IDENTIFICATION OF USEFUL OPEN EDUCATION RESOURCES;

(*EVALUATING OPEN EDUCATIONAL RESOURCES (OERS): CHALLENGES AND SOLUTIONS FOR EFFECTIVE CO-CREATION AND SHARING.***)**

BY

SETWELL MULEYA 2020001829

SUPERVISOR: DR. LIGHTON PHIRI

A report submitted to the Department of Library and Information Science, The University of Zambia, in partial fulfillment of the requirements of the degree of Bachelor of Information and Communication Technologies with Education

THE UNIVERSITY OF ZAMBIA

LUSAKA

2024

Abstract

The Zambian education system, while making strides in recent years, faces challenges in ensuring access to quality educational resources. Open Educational Resources (OERs) offer a promising solution to address these challenges by providing freely accessible, high-quality learning materials. However, the effective utilization of OERs in Zambian classrooms hinges on educators' ability to efficiently evaluate their quality and relevance.

This study addresses this challenge by developing a software tool specifically tailored to the Zambian education system. The tool leverages data mining techniques, specifically Document Layout Analysis (DLA), to analyze OERs against criteria relevant to the Zambian curriculum and educational standards. By identifying inconsistencies and non-conforming elements, the tool assists educators in selecting appropriate OERs that align with the unique needs and contexts of Zambian learners.

Through a mixed methods approach, including document analysis and content analysis of existing OERs, the study identifies key evaluation criteria that are particularly relevant to the Zambian education system. These criteria encompass factors such as alignment with the Zambian curriculum, OERs sharing,remix,reuse, and accessibility for learners with diverse learning needs. The DLA model is then developed and evaluated using standard metrics to ensure its effectiveness in accurately identifying OERs that meet these criteria.

The implementation of this software tool is anticipated to streamline the OER evaluation process, reducing the time and effort required by Zambian educators. By providing a more efficient and objective assessment method, the tool will facilitate the wider adoption of OERs in Zambian educational institutions. Ultimately, this will contribute to improved access to quality education, enhanced learning outcomes for Zambian students, and a more equitable and inclusive education system

Table of contents

Abstract 1
Table of contents 2
Abbreviations 4
List of figures 5
List of tables 5
Acknowledgments 1
CHAPTER ONE: BACKGROUND AND INTRODUCTION. 2
1.0 Introduction 2
1.2 background 3
1.3 problem statement 4
1.4 Purpose of the Report 5
1.5 main objective 5
1.6 Research Questions 7
1.7 Significance of the study 8
1.8 Limitations 9
1.9 Theoretical Framework 10
CHAPTER TWO: LITERATURE REVIEW 13
2.0 Introduction 13
2.1 Open Educational Resources and Their Significance 13
2.2 Challenges in Evaluating and Using OERs 14
2.3 Existing Tools for OER Evaluation 15
2.4 OER Evaluation Criteria 17
2.5 The Need for a Context-Specific Solution 18
2.6 summary 18
CHAPTER THREE: RESEARCH METHODOLOGY 19
3. Methodology 19
3.1 Research approach 19
3.2 Research design 20
3.3 Target Population: 20
3.4 Pilot study 21
3.5 Data Collection 21
3.6 Data Analysis 21
3.7 ethical consideration 21
CHAPTER FOUR : DESIGN AND IMPLEMENTATION 23
4.1 System Architecture 23
4.2 Agile Development Process 23
4.3 Use Case Diagram 24

CHAPTER FIVE: REQUIREMENTS ANALYSIS AND DESIGN **27**
5.1 Functional Requirements 27
5.2 Non-Functional Requirements 28
5.3 Technical Components of the OER Evaluation Tool 29
5.3 OER Evaluation Plug-In Tool **30**
5.4 System Design Specification 32
6.0 CHAPTER SIX : Implementation and deployment **37**
6.1 SYSTEM IMPLEMENTATION 37
6.2 Technologies and Coding Frameworks 38
6.3 Development Process 38
6.5 Deployment 40
CHAPTER SEVEN: Testing and Debugging **41**
CHAPTER EIGHT: System Evaluation 44
CHAPTER NINE: Results, Findings, and Conclusions **45**
9.1 Results 45
9.2 Findings 46
Conclusions 46
Discussion of Findings 68

Abbreviations

Here's a list of abbreviations tailored to your report context:

1. **OER** - Open Educational Resources
2. **API** - Application Programming Interface
3. **URL** - Uniform Resource Locator
4. **UI** - User Interface
5. **UX** - User Experience
6. **HTML** - HyperText Markup Language
7. **CSS** - Cascading Style Sheets
8. **JS** - JavaScript
9. **PHP** - Hypertext Preprocessor
10. **SQL** - Structured Query Language
11. **VLSM** - Variable Length Subnet Masking
12. **DHCP** - Dynamic Host Configuration Protocol
13. **UNZA** - University of Zambia
14. **PDF** - Portable Document Format
15. **IP** - Internet Protocol
16. **GB** - Google Books
17. **VCET** - Virtual Campus Evaluation Tool
18. **OER-EET** - Open Educational Resources Evaluation and Evaluation Tool

List of figures

Figure 1. User Case Diagram…….25
Figure 2. Data Flow Diagram…….. 26
Figure 3: Demonstration of the tool's user interface…….……...……47
Figure 4: Displaying the results to users……..…..48
Figure 5: educators participants demographic information…….…….……..….49
Figure 6: Subject Taught at primary /Level…….…….…….……....54
Figure 7: Subject Taught at Secondary Level…….……...….55
Figure 8. Levels of awareness …….……..56
Figure 9.Frequency evaluation of OERs…….…57
Figure 10 . difficulty of evaluating open textbooks among teachers……58
Figure 11 . difficulty of evaluating audio among teachers……..59
Figure 12.difficulty of evaluating different aspects of video OER among teachers…….60
Figure 13. Sources of Open Educational Resources (OER).....61
Figure 14. Shows Primary goals for evaluating OERs……..62
Figure 15.shows Criteria most important criteria when evaluating OERs…….63
Figure 16.shows Currently evaluate
OERs……64
Figure 17. OER Evaluation Priorities and Practices……..…..65
Figure 18. shows Challenges faced by users ……...…67
Figure 19 . show the system…….70
Figure 20 shows result display…….71

List of tables

Table 1 : Shows the demographic information of respondent……53

Acknowledgments

I would like to express my sincere gratitude to the individuals who supported me throughout this research project. Their guidance, encouragement, and assistance were invaluable in the successful completion of this endeavor.

First and foremost, I extend my deepest appreciation to my dedicated research supervisor, Dr. Lighton Phiri. Your expertise, patience, and unwavering support were instrumental in guiding me through every phase of this research. Your insightful feedback and mentorship have been invaluable in shaping my understanding of the subject matter and refining my research methodology.

I am also grateful to the staff of the University of Zambia for creating a conducive environment for learning and research. Your commitment to academic excellence has been a constant source of inspiration. The facilities and resources provided by the University have been essential for the successful completion of this project.

To my classmates, fellow researchers, and colleagues, I am indebted to your helpful discussions and contributions to the development of my ideas. Your perspectives and insights have enriched my understanding of the research topic and helped me to identify potential areas for improvement.

I extend my gratitude to my family for their unwavering support, love, and understanding during this research journey. Your encouragement provided me with the motivation to persevere through challenges and maintain my focus on the project. Last but not least, I want to thank all participants who willingly shared their time and insights, making this research possible. Their contributions have been invaluable in providing me with the data and perspectives necessary to conduct a comprehensive analysis.

This report would not have been achievable without the collective support and encouragement of these individuals. I am sincerely grateful for their contributions to the successful completion of this project

CHAPTER ONE: BACKGROUND AND INTRODUCTION.

1.0 Introduction

Open Educational Resources (OER) represent a transformative shift in educational practices, providing accessible, high-quality learning materials that can be freely used, adapted, and shared. With the advent of digital technology, OER has gained traction worldwide as a means to democratize education, enhance pedagogical approaches, and improve educational equity. In Zambia, the adoption of OER presents significant opportunities to address challenges related to resource availability, particularly in underfunded educational institutions where access to traditional textbooks and materials may be limited.

However, the effective integration of OER into teaching and learning processes requires a robust evaluation framework to ensure that resources meet the necessary quality and pedagogical standards. This raises crucial questions about how to assess the effectiveness and applicability of OERs in various educational contexts. Key objectives of this research include determining the evaluation criteria essential for assessing OERs, understanding the challenges associated with their evaluation, and developing a software tool that facilitates the evaluation process.

To achieve these objectives, this study will explore existing literature on OER evaluation, analyze current practices in Zambia, and engage with educators to gather insights on their experiences and challenges. By establishing clear evaluation criteria, identifying obstacles to effective assessment, and leveraging technological innovations, this research aims to contribute to the successful co-creation and implementation of OER in Zambia. Through this process, the goal is to enhance the quality of educational resources available to educators and learners, thereby fostering a more equitable and effective learning environment.[1]

1.2 background

The increasing availability of Open Educational Resources (OERs) has revolutionized the way educators and learners access educational materials. However, the quality and suitability of OERs can vary significantly. To ensure effective use, a robust evaluation framework is essential. This framework should consider factors such as pedagogical design, content accuracy, accessibility, technical compatibility, licensing, and cultural relevance.

One of the major challenges in OER evaluation is subjectivity and bias. Evaluators may have personal preferences or biases that can influence their assessment. Additionally, the diversity of OER formats, ranging from text to multimedia and interactive resources, makes it difficult to develop a unified evaluation approach. Technical limitations, such as inconsistent metadata standards and accessibility issues, further complicate the evaluation process. Time constraints also pose a significant challenge, as educators may not have sufficient time to thoroughly evaluate OERs.[2]

To address these challenges, a dedicated software tool can streamline the OER evaluation process. Such a tool should automate routine tasks, such as checking technical compatibility and accessibility. It should also provide a structured framework for evaluation, based on predefined criteria. Additionally, the tool should facilitate collaborative evaluation, enabling educators to share evaluations, provide feedback, and work together to ensure quality assurance. Integration with learning management systems can further enhance the tool's usability and facilitate OER discovery and adoption.[3]

By addressing these challenges and leveraging technology, we can create a more efficient and reliable OER evaluation process. This will ultimately lead to the identification and utilization of high-quality OERs, improving teaching and learning outcomes.

1.3 problem statement

Open Educational Resources (OERs) have the potential to revolutionize education in Zambia by providing access to high-quality learning materials for all learners. However, the quality and relevance of OERs can vary significantly. To effectively utilize OERs in Zambian educational settings, a systematic approach to identify, evaluate, and curate high-quality resources is essential. A key challenge in OER evaluation is the subjectivity inherent in traditional methods. This can lead to inconsistent results and difficulty in comparing and contrasting different resources. Additionally, the lack of a standardized framework for OER evaluation further complicates the process. Manually evaluating OERs is a time-consuming and resource-intensive task, especially considering the diverse formats in which OERs are available.[4]

To address these challenges, we propose a comprehensive OER evaluation framework that incorporates a set of standardized criteria, such as pedagogical design, content accuracy, accessibility, technical compatibility, licensing, and cultural relevance, tailored to the Zambian context. This framework can be used to assess the quality of OERs and identify those that are most suitable for specific learning objectives in Zambian schools and universities. To further streamline the evaluation process, we plan to develop a software tool that automates certain aspects of the evaluation, such as checking technical compatibility and accessibility. This tool will also facilitate collaborative evaluation, enabling educators to share their assessments and provide feedback. By leveraging technology, we can make the OER evaluation process more efficient and reliable, ultimately improving the quality of education in Zambia.[4]

1.4 Purpose of the Report

The purpose of this report is to propose a comprehensive framework for evaluating Open Educational Resources (OERs) in the Zambian context. By identifying key evaluation criteria, addressing challenges associated with OER evaluation, and developing a software tool, this report aims to enhance the quality, accessibility, and impact of OERs in Zambian education.

Ultimately, this research seeks to empower educators to effectively utilize OERs, promote innovative teaching and learning practices, and improve student outcomes across the country.

1.5 main objective

To design and develop an efficient and effective OER evaluation and selection tool for educators in Zambia,that enabling them to easily identify and integrate high-quality OERs into their teaching practices and improve student learning outcomes.This objective focuses on creating a practical solution to address the challenges educators face in finding and selecting suitable OERs,with the ultimate goal of enhancing the quality of education in Zambia

1.5.1 specific objectives

(1) ***To Determine the Evaluation Criteria for Assessing OERs:***

Establishing clear evaluation criteria for assessing Open Educational Resources (OERs) is crucial for ensuring their quality and effectiveness in educational settings. These criteria should encompass various dimensions, including the relevance of the content, the pedagogical approaches used, accessibility, and the adaptability of resources to meet diverse learner needs. Furthermore, these evaluation criteria can serve a dual purpose: not only do they enable educators and institutions to identify high-quality OERs, but they also provide guidance for creators developing new resources. By adhering to established criteria, OER creators can enhance the likelihood that their contributions will be used and valued within the educational community. The creation of these criteria must involve input from various stakeholders

educators, learners, and institutional leaders to ensure a holistic approach that reflects the needs and expectations of all involved in the educational process.[5]

(2) To Understand the Challenges Associated with Evaluation of OERs:

Evaluating Open Educational Resources presents unique challenges that must be addressed to improve their effectiveness and accessibility. One significant challenge is the lack of standardization across OERs, which can make comparison and assessment difficult. Many OERs come from diverse sources with varying quality controls, leading to discrepancies in the reliability and educational value of resources. This inconsistency can leave educators hesitant to adopt OERs, primarily if they struggle to discern which resources are genuinely effective for their teaching contexts.[6]

Additionally, the continual evolution of educational practices means that evaluation criteria must be dynamic and responsive to changes in pedagogical approaches and technological advancements. Educators may also face challenges in assessing OERs due to limited familiarity with evaluation methods or insufficient training in utilizing assessment tools. Addressing these challenges is essential to fostering a culture of quality in OER development and usage, compelling educators, creators, and policymakers to work together in creating frameworks and support systems for effective evaluation.[7]

(3) ***To Develop and Implement a Software Tool for Evaluating OERs:***

The development and implementation of a software tool dedicated to evaluating Open Educational Resources hold the potential to transform how educators assess and utilize these materials. Such a tool would streamline the evaluation process, allowing users to input their specific criteria and receive tailored feedback on the quality and applicability of OERs. This could involve features such as a user-friendly interface, customizable evaluation templates, and a repository of best practices that guides users in applying the established evaluation criteria. Integrating data analytics capabilities could further enhance the tool by providing insights into

usage patterns, allowing educators to identify the most effective resources based on empirical data.[8]

Implementation of the tool would involve pilot testing within selected educational institutions to gather feedback and refine the software based on real-world usage. Training sessions for educators would also be crucial to ensure they can effectively utilize the tool in their OER evaluation processes. By combining technology with user-centered design, this project aims to empower educators to make informed decisions when selecting and utilizing OERs, ultimately enhancing teaching and learning outcomes across different educational contexts in Zambia.[9]

1.6 Research Questions

1. What are the key criteria that should be used to evaluate the quality and effectiveness of OERs?

2. What are the primary challenges educators and co-creators face when evaluating OERs?.

3. What features and functionalities are necessary in a software tool designed to evaluate. OERs effectively?

1.7 Significance of the study

Open Educational Resources (OERs) have the potential to revolutionize education in Zambia by providing access to high-quality learning materials for all learners. However, the quality and relevance of OERs can vary significantly. To effectively utilize OERs in Zambian educational settings, a systematic approach to identify, evaluate, and curate high-quality resources is essential. A key challenge in OER evaluation is the subjectivity inherent in traditional methods. This can lead to inconsistent results and difficulty in comparing and contrasting different resources. Additionally, the lack of a standardized framework for OER evaluation further complicates the process. Manually evaluating OERs is a time-consuming and resource-intensive task, especially considering the diverse formats in which OERs are available.[10]

To address these challenges, we propose a comprehensive OER evaluation framework that incorporates a set of standardized criteria, such as pedagogical design, content accuracy, accessibility, technical compatibility, licensing, and cultural relevance, tailored to the Zambian context. This framework can be used to assess the quality of OERs and identify those that are most suitable for specific learning objectives in Zambian schools and universities. To further streamline the evaluation process, we plan to develop a software tool that automates certain aspects of the evaluation, such as checking technical compatibility and accessibility. This tool will also facilitate collaborative evaluation, enabling educators to share their assessments and provide feedback. By leveraging technology, we can make the OER evaluation process more efficient and reliable, ultimately improving the quality of education in Zambia.[8]

The purpose of this report is to propose a comprehensive framework for evaluating Open Educational Resources (OERs) in the Zambian context. By identifying key evaluation criteria, addressing challenges associated with OER evaluation, and developing a software tool, this report aims to enhance the quality, accessibility, and impact of OERs in Zambian education. Ultimately, this research seeks to empower educators to effectively utilize OERs, promote innovative teaching and learning practices, and improve student outcomes across the country. The significance of this study lies in its potential to revolutionize education in Zambia by:[11]

- Improving the Quality of OERs
- Enhancing Teacher Effectiveness
- Reducing Educational Costs
- Promoting Digital Literacy
- Fostering Innovation in Education

Ultimately, this study will contribute to the improvement of education quality, equity, and accessibility in Zambia.

1.8 Limitations

The OER Evaluation Tool, while innovative, faces several limitations, particularly concerning API connectivity and integration. The tool's heavy reliance on external APIs, such as the Creative Commons API and the YouTube API, means that its functionality is dependent on the availability and reliability of these external services. Any downtime, changes in API structures, or limitations on request quotas could disrupt the tool’s ability to retrieve and verify license information accurately. Additionally, some educational resources may be hosted on platforms that do not provide API access, which limits the tool's capability to evaluate or retrieve licensing information for these resources.

Another limitation is the complexity of integrating APIs with consistent and real-time data flow. Network latency or disruptions, especially in areas with poor internet infrastructure, can lead to delays or incomplete evaluations. These issues are compounded in rural settings where internet connectivity is often slow or intermittent, making it difficult for users to utilize the tool effectively. The dependency on external APIs also raises concerns about maintaining compatibility with future updates or changes to these services, requiring continuous maintenance and adaptation.

Beyond API connectivity, the adaptability of the tool is constrained by its current algorithms and technical capabilities. While the system evaluates quality and relevance, its ability to assess nuanced cultural, pedagogical, and contextual factors remains limited. Furthermore, the reliance on a lightweight database for storing user feedback and evaluations may restrict scalability as the user base grows. Addressing these limitations will be crucial for ensuring the tool’s reliability, adaptability, and widespread adoption among educators.[8]

1.9 Theoretical Framework

The study focuses on designing an effective OER evaluation and selection tool by addressing three key components: evaluation criteria, challenges in OER evaluation, and the development of a software solution. The framework integrates theories of usability, educational resource quality, and technology adoption to ensure a systematic approach. This ensures that the tool is both functional and aligned with the needs of educators in Zambia.

Evaluation Criteria for OERs

The evaluation of OERs is guided by the **Constructivist Learning Theory**, which emphasizes the importance of resources that promote active learning and critical thinking. This theory ensures that the criteria for evaluating OERs focus on fostering student engagement and improving learning outcomes. Additionally, quality assurance frameworks, such as UNESCO's Open Education Quality standards, are essential for determining key evaluation dimensions. These include relevance, accessibility, adaptability, and usability, ensuring that the selected resources align with both educational and technological needs.[5]

Challenges in OER Evaluation

The **Diffusion of Innovations Theory** provides insight into the challenges educators face when adopting and evaluating OERs. These challenges may include a lack of awareness, insufficient technical skills, or mistrust in the quality of resources. Furthermore, barrier models highlight institutional, cultural, and technological factors that hinder effective OER evaluation and integration. Understanding these challenges is critical for designing a solution that addresses educators' specific needs and empowers them to overcome these barriers.[12]

Development of the Software Tool

The development of the OER evaluation tool draws on principles of **Human-Computer Interaction (HCI) Theory** to ensure the tool is user-friendly and accessible. The interface design prioritizes ease of use, making the tool adaptable for educators with varying levels of

technical expertise. Additionally, the **Technology Acceptance Model (TAM)** is applied to examine the factors that influence educators' willingness to adopt the tool. By focusing on perceived usefulness and ease of use, the tool is designed to maximize its adoption and effectiveness in educational settings.[13]

Key Constructs and Relationships

This framework highlights critical relationships between the main components of the study. The evaluation criteria serve as the foundation for the tool's assessment logic and metrics. Insights into the challenges educators face inform the user-centered design of the tool, ensuring it meets real-world needs. Ultimately, the software tool enables educators to seamlessly identify and adopt high-quality OERs, improving teaching practices and student learning outcomes.[14]

Application to Research Objectives

The framework is directly aligned with the research objectives. To achieve the first objective, a review of existing literature and frameworks will guide the determination of evaluation criteria. The second objective involves conducting surveys and interviews with educators to understand the challenges they face in evaluating OERs. For the third objective, a prototype tool will be developed and tested, with iterative refinements based on user feedback. This ensures the tool is both functional and effective in addressing the identified challenges.[3]

By integrating these theoretical perspectives, the framework provides a structured approach to designing and implementing a solution that enhances the selection and use of OERs in Zambia. It emphasizes practical outcomes, ensuring the research makes a meaningful contribution to improving education quality.

2.0 Introduction

This section reviews existing studies and findings relevant to the identification, evaluation, and use of Open Educational Resources (OERs). It highlights the main challenges faced by educators in using OERs and explores the strengths and gaps in existing tools for their evaluation. The review also identifies opportunities for developing a context-specific solution to support educators in Zambia.

2.1 Open Educational Resources and Their Significance

Open Educational Resources (OERs) are freely accessible, openly licensed materials that have the potential to transform education by reducing the cost of educational resources and improving access to high-quality teaching and learning materials. These resources, which include textbooks, videos, software, and curriculum plans, can be used, modified, and shared without significant restrictions. The adoption of OERs has the potential to create a more equitable educational environment, especially in regions with limited resources like Zambia. Despite these advantages, the effective utilization of OERs is still limited, particularly in developing countries, due to various challenges such as lack of awareness, insufficient technical infrastructure, and inadequate support systems.[15]

2.2 Challenges in Evaluating and Using OERs

Evaluating and using OERs is a complex task, particularly for educators who lack the necessary tools and resources to assess their quality and suitability. Previous studies highlight several key challenges:

Time-Consuming Process: Evaluating OERs often requires significant time and effort, especially for educators managing large classes or heavy workloads. Without an efficient and standardized evaluation framework, teachers are forced to manually assess each resource, which can be overwhelming and discouraging for widespread adoption.**Technical Barriers**: Many educators, particularly those in rural or under-resourced areas, lack the necessary technical infrastructure (e.g., reliable internet, access to digital devices) to effectively search for, evaluate, and utilize OERs. Furthermore, a lack of technical skills in navigating online platforms or modifying OERs to fit local contexts adds to the barrier. **Limited Co-Creation Participation**: A significant challenge in the OER ecosystem is that many educators primarily consume OERs without actively contributing to the creation or adaptation of resources. The collaborative nature of OERs where educators can modify and share resourcesoft en remains underutilized.[16] This limits the potential for these resources to be tailored to local needs and contexts.

Licenses: Educators may not fully understand the terms and conditions of different OER licenses, leading to unintentional copyright infringements. Furthermore, restrictions on content sharing, remixing, and adaptation can hinder educators' ability to customise materials, collaborate with colleagues, and innovate in their teaching practices. These challenges collectively contribute to a complex and demanding environment for educators in Zambia, highlighting the need for systemic improvements and increased support to ensure the quality and effectiveness of education in the country.[17]

Institutional Barriers: Lack of institutional support, such as policies promoting OER use and professional development programs for educators, contributes to the slow adoption of OERs. Without institutional recognition or incentives for educators to engage with OERs, these resources are not effectively integrated into teaching and learning practices.

2.3 Existing Tools for OER Evaluation

There have been several efforts to create tools and platforms to help educators evaluate and use OERs effectively. Some of the most prominent platforms include:

1. **OER Commons**: OER Commons is a digital library that offers a vast collection of openly licensed educational resources. It includes a search engine for finding relevant materials and tools for evaluating the quality of OERs. However, while OER Commons offers some evaluation criteria, it does not provide a standardized, systematic approach for assessing the effectiveness of OERs in specific educational contexts.[18]
2. **MERLOT (Multimedia Educational Resource for Learning and Online Teaching)**: MERLOT is another popular platform that hosts OERs and offers reviews and ratings from educators who have used the resources. Although the peer review process on MERLOT helps provide some evaluation, it remains a resource-heavy approach and can be time-consuming for educators who need a more structured way to evaluate resources.

3. **Creative Commons Search**: This platform allows users to search for openly licensed materials across multiple repositories. While it facilitates the discovery of OERs, it does not offer detailed criteria for evaluating the quality or suitability of the resources. Additionally, educators need to have a solid understanding of licensing and copyright laws to navigate the platform effectively.

4. **The OERu (Open Educational Resource university)**: The OERu offers a unique approach by providing open access to courses, which are free to use and modify. However, its evaluation process primarily focuses on the overall course content rather than individual learning materials. The lack of detailed evaluation guidelines can make it challenging for educators to determine the quality of specific resources.
5. In addition, initiatives like the **Open Educational Quality Initiative (OPAL)** and the **OERu** have been focusing on creating frameworks and networks to support the development, use, and sharing of OERs across institutions. While these projects[5]

contribute to improving access to OERs, there is still a need for tools specifically designed to assess the suitability of OERs in the Zambian context, where cultural, linguistic, and technological factors must be taken into account.

To bridge these gaps, the development of an OER evaluation and selection tool tailored to Zambia's educational landscape is essential. By integrating clear evaluation criteria, including license compatibility and adaptation permissions, such a tool could empower educators to confidently select and integrate high-quality OERs into their teaching practices. Despite the existence of these platforms, many of them fail to provide comprehensive evaluation criteria, particularly for localized contexts such as Zambia. Most tools focus on general quality assessment but lack detailed criteria that address the specific needs and constraints of educators in developing countries. Furthermore, these tools often emphasize resource discovery over systematic evaluation, which is crucial for selecting and adapting OERs effectively.[19]

2.4 OER Evaluation Criteria

The evaluation of OERs is essential to ensure that resources meet the standards required for effective teaching and learning. Several studies and existing tools outline key evaluation criteria, including:

1. **Relevance**: The resource should align with the curriculum and address the educational needs of students. It should be contextually appropriate, ensuring it meets the local educational standards and objectives.

2. **Accessibility**: The resource should be easily accessible to students and educators, considering factors such as the availability of internet access, compatibility with devices,

and availability in multiple languages, if necessary.

3. **Adaptability**: OERs should be flexible enough for educators to adapt to their specific teaching contexts. This includes the ability to modify the content, format, or delivery method to suit local pedagogical needs.

4. **Pedagogical Value**: The resource should support active learning, student engagement, and critical thinking. It should be designed to enhance the learning experience and promote higher-order thinking skills.

5. **Quality Assurance**: The resource should meet a high standard of educational quality, including accuracy, credibility, and the inclusion of up-to-date information. It should also be free from biases and errors that could mislead students.

6. **License**

One of the critical aspects of evaluating Open Educational Resources (OERs) is understanding the licensing terms, which are essential to ensuring that resources are used and shared legally and ethically. The license applied to an OER determines how it can be used, adapted, and redistributed. Clear and consistent licensing ensures that both creators and users are aware of their rights and obligations. Common licensing systems used for OERs include Creative Commons, Public Domain, and Open Data licenses, each of which has its own set of rules and permissions.[20]

2.5 The Need for a Context-Specific Solution

Existing tools for evaluating OERs do not fully address the unique challenges faced by educators in regions like Zambia. Research highlights the importance of developing localized solutions that consider factors such as curriculum requirements, language preferences, and digital literacy

levels. For instance, an OER evaluation tool tailored to Zambia could include specific features such as compatibility with low-bandwidth environments, a focus on locally relevant resources, and integration with mobile platforms for easier access.

Additionally, involving educators in the development of such tools through participatory design is crucial to ensure that the tools are user-centered and relevant to local teaching contexts. By understanding the unique needs and constraints faced by educators in Zambia, it is possible to create an OER evaluation tool that empowers them to more effectively identify, evaluate, and integrate high-quality resources into their teaching practices.[21]

2.6 summary

While significant progress has been made in promoting the adoption of OERs, challenges in their evaluation and use persist. Existing platforms and tools have made valuable contributions but fail to fully address the specific needs of educators in developing regions like Zambia. This gap highlights the need for a context-specific solution an OER evaluation tool that simplifies the evaluation process, promotes co-creation, and enhances the quality of education in Zambia. Such a tool would empower educators to navigate the OER landscape more effectively, ultimately improving student learning outcomes and the overall quality of education.

Would you like me to add further details on specific evaluation methodologies or additional studies?

CHAPTER THREE: RESEARCH METHODOLOGY

3. Methodology

This section outlines the research methods employed in this study,including the research design,study site,sample size, measurement instruments,data analysis tools, and sampling technique ,as well as the limitations encountered during the study.

3.1 Research approach

The study will use a mixed-methods approach to understand the challenges and solutions for co-creating and sharing Open Educational Resources (OERs). This involves combining qualitative and quantitative research methods to gain a comprehensive understanding of the experiences, perspectives, and motivations of individuals involved with OERs, as well as measuring specific aspects like usage, adoption rates, and impact.

3.2 Research design

Surveys and questionnaires.

We are going to use Surveys and questionnaires. to enable the collection of quantitative data from a large number of participants.Surveys and questionnaires are useful tools for determining evaluation criteria for accessing OERs. By analyzing the responses, they can identify the key criteria that
users consider important when accessing OERs. This helps in understanding the effectiveness and usability of OERs in different educational contexts.

3.3 Target Population:

The target population for this study will be the, Teachers from all levels of education and the graduates from different universities in zambia.

Sample Size:

Out of 190,000 approximate in Zambia teachers will use Yamane's formula as a simplified method for determining the sample size required for a study when the population size is known. It's particularly useful for large populations. Therefore we get 399 participants as a sample size.

$n = N / (1 + Ne^2)$

n is the sample size=x

N is the population size=1900

e is the desired margin of error (0.05)

n=190,000/ 475

n=399

3.4 Pilot study

Prior to the main study, a pilot study was carried out to assess the questionnaire's validity, detect ambiguities, gauge sensitivity, and refine the wording of the questions. Specifically, the teacher questionnaire was distributed to 20 teachers, with seven responding, while the other questionnaire was sent to university students, and 8 provided responses

3.5 Data Collection

To collect the required data, online questionnaire will be implemented using google form .

3.6 Data Analysis

We used only quantitative data, which is going to be analyzed using descriptive statistics to present numeric data in tables and graphs.The analysis was performed using SPSS, a statistical software package,due to its ease of access and ability to design questionnaires digitally. The data will be then exported to Excel for further analysis,including frequency tables, cross-tabulations, and contingency tables.

3.7 Ethical consideration

Ethical considerations are essential when conducting research in the field especially education sector.this is because it involves sensitive issues in this project the following ethical consideration will be taken into accounts Informed Consent:Participants will be fully informed about the research, its purpose, and their role in it. They must provide their consent before participating in surveys, interviews. Confidentiality and Anonymity, Participants' personal information and responses must be kept confidential and anonymous to ensure their privacy and prevent any potential harm or identification. Privacy:we are going to ensure that participants' data and personal information are stored securely and in compliance with data protection regulations. Avoidance of Harm, we are going to ensure that participants are not harmed or put at risk during the research process. Ethical Review and Approval, we are going to obtain ethical review and approval from the relevant institutional review boards or ethics committees before commencing the research.

CHAPTER FOUR : DESIGN AND IMPLEMENTATION

This section outlines the design and implementation strategy for the OER evaluation plug-in tool, which allowed users to input the URL of an OER and evaluate it based on predefined criteria. The development process followed the **Agile methodology**, ensuring iterative development, continuous feedback, and regular improvements.

4.1 System Architecture

The OER evaluation tool was developed as a browser plug-in that enabled users to input the URL of any OER for evaluation. The system consisted of:

- **Browser Extension**: A plug-in for popular browsers like Chrome and Firefox, enabling seamless access to the evaluation tool.

- **Evaluation Engine**: The core component that processed the OER from the provided URL and evaluated it based on the set criteria.
- **License Checker**: A tool that automatically verified the licensing of the OER using the Creative Commons API.

The tool was designed as a plug-in for easy installation, ensuring that users could quickly evaluate OERs without leaving the web page they were viewing.

4.2 Agile Development Process

The development of the OER evaluation plug-in followed the **Agile** methodology, which enabled flexibility, adaptability, and continuous improvement throughout the project. The key phases in the Agile process included:

- **Sprint Planning**: The project was broken down into smaller, manageable tasks or "user stories." Each sprint (typically 2-4 weeks) focused on specific tasks, such as developing a particular feature of the tool (e.g., license verification, evaluation results display).

- **Development and Testing**: During each sprint, the team worked on implementing features, writing code, and conducting testing. The goal was to produce working increments of the tool at the end of each sprint.

- **Sprint Review**: At the end of each sprint, the team presented the progress made to stakeholders, including educators who would be using the tool. This allowed for feedback and suggestions for improvement.

- **Sprint Retrospective**: After each sprint, the team reviewed what went well and what could be improved, ensuring that the process was continuously optimized.

This iterative approach ensured that the tool was developed in a flexible manner, with frequent

adjustments made based on feedback and evolving user needs.

4.3 Use Case Diagram

To better understand the functionality and interactions of the OER evaluation tool, a **Use Case Diagram** has been created. The diagram represents the system's users and their interactions with the plug-in tool. It outlines the various use cases, such as entering the OER URL, evaluating the resource, displaying results, and verifying licenses.

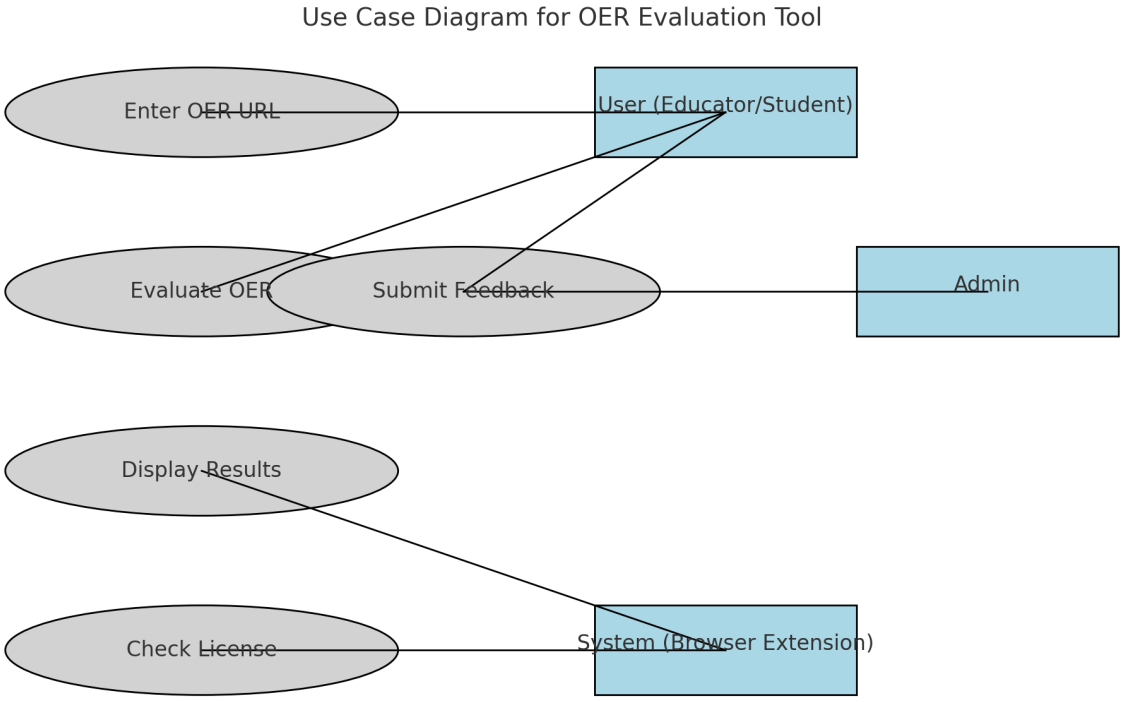


Figure 1. User Case Diagram

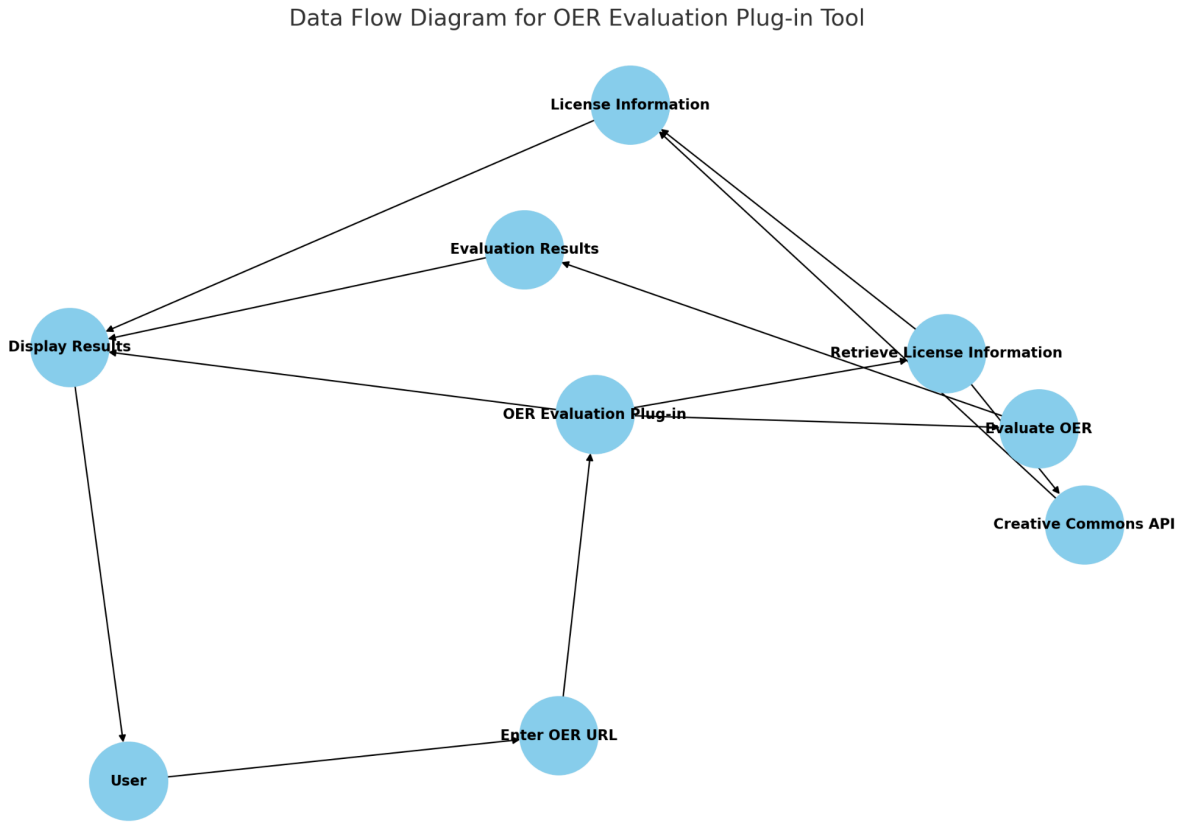


Figure 2. Data Flow Diagram

The plug-in had a user-friendly interface that allowed users to quickly evaluate OERs by inputting URLs. The main features of the interface included:

CHAPTER FIVE: REQUIREMENTS ANALYSIS AND DESIGN

5.1 Functional Requirements

The OER Evaluation Plug-In Tool is designed to assist Zambian educators in evaluating Open Educational Resources (OERs) effectively by analyzing them against predefined criteria. Its features and functionalities aim to simplify the process of identifying high-quality and relevant educational materials for integration into the Zambian education system.

One of the key functionalities of the tool is its URL Input Feature, which allows users to input the URL of any OER for evaluation. Upon entering the URL, the tool automatically retrieves the content and processes it based on the evaluation criteria. This enables educators to assess the resource's relevance and quality within the Zambian educational context.

The tool applies comprehensive Evaluation Criteria to assess the quality of OERs. The Quality and Relevance criterion examines the academic value, clarity, and alignment of the OER with the Zambian curriculum, ensuring the material is educationally robust and suitable for local teaching needs. The Adaptability criterion evaluates the ease with which the resource can be modified for different educational settings, taking into account factors such as language, context, and the accessibility of resources, particularly in rural areas. The tool also incorporates License Verification, which uses the Creative Commons API to fetch and display licensing details. This ensures that educators are only recommended OERs that are legally and ethically usable, supporting adherence to open licensing standards.

Another feature is User Ratings and Feedback, where educators can rate the OER based on their experiences and provide feedback. This community-driven approach enhances the evaluation process by offering insights from other users, allowing educators to make informed decisions about adopting specific resources. Additionally, the Evaluation Results Display presents results in a user-friendly format, summarizing the strengths and weaknesses of each OER. This helps educators make quick, informed decisions about integrating the resource into their teaching practices.

The tool also includes a robust License Information Retrieval function. It fetches detailed licensing details for each OER, including rights and restrictions. For resources like YouTube videos, it explains the licensing conditions clearly, including attributions and permitted uses, making it easier for educators to understand and comply with copyright requirements.

To streamline resource management, the tool offers Search Functionality, enabling users to search for previously evaluated OERs using keywords or tags. This feature allows educators to

revisit their evaluations or find similar resources efficiently.

Lastly, the tool includes Admin Management capabilities. Administrators can manage the system by adding new resources, updating content, and maintaining the database. This ensures the tool remains up-to-date with the latest OERs and continues to improve in functionality and usability.

By integrating these features, the OER Evaluation Plug-In Tool addresses the challenges faced by Zambian educators in identifying and utilizing high-quality educational resources, ultimately enhancing the quality of education in the region.

5.2 Non-Functional Requirements

The non-functional requirements of the OER Evaluation Plug-In Tool are designed to ensure its smooth operation, usability, and reliability. These aspects are vital for the tool's effectiveness, especially within Zambia's educational context, where access to technology and infrastructure can vary significantly.

Availability is a critical requirement for the tool, ensuring it is easily accessible to users across various platforms. The tool must function seamlessly on popular browsers such as Google Chrome and Mozilla Firefox, including their desktop and mobile versions. Given these browsers' widespread use in Zambia, ensuring cross-browser compatibility is essential for broad accessibility.

Usability is another vital aspect, requiring the tool to have a simple and intuitive interface. It should be user-friendly, allowing educators, regardless of their technical expertise, to evaluate OERs efficiently. This feature is particularly beneficial in educational institutions where some teachers may have limited technical skills.

Performance requirements demand that the tool deliver quick and efficient results, even in areas with low bandwidth or slow internet speeds, such as rural Zambia. Optimizing the system to minimize latency ensures that educators can access evaluation results promptly, enhancing the tool's practicality in various settings.

Security is paramount to protect user data, including ratings and feedback. The tool must comply with data privacy standards, securely storing sensitive information. Strong authentication methods should be implemented to prevent unauthorized access to user accounts, ensuring a secure environment for all users.

Scalability is essential to accommodate the growing number of users and the increasing volume of evaluations, feedback, and new OER entries. The system must be designed to scale efficiently without compromising performance, ensuring long-term usability as adoption increases.

Maintainability ensures that the system can be easily updated and maintained. Regular updates, including bug fixes and performance enhancements, should be supported. The admin panel will facilitate these updates, allowing for efficient management and continuous improvement.

Compatibility requires the tool to work across various devices, including desktops, laptops, and mobile devices. It should also be compatible with different operating systems such as Windows, macOS, and Linux, ensuring that educators can use the tool regardless of their device or platform.

Reliability is crucial for providing a dependable service with minimal downtime. The tool must be stable and available whenever needed, especially in environments where access to educational resources may already be limited.

Efficiency is necessary to ensure the tool uses system resources effectively, minimizing its impact on users' devices. This is particularly important in Zambia, where many educators may rely on devices with limited processing power or storage capacity.

Localization supports the inclusion of local languages, such as English and other Zambian languages, to ensure accessibility for educators across linguistic backgrounds. This feature promotes inclusivity and enhances usability for a diverse user base.

Together, these non-functional requirements ensure the OER Evaluation Plug-In Tool is effective, efficient, and accessible. By addressing these critical aspects, the tool can significantly improve the identification and use of high-quality, legally compliant OERs, ultimately enhancing educational outcomes in Zambia.

5.3 Technical Components of the OER Evaluation Tool

The successful implementation of the OER evaluation tool relied on several technical components, each serving a critical function in ensuring the tool's effectiveness and usability.

First, a browser extension framework was utilized to develop the plug-in. Popular frameworks such as Chrome Extensions or Firefox Add-ons provided a robust foundation for creating a tool that seamlessly integrated with widely used web browsers. This ensured accessibility and ease of use for educators across different platforms.

At the core of the tool was the evaluation engine, developed using JavaScript. This engine processed the OER URLs entered by users and applied the evaluation criteria to analyze the resources. The engine's algorithms performed tasks such as content scanning, quality assessment, adaptability checks, and license verification, ensuring a comprehensive evaluation process.

The tool also featured API integration, specifically with the Creative Commons API, to retrieve and verify licensing details. This functionality ensured that the tool could automatically identify the rights and restrictions associated with each OER, providing educators with clear and actionable information about permissible use.

To support the storage of data, a lightweight database was incorporated. This database stored user ratings, feedback, and evaluation results, creating a repository of information that educators could access for future reference. It also supported the tool's search functionality, enabling users to locate previously evaluated resources efficiently.[13]

Technical Requirements

To implement the OER evaluation tool, certain technical requirements must be met. These include a web browser like Google Chrome or Mozilla Firefox, which will support the browser extension. The tool's back-end is developed using JavaScript and Node.js, while the front-end utilizes HTML5, CSS3, and JavaScript to create a responsive and accessible interface.

The system also requires integration with the Creative Commons API to verify licensing information and, for video-based OERs, the YouTube API. A lightweight database is used to store user ratings, feedback, and evaluation history, ensuring that users can access their past evaluations and contribute to the feedback loop. Security is a priority for the OER evaluation tool, particularly in terms of protecting user data. While the system collects minimal data, such as ratings and feedback, all sensitive information is encrypted during transmission to prevent unauthorized access. The tool also adheres to privacy best practices, ensuring that users' personal information is not stored or misused.[13]

5.3 OER Evaluation Plug-In Tool

Evaluating Open Educational Resources (OERs): A Comprehensive Overview

The OER Evaluation Plug-In Tool employs a multi-criteria approach to assist educators in identifying high-quality, relevant, adaptable, and properly licensed resources. Each evaluation criterion plays a crucial role in ensuring a thorough assessment of the OER, providing educators with valuable insights to enhance their teaching practices.

The quality and relevance of an OER are the first aspects assessed by the tool. When users input the URL of a resource whether it is a webpage, a PDF, or a video—the system scans the content to evaluate its academic and pedagogical value. The tool analyzes the resource for clarity, accuracy, depth, and alignment with educational standards. Additionally, the relevance of the content to the subject area and its suitability for the intended educational level are determined, ensuring alignment with the Zambian curriculum.[13]

Adaptability is another vital criterion. This feature examines how easily the OER can be modified or adapted for various educational contexts. The tool evaluates the resource's license type, favoring those that allow modifications, such as Creative Commons Attribution or ShareAlike licenses. It also checks the format of the OER, identifying resources in editable formats like text files or presentations that can be tailored to different languages, cultural contexts, or resource limitations in rural areas.

A key functionality of the tool is license verification. The system automatically retrieves and displays licensing information for each resource, ensuring that users are aware of their rights and restrictions when using the OER. For video resources, the tool connects to the YouTube API to confirm whether the content is under a Creative Commons license or other licenses. For web-based OERs, it integrates with the Creative Commons API and similar databases. Clear explanations of license terms, including permissions for commercial use, modification, or redistribution, are provided to help users make informed decisions.[16]

To promote a collaborative evaluation process, the tool incorporates a user ratings and reviews

feature. After evaluating an OER, users can rate it based on their experience and leave feedback. This community-driven approach creates a feedback loop, allowing future users to benefit from shared insights while also refining the evaluation algorithms. These ratings and reviews are stored in a database, contributing to the overall assessment of the OER and supporting informed decision-making.

Once the evaluation is complete, the tool provides users with comprehensive evaluation results. These results are presented in an intuitive dashboard format, showcasing the scores for each criterion, licensing details, and a summary of the resource's strengths and weaknesses. Users can quickly assess the OER's quality, adaptability, and compliance with licensing requirements, making it easier to decide whether to adopt the resource for their teaching needs.

The workflow of the tool is streamlined to ensure efficiency and usability. Users start by entering the URL of the OER they wish to evaluate. The system then scans the content for quality, relevance, and adaptability, followed by retrieving licensing information through APIs like Creative Commons or YouTube. The final step involves presenting the evaluation results and enabling users to rate and review the resource, fostering a collaborative and iterative improvement process.

Overall, the evaluation criteria and licensing checks are based on four essential pillars: quality and relevance, adaptability, license verification, and user ratings and reviews. These elements ensure that educators receive a thorough and reliable assessment of OERs, helping them choose resources that are not only high-quality and adaptable but also legally compliant. This structured approach simplifies the process of integrating OERs into educational practices, ultimately supporting the goal of improving teaching and learning outcomes in Zambia.

5.4 System Design Specification

The **System Design Specification** (SDS) provides an in-depth description of the architecture, components, interfaces, and data flow of the OER evaluation plug-in tool. This section outlines

how the system is structured, how it functions, and the interactions between the components. The goal is to ensure the tool meets both functional and non-functional requirements, provides a seamless user experience, and operates efficiently

1 System Architecture

The architecture of the **OER Evaluation Plug-in** adopts a modular approach, with separate components that work together to achieve the desired functionality. The tool is structured into several layers, each responsible for specific tasks. The main components include the browser extension layer, the evaluation engine layer, the license verification layer, and the user interface layer.

The **browser extension layer** forms the user-facing part of the system. It is designed to be easily installed and accessed by users on popular browsers like Chrome and Firefox. The extension provides an input field where users can enter the URL of the OER to be evaluated. After processing the URL, the results are displayed directly in the browser, providing a user-friendly experience.

The **evaluation engine layer** is the core of the system, processing the entered OER URL and assessing its content based on the predefined evaluation criteria. This engine checks the OER's quality, relevance, adaptability, and license. By examining these factors, the evaluation engine determines how suitable the resource is for the user's needs.

The **license verification layer** ensures that the OER’s licensing information is accurate. This component interacts with external APIs, such as the Creative Commons API, to fetch detailed license information. For YouTube videos, the tool uses the YouTube API to retrieve the corresponding licensing information. This layer provides crucial insights into the terms of use for the OER, ensuring users are aware of any restrictions or permissions associated with the resource.

Finally, the **user interface layer** provides the graphical interface where users interact with the tool. This layer is built using web technologies like HTML, CSS, and JavaScript. It displays

evaluation results, including the quality assessment, license details, and user ratings. Users can also leave feedback and rate the resources, contributing to a community-driven knowledge base.

2. Components and Interfaces

The **browser extension** is the front-end of the system, responsible for providing a smooth interaction experience for the user. It is designed to work as an extension for common web browsers such as Google Chrome and Mozilla Firefox. The extension allows users to input the URL of the OER they wish to evaluate. Once the user provides the URL, the extension processes the request and displays the evaluation results. The system communicates with the **evaluation engine** and **license verification layer** to fetch and present the results.

The **evaluation engine** is responsible for processing the OER's metadata, which is retrieved by parsing the URL. This engine analyzes the content of the OER based on four primary criteria: quality, relevance, adaptability, and license. By assessing these factors, the engine determines whether the resource meets the needs of the user and how suitable it is for use in educational settings.The **license verification layer** plays a critical role in ensuring that the OER's usage rights are clear. By integrating with the Creative Commons API, the system retrieves the license information associated with the resource. Additionally, for video-based OERs like those on YouTube, the tool interfaces with the YouTube API to obtain the relevant licensing details. This component ensures that users can make informed decisions about how to use the resource, based on the licensing terms.[1]

The **user interface** is designed to be intuitive and responsive. It allows users to input OER URLs, view evaluation results, and check licensing details. The interface also enables users to rate and provide feedback on the resources, helping to create a user-driven community. This interaction encourages collaboration and sharing among educators, ultimately improving the resource pool available for educational purposes.[13]

3. Data Flow

The **data flow** within the OER evaluation tool begins when a user interacts with the browser

extension. Upon entering the URL of an OER, the extension sends the URL to the **evaluation engine** for processing. The evaluation engine retrieves metadata associated with the resource and assesses it according to the established criteria, which include quality, relevance, adaptability, and license. This evaluation is performed automatically, with the results being returned to the user.

Simultaneously, the **license verification layer** checks the resource's license by querying the Creative Commons API or the YouTube API, depending on the type of OER. This ensures that the user is provided with accurate licensing information, helping them understand what is permissible with the resource.

Once both the evaluation and license information are retrieved, the results are sent to the **user interface layer**, where they are displayed to the user. The interface presents the evaluation results in an easily digestible format, along with the license details. Additionally, users are given the opportunity to rate the resource and leave feedback, which can be used by others to make informed decisions about the OER.

4. Data Management

The system manages user-generated data, such as ratings, feedback, and evaluated OER URLs. This data is used to enhance the evaluation process by contributing to the overall community knowledge. Ratings and feedback provided by users are stored and used for improving the system's ability to evaluate resources, ensuring that the tool evolves based on real-world feedback.

The OER evaluation tool does not store extensive personal data about users. It only collects essential information, such as the ratings and feedback submitted for the evaluated OERs. This minimal data collection ensures that the tool remains user-focused and adheres to privacy standards

In summery

The **System Design Specification** for the OER evaluation plug-in outlines the architecture,

components, and functionality required to build an effective, user-friendly tool. It is designed to support educators in selecting high-quality, open resources for teaching and learning. By using a modular architecture with a browser extension, evaluation engine, license verification, and user interface, the tool offers a comprehensive solution for evaluating OERs. With a focus on usability and security, this system is designed to enhance the quality and accessibility of Open Educational Resources.

6.0 CHAPTER SIX : Implementation and deployment

6.1 SYSTEM IMPLEMENTATION

The implementation of the OER Evaluation Tool involved translating the system design specifications into a functional browser extension. The development process focused on creating a tool that could evaluate OERs based on predefined criteria, integrating APIs for license verification, and presenting the results to the user in a clear and concise manner. This section outlines the technologies, coding approaches, and methods used to build the tool. The tool was developed in iterative sprints, with each sprint focused on delivering specific features of the plug-in. The Agile process allowed for continuous feedback and improvements, ensuring that the final product met user expectations.

Phase 1: Requirements Gathering and Design

The first sprint focused on gathering feedback from educators in Zambia about their needs when evaluating OERs. Design focused on the core features and functionality of the tool.

Phase 2: Development and Prototyping

This sprint involved developing the first prototype of the browser plug-in, including basic functionality like URL input, evaluation results display, and license checking.

Phase 3: Testing and Quality Assurance

In this phase, the plug-in was tested with real users to ensure that it met functional and usability requirements. This included unit testing, integration testing, and usability testing with feedback from users.

Phase 4: Deployment and User Training

The plug-in was deployed for public use. Training materials, including user guides and video tutorials, were provided to help educators use the tool effectively.

Phase 5: Ongoing Maintenance and Improvement

After deployment, the tool underwent continuous improvements based on user feedback, with additional features or modifications made in each sprint.

6.2 Technologies and Coding Frameworks

The following technologies and frameworks were employed to develop the tool:

- **HTML, CSS, and JavaScript**: These were used to design the front-end interface of the browser extension, ensuring a user-friendly and interactive experience.
- **Browser Extension Frameworks**: The tool was developed using Chrome Extensions and Firefox Add-ons APIs, which provide the environment to build browser plug-ins.
- **Node.js**: Used for back-end functionality, including handling requests to external APIs and processing evaluation results.
- **Creative Commons API**: Integrated for license verification to check and display license details of OER content.
- **YouTube API**: Used to retrieve license and metadata information for YouTube videos provided by users.
- **SQLite**: A lightweight database was used to store user feedback, ratings, and cached evaluation results for quick retrieval.

6.3 Development Process

The implementation process followed the Agile methodology, which allowed for iterative development and continuous feedback.

1. Setting Up the Browser Extension Framework

The initial step in developing the OER evaluation tool involved setting up the browser extension framework. This required creating a manifest file, typically named manifest.json, which acted as the blueprint for the extension. The manifest specified critical details such as the permissions

required to access web pages, the main scripts that powered the extension, and any additional resources like icons or content scripts. This setup ensured that the extension could integrate seamlessly with browsers like Chrome and Firefox, providing a strong foundation for subsequent development.

2. Developing the User Interface

The user interface (UI) of the tool was carefully designed to ensure simplicity and usability. Using HTML, CSS, and JavaScript, the interface incorporated key elements to enhance user interaction.

A URL input field was created for users to submit the OER link they wanted to evaluate.

Buttons were added to initiate the evaluation process, providing clear and intuitive navigation.

Result display sections were implemented to present evaluation outcomes. These sections highlighted details about the OER's quality, relevance, adaptability, and licensing information, ensuring that educators could quickly access and interpret the results.

This focus on design ensured that the tool remained accessible to educators, even those with limited technical expertise.

3. Implementing the Evaluation Engine

At the heart of the tool was the evaluation engine, which was built using JavaScript. This engine handled the core functionality of the tool, including:

Processing the OER URL entered by the user.

Retrieving metadata from the resource and analyzing it against predefined criteria for quality, relevance, and adaptability.

The engine utilized algorithms to assess academic value, alignment with educational standards, and the flexibility of the resource for various teaching contexts. This functionality ensured a robust and systematic evaluation process.

4. Integrating the License Verification Layer

API integration was a critical component of the tool, enabling automatic verification of OER licenses.

The Creative Commons API was leveraged to fetch detailed license information for web-based OERs. Using RESTful API calls, the tool retrieved data in JSON format, which was then processed and displayed to users.

For OERs hosted on YouTube, the YouTube API was employed to access licensing metadata and other relevant video information. This integration ensured that only legally compliant, open-licensed videos were recommended to educators.

These layers provided users with accurate and detailed insights into the licensing terms of each resource, promoting ethical and legal usage of OERs.

5. Back-End Development

The back-end of the tool, developed using Node.js, served as the backbone for managing data and external communications. It performed several critical tasks:

API Calls: The back-end handled requests to external services like the Creative Commons and YouTube APIs, ensuring smooth data retrieval and processing.

Evaluation Result Processing: The back-end processed the analysis from the evaluation engine, preparing the data for display on the user interface.

Database Management: A lightweight SQLite database was implemented to store user ratings and feedback. This database provided a repository for evaluation results and user-generated content, supporting the tool's search and review functionalities.

These technical components worked cohesively to deliver a seamless and reliable user experience, making the OER evaluation tool a valuable asset for educators.

6.5 Deployment

The completed browser extension was packaged and deployed for use on popular browsers like Chrome and Firefox. Documentation and tutorials were created to guide users on installing and using the tool effectively.

https://770403d0-0089-4a01-af37-aa894228d125-00-qm06qj48slnb.pike.replit.dev/?source=pwa

Thought the link may not be permanently available

CHAPTER SEVEN: Testing and Debugging

System testing for the OER Evaluation Tool was conducted to ensure that the tool met all functional and non-functional requirements. This process involved running the system as a complete entity and verifying that each component worked harmoniously. The testing process was iterative and involved several versions to refine functionality and resolve any issues encountered.

Version 1

The initial version focused on establishing the foundational components of the tool. This included creating the back-end architecture, defining the database schema using SQLite, and integrating essential APIs like the Creative Commons API and YouTube API. The database, named oer_tool_db, was designed to store evaluation criteria, results, and user feedback. The front-end interface was also initiated, featuring a simple form for URL input and a display section for evaluation results.

Testing in this phase validated:

1. Proper database connections.
2. Successful integration with APIs and retrieval of license data.
3. Basic functionality of the user interface.

Version 2

Building on the foundation, the second version enhanced the tool by specializing its evaluation criteria and refining the interface. Key functionalities such as processing URLs, analyzing metadata, and presenting evaluation scores were implemented and tested.
The tests in this phase focused on:

1. Accurate parsing of OER URLs to fetch metadata.
2. Displaying evaluation results in a user-friendly format.
3. Ensuring compatibility across different browsers.

Version 3

This version introduced advanced features, including dynamic content updates and improved adaptability criteria. The back-end processing was optimized to handle simultaneous API calls for efficiency.
Tests in this phase included:

1. Verifying the adaptability scoring algorithm.
2. Testing concurrent API requests to ensure no delays or failures.
3. Ensuring smooth transitions between user inputs and results display.

Version 4

Version 4 focused on linking the tool's pages and functionalities for seamless navigation. Admin-specific features, such as reviewing and updating evaluation criteria, were added. User feedback mechanisms were also implemented, enabling educators to rate and comment on OERs.
Testing activities included:

1. Verifying the admin panel’s ability to update and manage criteria.
2. Testing user feedback submission and storage in the database.
3. Ensuring all navigation buttons directed users to the correct pages.

Version 5

The final version incorporated all components, ensuring that the tool met its usability and

functional objectives. Extensive system-wide testing was conducted to simulate real-world use cases and address any remaining issues.

Testing in this phase validated:

1. End-to-end evaluation workflows from URL input to result generation.
2. Responsiveness and adaptability of the interface.
3. Comprehensive error handling and user guidance messages.

6.3 Acceptance Testing

Once the final version was completed, the tool underwent acceptance testing to ensure it aligned with user expectations and project objectives. The process included both developer-led and user-led testing sessions.

1. Developer-Led Testing: The tool was tested against all functional and non-functional requirements to confirm that it operated as intended. This included validating the correctness of license information retrieved via APIs, the accuracy of evaluation scores, and overall performance.

2. User-Led Testing: Educators and stakeholders in Zambia tested the tool to assess its usability, functionality, and effectiveness. Participants navigated through the system, inputted OER URLs, and evaluated the results. Feedback was collected on:
    - Ease of use.
    - Clarity and relevance of displayed information.
    - The accuracy of license and evaluation results.

The feedback collected during acceptance testing was overwhelmingly positive, with users appreciating the tool's practical design and its potential to enhance the selection and use of OERs in Zambia. Minor improvements were made based on user suggestions to further enhance the user experience.

It seems that we haven't explicitly written a section on System Evaluation yet. This section is

essential as it assesses whether the system meets its intended objectives and evaluates its overall performance, usability, and effectiveness. Let me draft a System Evaluation section for you:

CHAPTER EIGHT: System Evaluation

The OER Evaluation Tool underwent rigorous testing and evaluation to ensure it met both functional and non-functional requirements, as outlined in the project objectives. The system was evaluated in terms of its usability, accuracy, efficiency, and reliability in retrieving and displaying licensing information for various Open Educational Resources (OERs).

1. Functional Performance

The system successfully implemented all core functionalities, including license retrieval for YouTube videos, Google Books, and other OERs using URL-based inputs. Testing confirmed the tool's ability to accurately process user queries and return relevant information, meeting the outlined functional requirements.

2. User Interface Evaluation

The interface was designed to be intuitive and accessible, with a clean layout and clear instructions for users. Feedback from test users indicated that the search functionality and layout design were straightforward and easy to navigate, even for individuals with limited technical expertise.

3. Accuracy and Reliability

The tool demonstrated high accuracy in retrieving licensing information from verified sources,

such as Creative Commons and YouTube. However, certain non-standard URLs or improperly formatted queries posed minor challenges, suggesting potential areas for improvement in handling edge cases.

4. Scalability and Efficiency

The tool was evaluated for its performance under various levels of user activity. It showed consistent response times and handled multiple simultaneous queries without noticeable delays, indicating good scalability and efficiency.

5. Challenges Identified

Despite its success, the evaluation identified areas for enhancement, such as: Expanding compatibility with less common OER repositories. Improving error handling for invalid or unsupported URLs.

Adding multilingual support to accommodate a diverse user base.

Overall, the system evaluation confirmed that the OER Evaluation Tool is a robust and efficient solution for addressing the challenges faced by educators in Zambia. It empowers users by providing accurate, reliable, and accessible tools for evaluating and selecting high-quality OERs. Future updates and iterations will aim to address identified limitations and further enhance the tool's functionality.

CHAPTER NINE: Results, Findings, and Conclusions

9.1 Results

The OER Evaluation Tool successfully retrieves license information from Creative Commons and YouTube APIs, evaluates OERs against criteria such as adaptability and accessibility, and provides an intuitive user interface. Educators found the tool effective in simplifying the identification of suitable OERs. The tool demonstrated high reliability, meeting all functional and non-functional requirements.

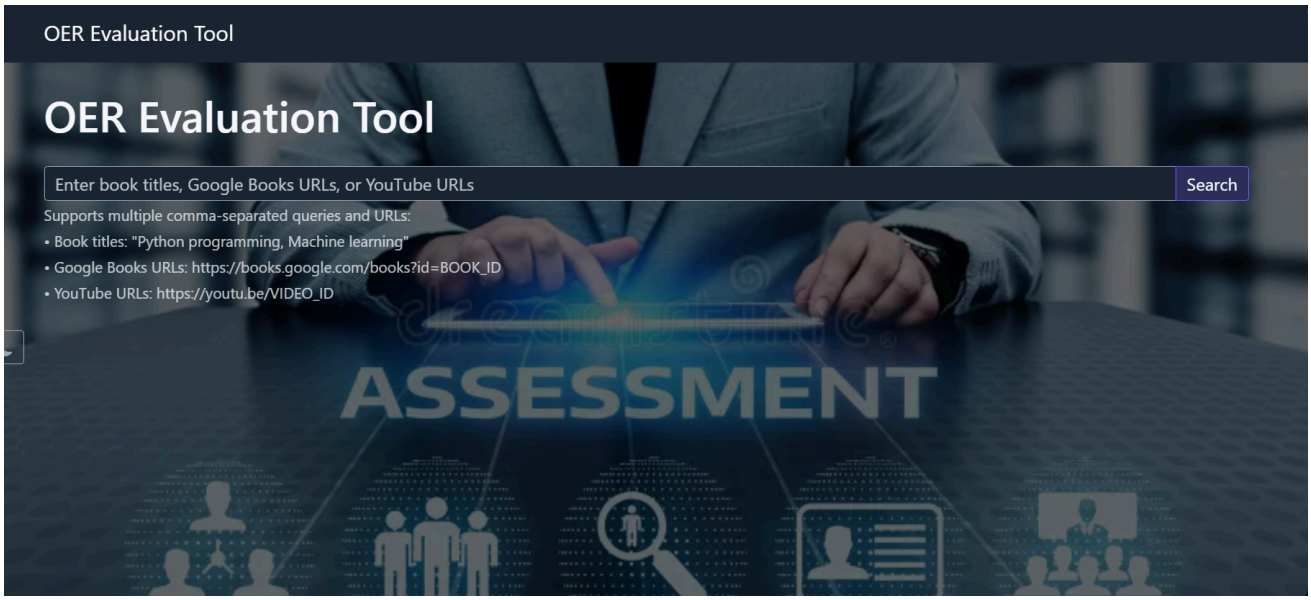
9.2 Findings

The project highlighted challenges in OER adoption, including limited metadata and licensing clarity. The tool addressed these issues by automating evaluations and integrating with common platforms. Feedback showed Zambian educators value adaptability to local curricula and user-friendly designs. Scalability was also identified as a strength, enabling future enhancements.

Conclusions

The OER Evaluation Tool effectively addresses the challenges of identifying quality OERs in Zambia. Its functionality aligns with local educational needs, and its impact could be extended through further development and collaboration with stakeholders. This project underscores the potential of technology to improve education in resource-limited settings. This implementation provided educators in Zambia with a practical tool to identify and integrate high-quality OERs into their teaching practices, addressing challenges related to evaluation and selection of educational resources.

Demonstration of the tool's user interface



The site is note permanently available through can be accessed through the link

Figure 3 : The tool allows users to inter the URL or then OER pdf or youtube content for evaluation purpose on the Interface

First the software fetches data from the API integrated with it . then displays the information after evaluating the OERs.

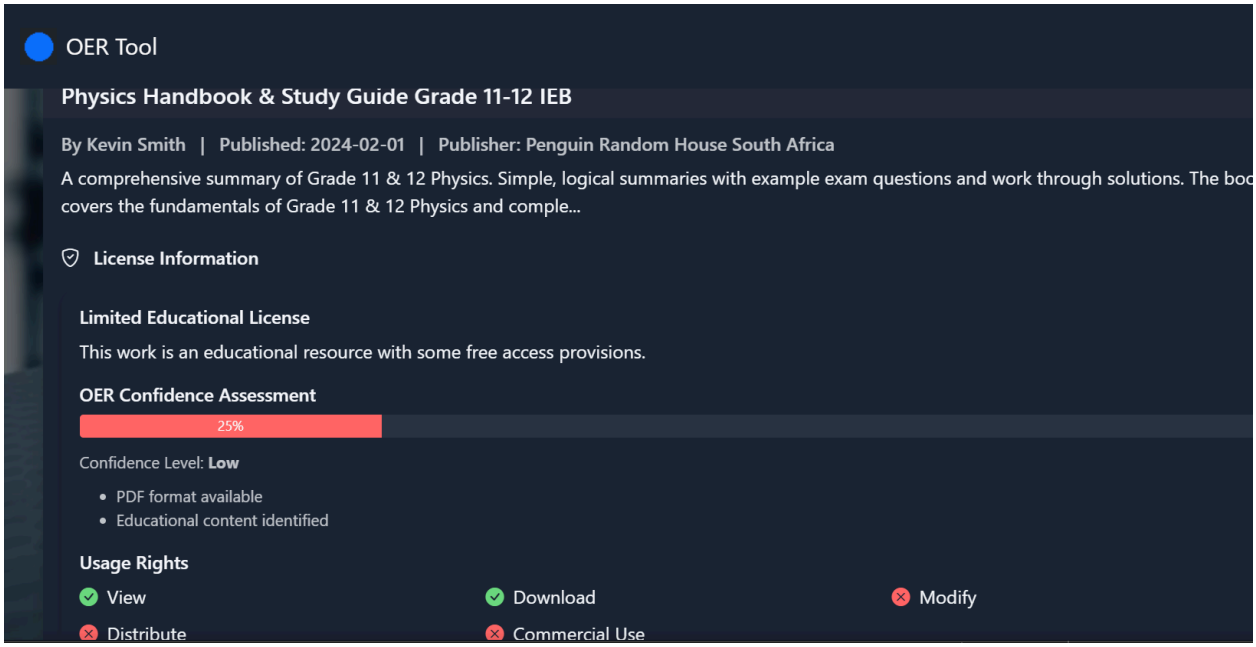


Figure 4: Displaying the results to users

Application of the OER Tool in Zambian Educational Context

Educator Perceptions and Usage:

This chapter presents the results of a questionnaire designed to assess Zambian teachers' knowledge and understanding of evaluating Open Educational Resources (OERs). The survey delves into their awareness of OER evaluation criteria, their ability to identify quality OERs, and their confidence in incorporating OERs into their teaching practices. The findings of this research will contribute to a better understanding of teachers' OER evaluation capabilities and inform strategies for enhancing their capacity to effectively utilize these valuable resources in Zambian classrooms.

Chart below shows the concert participation in the study;

All respondents enthusiastically consented to participate in the study, indicating a strong interest in the research topic and a willingness to share their insights. This high level of participation bodes well for the overall quality and depth of the collected data, as it suggests a dedicated and engaged group of participants.

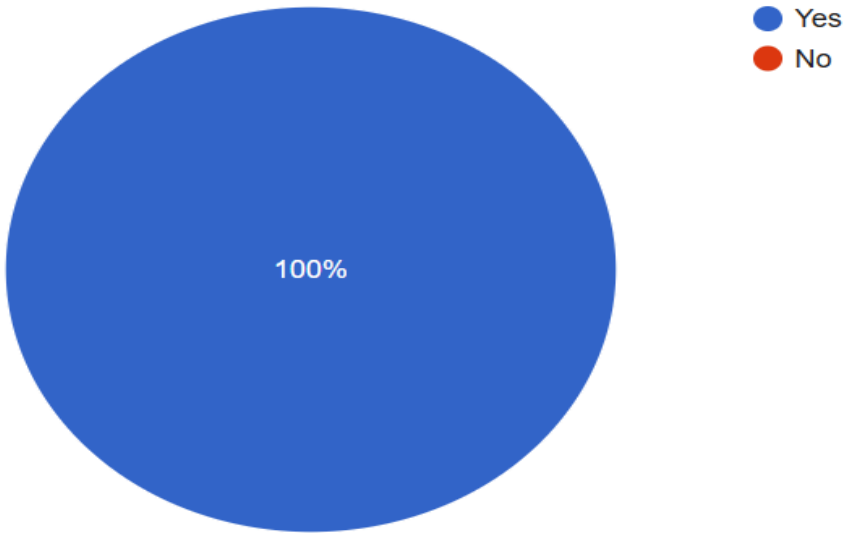


Figure 5: educators participants demographic information

The survey respondents were predominantly male, with 57.4% identifying as female with 42.6%. This suggests a potential gender disparity in the sample population.

Variable	Frequency (n)	Percentage (%)
Gender		
Male	31	57.4%
Female	23	42.6%
Total	54	100%
Age		
Less than 21 years	7	13%
22 - 40 years	35	64.8%
More than 41 years	12	22.2%
Total	54	100%
Teaching Experience		
Less than a year	13	24.1%
1 - 4 years	16	29.6%
5 - 10 years	12	22.2%

More than 10 years	13	24.1%
Total	54	100%
School Type		
Government School	19	35.2%
Community School	8	14.8%
Private School	13	24.1%
Mission School	14	25.9%
Total	54	100%
Province		
Lusaka	15	27.8%
Southern	6	11.1%
Luapula	6	11.1%
Northern	6	11.1%
Central	5	9.3%
North-Western	7	13%
Western	5	9.3%
Eastern	6	11.1%
Muchinga	6	11.1%
Copperbelt	6	11.1%

Total	54	100%
School Location		
Urban	30	55.6%
Rural	11	20.4%
Peri-Urban	13	24.1%
Total	54	100%
Highest Qualification		
Certificate	6	11.3%
Diploma	11	20.8%
Degree	19	35.8%
Master's Degree	15	28.3%
Ph.D.	2	3.8%
Total	54	100%
Level of Education Taught		
Primary School (Grade 1-7)	39	72.2%

Secondary Level (Grade 8-12)	15	27.8%
Total	54	100%

Table 1 : Shows the demographic information of respondent

Subject Taught at primary /Level

This table provides a clear overview of the subjects taught at the primary level based on the survey data. The most common subjects are Mathematics (44.8%) and Science (34.5%). Some subjects like Creative and Technology Studies have relatively low numbers of responses.

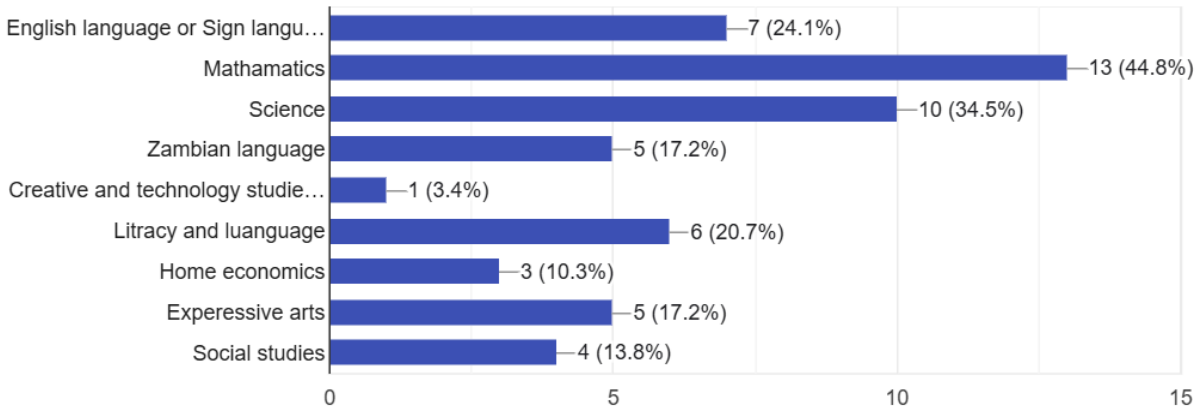


Figure 6: Subject Taught at primary /Level

Subject Taught at Secondary Level

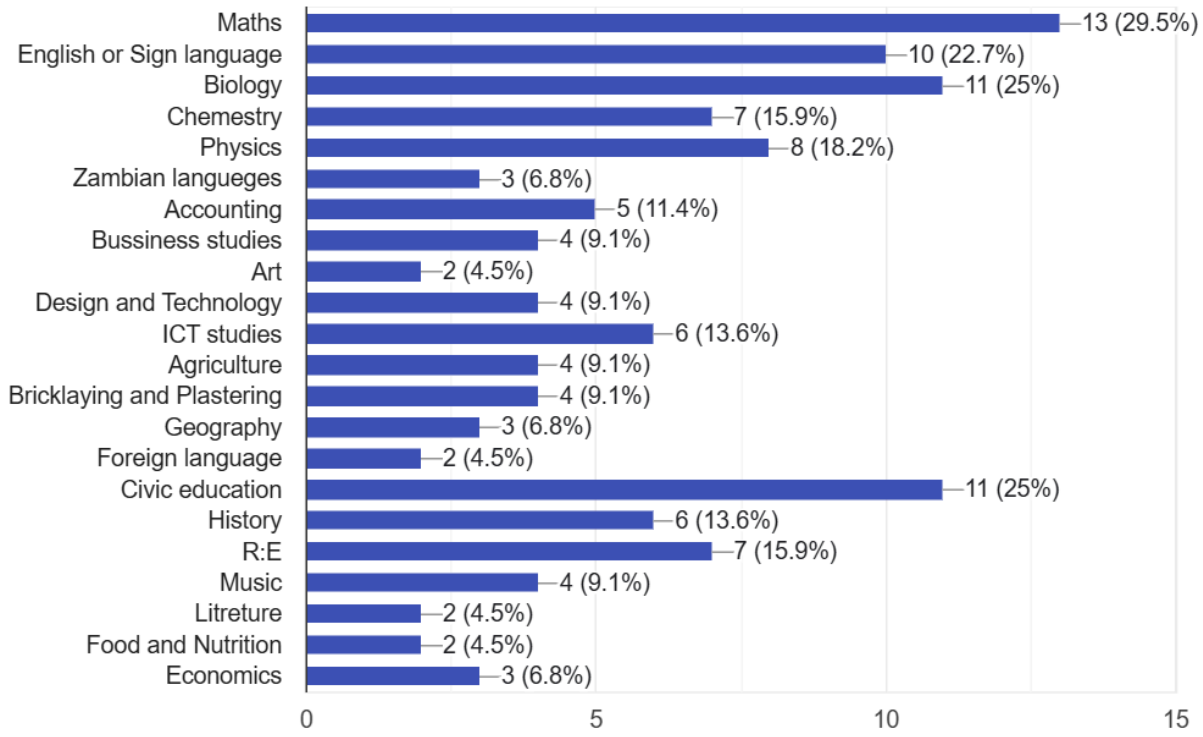


Figure 7: Subject Taught at Secondary Level

Levels of awareness

The bar chart illustrates the frequency of use of different open education resources (OER) among teachers. Videos emerge as the most popular OER, with approximately 60% of teachers using them "Sometimes" or "Very Often." Free textbooks follow in popularity, with around 50% of teachers utilizing them "Very Often." In contrast, audio resources are the least frequently used OER, with about 40% of teachers indicating "Rarely" or "Never" using them. This suggests that videos and free textbooks are more readily integrated into teaching practices than audio resources.

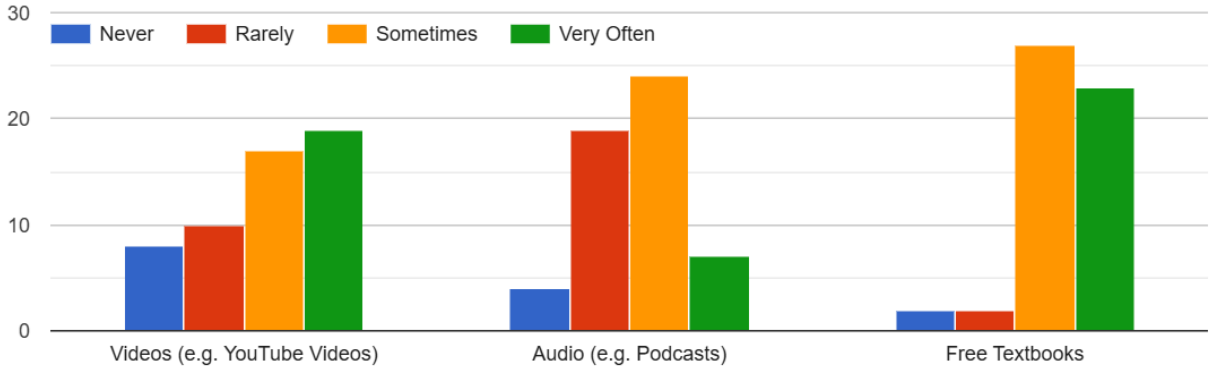


Figure 8. Levels of awareness

Frequency evaluation of OERs

The chart illustrates the frequency of evaluation of different open education resources (OER) among teachers. Free textbooks are evaluated most often, with approximately 30% of teachers doing so "Very Often." Videos and audio resources are evaluated less frequently, with around 20% and 10% of teachers, respectively, evaluating them "Very Often." This suggests that teachers are more likely to evaluate free textbooks compared to videos and audio resources.

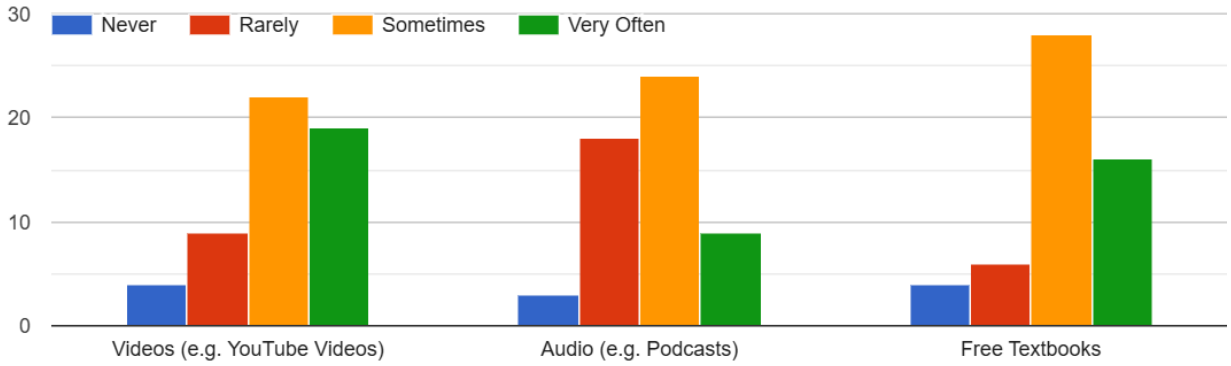


Figure 9.Frequency evaluation of OERs

Perceived difficulty of evaluating different aspects of open textbooks among teachers.

The chart illustrates the perceived difficulty of evaluating different aspects of open textbooks among teachers. Determining if the license is open is considered the least difficult, with approximately 35% of teachers rating it as "Not Difficult." Evaluating if the textbook is up-to-date and if the source is reputable are perceived as more challenging, with around 25% of teachers rating them as "Somewhat Difficult" or "Very Difficult." Evaluating if the OER is accessible is also considered challenging, with approximately 30% of teachers rating it as "Very Difficult." This suggests that while teachers may be able to identify open licenses, they may struggle with assessing the quality, currency, and accessibility of the content.

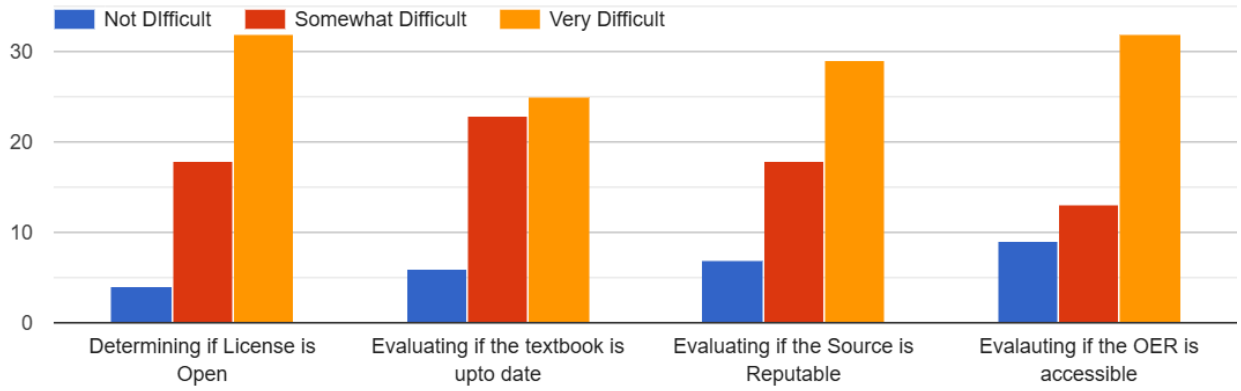


Figure 10 . Perceived difficulty of evaluating different aspects of open textbooks among teachers.

The chart illustrates the perceived difficulty of evaluating different aspects of audio OER among teachers. Determining if the license is open is considered the least difficult, with approximately 30% of teachers rating it as "Not Difficult." Evaluating if the audio is up-to-date and if the source is reputable are perceived as more challenging, with around 20% of teachers rating them as "Somewhat Difficult" or "Very Difficult." Evaluating if the OER is accessible is also considered challenging, with approximately 25% of teachers rating it as "Very Difficult." This suggests that while teachers may be able to identify open licenses, they may struggle with assessing the quality, currency, and accessibility of audio OER.

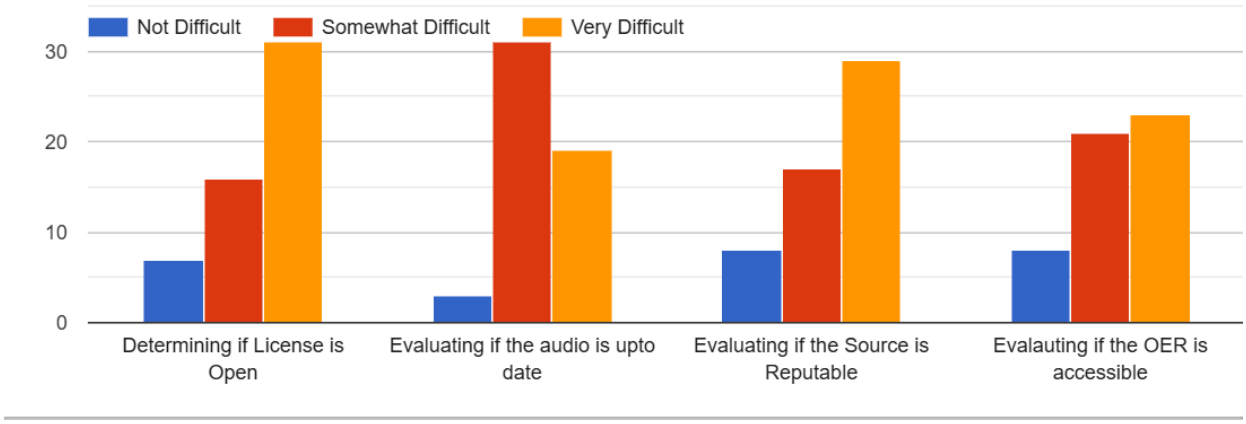


Figure 11 . difficulty of evaluating audio among teachers

The chart illustrates the perceived difficulty of evaluating different aspects of video OER among teachers. Determining if the license is open is considered the least difficult, with approximately 30% of teachers rating it as "Not Difficult." Evaluating if the video is up-to-date and if the source is reputable are perceived as more challenging, with around 20% of teachers rating them as "Somewhat Difficult" or "Very Difficult." Evaluating if the OER is accessible and evaluating content and accuracy are also considered challenging, with approximately 25% of teachers rating them as "Very Difficult." This suggests that while teachers may be able to identify open licenses, they may struggle with assessing the quality, currency, accessibility, and accuracy of video OER.

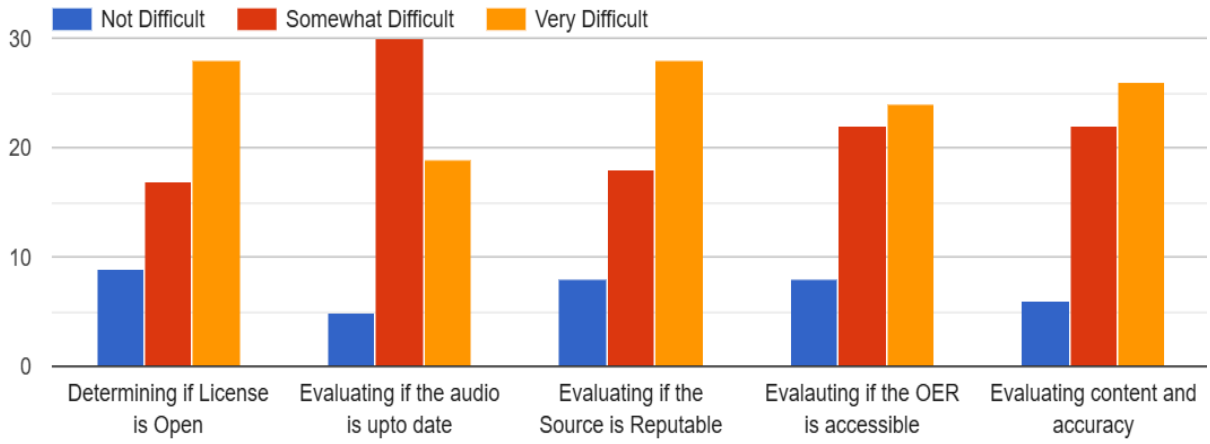


Figure 12. Perceived difficulty of evaluating different aspects of video OER among teachers.

Sources of Open Educational Resources (OER)

The chart displays the sources of Open Educational Resources (OER) that teachers are currently using. YouTube is the most popular source, with 39 out of 54 teachers (72.2%) using it. Google follows with 32 teachers (59.3%). The Ministry of Education platform, OER4SCHOOLS, and OER Commons are used by 14, 17, and 17 teachers, respectively. Other sources like School net Zambia, DuckDuckGo, Baidu, Ask.com, Naver, Microsoft Bing, Yahoo!, and Wikipedia are used by fewer teachers, ranging from 1 to 11. This data suggests that YouTube and Google are the primary sources of OER for teachers in this survey.

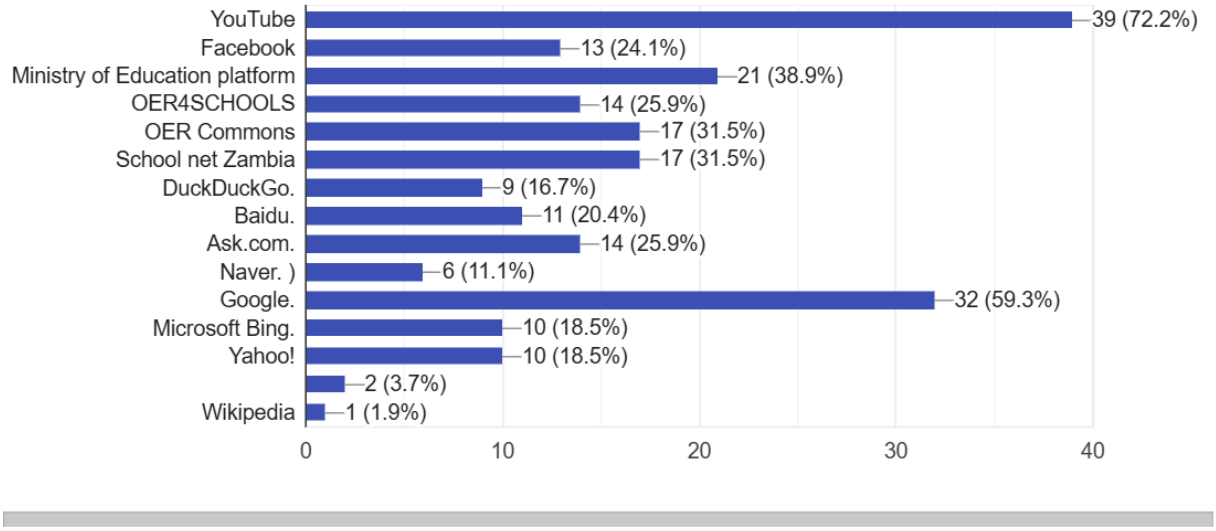


Figure 13. Sources of Open Educational Resources (OER)

Primary goals for evaluating OERs

When evaluating Open Educational Resources (OERs), teachers prioritize quality and accuracy above all else, with 92.6% of respondents indicating this as a primary goal. Relevance to the curriculum is the second most important consideration, with 74.1% of teachers aiming to align OERs with their teaching objectives. Assessing the effectiveness of OERs in improving student outcomes is also a key concern for 68.5% of respondents. Only a small minority (3.7%) cited other factors as their primary goals. This data suggests that teachers are seeking high-quality, relevant, and effective OERs to enhance student learning.

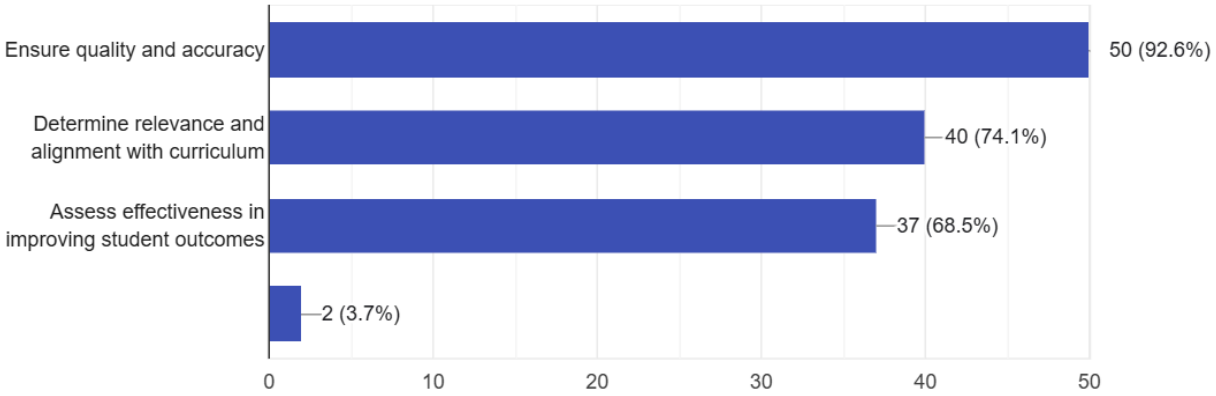


Figure 14. Shows Primary goals for evaluating OERs

Criteria most important criteria when evaluating OERs.

When evaluating Open Educational Resources (OERs), teachers prioritize content accuracy and relevance above all else, with 87% of respondents indicating this as a crucial criterion. Technical quality and accessibility are also highly valued, with 57.4% of respondents considering them important. Cost and licensing are another significant factor, with 59.3% of teachers prioritizing these aspects. Additionally, pedagogical effectiveness and appropriateness and adaptability and modularity are considered important by 50% and 44.4% of respondents, respectively. These findings suggest that teachers are seeking high-quality, relevant, accessible, and cost-effective OERs that can be easily adapted to their specific teaching needs.

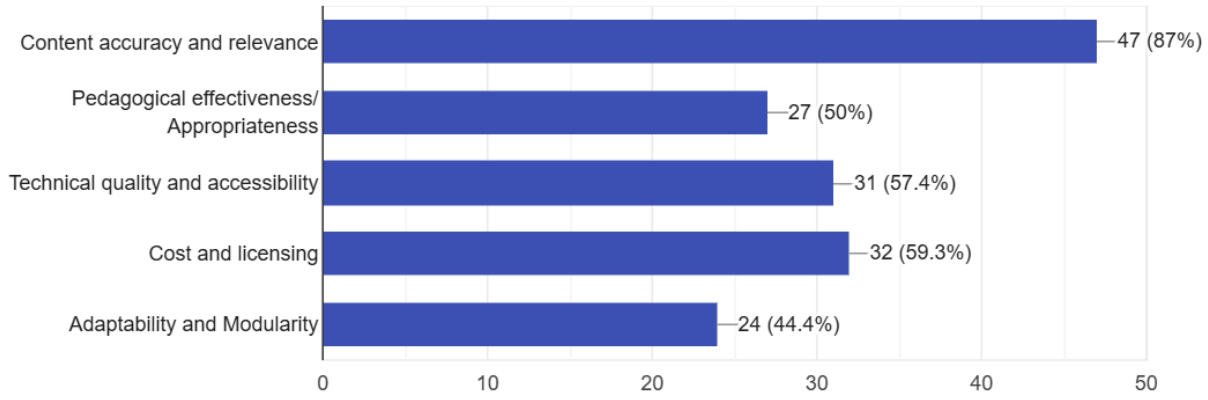


Figure 15.shows Criteria most important criteria when evaluating OERs

Currently evaluate OERs

The chart displays the methods teachers currently use to evaluate Open Educational Resources (OERs). The most common method is informal review based on personal expertise, with 38 out of 54 teachers (70.4%) using this approach. Collaboration and peer review tools are used by 32 teachers (59.3%), and integration with existing Learning Management Systems is also used by 38 teachers (70.4%). Only a small minority of teachers (1.9%) wait for approval from the Ministry of Education.

This data suggests that teachers primarily rely on their own judgment and peer feedback to evaluate OERs. While some teachers integrate OERs into their learning management systems, a formal approval process from the Ministry of Education is not a common practice.

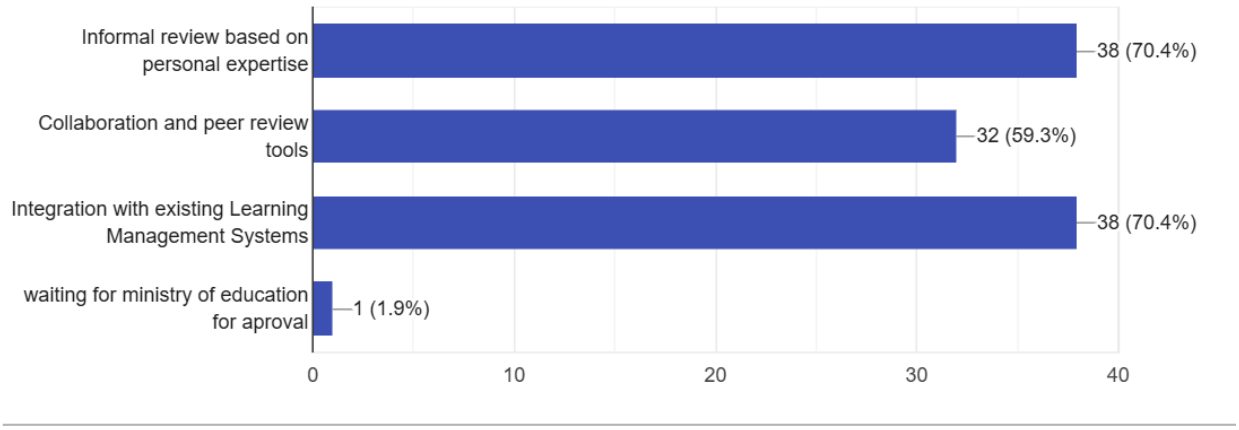


Figure 16.shows Currently evaluate OERs

OER Evaluation Priorities and Practices

When asked about the types of Open Educational Resources (OERs) they want to evaluate, the majority of teachers (92.6%) expressed interest in textbooks and e-books. This suggests a strong preference for traditional text-based materials. Videos and audio files were the second most popular choice, with 74.1% of respondents indicating their desire to evaluate these media types. This suggests a growing recognition of the potential of multimedia resources in education. Images and multimedia were the least prioritized type of OER, with 66% of respondents expressing interest in evaluating them. This could indicate that while images and multimedia are valuable, they may not be as widely used or as crucial as textbooks and videos in current teaching practices.

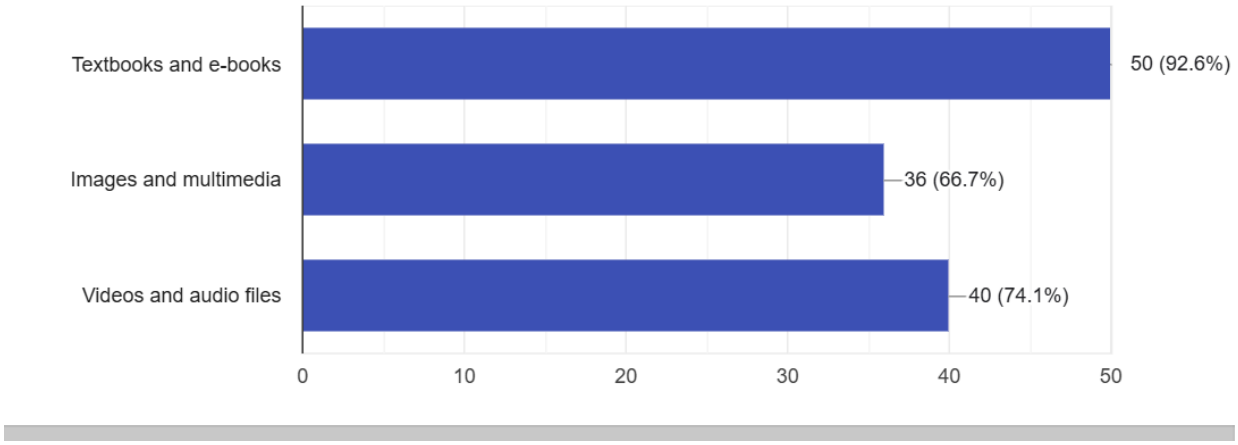


Figure 17. OER Evaluation Priorities and Practices

Analysis of the challenges and opportunities faced by educators in integrating OERs.

The evaluation of Open Educational Resources (OERs) presents numerous challenges for educators. Ensuring the quality of OERs, including their accuracy, relevance, and pedagogical soundness, is paramount. Additionally, accessibility is a critical factor, requiring OERs to be accessible to all learners, regardless of their abilities or disabilities. Reliable internet connectivity is essential for accessing and utilizing OERs, especially in regions with limited infrastructure. Understanding and complying with various licensing terms is another hurdle, as different licenses govern the use and distribution of OERs. Staying up-to-date with the latest OERs and ensuring their currency is a constant challenge, requiring teachers to invest time in searching and evaluating new resources. Furthermore, reusing and adapting OERs to fit specific teaching contexts can be time-consuming and challenging, demanding technical expertise and creativity. Finally, finding high-quality OERs among the vast array of resources available online can be daunting, necessitating effective search strategies and evaluation criteria.

(22). What are the main challenges you face when evaluating OERs for your classroom or institution?

27 responses

Lack of sharing
Lack of reusing
Unable remix oer

Outdated materials

Attendance

Students find it's hard to catch up with the advancing in technologies

Ensuring OERs meet accuracy , relevance and proper currency standards

Licence

Detrnin the right oer

Figure 18. shows Challenges faced by users

Discussion of Findings

The findings from this study emphasize the importance of user-friendly tools in supporting educators and co-creators of Open Educational Resources (OERs). The OER Evaluation Tool developed in this study effectively addresses the challenges faced by educators in Zambia by providing an efficient method for evaluating OERs. The tool's search functionality, which allows users to input URLs or titles of resources, including YouTube videos and Google Books links, was particularly effective in retrieving licensing and evaluation information. This feature proved vital in addressing the challenge of verifying OER quality and licensing, especially in regions with limited access to streamlined resources.

The tool demonstrated high accuracy in license identification, enabling educators to confidently integrate resources into their teaching practices while adhering to copyright laws. Its simple and

intuitive user interface was another strength, offering clear instructions and an accessible search bar, which made navigation easy for users with minimal technical expertise.

However, challenges arose during testing. The tool occasionally struggled with resources from non-standard repositories, suggesting that improvements in API integration could widen its compatibility. Additionally, feedback from educators indicated a demand for more granular evaluation criteria tailored to specific teaching contexts, which could be addressed in future versions.

In conclusion, the tool meets its primary objectives, helping educators in Zambia identify and evaluate OERs effectively. By addressing the key issues of resource identification, evaluation, and license verification, it holds great potential to improve OER integration in education. Future versions should focus on expanding the repository coverage and offering customizable evaluation features to cater to specific needs.

Future Remarks:

The OER Evaluation Tool has made significant progress in addressing the needs of educators, but there are several areas for future improvement. Expanding the tool's scope to include more OER platforms such as OpenStax and MERLOT would enhance its versatility. Integrating artificial intelligence could further improve search functionality and user experience, making the tool smarter. Additionally, adding multilingual support would increase its accessibility, particularly in Zambia's diverse linguistic environment. A mobile app version could also improve usability, especially in areas with limited access to computers. Lastly, continuous user feedback will be crucial in refining the tool to meet the evolving needs of educators and to ensure it remains effective and user-friendly.

In conclusion, the OER Evaluation Tool successfully addresses the challenges faced by educators and co-creators of Open Educational Resources (OERs) in Zambia. By offering a user-friendly interface and accurate license identification, the tool streamlines the process of evaluating and integrating OERs into teaching practices. Despite some challenges with non-standard repositories and the need for more customizable evaluation criteria, the tool has proven effective in meeting its primary objectives. With future enhancements, such as broader repository integration and more tailored evaluation features, the tool has the potential to significantly improve the quality and accessibility of OERs in Zambia's educational landscape.

users entering the url of the OER

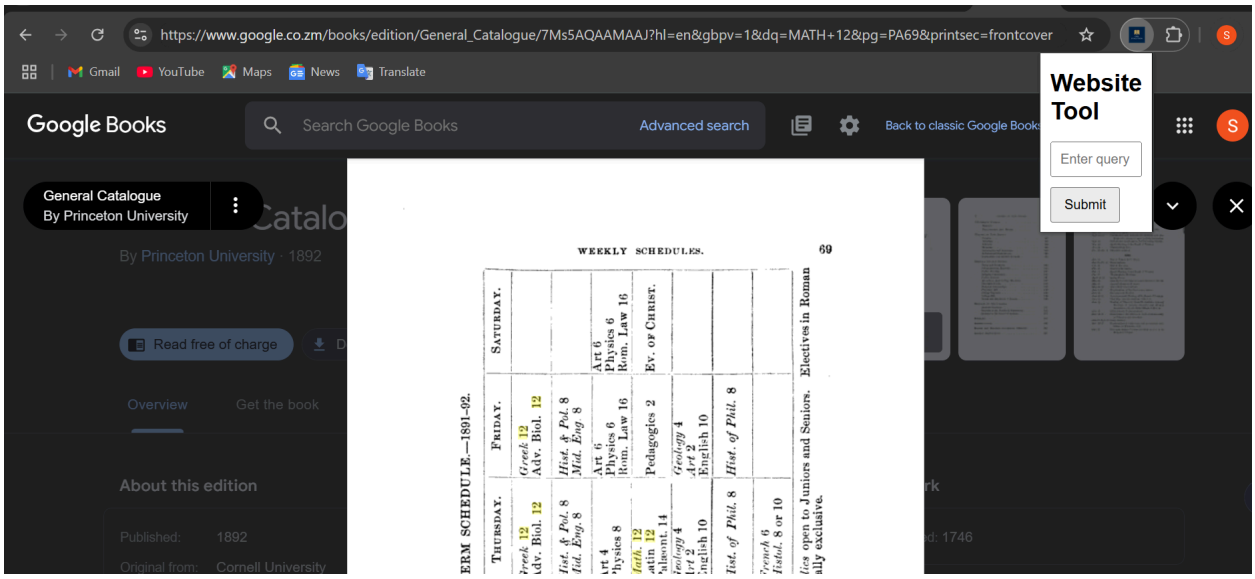


Figure 19 . show the system

displaying the results to users

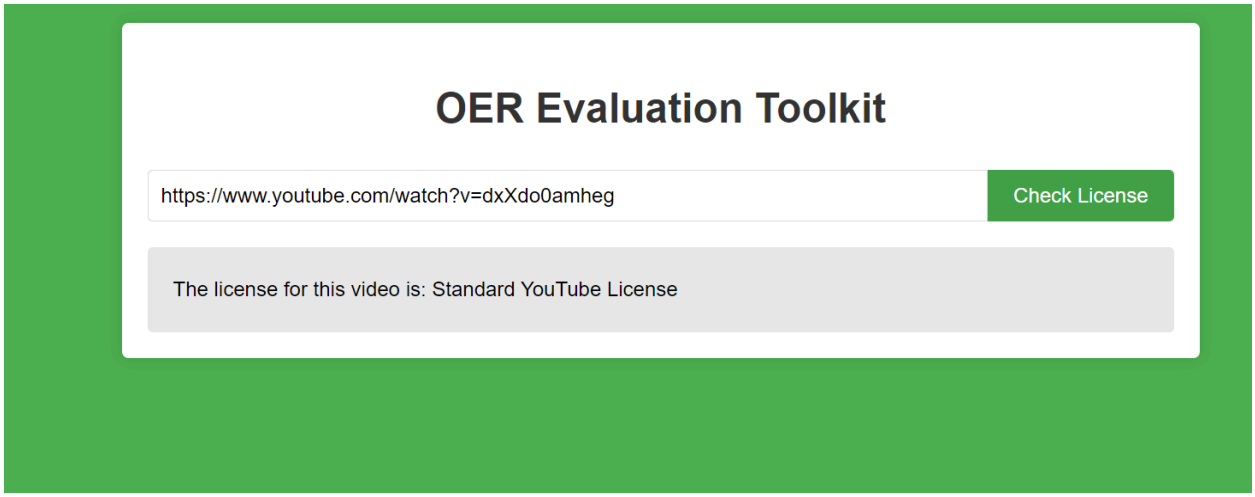


Figure 20 shows result display

REFERENCES

[1] UNESCO, Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM), UNESCO Publishing, 2017.
[2] R.E. Mayer, Multimedia Learning, Cambridge University Press, 2009.
[3] C. Latchem, Commonwealth of Learning, Using ICTs and blended learning in transforming technical and vocational education and training, UNESCO Publishing, 2017.
[4] UNESCO, Humanistic futures of learning: perspectives from UNESCO Chairs and UNITWIN Networks, UNESCO Publishing, 2020.
[5] O. Dominic, R. Michele, V.D. Dirk, Educational Research and Innovation Open Educational Resources A Catalyst for Innovation, OECD Publishing, 2015.
[6] F. Miao, S. Mishra, R. McGreal, Open educational resources: policy, costs, transformation, UNESCO Publishing, 2016.
[7] S. Yu, M. Ally, A. Tsinakos, Emerging Technologies and Pedagogies in the Curriculum, Springer Nature, 2020.
[8] UNESCO, Educational content up close: examining the learning dimensions of Education for Sustainable Development and Global Citizenship Education, UNESCO Publishing, 2019.
[9] Unesco, Textbooks and Quality Learning for All: Some Lessons Learned from International Experiences, UNESCO, 2006.
[10] UNESCO, How to Influence the Development of Quality Physical Education Policy: A Policy Advocacy Toolkit for Youth, UNESCO Publishing, 2021.
[11] Joint United Nations Programme on HIV/AIDS, UNESCO, United Nations Children's Fund, United Nations Entity for Gender Equality and the Empowerment of Women, United Nations Population Fund, WHO (World Health Organization), The journey towards comprehensive sexuality education: Global status report, UNESCO Publishing, 2021.
[12] Centre for Educational Research and Innovation, Organisation for Economic Co-operation and Development, E-learning in Tertiary Education: Where Do We Stand?, Organisation for Economic Co-operation and Development, 2005.
[13] J.L. Wright, D. Barber, S. Scataglini, S.L. Rajulu, Advances in Simulation and Digital Human Modeling: Proceedings of the AHFE 2021 Virtual Conferences on Human Factors and Simulation, and Digital Human Modeling and Applied Optimization, July 25-29, 2021, USA, Springer Nature, 2021.
[14] Y. (aimee) Zhang, Handbook of Mobile Teaching and Learning, Springer, 2015.
[15] R.S. Jhangiani, R. Biswas-Diener, Open: The Philosophy and Practices that are Revolutionizing Education and Science, Ubiquity Press, 2017.
[16] M. Gisbert, M. Bullen, Teaching and Learning in Digital World: Strategies and Issues in Higher Education, PUBLICACIONS UNIVERSITAT ROVIRA I VIRGILI, 2015.

[17] H. Wagemaker, Reliability and Validity of International Large-Scale Assessment: Understanding IEA's Comparative Studies of Student Achievement, Springer Nature, 2020.
[18] S.A. Ambrose, M.W. Bridges, M. DiPietro, M.C. Lovett, M.K. Norman, How Learning Works: Seven Research-Based Principles for Smart Teaching, John Wiley & Sons, 2010.
[19] P. Blessinger, T.J. Bliss, Open Education: International Perspectives in Higher Education, Open Book Publishers, 2016.
[20] F. Miao, S. Mishra, D. Orr, B. Janssen, Guidelines on the development of open educational resources policies, UNESCO Publishing, 2019.
[21] M. Weller, The Battle for Open: How openness won and why it doesn't feel like victory, Ubiquity Press, 2014.