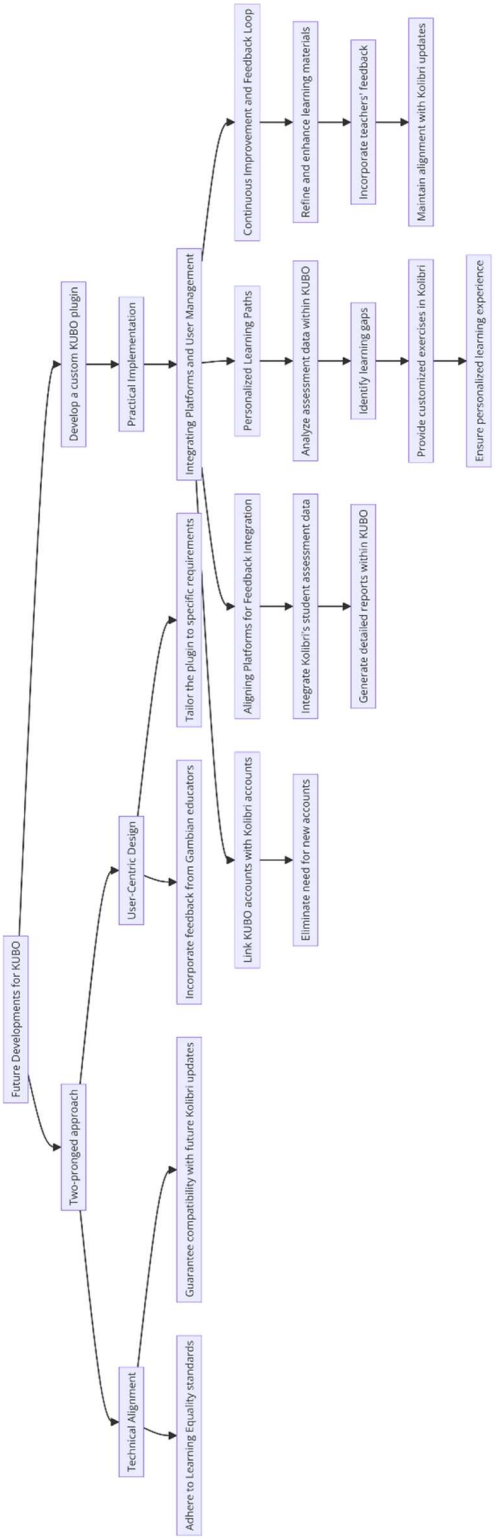


Figure 16: Future Developments Diagram

Incorporating gamification into the Kolibri/KUBO platform.

The integration of extended gamification into the Kolibri/KUBO educational platform could serve as a strategic enhancement, fostering greater engagement and retention among learners. Gamification involves applying game-design elements in educational settings, an approach supported by studies such as those conducted by Pol Goetstouwers[20], which suggest a positive trend in retention and engagement through these methods.

Briefly, the potential benefits of introducing gamification into Kolibri include:

- **Increased engagement:** Game mechanics like points, badges, and leaderboards can make learning more interactive and enjoyable, which is crucial in maintaining student interest.
- **Enhanced retention:** Incorporating challenges and rewards can help reinforce learning content, improving retention over time.
- **Personalized learning:** Adaptive learning paths enabled by gamification can cater to individual learner needs and pace, enhancing the personalization of education.
- **Consistent participation:** The motivational aspects of gamification can encourage regular engagement with educational content, an essential factor in environments with limited educational resources.
- **Deeper learning opportunities:** Though more research is needed, gamification could potentially foster critical thinking and problem-solving through engaging, real-world applicable challenges.

Given these potential benefits, future iterations of the Kolibri/KUBO platform should consider testing and implementing gamification strategies to assess their impact on engagement and learning outcomes in diverse educational settings.

[20] Goetstouwers, "Een Onderzoek Naar Het Effect van Gamification Op Retentie."

9.3 Potential impact on education in developing countries

The Kolibri implementation in The Gambia holds immense potential to serve as a blueprint for similar initiatives in developing countries. By meticulously documenting and analyzing the adaptation process and the challenges overcome, we can create a valuable framework for regions facing comparable educational and infrastructural hurdles.

Kolibri's inherent scalability and adaptability make my findings universally applicable across diverse educational technology deployments. Crucially, the platform's effectiveness in low-resource settings, coupled with its flexibility for integrating local content, allows for replication and customization to address the specific needs of learners in various geographical and cultural contexts.

9.4 Community-driven content creation

Moving forward, we're excited to launch a pilot project exploring the power of community-driven content creation. Local teachers and students will participate in workshops, equipping them with the skills to use Kolibri Studio and develop educational content directly relevant to their cultural and educational background.

This project goes beyond content creation. We'll measure its impact on student engagement and learning outcomes, investigating how empowering local voices can enhance the learning experience. By fostering a sense of ownership and pride within the community, we aim to not only increase the relevance and engagement of learning materials, but also establish a model for participatory educational resource development. This model has the potential to spark innovation and creativity in learning across diverse contexts.

To do before trip to The Gambia

Task	Status	Date	J	J	A	S	O	N	D
Curriculum Mapping	Finished	Now – Sep 1st							
Afrodidact Learning Materials	Delivered	Now – Sep 31st							
Channel Creation	Finished	Aug 1st – Oct 31st							
Kolibri Configuration	In progress	Sep 1st – Oct 31st							
Training Preparation	Finished	Sep 1st – Departure							

Figure 17: Preparation planning The Gambia

To do on-site in The Gambia

Task	Who	W1	W2	W3	W4	W5	W7	W8
Installation & Introduction Kolibri	Teachers							
Training/Workshops	Teachers & Learners							
Discussing Lesson Planning	KUBO & School							
Initiate Individual Usage	Teachers & Learners							
Analysing Usage	KUBO							

Figure 18: On-site planning The Gambia

10 Reflection

10.1 Personal learning experiences

My passion for leveraging technology to make a positive impact drove my pursuit of this research endeavor. While not stemming from a specific personal anecdote, it aligned with my unwavering belief in providing equitable opportunities for all.

The research process presented its challenges, particularly the realization that my role was not to develop a product but rather to conduct in-depth research. I persevered by finding gratification in milestones such as establishing international connections, securing an article on the Learning Equality blog, and contributing to a radio spot for Afrodidact.

Through this experience, I discovered that while a wealth of high-quality educational resources exists, a significant gap remains in distribution mechanisms for underserved communities. The human factor proved paramount; without practical implementation, even the most sophisticated systems would falter. These insights fundamentally altered my perspective on education and technology, highlighting the potential for improvement, even within Belgium's own educational landscape.

The research notably enhanced my communication skills with stakeholders and my ability to take initiative. These refined competencies will undoubtedly serve me well in my future career aspirations, where I envision myself seamlessly blending development, analysis,

10.2 Reflection on the research process

My sincere gratitude extends to my internal and external supervisors, Yentl and Shane, whose invaluable guidance and feedback were instrumental in shaping the trajectory of my research. Their unwavering support in reviewing my work and providing strategic counsel proved indispensable.

Key findings emerged, including the exploration of offline educational material accessibility through Kiwix and the utilization of platforms like Kolibri and BEEKEE to deliver comprehensive learning environments. Collaboration with fellow interns and colleagues was intentionally limited, allowing me to foster my independent research capabilities.

In conclusion, this research experience has profoundly impacted my professional growth and underscored the critical importance of accessible education in disadvantaged contexts.

AI Engineering Prompts

I haven't used any relevant AI Prompts (most of them are about text-correcting and visuals). The only entered prompts are:

- "Correct these sentences and make them more clear/understandable without changing the content [text]"
- "Can you make sure this text aligns with the previous, it needs to be a story I'm telling: [text]"
- "Translate this to English: [dutch text]".
- "Create a 2d diagram for this text: [text]"

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Appendices

Figures