

Usability Study of a Pilot Database Interface for Consulting Open Educational Resources in the Context of the ENCORE Project

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Abstract. Open educational resources (OER) are materials such as textbooks, lessons, and other teaching and learning tools that are freely accessible for use. OER are gaining popularity as a means for educators to give their students access to high-quality, economical educational materials. OER can encourage sharing information and resources throughout the educational community while also helping lower the cost of education for both students and teachers. In this context, the ENCORE project seeks, among other goals, to assist students and workers in acquiring the skills necessary to deal with economic, ecological, and technological challenges as well as to address the skills gap between the supply of educational institutions and the demand of employers and assist educators in staying abreast of the constantly changing landscape of skills. One of the first steps to reach the project's goals is to build a robust database that contains quality OERs linked to green, digital, and entrepreneurial (GDE) skills. A graphical interface has been developed to retrieve and display information about the OERs, and, in turn, to make these resources available for any stakeholder. However, due to the significant quantity of information, it is important to develop an interface that enhances user experience. This work presents a usability study of the ENCORE project's OER database interface carried out through a System Usability Scale (SUS) questionnaire, as well as future interface improvements based on the results.

Keywords: Data management · Open Educational Resources · GDE skills · Usability · SUS

1 Introduction

Open educational resources (OER) are increasing their popularity due to their free accessibility and their high availability for teachers and students. Open textbooks, lessons, and any freely accessible learning tool can foster information sharing through educational

communities while helping to overcome the cost of education, enriching the learning experience.

However, it is important to keep improving the means to access OERs, to leverage them, continue extending their use, and develop new quality resources.

In this context, the ENCORE project (ref. 101055893 - ERASMUS-EDU-2021-PI-ALL-INNO) aims to assist students and workers in acquiring the skills necessary to deal with economic, ecological, and technological challenges as well as to address the skills gap between the supply of educational institutions and the demand of employers and assist educators in staying abreast of the constantly changing landscape of skills.

To do so, one of the first steps to reach the project's goals is to build a robust database that contains quality OERs linked to green, digital, and entrepreneurial (GDE) skills.

The ENCORE database seeks to offer quality OERs through a simple and interoperable interface that allows users to search, filter, examine, and access quality educational resources.

This work presents the initial version of the ENCORE database interface and the results obtained from a preliminary usability study through the System Usability Scale (SUS) evaluation. The results of this initial evaluation are promising and have been vastly useful in supporting the introduction of new improvements and features for subsequent versions of the database management system.

The rest of this paper is organized as follows. Section 2 describes the methodology followed to develop the database, as well as the usability study protocol. Section 3 outlines the evaluated version of the database interface. Section 4 presents the quantitative and qualitative results obtained from the SUS evaluation. Finally, Sect. 5 discusses the results and Sect. 6 presents the conclusions of the work.

2 Methodology

2.1 Database Conceptualization

The main goal of the ENCORE database is to unify OERs and make them available and searchable by different parameters. To unify and characterize these resources, it is crucial to work under a well-defined and general schema.

Following this idea, the ENCORE database schema is based on the Dublin Core Metadata Element Set (DCMES) [1, 2]. This open-standard metadata provides different attributes to define educational resources. Furthermore, since DCMES's objectives center on "simplicity of creation and maintenance, commonly recognized semantics, worldwide scope, and extensibility," they are in line with the specifications of the ENCORE database [1, 2].

Considering this schema, each OER is characterized by the following DC metadata attributes (Fig. 1):

- Title. An OER should have a title describing its content.
- Description. The description is crucial in the context of the ENCORE project. OERs must be clearly described to extract the GDE skills from their content.
- Subject. The subject of the OER depicts the field addressed by the resource, and it is also crucial to identify the skills addressed through the content.

- Creator. The author or authors of the OER.
- Contributor. Entity or entities that contributed to the OER content.
- Publisher. Entity or entities in charge of making the resource available.
- Publication date. The date in which the OER was published.
- Type. Category of the resource (image, dataset, text, etc.).
- Format. Technical format of the resource (application/pdf, image/gif, etc.).
- Source. Reference to other resources from which the OER was derived.
- Language. The language of the OER.
- Coverage. The applicability of the resource.
- Rights. Information related to the OER’s rights.
- Relation. This attribute is represented to the “related to” relationship in the domain model and depicts related resources to a certain OER.

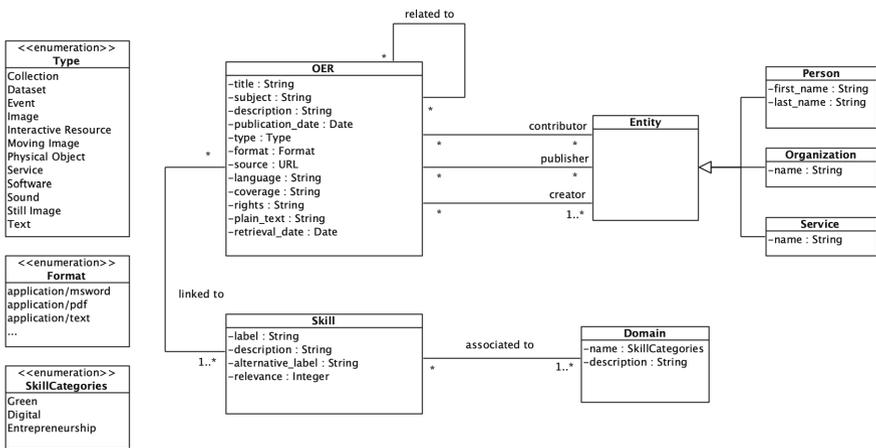


Fig. 1. Domain model of the ENCORE database.

2.2 Database Development

Selecting the proper technologies is crucial to provide an efficient, flexible, and robust database. In this sense, different database technologies were analyzed to identify their main features and potential caveats in the project’s context. After the analysis, PostgreSQL was selected as the base technology for the ENCORE database.

PostgreSQL is a robust object-relational database system that is completely free and open source. Due to its many features, including native partitioning, parallel query, support for foreign data wrappers, robust JSON features, streaming and logical replication, and the availability of numerous open-source tools for high availability (HA), backups, and monitoring, PostgreSQL aligns with the ENCORE database requirements.

Moreover, the possibility of handling queries using either SQL or NoSQL syntax provides great flexibility, as well as scalability, as the database schema could be modified to fit new requirements or necessities without consuming significant resources.

The database is complemented with a custom graphical interface developed with the Django (<https://www.djangoproject.com/>) web framework.

2.3 Usability Study

The System Usability Scale was selected as the instrument to assess the platform's usability (SUS). The SUS questionnaire offers a practical, reliable, and valid [3, 4] method for rating a system's usability. Given that there are only 10 things in the test, it is also a useful tool that can be used with a variety of systems [5].

The items of the questionnaires are positive and negative alternated statements rated on a 1 to 5 Likert scale (from "strongly disagree" to "strongly agree", respectively) [6].

The simplicity and reliability that the SUS test provides fit the goals of the preliminary usability study of the ENCORE database management system interface.

The instrument was implemented using a customized version of LimeSurvey (<https://www.limesurvey.org>), an Open-Source on-line survey web application.

The data collected by the instrument were downloaded to obtain a structured dataset with all the answers. Although the score calculation is relatively simple [6], the analysis of the responses has been made through the Python Pandas [7] library to keep track of the data transformations.

The interpretation of the results is based on previous System Usability Scale studies and benchmarks [8, 9] which allow SUS score comparisons and provide insights about the perceived usability of the system.

The participants of this study were reached out through the ENCORE project's consortium. For this initial evaluation, they were asked to try and navigate through the platform and fill out the SUS questionnaire with their opinions and suggestions for improvements.

3 Platform Overview

The ENCORE database management system's first version consists of a single-page web application. The application's homepage shows the OER database through a data table containing the main attributes of each OER (Fig. 2); title, subject, publication date, retrieval date, resource format, level (of the contents), and related GDE skills.

Also, a set of data visualizations summarize the contents of the database, including the total number of OERs, unique creators, the number of different OER formats, and the top GDE skills covered by the OERs.

More details regarding each record are displayed in the interface when clicking on the information icon, including the description, creators, publishers, etc.

The system also allows users to filter the results displayed on the screen. Every attribute present in the database is available for filtering (Fig. 3).

Finally, it is important to remark that in the evaluated first version of the platform, the database was populated with automatically generated (synthetic) data.



Showing 1 to 10 of 6,453 entries

Previous **1** 2 3 4 5 ... 646 Next

Title	Subject	Publication date	Retrieval date	Resource format	Level	Skills
OER 6081	Subject 6081	2009-08-11	2022-12-27	Software	Intermediate	mass customisation, business process modelling, programmable logic controller, use microsoft office, mass customisation, customer service
OER 1854	Subject 1854	1994-08-20	2022-12-24	Service	Intermediate	computer programming, advise others, school psychology
OER 5788	Subject 5788	1990-10-12	2022-12-24	Physical Object	Basic	biometrics
OER 5175	Subject 5175	2000-07-05	2022-12-23	Still Image	Basic	analyse scientific data, communication studies
OER 5099	Subject 5099	1992-01-20	2022-12-21	Still Image	Intermediate	entrepreneurship, mechanics
OER 1022	Subject 1022	1991-12-02	2022-12-20	Model	Intermediate	publishing market, telecommunications engineering, organic chemistry, cognitive behavioural therapy, anthropology, health informatics
OER 2149	Subject 2149	2005-02-21	2022-12-18	Place	Basic	learn by doing, microelectromechanical systems, search engines, database management systems, self-promote
OER 515	Subject 515	2021-03-29	2022-12-18	Place	Advanced	project management principles, risk management, web programming, improvise, conduct participatory research, control systems

Fig. 2. Homepage of the ENCORE database system.



Showing 1 to 8 of 8 entries

Previous **1** Next

Title	Subject	Publication date	Retrieval date	Resource format	Level	Skills
OER 2395	Subject 2395	1991-10-01	2017-06-17	Dataset	Advanced	microelectromechanical systems, crowdfunding, promote ideas, products, services, leadership principles
OER 2706	Subject 2706	2017-02-24	2015-01-08	Image	Intermediate	ICT system integration, characteristics of waste, study human societies, security threats, financial statements
OER 4521	Subject 4521	2012-04-30	2009-10-17	Dataset	Advanced	botany, sociology, education administration, adapt to change
OER 4239	Subject 4239	2010-08-14	2005-09-02	Sound	Basic	implement ICT recovery system, unified modelling language

Title	Subject	Description
<input type="text"/>	<input type="text" value="2"/>	<input type="text"/>
Creator	Publisher	Contributor
<input type="text" value="Select Creator(s)"/>	<input type="text" value="Select Publisher(s)"/>	<input type="text" value="Hathaway (Organization)"/>
Resource Format	Media Type	Source

Fig. 3. Filtering capabilities of the ENCORE database.

4 Results

Ten users from the ENCORE project’s consortium participated in the survey, which, although small, is a reliable sample for the SUS questionnaire [4].

The guidelines from [6] were followed to compute the SUS score. In this case, the score contributions from each item were added. Given that each item’s score must range from 0 to 4, the positive items of the questionnaire were subtracted 1 point, while the negative items’ scores were subtracted from 5, to normalize the sample. The sum of the scores is finally multiplied by 2.5 to obtain the overall value of the SUS between 0 to 100.

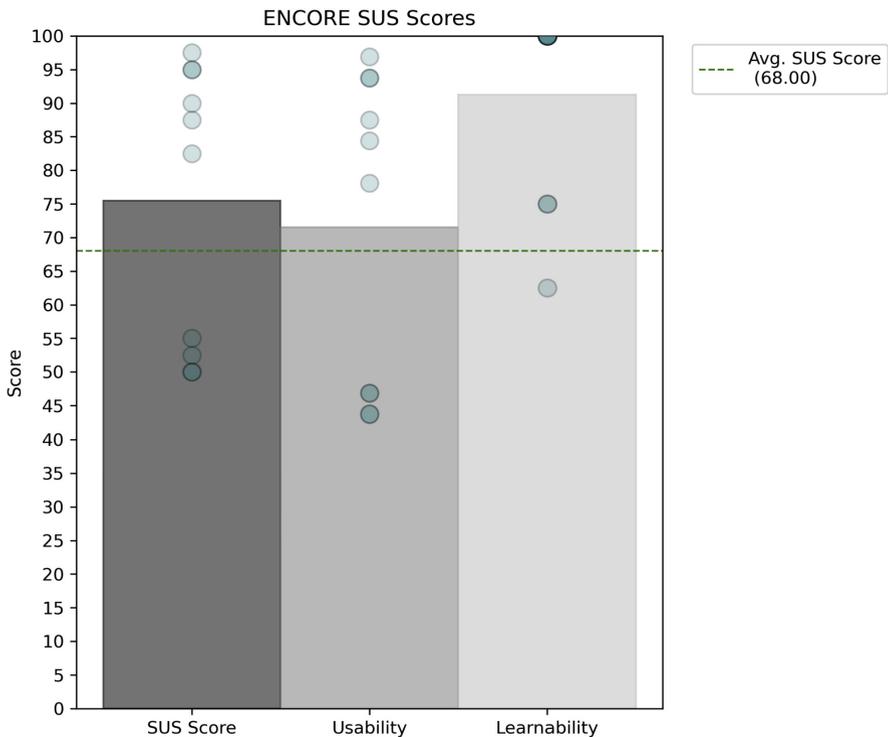


Fig. 4. Visual representation of the SUS questionnaire results. Individual points represent the individual responses.

The SUS score was calculated following the scoring instructions [6] for every participant’s responses. Additionally, the learnability score (from items 4 and 10) and usability score (from items 1, 2, 3, 5, 6, 7, 8, and 9) were also calculated and transformed to fit a scale from 0 to 100. These calculations yielded the following results (Fig. 4):

- The average perceived usability of the ENCORE database is **75.5**, which is considered a good SUS score (interpretation based on the studies done in [8, 9]).

- On the other hand, the perceived learnability is significantly higher (**91.25**) than the usability (**71.56**), both also being good scores.

Some useful comments were also retrieved from the participants. The main concerns are related to using synthetic data for the first version of the database, and the filters. For example, Participant #1 pointed out that “Having a code in the subject section does not orient well.” This issue is only related to the use of synthetic data, as the subjects were not meaningful yet.

Regarding the filter panel, participant #2 highlighted that the position of the filter is not intuitive, participant #3 suggested switching the position of the OER list, and participant #5 remarked that the position did not seem right.

Participant #9 also mentioned interesting usage scenarios: “Since the OER loaded are ‘fake,’ it was difficult for me to evaluate most dimensions. I liked the interface and the visualizations. But as a teacher, the first thing I would do is to try and search for some interesting OER about my subjects taught. Then I would analyze the quality and how informative the visualizations are. Also, I would consider how efficient the search engine is in leading me to what I’m interested in.”

Finally, most of the participants, pointed out that the sorting capabilities did not work. This problem is related to the initial stages of development and will be addressed in subsequent iterations. However, these issues were known by the participants. For example, participant #7 commented: “I understand that this is a test it will be implemented in the future.”

The complete results derived from the analysis and related comments can be consulted at <https://zenodo.org/record/7576915>.

5 Discussion

After carrying out the analysis, the average usability of the ENCORE database interface for 10 users was 75.5, which is, as pointed out in the previous section, a good SUS score above the average of perceived usability in web systems (68.00) [5]. Following the interpretation guidelines of the SUS evaluation and the SUS adjective rating [8], the obtained score falls in the “Good” and “Excellent” intervals.

Regarding the derived dimensions, the learnability of the system obtained excellent results with a score of 91.25. One of the main reasons for this high score could be the system’s simplicity, as it only consists of a single page containing a table of OERs and a set of filters. In this sense, users did not perceive any problems in learning how to use the system from scratch.

On the other hand, the usability dimension scored the lowest result in this analysis, with a 71.56 rating. This result is also good following the SUS analysis interpretation, however, the open comment section of the questionnaire shed light on the usability issues present in the system.

For example, the main issues were related to the filters, as users indicated that their location on the screen was not intuitive or practical. Also, the navigation of the OER table was also complex, as several important attributes needed to be displayed in a limited screen space.

Following the user evaluation results and comments, a new version of the ENCORE database interface is being designed to tackle the mentioned issues. One of the goals of the new interface is related to the OER attributes arrangement to improve the readability of the records (Fig. 5).

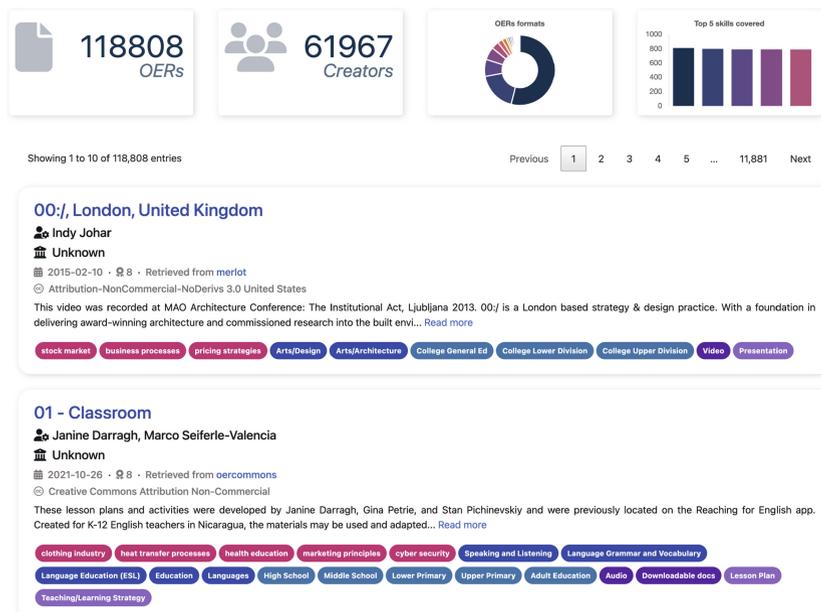


Fig. 5. Improvements made on the interface following the evaluation results.

In this sense, the original OER table has been broken down into individual “cards” that hold the same amount of information in a newer, more readable format. As displayed in Fig. 6, each OER record holds (in order of appearance) the title, the creator(s), the publisher(s), the date of publication, the quality score given by the ENCORE OER quality guidelines (out of the scope of this paper), the ROER from which it was retrieved, the copyright, the description, and a set of pills that depict the related skills (pink), the subject (blue), the audience (light blue), the format (purple), and the media type (light purple).

Further improvements will involve the modification of the filters section to address the issues related to the intuitiveness and usability of this crucial feature.

100 Free Web Tools for Elementary Teachers

 John Costilla

 Ohio State University College of Education and Human Ecology

 2014-10-17 ·  9 · Retrieved from [nsdl_oercommons](#)

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This article includes the URL and description of 100 free web tools that can be used by all teachers. The tools are categorized into search engines, math and science, games, templates and lesson plans, and more... [Read more](#)

analyze

scientific research methodology

Education

Lower Primary

Upper Primary

Text/HTML

Reading

Fig. 6. Detail of a record in the new interface.

6 Conclusions

The ENCORE database is a software component that aims to centralize, characterize, and make Open Educational Resources available for teachers and students. This database will be employed to link OERs to GDE skills, create conceptual maps of the OER contents, and develop learning paths, among other uses.

However, it is crucial to provide a powerful user interface to enable users to leverage the valuable information contained in the ENCORE database. For these reasons, a custom interface has been developed to ease navigation among thousands of OERs.

The System Usability Score has been applied to the first version of the database interface to obtain insights about its usability. It is important to remark that the SUS is not diagnostic, but it gives an overview of the usability of a system. The database interface obtained an average score of 75.50, which is a score above the average (68.00) and is considered a good result.

However, the SUS questionnaire was complemented with an open field to gather comments and opinions about the system. This information gave hints about the improvements to be made to increase the system's usability, which is being addressed following the suggestions.

Future works will be focused on solving the usability issues related to the filtering feature of the system, as well as continuing to test the platform with end users.

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