# Lemon Teacher

Social Media Platform for Teachers in Sarawak, Malaysia

ICT4D in the Field - Group 4

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# 1 Introduction

Sarawak is a state in Malaysia on a mission to achieve a high-income developed state status by 2030 [1]. A good education for its children is therefore essential. The goal of this project is to find sustainable ways in which we can support the primary education system in Sarawak to achieve its goals. To do so, we listed the ways in which this could be achieved, namely: support the children outside school, support the teachers outside the school or support the classes themselves. During the interviews, we got a much better picture of the context and were able to narrow down our focus. For example, in our target area, most children have a mobile phone or access to their parent's mobile phone and teachers need to take care of their own teaching material in large part.

To improve the situation, we could either focus on improving the classes themselves or improve the situation outside classes for either the teachers or the children. For the latter, this would mean trying to get the children's attention for education. Although educational mobile games exist and have been developed, in practice it is hard to compete with entertainment-first applications such as mobile games and social media. To improve the situation in class, teachers indicated that the best way is interaction. Therefore we considered developing interactive games that could be used by teachers in class, but similar to mobile games, this takes significant time to develop for each part of each course. Furthermore, Sarawak is dealing with a major teacher shortage [2], resulting in a heavy workload. Hence, we decided to focus solely on supporting elementary teachers.

During the interviews, teachers indicated that they have to spend quite some time preparing for classes and gathering the right teaching material. Facebook and Telegram groups are used for sharing free and paid content. These are not designed as a marketplace for teaching materials, making it difficult to find the right materials and to know the real creator of the teaching material. In this report, we present *Lemon Teacher*. Lemon Teacher is a platform where Sarawak teachers can search, manage and share teaching material. Experienced teachers that have gathered teaching materials over their career can earn status by sharing it. Starting teachers can easily find material thanks to the structured setup of the platform. In section 4 we present the proposed design and interaction of the system and in section 5 the technology behind it. Subsequently, we discuss the details and how we think Lemon Teacher can be a sustainable solution for elementary teachers in Malaysia.

# 2 Stakeholders

We performed the initial context analysis and identified the needs and outlined the requirements in the state of Sarawak. We interviewed the teachers at the school of SK Muhibbah. The three core stakeholders for this project are the school children in the rural area and Malaysian teachers. The children are from a school named SK Muhibbah, with ages between 9-11. The teachers are divided into two categories: UNIMAS students who are currently undergoing their internship under Dr. Cheah Wai Shiang's supervision and who are appointed as tuition teachers for Saturday classes at SK Muhibbah as part of their internship tasks, as well as regular school teachers from SK St James Quop and SK Muhibbah. The stakeholder's goals and responsibilities are illustrated in Table 2.

| **Stakeholders** | **Goal/Objective** | **Responsibility** |
|---|---|---|
| School children | Access to high quality education that nurtures their overall development | Active participation in the learning process |
| Teachers | Provide education through effective teaching and learning experiences | Act as an educator and update their knowledge and skills |

Table 1: The goal/objective and responsibility for the stakeholders involved in the system

A regular school teachers must follow a specific route in order to attain the status of a teacher where they are presented with three options offered by the Ministry of Education [3]. The first option is to enroll in the Institut Pendidikan Guru (IPG) and apply for the Program Ijazah Sarjana Muda Perguruan (PISMP). This involves completing a one-year preparatory program followed by a 4-year bachelor's degree program in education, Program Ijazah Sarjana Mudu Perguruan (PISMP). After registering with Suruhanjaya Perkhidmatan Pendidikan (SPP), graduates can teach in government primary schools.

The second option requires the individual to pursue a diploma in education, where meeting minimum requirements at the SPM level is necessary. This program focuses on providing the essential

skills for teaching, including a teaching practicum. After passing the program and registering with SPP, individuals can become primary school teachers in government schools. Alternatively, a degree in education is required for teaching at the secondary school level and beyond. Graduates of this program must also register with SPP and may need to wait for a posting call.

Individuals who already hold an unrelated degree can pursue a postgraduate diploma in education. This program is available at both public and private universities. Completing the postgraduate diploma allows individuals to become teachers in government schools or apply directly to the private sector.

Lastly, the Teach for Malaysia (TFM) Fellowship program offers an opportunity to gain teaching experience without requiring an education-related degree. After graduation, applicants can apply for the program, but placement is determined by the Ministry of Education and there is no guarantee of a teaching position after the two-year fellowship.

# 3 Context

## 3.1 Interview Summaries

Several key points have emerged from the interviews conducted with UNIMAS students who serve as tuition teachers for Saturday classes, regular school teachers and students from SK Muhibbah. The detailed interview transcripts are in the Appendix Section 14.1.

### 3.1.1 Educational Materials Acquisition Through Multiple Platforms

The teachers gather and acquire their teaching materials from various platforms in order to cater to the diverse learning needs of their students. Telegram, free or paid membership, serves as their primary platform for accessing teaching materials, engaging in discussions and sharing tips with other teachers in the same subject area. They find Telegram particularly useful for obtaining resources that align with their teaching requirements. Google is another platform they utilize, where they access teaching materials and make necessary edits to tailor them to their specific classroom needs. This allows them to customize the content to better suit their students' learning preferences. In some cases, the teachers convert their self-created slideshows into videos using Microsoft PowerPoint. This enables them to transform their presentations into more interactive and dynamic formats, enhancing student engagement during lessons. Overall, the teachers leverage different platforms to acquire, adapt and enhance their teaching materials in order to cater to the individualized learning needs of their students.

### 3.1.2 Student Disengagement

Students demonstrate a noticeable lack of enthusiasm and motivation to actively engage in classroom activities. Consequently, absenteeism among students significantly rises as they perceive the class and instructional materials as monotonous and uninteresting. They find it challenging to maintain focus during learning sessions, resorting to other activities to alleviate boredom and combat feelings of drowsiness. Furthermore, students struggle to sustain interest and participation when teachers predominantly deliver theoretical content without incorporating interactive activities that promote active engagement and enjoyment.

### 3.1.3 Insufficient Grasp of Fundamental Knowledge

Some students demonstrate a lack of proficiency in essential knowledge areas such as reading, writing, basic mathematics and even basic IT skills like using a mouse or keyboard. With the shift to remote learning during the pandemic, these challenges were amplified, particularly for students in rural areas who face difficulties accessing reliable internet connections. As a result, they often encountered difficulties attending online classes and experienced gaps in their education. Furthermore, the insufficient availability of teaching materials also contributes to this issue, despite the government providing yearly incentives to schools. The allocated incentives are insufficient to cover the cost of acquiring the necessary teaching materials. This shortage of resources further exacerbates the deficiencies in fundamental knowledge among students.

### 3.1.4 Challenges in Student Behaviour Management

Managing student behavior is a notable challenge in the teaching process. This challenge is particularly evident when dealing with Class 3 students, who are around 9 years old and tend to

exhibit high levels of hyperactivity. Due to the difficulty of controlling and managing these students individually, teachers often rely on the use of candy rewards to incentivize good behavior and performance. In addition, teachers recognize the need to create a more engaging and interactive learning environment rather than solely focusing on traditional teaching methods, such as writing on the whiteboard. Additionally, it is noted that the pandemic has contributed to the lack of discipline among students. Certain students display diverse behavior patterns that necessitate teachers to adopt specific strategies during their learning sessions. This is particularly true for students with autism, who may require alternative approaches to effectively manage their behavior. The teacher may employ techniques such as using a softer, more patient tone when speaking to these students or incorporating play-based activities into the learning process. These individualized approaches ensure that students with autism receive appropriate support and create an inclusive learning environment that addresses their unique needs.

## 3.2 Context Analysis

After picking the use case, we conducted multiple interviews with the Saturday teachers, regular teachers of SK Muhibbah, the resource people and Dr. Cheah. We also approached Dr. Anna to understand the solutions implemented and proposed in the previous iterations of the ICT4D in the Field course. We went through five solutions that have been implemented since 2018; all of these solutions have been focused on improving the learning of the students through the use of game-based learning applications. The drawback so far that has to be acknowledged is the fact that these applications have had a limited time frame in which they can be used and they all need constant human intervention to keep the applications updated and relevant. These solutions also do not have any innovative ideas that set them apart from the competition in the industry.

We did explore the use of games as a means to improve the attention and motivation of the students and help them in their studies. We explored, proposed and implemented a few interactive games and exercises. We initially tested a couple of games in the Saturday school with the help of the Saturday Teachers in our course. We received positive feedback from the teachers as there was a noticeable improvement in the learning of the students. But this also brought to our notice the problem that this would not address the root cause of the problem we were seeing with the students. The problem that we noticed when we dug deeper and it was validated by the teachers in the interviews, was that there had been a lack of access to teaching materials. This problem is amplified for the Saturday Teachers, as they have had no professional experience in teaching, nor have they received any training to teach any students. This was not a situation of mentoring fully-grown students but a situation that demanded a lot of pedagogical skills. This made us want to explore a different path of addressing the needs of teachers instead of focusing on the students to help address the use case.

## 3.3 Problem Statement

The teachers across Sarawak, both the Regular teachers and the Saturday teachers, face the problem of finding and accessing teaching resources that would improve the teaching experience for the teachers and the learning experience for the students. The teachers basically have to reinvent the wheel and prepare their own teaching material and every teacher starts from scratch at the start of their careers and they need to keep updating their materials to grasp the attention of the students and keep them motivated. The regular teachers do have access to Telegram groups, which sell materials, but it is not easy to filter or search through the materials, as these messaging applications are not built for this purpose. The Saturday teachers have to find their materials through Google and spend a considerable amount of time doing so. They also do not have access to good quality materials, nor do they have the necessary skills in teaching. The teachers also do not have a forum to interact with each other, exchange experiences and discuss anything related to teaching. The teachers also saved their materials in portable storage devices, such as flash drives and are at risk of potentially losing their materials due to the loss of such devices or failure due to corruption.

## 3.4 Proposed Solution and Scope

We propose our solution, Lemon Teacher, a resource repository and educational sharing platform that would enable all the teachers in the area of Sarawak and theoretically across Malaysia and even the world to share and obtain teaching materials that they require. The teaching materials could take many forms, such as Worksheets, Videos, Podcasts, Exercises, Presentations, PDFs,

Games, Exercises, etc. These teachers will also have access to a forum where they can interact and discuss with other teachers about any topic and also share their own experiences on the posts or answer the questions asked by other teachers. We also enable the teachers to bookmark and save the resources that have caught their eye as a repository for easier access from anywhere and at all times. We also provide the features, such as filtering and searching, that would make it easier and faster to access the resources that they need. The resources can be filtered and searched based on the type of resource, the intended audience of the resource, the subject and the course or topic. We also have added a ChatBot that would enable the teachers to interact with ChatGPT, which can enhance and augment their experience.

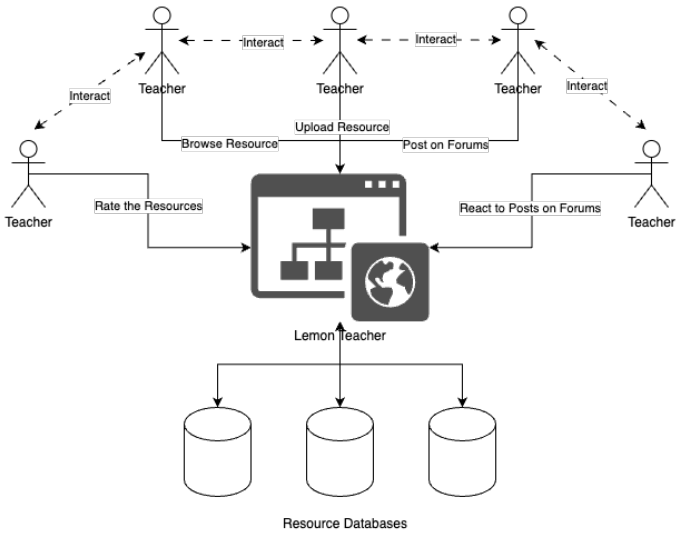


Figure 1: Interaction between the stakeholders and the proposed solution

The scope of our solution assumes that the teachers are willing to upload and share their resources without expecting any remuneration. But in the future, we will fully be able to implement a payment module that would take donations or payments in exchange for the material. We also do not focus on content moderation and validation in this iteration of the solution, but we acknowledge that this will be important to provide a better user experience for all the stakeholders. We support self-regulated content moderation in the form of user reviews in the form of a 5-star rating and comments that would help guide the users(teachers) to find good quality resources from a selection of similar resources.

## 3.5 Interaction between the involved parties

Figure 1 depicts the illustration of the interaction between the involved parties, the teachers and school children. The teacher uses the platform to upload and download their educational resources. The uploaded contents will be stored in the database and available publicly to other users of the platform and can be downloaded. The teachers are also able to browse more content on the platform.

## 3.6 Interaction with the stakeholders and their concerns

### 3.6.1 Internal Stakeholders

The teachers are classified into two groups: UNIMAS students who serve as part-time tutors on Saturdays and regular school teachers in Malaysia. These teachers often rely on platforms like Telegram, YouTube, or Google to find their teaching materials. However, these platforms do not fully meet their expectations as the search process can be time-consuming. There are also a few notable reasons for their dissatisfaction including limited or incomplete content, quality concerns and limited customization options. The proposal aims to address this issue by offering a convenient platform that allows teachers to access teaching materials tailored to their specific needs and saves them time simultaneously. By providing a centralized hub for gathering teaching materials and facilitating connections with other teachers such as through forums, teachers would greatly benefit from a streamlined and efficient process before entering the classroom.

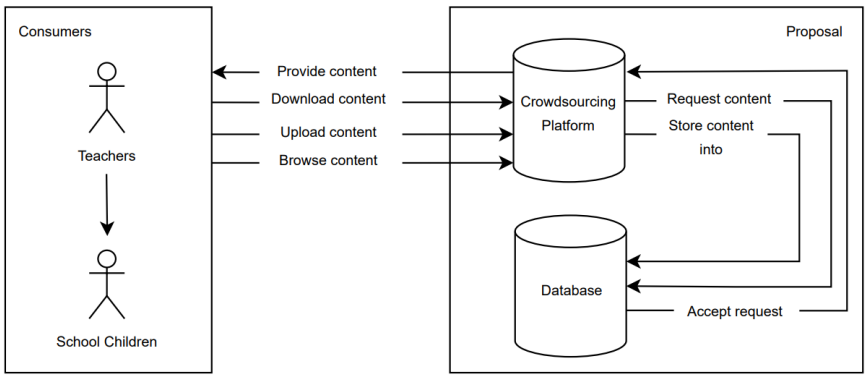


Figure 2: Interactions between the involved parties.

### 3.6.2 External Stakeholders

The primary external stakeholder in this context is school children residing in the rural area of Kampung Muhibbah. Typically, the government offers an annual incentive to teachers to purchase materials that support the students' learning needs. However, the provided incentive is often insufficient, resulting in a lack of adequate learning resources. While the school children are not directly involved in implementing the proposal, they are one of the central focuses and are greatly impacted by it. The proposal aims to address issues related to their education, benefiting them by providing necessary resources and support.

### 3.6.3 Scope of the scenario

To prepare for their classroom sessions, teachers gather teaching materials from various sources, with Telegram being their primary platform. They join Telegram groups consisting of teachers in the same geographical area or teaching domain, as well as content creators who design and sell specific teaching materials. While some content is fully free, there are also partially free resources available, with teachers having the option to purchase the full version if they find it beneficial for their students. Teachers sometimes share teaching materials with their peers, which they acquire from Google and modify to suit their students' needs. However, selling these materials without proper authorization can potentially lead to issues of plagiarism or copyright infringement. It can also be challenging for teachers to locate the specific teaching materials they want to use or purchase, as they often have to scroll through the group to find what they need. Therefore, the project aims to only cover several key aspects that include sharing teaching resources among teachers, ensuring the quality of the materials shared, organizing and categorizing resources based on subject, grade level and topic; and fostering collaboration and community engagement among teachers.

### 3.6.4 Success or performance measures

A few metrics are used to measure the success or performance of the proposal, including the number of daily and registered users, the volume of uploaded and downloaded files, as well as user satisfaction. Assessing the platform's success through the number of daily and registered users indicates consistent engagement and growth among active users, reflecting its expanding influence within the teaching community. Moreover, the quantity of educational resources shared and accessed on the platform indicates its effectiveness in facilitating knowledge exchange among teachers. User satisfaction, measured through feedback and ratings from platform users, offers valuable insights into the extent to which the platform fulfills their needs and expectations.

### 3.6.5 Important preconditions

In order for our proposal to succeed, there are three preconditions that must be met. Firstly, it is important that teachers perceive value in the platform's resources. This ensures that the platform attracts quality resources and encourages teachers to actively participate. We need to ensure that this perception of value must translate into an economically sustainable model. We assume that the teachers upload their resources for no cost, or even if they expect a small nominal payment, we

would assume the other users would be willing to pay for it. Secondly, the platform must generate sufficient interest and engagement to attract a diverse community of teachers, enabling them to gather a wide range of valuable resources. Lastly, it is crucial that teachers who upload teaching resources do so in good faith, without plagiarism or copyright infringement. Upholding ethical practices promotes trust and ensures that the platform maintains a high standard of quality and originality.

### 3.7 Barriers to Adoption

There could be many potential barriers to the adoption of our system by the users, which we will have to tackle to truly make an impact and help make the education system at Sarawak better. The first barrier could be a lack of awareness of our system among the teachers. This lack of awareness not only hinders our effort to make a difference and help them, but it would also cause a problem where our envisioned platform would not have enough crowd-sourced resources to keep it self-sustainable. The user interface and user experience of the platform should be simple, keeping in mind the fact that the teachers are not tech-savvy and any challenges faced due to unfamiliarity with technology might keep them from using the platform. Some teachers may also be resistant to the idea of sharing resources with other teachers or using resources from other teachers. They may also be resistant to embracing the digital platform in general and might stick to offline methods. We need to acknowledge this resistance that is seen in general among the citizens of the Global South and this has been noticed in the other ICT4D implementations as well. We also need the platform to be trustworthy in terms of data privacy, security, the quality of the content and many other aspects. We have discussed in detail the quality aspects of our platform in Section 9. The resources and the features that we have planned to provide should also be easily accessible to save time and effort, as it should not feel like an extra burden on the already hectic work schedule of the teachers and this platform should aim to ease their workflow and not the opposite. These are some of the main barriers that would pose a problem in the adoption of the platform with a larger crowd, which have to be taken into consideration and we should workaround around these challenges.

## 4 System Design and Description

### 4.1 Use Case Scenario

The system aims to provide an easy to use platform that meets the needs and wishes of the users. The two most basic functions of the website are facilitating the posting and finding of teaching materials. Both functions are illustrated in the following scenarios.

#### 4.1.1 Posting new materials

The first scenario covers teachers who wish to upload their teaching materials to the website. They will use the platform as followed:

1. The user goes to the website, then to the upload page.
2. The user uploads the materials.
3. The user adds title and descriptions to the post.
4. The user adds relevant tags and keywords to the post, the system will offer auto complete features to minimize the likelihood of typos.
5. The user sets the post to public or private.
6. The user confirms the post.
7. The system will save the material to the database.


Figure 3: Use Case for Posting Content

### 4.1.2 Discovering teaching materials

The second scenario covers users who are looking for teaching materials using the platform. They will use the platform as followed:

1. There are 2 ways a user can find posts to their desired materials: by browsing through their feed or using the search function.
   (a) When browsing the feed, the user is shown post of other users that they have followed. The user can select the post that they are interested in.
   (b) When searching for posts, the user can input specific tags or keywords to filter results.
2. After selecting a post, the user can download the material.
3. The user can also follow the user and like the post.

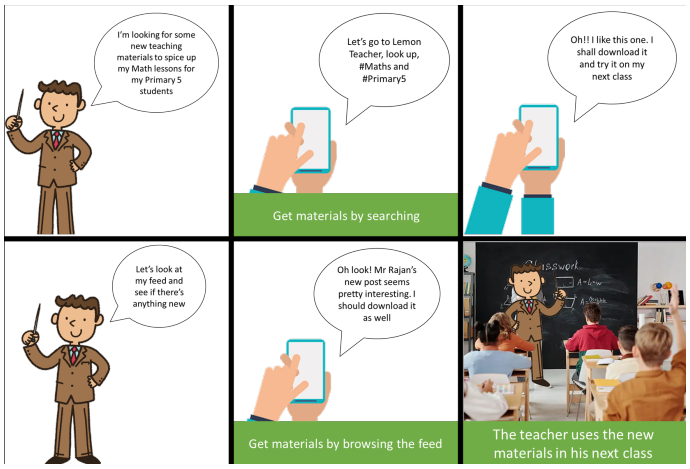


Figure 4: Use Case for Downloading Content

## 4.2 Interaction and Communication

The proposed main flow of the application is illustrated in the figure below, which shows the possible narrative for the user. When it comes to posting new materials, teachers can easily upload their

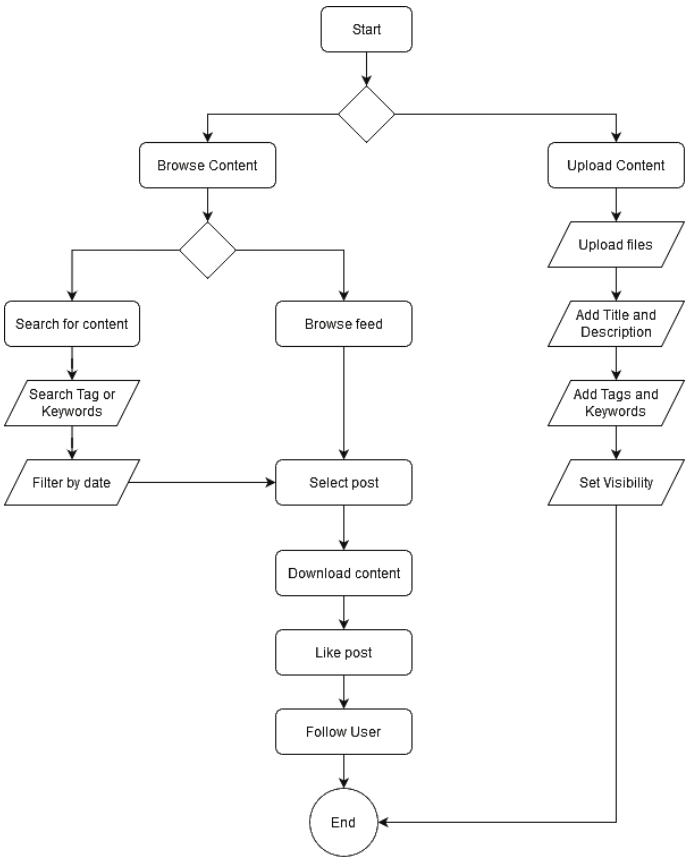


Figure 5: Main Flow of Platform

resources on the platform. They provide titles, descriptions and relevant tags and choose whether the post should be public or private. This ensures that their materials are appropriately categorized and searchable. Once confirmed, the system securely saves the materials to the platform's database, making them readily available for others to access and benefit from. Users can browse for content in two ways: via the home page or the search function. In future prototypes, when exploring a user's personalized feed, posts from users they follow are displayed. Alternatively, users can use the search function to find specific materials. By entering relevant tags or keywords, they can refine their search and discover resources that align with their specific needs. Once users have found a post that interests them, they can easily download the material. Additionally, in the future, users will have the option to follow the creator, like their posts and provide feedback.

## 4.3 Innovation and Reliability

Our proposed solution, Lemon Teacher, aims to bring innovation and improvement to the current challenges faced by teachers in Sarawak. We want to strive to create a platform that not only addresses the need for accessible teaching resources but also fosters a sense of community and collaboration among educators. By providing a centralized repository of teaching materials, we want Lemon Teacher to revolutionize the way teachers access resources. We want to remove the unnecessary effort that the teachers have to put in spending countless hours searching for resources through multiple platforms or relying on fragmented Telegram groups.

We want to encourage teachers to share their own resources and serve as a catalyst for knowledge sharing, empowering teachers with a wealth of diverse materials. This would a collaborative environment where educators can learn from one another, exchange ideas and improve their teaching practices. This collaborative spirit not only benefits individual teachers but also contributes to the overall growth and development of the teaching community in Sarawak.

We also recognize the importance of personalized learning experiences. Lemon Teacher's bookmarking feature allows teachers to curate their own collections of favorite resources. This personalized repository enhances their teaching methods and ensures easy access to materials from any device, eliminating the risk of losing valuable resources due to device failure or loss.

With Lemon Teacher, we want the teachers to trust in the reliability of the platform. We aim

to have all resources to have undergone a quality check. The teachers can also be confident with the fact that the resources are shared by fellow educators. The resources available on our platform are curated and reviewed, ensuring that they meet the required standards and are relevant to the specific educational needs of Sarawak's teachers.

# 5 Technology Infrastructure

## 5.1 Information Concepts

Our application is a one-stop shop for educational resources. The users can access a wide range of resources and even contribute their own by uploading documents or links. We store all resources securely in cloud storage buckets, which can then be accessed through our website's interface, making it easy for teachers and students to find what they need. Our user-friendly interface allows users to save their favorite resources and create personalized profile for easy access. This feature lets users curate their own collection of educational materials, giving them a sense of ownership and enhancing their overall learning and teaching experience.

Our application not only has a resource repository but also has interactive forums where users can participate in discussions and share comments, tips and insights on educational topics and resources. This creates a collaborative environment that promotes peer-to-peer learning and knowledge exchange, allowing users to benefit from the collective wisdom of the community. By utilizing user-generated content, our website fosters a dynamic ecosystem that connects educators, encourages collaboration and enriches the educational journey for everyone involved.

## 5.2 Technical Description

### 5.2.1 Frontend Application

Our proposed application, which has been implemented as a prototype and tested, has the Frontend Web Application as the main UI for the users to interact. We have multiple features enabled right now based on our initial analysis of needs and requirements elicitation.

We provide a simple and easy-to-view method of interacting and viewing the resources. The UI is clear enough to display the title, the intended audience and other necessary details. Our most notable value-add is that we provide a robust filtering and search system, which enables users to easily navigate through our extensive collection of resources. This allows individuals to quickly find the materials they require, saving time and effort in their pursuit of good educational materials.

Our website has interactive forums to encourage engagement and collaboration among users. These forums provide a platform for users to share their thoughts, insights and tips regarding educational topics and resources. They also create an opportunity for users to learn from and support each other. Moreover, we offer a resource-saving feature that allows users to create personalized collections within their user profiles. This feature enables users to easily access and utilize their favorite resources, making the teaching experience seamless and tailored to their needs. This would enable the users to access our platform not only as a means to search for new resources but also to save their resources, acting as cloud storage. This would drive up the engagement rates, inducing constant interaction on the forums and also hopefully increasing interaction with the content and the content providers and leading to a positive feedback loop that would promote the creation of new resources and uploading new content.

Lastly, our website has the feature to be linked to a chatbot, based on OpenAI's GPT-3.5 large language model, similar to ChatGPT. This chatbot will make use of the recent advancements in AI to provide users with quick and accurate responses to their questions. It helps users find the information they need, making their website experience better.

### 5.2.2 Backend Application

The backend application is not yet implemented, but this would essentially be the most essential part of the platform working its magic behind the scenes. The idea is simple and if we had a little bit more time, we would aim to implement this using the NodeJS framework to keep the development work simple and for easier maintainability. This would include building the backend routing and processing capabilities using the ExpressJS framework to construct the Rest API that the frontend application would use to communicate. This backend server would also have a database, probably created using MySQL, that would store the metadata of the resources and other details like user details, ratings, likes, comments on resources, forum posts and so on. This

would reduce the number of storage transactions that we would make to the storage buckets, as we will be charged based on the number of requests we make to the bucket. This would also help speed up the process of serving the necessary details to the users without having to make heavy fetch requests along with the resources. The main tasks of the backend server are to provide an API framework for the UI to interact with, to interact with the Database, to perform any server-side computing and to interact with the storage buckets.

- Fetching resource details from the database and also fetching them from the storage buckets and displaying them on the frontend UI.
- Handling the interaction with the resources, such as rating, likes and comments. It should also pass the tags and categories of the resources to the UI so that the filtering and searching can be done on the client-side device.
- Handling the uploading of new resources and storing them in the storage buckets and all the metadata on the database.
- Displaying forum posts with all the likes, comments and details by fetching them from the database. Also, handling new interactions with the posts.
- Storing the saved resources of each user and also the interaction made by each user with every resource, such as likes, ratings and comments, on a resource or forum post. This should be then displayed again when the user views the resource again.
- Facilitating and handling the communication between the user and the OpenAI's GPT3.5 model's API.

The entity relationship diagram, of the databases, in the envisioned system is shown in the Figure 6.

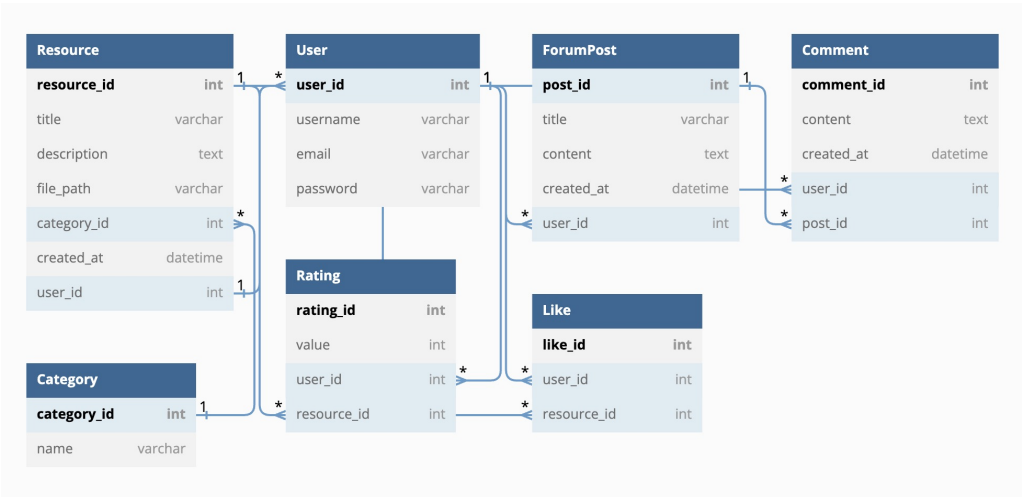


Figure 6: Entity Relationship Diagram of the Lemon Teacher platform

These are some of the main tasks that have been highlighted, but it is not limited to this. The database interactions are also complex and have to be implemented, by weighing the advantages and challenges that would be faced, in terms of usability and technical difficulties.

## 5.3 Future Technical Plans

We have implemented a preliminary prototype based on minimal interactions with the stakeholders. But we envision our ICT implementation to serve a larger purpose and we should be able to adapt to the increasing needs in case we take on a larger user base and also attract new users to the platform YouTube, Twitch and Patreon would help increase the resources.

Economic and financial sustainability is one of the most important factors that we have to address and work towards. The ease of access to resources and the plethora of resources that would be available to the teachers at their fingertips is the primary attraction of the platform. We need to explore ways to gain a stream of revenue that would help sustain the platform. A few options are, enabling the resource creators and uploaders to make money and this would help

in two ways. The creator would be further incentivized to share their resources, along with the existing motive of helping other teachers and improving the teaching system overall. We can build a feature of collecting fees for resources that will be bought by other teachers or re-purpose the payment feature as a donation feature, where the users can donate money to support the creator. This is in line with the revenue models of websites such as YouTube, Twitch, Patreon and other similar websites. We could also build a feature that would collect subscription fees from the users to access resources. The free tier would provide a preview of what the resource has to offer and the premium tier would allow the entire resource to be downloaded or make it accessible. However, we will need to resolve any legal issues when facilitating teachers selling their materials, which is a grey area in Malaysia's law.

Another feature that would add value to the platform is having user profiles much like a social networking platform. We can allow the users to follow other users who are creators and can be updated when new content is added by their favorite creator. We can list out all the resources that are uploaded by that particular user and display their saved resources as part of a collection - this would help guide other users to follow the same or gain inspiration from them. We can encourage users to fill out their profiles with pertinent data to help improve the platform's sense of community.

The platform may also provide users with individualized or personalized suggestions for resources that match their particular interests by examining their preferences, search histories, ratings and interactions. The accuracy and usefulness of the recommendations can be improved by employing a suitable AI-powered recommendation algorithm by taking into account variables like user feedback, popularity and relevancy. The system can also show related content on the page of each post to make it easier to discover similar content. This can boost user engagement and satisfaction.

We have enabled a feature where users can interact with a "ChatGPT"-like chatbot to help assist the teachers with their preparation or answer their doubts. Right now, we have just provided a link to ChatGPT, but the performance of the AI chatbot model can be improved by providing the GPT3.5 model access to the anonymized data, which would make the ChatBot more personalized and can answer and perform tasks better and exclusively for the teachers. We can even adopt the latest GPT4 LLM model, which has shown promising results. The user experience can be further improved by personalizing the chatbot's responses based on user profiles and preferences, which will make interactions more effective and tailored.

As the platform expands, it is essential to put in place an admin portal or moderators portal that enables the admins and moderators to control and regulate the material. Administrators would have the tools they need to evaluate posted materials, ensuring that the platform maintains a high standard of quality and applicability. They would also be able to deal with any infractions of the community rules.

It would be a positive addition to introduce a request feature for teachers. The teachers can request certain kinds of materials and other users or content producers can create and submit such materials in response, possibly with a monetary reward. This method can help in filling in the gap in certain niche topics.

## 5.4 Challenges

There are some challenges that we have faced so far in implementing this and there are some challenges that we foresee in the near future when we fully implement and deploy this platform.

The first challenge we faced when implementing this and could be a potential issue in the near future is the "Cold Start Problem". We do not have access to many materials, especially the materials and resources related to teaching in the region of Sarawak. This posed an issue in terms of conducting user experience evaluation. We need to perform a fine-tuning of the filter and search module. The lack of materials hinders us from identifying the problems and improvements that can be made to this module. This problem would also hinder attracting teachers to visit and contribute to our platform. A lack of materials would also stop any teacher from using our platform and it would go on to create a negative cycle.

The second challenge was quite specific to the resources in the region. This has to do with the diversity and culture of the region in Sarawak. We do not have access to the different materials used by the teachers. There are multiple languages being spoken in the region and many different types of schools, all having different syllabuses. There are also materials available in different forms and quality - in terms of both readability and usability/effectiveness. This would affect the quality of the website and we need to devise a way to organize and make the platform look professional.

The third challenge would arise in implementing the ChatBot. This might take up a considerable amount of resources in terms of revenue if OpenAI's API access is expensive. We would also need to tune the AI Model to be unique and useful to our platform and also keep it personalized in terms of each user. This might need some developmental effort, as the GPT3.5 and GPT4 are still new and there is not a lot of documentation out there to help our effort. We also need to consider the ethical aspect of using the AI bot in our platform so that it does not produce any biased or incorrect results.

# 6 Feedback and Updates

## 6.1 User Experience Evaluation

In order to improve our application in accordance with the users' requirements, we conducted a survey.

The target users are teachers from Malaysia that have an interest in uploading and downloading educational content on a user-friendly platform. Among our potential target users is Madam Belinda, a Malaysian primary school teacher at SK St. James Quop. We are very grateful that Madam Belinda was willing to test our application and provide us with feedback. (The full survey and Madam Belinda's answers can be found in Appendix 14.2.)

In general, Madam Belinda described Lemon Teacher as a 'multi-resource, user-friendly and helpful' platform and she expressed that she would be willing to use the platform as a source for teaching content. Specifically to the home page, she mentioned that it was easy to explore and that she could easily find what she was looking for. Regarding the upload page, she found the steps to upload content easy and had no trouble selecting the appropriate category from the provided options. As for the forum page, she mentioned her interest in using it to gather insights and opinions from other teachers. She anticipated using the platform on a daily basis.

Compared to the Telegram platform, Madam Belinda expressed that Lemon Teacher is easier to use and provides a wider range of services. She mentioned that she expects transitioning from Telegram to Lemon Teacher to go without any problems, as she found the platform intuitive and user-friendly. She had no suggestions for improvement and expressed her satisfaction with using the platform.

Regarding the financial aspect, Madam Belinda stated that she would not be willing to pay a monthly or yearly subscription fee. However, she would be open to uploading content for free.

## 6.2 Updates done based on Feedback

Taking into account Madam Belinda's positive feedback, we decided to focus on perfecting the existing features rather than making significant changes. We appreciate her feedback regarding the subscription fee and we will keep it in mind for future considerations. Currently, generating revenue is not a priority, but we anticipate that it may become necessary in the future (see section 7 and 9). If and when that time comes, we will explore alternative revenue streams before considering the option of a subscription fee.

# 7 Cost considerations

In order to ensure broad availability and minimize hosting costs, Lemon Teacher has been developed as a lightweight Angular application hosted on Microsoft Azure. By utilizing the Standard B2s Virtual Machine instance, which costs $0.053/hour in the Southeast Asia region, we can maintain a cost-effective solution. This amounts to approximately $38 per month for hosting [1].

The B2s hardware is expected to handle workloads from up to 100,000 users, providing sufficient computing power for our initial user base. As user adoption and workload increase, we have the flexibility to scale vertically by migrating to more advanced hardware. This scaling process would involve an increase in costs that aligns approximately linearly with the growing user base.

In the event that workloads demonstrate peak usage at specific times, such as immediately after school ends, we may consider migrating to a serverless architecture. However, this option could result in a significantly higher cost per user and require more time for setup and configuration. Hence, our initial approach focuses on a lightweight and simple setup to ensure efficient utilization of resources.

[1] https://azure.microsoft.com/en-us/pricing/calculator/

In terms of storage, Lemon Teacher utilizes Azure's storage services, specifically buckets for storing the actual teaching resources and a database for storing metadata. By leveraging Azure's storage capabilities, we can efficiently manage and store a large volume of resources while keeping costs under control.

The use of buckets for storing teaching resources allows us to optimize storage costs based on the size and number of files uploaded by teachers. Azure's storage pricing is designed to be flexible, providing options for different storage tiers and redundancy levels to meet our specific requirements. We can choose the appropriate storage tier based on factors such as the frequency of access and performance needs of the resources. This ensures that we only incur the necessary storage costs without overpaying for unused or infrequently accessed data.

Additionally, Lemon Teacher's database stores metadata related to users, such as their profile information and resource preferences. Azure provides various database options, including both relational and NoSQL databases, each with its own pricing structure. By selecting the most suitable database service for our needs, we can effectively manage the costs associated with data storage and retrieval.

Storing metadata in databases helps reduce storage costs by optimizing resource allocation. Metadata contains structured information about resources, including user details, timestamps, file names and relevant attributes. Databases provide efficient data organization, indexing and querying capabilities, enabling fast and effective storage and retrieval of metadata. Compared to storing metadata alongside the actual resources or inexpensive storage mediums like high-performance disks, databases offer cost-effective storage options. They also provide built-in features for data compression, deduplication and optimization, reducing storage requirements and further lowering costs. Leveraging databases for metadata storage allows us to allocate high-performance storage resources to actual content while using more economical storage solutions for metadata, optimizing costs without compromising functionality or accessibility.

Load balancing evenly distributes traffic across multiple VMs or instances to optimize performance and resource utilization. It prevents the overloading of any single instance, maximizing the computing power of each VM and minimizing wasted capacity. This allows us to handle a larger number of concurrent users without excessive hardware resources, leading to cost savings while providing an optimal user experience.

Auto-scaling dynamically adjusts resources based on workload. It scales the number of VM instances up or down based on predefined criteria like CPU utilization, network traffic, or request latency. During high demand, auto-scaling provisions additional instances to ensure optimal performance. Conversely, it reduces instances during low demand to avoid unnecessary costs. By dynamically allocating resources as needed, auto-scaling optimizes costs by avoiding over-provisioning and minimizing idle resources.

The cost considerations for bug-fixing and improving features for the platform can be managed by involving students of UNIMAS under the guidance of a senior developer. This could serve as a test bed for the students to improve their skills and serve the community as part of their community service learning. This would also reduce the costs of having to hire specialized development teams, which can hurt the budget that is available to keep the platform sustainable.

# 8 Key Requirements

The key requirements of the project can be found in table 2 (labeled as 'must have'); together with requirements that are also important but not necessary ('should have'), requirements that are not necessary but that could improve the user experience ('could have') and requirements that are the least critical ('won't have').

# 9 Feasibility and Business Sustainability

Based on our research findings, a substantial majority of our target users possess smartphones and/or computers, along with internet connectivity. Moreover, our platform is designed to be accessible in English, Mandarin, Malay, and Tamil, covering more than 92% of Malaysia's population. This ensures that the platform is within the technological and linguistic reach of a significant portion of the population, enhancing its accessibility.

Right now, we will be working under the assumption that the platform is hosted on some of the Cloud Provider's VM, initially with some support from UNIMAS. In the future, our goal is to ensure the long-term sustainability of the platform by carefully analyzing its usage patterns and

| | Requirements | MoSCoW |
|---|---|---|
| 1 | Repository to store teaching materials | must have |
| 2 | Users can upload teaching materials | must have |
| 3 | Users can search for teaching materials | must have |
| 4 | Users can view other posts | must have |
| 5 | Users can download teaching materials | must have |
| 6 | Users can rate and like posts | should have |
| 7 | Content moderation | should have |
| 8 | Users can set paywall for content | could have |
| 9 | Users can follow other users | could have |
| 10 | Application supports other local languages | could have |
| 11 | Real-time chatting functionality | won't have |
| 12 | Gamification Elements | won't have |

Table 2: MoSCoW prioritization

exploring various avenues to achieve economic self-sufficiency. By closely monitoring how users engage with the platform and leveraging data-driven insights, we aim to identify opportunities for generating revenue or implementing sustainable funding models. To keep the costs of hosting low from a technical perspective, we have designed the code in such a way that most of the data processing, such as filtering and searching - which has the potential to consume more computing resources, is shifted onto the client-side device. Browsers these days have the capability to handle this workload without placing a lot of burden on the users' devices. This is also an approach taken by many tech companies after the popularization of Javascript-based web applications. The storage-bucket costs are also cheap, and the forecasts suggest that the costs will get lower over the years, which will keep our costs low as well. When our platform has a considerable number of active users, we would want to explore the revenue streams. The web application platform is also lightweight and robust, built using Angular, and apart from running regular maintenance and a few updates, it would not need much developmental work. We have also dockerized our application, making it easier to host it on any platform in a matter of seconds. Dockerization will also help in horizontally scaling our service to a larger user base, and the advantage of hosting on the Cloud Service Providers is that the process of vertically and horizontally scaling the nodes is easier. We can configure load-balancing mechanisms to scale up when the user requests rise and scale down when the requests drop to help save resources and provide reliable and robust service as well.

Currently, our target users are united in a Telegram group, and they actively utilize this group to exchange content. This group currently consists of 3877 people interested in educational content and communicating with each other. Our research indicates that the users have a great interest in a similar platform that also addresses the current limitations by providing a good filtering and search system. Additionally, our platform is revolutionary in offering a quality control system and the use of a recommendation algorithm. From our research, it follows that a platform that embodies their preferences would be welcomed enthusiastically and, thus, that there is a strong willingness, coupled with the necessary adaptability, to embrace this new technology. Our platform also has interactive forums to encourage engagement and collaboration among users. Based on the active engagement observed within the Telegram group, we anticipate that a platform such as Lemon Teacher, which combines the existing features extensively utilized by teachers and incorporates additional functionalities they currently lack, would foster a highly engaged user base.

Common challenges with information-sharing platforms, like Lemon Teacher, are receiving low-quality work, not receiving enough content, and having intellectual property rights. As mentioned, our platform has a built-in quality control system; ensuring the quality of the content. Additionally, most of our user base is already united in one group, making it easy to directly send them an invitation to use Lemon Teacher. Since this group is already very active and has responded enthusiastically to the proposed platform, we anticipate that if our platform caters to the wishes of these users, we will receive a fair amount of content. To eliminate uncertainty even more, we plan to upload a selection of open-source content to initiate the platform and provide a solid foundation for users. Lastly, we have included the option to flag content that violates intellectual property rights. Another legal challenge is the fact that teachers in Malaysia are not allowed to receive money for work related to education outside of the work they do for their school. Since, for now, we do not have a moderator base that could tackle verifying users' legal position to ask money for content, we strongly encourage users to only ask money for content if they have a legal position to do so. To ensure compliance with legal regulations, the purchase of paid content on our

platform will be facilitated through external websites owned by the respective content providers. This approach prevents any potentially illegal financial transactions from taking place directly on our website.

Based on our research findings, the initial running costs of the platform are projected to be extremely low for up to 100,000 users (see paragraph 7). Consequently, we anticipate that income generation will not be a concern during the first three years of operation. However, as the platform scales and attracts over 100,000 users, we recognize the need to explore significant revenue streams. Once the platform attracts this amount of traffic, numerous revenue options become viable. For instance, establishing paid partnerships with content creators could ensure that their content receives priority placement in search results. Additionally, implementing referral fees or incorporating small advertising blocks on the platform's pages are potential avenues for generating revenue. As user numbers grow, we will assess and select the most appropriate strategies to maintain financial viability while providing value to our user base.

# 10 Ethics

Ensuring a safe and supportive community is of great importance to us, aligning closely with the core objective of our proposed platform, Lemon Teacher. We are committed to creating an environment where teachers feel secure, respected and empowered to share their knowledge and resources. We will try to achieve a positive and respectful online environment by discouraging harassment, bullying, discrimination, or any other form of harmful behavior. We also plan on implementing a reporting option so that users can flag inappropriate content or abusive behavior and we will take prompt action to address such incidents. We also plan on utilizing an AI algorithm that can automatically recognize and flag harmful content. Besides this, we also give great importance to respecting intellectual property. We would like to have the reporters report IP-infringed content uploaded in bad faith, which the moderators would strike down from our platform.

In our pursuit of creating a safe environment, we acknowledge the importance of fostering inclusivity within our platform. Recognizing the diverse needs and perspectives of our user base, we are committed to ensuring that our platform promotes an inclusive atmosphere where individuals from all backgrounds feel welcome and valued. An instrumental step towards achieving inclusivity is offering our website in the four primary languages spoken in Malaysia: Malay, English, Chinese, and Tamil.

Also in line with creating a safe environment is creating a space where privacy and data protection are respected. This is why safeguarding user data and privacy is one of our top priorities. We will implement strong security measures to prevent unauthorized access to user data. During the registration process, we will strictly limit the collection of personal information to only what is necessary, and we will be transparent in communicating to our users how their personal data will be collected, stored, and utilized. We assure our users that their data will not be utilized for commercial purposes or shared with third parties without their explicit consent. However, we will leverage user data to track their behavior and provide personalized content recommendations aimed at improving their overall experience on the platform. We understand that not everyone may wish to utilize certain functions or features, so we will offer the flexibility to enable or disable specific functionalities like the recommendation function. It is also of great importance to us to diligently address and eliminate any potential biases that may arise in the algorithms we use for content recommendation. We would also have to ensure that the AI Chatbot is properly trained and thoroughly tested to address any issues related to ethics, discrimination, misinformation, and other aspects.

# 11 Reflection

The formulation of the idea for the Lemon Teacher platform has been a bumpy ride and has had many challenges, context switches, and discovering new things at each step of the interview. This was a rewarding experience, as one of the team members, Adithya, could relate to this problem due to his previous experiences, and two of the team members, Alex and Zulaikha, were also resource persons for this case study that we picked. Eva and Zulaikha also provided their insights gathered from their close friends and family who were in the field of education. We gathered a lot of information in the first two weeks by conducting more than a dozen interviews with all the stakeholders possible, and sometimes, we even conducted interviews with the same people more than once to clarify any doubts or to validate and test our assumptions and prototype.

The case study, when presented initially, asked us to focus on improving the literacy levels of the primary students in the subjects that they were weak in. Some of the team members pitched in ideas about different kinds of game-based learning applications that would help capture the attention of students, motivate them to learn, and make their learning fun, all while educating them on the relevant topic. While some games and applications were suggested and tested, other team members focused on identifying the root cause of the problem. This would help address the problem from a long-term perspective and bring about a meaningful change. We conducted on the shortcomings of the previous implementations of games as the means of learning and tried to understand the reason for failures. Although the interviewees were receptive to the idea of building games, they held their reservations. Eva's friend, who is a teacher and one of the regular teachers we interviewed, highlighted the negative effects that games could have on young minds. Dr. Cheah was also excited about the possibility of proposing a solution that would not result in game-based learning applications. On holding continuous interviews, we concluded that it would be innovative to focus on teachers and address their problems.

The Saturday teachers and New teachers all faced the same problem of not having access to teaching materials, which made their job harder and ate away all their time. This was also validated in the team personally by Adithya, who faced the same issue when leading the educational team at an NGO in India for 4 years, and also by one of the teachers, who were new to teaching, we interviewed. This solution, we aimed, would focus more on bringing change through collective support, collaboration, and cooperation.

We brainstormed ideas of how we could utilize crowd-sourcing as a method to improve the situation, and on further exploration, we became aware of the existence of Telegram and Facebook Groups that sold teaching materials for a nominal price. These social media and messaging platforms were used mainly by regular teachers. We wanted to bring in the crowd-sourcing model to help both the Saturday teachers and Regular Teachers. We built a prototype that would encourage resource-sharing and communication.

Upon further reflection, it is evident that teachers face significant challenges in accessing reliable teaching materials due to the absence of a dependable source. Although the teachers rely upon Telegram as their primary dependable source for teaching materials acquisition, however, they find it lacking in certain aspects, such as it necessitates manual scrolling to search for specific materials, which proves to be time-consuming and inefficient. Hence, to improve Lemon Teacher's reliability, brainstorming sessions can be conducted to propose enhancements. Continuously monitoring and iterating on the enhancements or improvements implemented in the platform will be crucial for ensuring a dependable source of teaching materials for teachers in the long run.

Although we have conducted some good interviews and learned more about the challenges teachers face, specifically in acquiring teaching materials, we still need to have more discussions to really comprehend the specific problems. This solution would just scratch the surface of the problem, help make a dent and serve as a tool in the arsenal of any of the more specific solutions that can come up in the future. We have made progress in understanding the big picture. However, it is crucial to talk more and find out the main issues and details that teachers deal with. We can discover small but important problems that we might have missed before by having more conversations with a larger diverse crowd and getting a better idea of the specific challenges we need to solve.

## 12 Future Work

The foundation of Lemon Teacher now exists, but as it is a platform, we still have to solve the cold start problem. Beginning teachers visit if there is sufficient valuable content, and experienced teachers only post if there is sufficient demand. To solve this problem, we suggest scraping the Facebook and Telegram groups for specific content. So far, we have interviewed potential users with dummy content. Therefore, interviewing teachers with actual relevant content can provide interesting insights, in particular about their most pressing needs. Furthermore, we have not been able to interview experienced teachers that sell their materials in these groups. It would be interesting to reach out to and interview them to better understand why they share content with others or why they do not. Similarly, pinpointing what features specifically add the most value to them, or would convince them to start sharing content, would be an interesting track for future work.

The future focus of our work should lie in attracting users to our platform. This should be done through word of mouth or on social media platforms through the users themselves. To achieve this, we need to focus on continuous improvement based on user feedback. It is crucial

that we actively solicit feedback from the users and incorporate their suggestions. Conducting user surveys, interviews, and feedback sessions can provide valuable insights into the user experience and help identify areas for enhancement. These regular updates on the platform would ensure that helping the users would remain our primary focus. Exploring partnerships with educational organizations, publishers, and content creators can provide opportunities for exclusive content offerings, ensure a steady stream of high-quality teaching materials and potentially generate revenue through partnerships or sponsorships, which can be used to further improve our platform.

While Lemon Teacher aims to cater to a broad range of subjects and grade levels, further customization and specialization in specific subject areas can be explored. Collaborating with subject matter experts and experienced teachers in different disciplines can help curate targeted resources and content that align with specific curriculum requirements.

# 13 Conclusion

Sarawak, a state in Malaysia, has set the target to improve education significantly this decade. However, it is struggling with large teacher shortages. Therefore we present Lemon Teacher, a web-based sharing platform for educational content. Its goal is to make finding and managing teaching material more convenient, helping teachers with class preparation. Due to the shortage, teachers have little time for this, especially when filling up gaps in the schedule outside their expertise. At the moment, teachers search content through Google search and scrolling through Telegram and Facebook groups. Thanks to Lemon Teacher's features, such as filtering, quality control and profile reviews, teachers should be able to find better content faster. It is ready to be tested specifically in Sarawak, but it is designed to spread across Malaysia and potentially other countries. Thanks to its lightweight set up, it runs with low costs, making the application more sustainable and suitable to deploy in other regions of the Global South as well.

Our goal is to make a positive impact in the education sector by empowering educators and students through our educational resource platform. Our platform serves as a hub for accessing a wide range of valuable resources, fostering collaboration, and promoting knowledge exchange. By connecting teachers and facilitating the sharing of high-quality educational materials, we contribute to the enhancement of teaching practices and student learning outcomes. We strive to create a transformative learning ecosystem that addresses the diverse needs of educators and students, utilizing a combination of robust technological infrastructure, user-friendly interfaces, collaboration features, and AI assistance. Our commitment to continuous improvement and community involvement drives us to make a lasting impact in the field of education.

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# 14 Appendix

## 14.1 Appendix 1: Interviews

### 14.1.1 Interview with Cheah Wai Shiang

Dr. Cheah is the professor at UNIMAS who is leading the initiative of conducting the extra coaching classes each Saturday at SK Muhibbah's school.

There were a lot of mobile applications built using gamification concepts. There was a mobile application built to improve the skills of the students in Malay. But that application satisfied the needs of a different audience and is not really suitable at this school. This is mainly due to the change in the syllabus due to governmental initiatives. There was another application for teaching Maths. This was built in the context of a Chinese school. There are many types of schools in Malaysia and it includes National schools where English is the medium of education. The other types of schools include Chinese, Malay and Arabic schools. The application itself was not completed and hence remains unusable. It needs a lot of improvement to be used, which includes adapting to the latest syllabus and the game has enough content to only last a month. There was another project called EduComX, which had a similar set of drawbacks. It has no set syllabus and it has content that would only last for a month. There was no manpower left to keep it updated for further iterations. The students of the ICT4D courses may also not have enough motivation or time to build a truly sustainable application. Crowdsourcing-based applications are a good initiative as the teachers are facing the problems of not being able to interact with each other and communicate and share resources and tips. Digital Storytelling applications were also prototyped before and received positive feedback.

The initiative at the school in SK Muhhibah is part of a new initiative that will last for 6 months. It was started in the month of May. The idea is to act as tuition in the school to provide extra support to the students that are part of this school. The school principal is very supportive and has been receptive to new ideas. He concurs that the Face to Face teaching after the Covid-19 pandemic period has helped improve the situation in the school. The school will also be receiving an upgrade in the form of a fiber optic internet connection. The Saturday classes also function differently as they focus more on reinforcing what is taught in the school and performing interactive exercises in the class and also some repetition-based exercises. We can also take an interest in the pedagogical techniques of the European countries. It is also possible that the recent change in the laws related to the education system in Malaysia has caused a drop in interest in studying. The laws removed the mandate where there existed standardized exams for kids in certain grades across the country.

### 14.1.2 Interview with Alexander Yapp Cheng Hao

Alex is one of the resource persons for the use case that our group has selected and is also a team member along with Nur Zulaikha. Alex teaches about computers to the primary class students 3, 4 and 5.

The children in the school primarily speak Malay. There are many dialects of Malay, but they are pretty similar and it does not cause any gaps in communication. The major challenges faced by the kids are that they are completely unaware of the basics of how to use computers, which includes powering them up or typing on a keyboard or any basic operations. The teachers teaching in the Saturday classes at the SK Muhibbah are the students from UNIMAS teaching here as part of their community service initiative. They have set themselves a schedule to follow and teach in each class. There are about 20 students in each class and a total of 67 students. The age varies from 9 to 13 in the three classes they teach. This teaching initiative is a part of their pilot project that will last for 6 months. They aim to reinforce the students in their learning which will complement their regular schooling. Alex suggests that it would be nice to focus on short-term literacy issues in IT, Math, or English. This would help the students in gaining something from this initiative. The challenge is also in figuring out how to keep the attention of students on the topic being taught and also boils down to the question of how to motivate the students to study. We discuss a few ideas like having games, interactive exercises, teaching interesting topics, etc. There has been a noticeable drop in interest among the students.

Game development takes a lot of time to develop and design. It also gets challenging to keep refreshing and extending the content. It would be obvious that we should not be building multiple games for multiple topics and it would be nice to consolidate everything into the same platform, if not the same game. The existing games that were searched for do not suit the needs of this school or situation. It is interesting that there was no knowledge transfer done between different schools.

### 14.1.3 Interview with Nur Zulaikha Nadhirah Binti Adi

Ikha is the Science, Malay and English subjects at the school in SK Muhibbah. She is pretty new to teaching and it is quite tricky as it is a different setting than what she is used to. Her experiences are pretty similar to Safarah and they teach the same class. There are usually two teachers present per subject when teaching in the class. Ika teaches the Primary 5 class and Safarah teaches the Primary 4 class. But they get together to teach the Primary 3 class, as the 9-year-olds are much more difficult to be handled by a single teacher. This is a draining experience, mentally and physically. They take turns teaching and rest a bit during the breaks. The classes usually lasted from 9 am to 12 pm, but with the addition of a new subject, 'IT,' the classes have been extended until 1 pm. The 9-year-olds must be attracted by giving candies to pay attention and study during the class. On Saturdays, it gets tiring as they have no breaks between classes and they must start teaching every class they enter immediately. The attendance was higher on the first day and some kids did not show up afterward.

### 14.1.4 Interview with Muhammad Hafiz bin Awang Arsat

Hafiz is the Math teacher at the school in SK Muhibbah. The students in the classes they teach are aged between 9 to 11. The major problem faced by Hafiz when teaching is that the students lack a foundation that they should have had for their age group and they struggle with basic mathematical operations such as addition and subtraction. The Primary Class 3 students are of the age of 9 are problematic to handle, as they are too hyperactive and do not pay attention in class. This could be because the Class 3 students had never attended school before, as the schools were closed during the Covid-19 pandemic and they lacked the discipline and basics that would have been learned if everything were normal. Each session lasts for about 55 minutes. The children are more interested in playing or resting than studying, impacting attendance.

### 14.1.5 Interview with Safarah Binti Mohammad Hasbullah

Safarah is the Science, English and Malay teacher at the SK Muhibbah, Kuching, Sarawak, Malaysia. Safarah is a student at UNIMAS, Sarawak and she teaches the children in the school on Saturdays. It has been a long time since she studied the subjects that she is teaching and she has to refresh her knowledge as the syllabus is constantly changing and it is much more advanced than what Safarah studied during her school days. The more challenging syllabus has also caused the children to lose interest in learning. The children neither had an ambition nor vision when asked about their goals. They are not aware of the opportunities that exist in the world due to the environment that they live in. She has been teaching in this particular school for one month and this is a new project undertaken by Unimas. The children are generally intimidated by the teachers and the knowledge being imparted. Rural schools in Malaysia have a limited budget and are also based on the number of students enrolled. In the Saturday classes, any infrastructure and items needed to conduct the classes must be funded by the teachers, such as Safarah. The Class 3 students have low literacy, as during one of the English reading assessments, it was noticed that only one student could do fast reading and comprehension and the rest could not do so. Dr. Cheah has provided the teachers with a few books and the teachers are the ones who build the syllabus and content and then teach that in the class. Safarah likes doing interactive exercises as the children enjoy it. But they are very time-consuming to prepare for with the existing workload, such as studying and working. The commute to the school from home takes about an hour. Safarah has her weekly holidays on Sunday and Monday, as she teaches in the schools on Saturdays. The preparation between the class has to be rushed; even if there are any technical issues, they have to be fixed by themselves, as there is no other support. The attendance is inconsistent, even on regular school days and Saturday classes. The current measures to attract students to class are not sustainable on a long-term horizon. Safarah and the team had discussed some ideas internally to make games similar to the Adobe Flash games. Some students show symptoms of ADHD, Dyslexia and other conditions. The parents are in denial about such symptoms and sweep them under the rug.

### 14.1.6 Interview with Students of SK Muhibbah

During a recent tuition class on June 10th, 2023, an interview was conducted with four students from Class 5 and Class 3. The questions were centered around three main areas: Technology and Internet Access, focusing on the student's personal technology ownership and internet accessibility at home; School and Education, delving into how they handle less engaging classes, their preferences for specific teachers and reasons behind their choices; and Games and Learning, inquiring

about their preferred games as well as viewpoints on incorporating games into the learning process.

*Technology and Internet Access*

Most students from both classes possessed their own smartphones, which they would use for studying, playing games and watching YouTube videos. However, one student from Class 3 expressed her inability to utilize her smartphone as it is already damaged, while another student from the same class mentioned that she shares her smartphone with her father, where she could only use it specifically for her studies. Additionally, she also stated that she had a laptop of her own, although she uses it infrequently.

When inquired about their home internet access, the students revealed they lacked a reliable internet connection. As a result, they seek alternative locations to access the internet, such as the wharf nearby, as mentioned by some students. One of the students from Class 5 also claimed that the ship's presence at the wharf affected his internet connection.

*School and Education*

In response to inquiries about how they would handle subjects during class that they find less interesting, most students admitted that they have difficulty concentrating and tend to feel drowsy. This was due to teachers primarily delivering theoretical explanations without incorporating interactive activities to engage the students. One student from Class 5 mentioned nail-biting when asked how they pass the time in these dull classes, while others admitted to doodling on paper or discreetly playing with their friends. A few students would rely on their peers to learn the class content, while the rest had no interest in the boring subject.

Conversely, it was revealed that they would engage during classes taught by their favorite teachers. Several reasons for favoring these teachers were identified, including their favorable treatment of students, provision of easy questions and a lack of anger, especially towards those who couldn't answer the questions.

*Games and Learning*

Most students were actively involved in smartphone gaming, with a particular preference for games like football. Meanwhile, the remaining students did not have a particular fondness for games and preferred to watch YouTube videos or use their smartphones for learning purposes. All the students who played games, along with a few who did not, agreed that incorporating games or entertaining activities that evoke a similar sense of engagement would benefit them. However, there were also a few students, particularly those with a lack of interest in playing games, who disagreed with the idea.

### 14.1.7 Interview with Malaysian School Teachers

Two primary school teachers from Malaysia, Madam Belinda from SK St. James Quop and Madam Khairunisa from SK Muhibbah, were interviewed on 16th and 17th June 2023. The objective of the interview was to gain insights into the teaching experience of Malaysian school teachers, mainly primary school, particularly regarding their accessibility to teaching materials, the quality of those materials, their preparation methods before entering the classroom and their approach to teaching and managing students with different behaviours during learning sessions. Madam Belinda specializes in teaching Malay language and Mathematics to preliminary class students, where she teaches the foundational aspects of the two subjects such as teaching students how to construct simple sentences in Malay and applying basic mathematical problem-solving skills to real-life situations. In contrast, Madam Khairunisa's focus lies in the field of Islamic studies, where she teaches her students about the religion of Islam, covering its historical background, beliefs, practices and cultural aspects. Regarding the acquisition of teaching materials, both teachers shared their reliance on Telegram as a primary source. Madam Belinda joined a free group on the platform, consisting of teachers who teach preliminary class within the same district. Madam Khairunisa, on the other hand, joined a paid membership group which required her to pay 50 MYR ( 9.78 EUR). The Telegram group also provides a platform for teachers to engage in open discussions, freely exchanging ideas and seeking opinions from one another on matters pertaining to their teaching domains. Despite being a paid membership, it provides Madam Khairunisa with unlimited access to continuously updated teaching resources. Madam Belinda also mentioned three additional sources for her teaching materials: Google search, YouTube, Microsoft PowerPoint (PPT), as well as educational games available on various websites, including puzzles and word-building activities. As for the materials that she found on Google search, she would have to edit the material found to cater to the specific needs of her students. The utilization of various types

of teaching materials by Madam Belinda is based on her belief that different students may require different approaches to learning. Regarding the quality of the teaching materials they acquire, both teachers concurred that most of the materials are of good quality. However, as mentioned by Madam Khairunisa, there are certain materials that require purchasing. The cost of these materials varies based on their content and the specific needs of the teacher. While some teaching materials offer a free version with limited content, additional payment is required to access more extensive resources for those materials.

#### 14.1.8 Pointer to application code

Github Repository - `https://github.com/adithyavasisth/LemonTeacher`

#### 14.1.9 Pointer to access application

URL to Prototype - `http://lemonteacher.westeurope.cloudapp.azure.com:8000`

### 14.2 Appendix 2: User Experience Survey

*Personal questions:*

1. How old are you?
2. What is your profession?

   If you are a teacher,
   (a) What primary are you teaching?
   (b) What is the most challenging thing about teaching?
3. Where do you live? Is it a rural or urban area?
4. Do you have a phone and/or laptop?
5. Do you have internet connection? How reliable is the connection?
6. Are you now or have you ever used the Teachers of Malaysia Telegram group (or something similar)?

   If so,
   (a) What did you use the platform for (e.g. finding or sharing content)?
   (b) How often did you use the platform?
   (c) What did you like about the platform?
   (d) Was anything inconvenient about the platform? Please explain.

*Story line:*
We would like to ask you to use the Lemon Teacher platform, a digital space specifically tailored for teachers in Malaysia to connect, collaborate and share educational content. Please feel free to explore the platform in your own paste and guided by your own interests. We would also like to ask you to test different functions available on the platform, namely: the home page, the upload function, the forum page, the professional opportunities page, the categories function and the search function.

*User experience questions:*

1. What is your initial response after using the platform?
2. Would you be interested in using the platform? What would be your reason for using it?
3. How do you feel about this platform compared to the Telegram group?
4. How do you feel about the 'home' page?
   (a) Did you know where to find what you are looking for?
   (b) Did it give you a good overview of the content and options (or was it e.g., too overwhelming?)
5. How do you feel about the 'upload' page?
   (a) Were you able to navigate your way through the uploading process?
   (b) Were the steps obvious? Why?
6. How do you feel about the 'forum' page?
   (a) Do you think the forum has added value to the website? Why?
   (b) How often do you think you would use the forum?
7. How easy was it to find content with the categories function?
8. How easy was it to find content with the search function?
9. Is there anything you haven't mentioned yet, but that you would like to see improved?
10. Do you think it would take you some time to get used to? Why? And how long?
11. Would you upload your materials for free? If not, at what price?
12. Would you be willing to pay a small subscription fee every month if every resource available was free of cost?
13. Is there anything else you would like to share?
14. What were your thoughts/feelings regarding this survey?

*Answers by Madam Belinda:*

1. Multi-resources, user friendly and helpful.
2. Yes. As a resources for teaching aids.
3. Multi-resources and more easy.
4. Very easy to explore what we want to find.
   (a) Yes.
   (b) Yes.
5. Simple and easy (there is a list of options to choose).
   (a) Yes.
   (b) Yes.
6. A good addition.
   (a) Yes. We can get opinions from others that may be useful.
   (b) Once a day.
7. Very easy.
8. Very easy.
9. At this moment no.
10. For me no. This platform easy to explore and use.
11. Yes.
12. For free.
13. At this moment no. Good job.
14. Easy to answer.