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ARTICLE

Aspects and indicators for assessing the quality of learning objects created by the University of Information Sciences, Havana

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Abstract

The study presented in this article examines various conceptual aspects for assessing the quality of learning objects (LOs). The main aim is to design an assessment guide enabling the level of quality attained by LOs to be determined by means of a series of indicators. These indicators take into account characteristics relating to design and presentation, and also to pedagogy and technology. The metrics used to measure the level of quality are explained. These entail quantifying the assessment by means of the proposed mathematical expressions and the adopted scale, which is based on values assigned to each indicator. Also presented are the results obtained after applying the proposed guide to a sample of LOs created by the University of Information Sciences (UCI), Havana, to support the educational process.

Keywords

quality, assessment, assessment guides, assessment indicators, learning objects

Aspectos e indicadores para evaluar la calidad de los objetos de aprendizaje creados en la Universidad de las Ciencias Informáticas

Resumen

En la presente investigación se abordan varios aspectos conceptuales relacionados con la evaluación de la calidad de los objetos de aprendizaje (OA). El objetivo fundamental es diseñar una guía evaluativa que permita la determinación de la calidad alcanzada por los OA mediante una serie de indicadores que toman en consideración tanto las características de diseño y presentación como aquellas relacionadas con la pedagogía y con los elementos tecnológicos. Se explican las métricas utilizadas en la obtención del nivel de calidad, que consisten en cuantificar la evaluación mediante las expresiones matemáticas propuestas y la escala adoptada a partir de los valores asignados a cada uno de los indicadores. También se reflejan los resultados obtenidos tras la aplicación de la guía propuesta a una muestra de OA creados en la Universidad de las Ciencias Informáticas (UCI) para apoyar el proceso de formación.

Palabras clave

calidad, evaluación, guías de evaluación, indicadores de evaluación, objetos de aprendizaje

1. Introduction

At the FORTES Educational Technology Centre, there have been tangible results in the production of digital resources such as learning objects (LOs) for a variety of different topics. Based on that experience, a quality assessment guide was drafted. The guide comprises a number of qualitative aspects that are complemented by a quantitative weighting. The assessed aspects are divided into three representative groups: formative, design and presentation, and technological. The main aim of the research is to develop a guide for assessing and determining the quality of LOs, for use by their creators and reviewers alike.

To assure not only the quality of knowledge, but also the students' better grasp of it, it is crucial for LOs to be assessable and reviewable. Lecturers must feel confident about the reuse of teaching resources like LOs, and this depends on the level of quality reflected in their assessment.

The authors Martha Lucia Palacios Huertas and Mario Dustano Contreras (2010) believe that there is a great need to assess LOs because they are resources used to support student learning. In addition, such assessment ensures that quality is not diminished in either the learning process or the student outcomes as a consequence of using LOs. A systematic way of assessing the quality of LOs is to use guides as assessment instruments, following a series of sequential steps.

In their respective studies, various authors have taken existing instruments as their points of reference, such as the *Learning Object Review Instrument (LORI)* and *ISO 9126*, and have applied different adaptations of them to suit the needs of their institutions. Among these is the Complutense University of Madrid (UCM), which developed the *Herramienta para la revisión de la calidad de los OA Universitarios (COdA): guía del usuario* (Tool for reviewing the quality of University LOs: A user's guide, also known as *COdA*) (Fernández-Pampillón Cesteros et al., 2011). The *COdA* assessment model defines LO interoperability requirements. It not only permits content that is part of *de facto* standards, but also expands the *LORI* model with a detailed description of W3C and IMS Global Learning Consortium accessibility recommendations for LOs (Fernández-Pampillón Cesteros et al., 2011).

A group of authors led by Almudena Caballos Villar (2010) believes that the *Guía para la evaluación de repositorios institucionales* (Guide for assessing institutional repositories) should be considered an internal auditing tool to improve the quality of repositories. Morales, García and Barrón (2008) have established comparisons between *LORI* and their proposal (2007), where they believe that every *LORI* dimension clearly explains the aspects that should be assessed. However, in order to obtain a suitable assessment, it is their opinion that a dimension or category does not need to be assessed so broadly. They claim that doing so leads to diminished objectivity and may confuse the assessors if they do not agree with some of the criteria. *LORI* has dimensions that directly concern the inherent characteristics of an LO, which are accessibility and reusability. They also reflect on the relevance of the latter dimension within a tool and on the way it is assessed. It is important to underscore that the use of an LO assessment tool should, whenever possible, be accompanied by a strategy that enables a collaborative debate among experts, who, when faced with divergent opinions, will ultimately be able to reach consensus. By now, the reader will have noted two important components of the kind of assessment advocated in this study: first, the use of an instrument, and second, the participation of several people to rate a resource.

Based on the definitions given by Almudena Caballos Villar et al. (2010), an assessment guide is considered to be a document that enables a set of assessment indicators to be formed for the purpose of assessing quality, in this case of LOs. Almudena Caballos Villar et al. (2010) claim that an assessment guide can be divided into five sections, and they describe the content of each one. The sections are: introduction; methodology used; document containing the indicators – adapted to the setting – that should be assessed; glossary to help with the interpretation of the indicators; and, finally, references.

The use of a guide provides excellent advantages. It enables every aspect to be assessed rigorously, precisely and systematically, and helps to obtain satisfactory, compliant results. The structure of a guide should follow a logical, systematic sequence of aspects containing sets of indicators to measure quality, in this case of LOs. Having an assessment guide is of utmost importance in order improve the quality of LOs. Thus, its visibility and dissemination among the academic community of the UCI will be increased.

2. Assessment guide for LOs created at the UCI

The guide has three sections. The first section contains the assessment indicators grouped under the three previously mentioned aspects: formative, design and presentation, and technological. The structure, distribution and quality of the content are assessed in the formative aspect. Font format, the use of colour, etc. are assessed in the design and presentation aspect. The indicators relating to the level of organisation of the file and folder structure, and to the association of files with the didactic structure, among others, are assessed in the technological aspect. The second section uses metrics to calculate the final assessment of the LOs, and this value serves to determine their quality on a qualitative scale. When assessing these aspects, the ranges on the defined scale are very suitable, suitable, not very suitable and unsuitable. The third section provides the level of quality attained by LOs, based on the results obtained in the second section. The guide is used to assess a sample of LOs published in the UIC repository.

Section 1. Assessment indicators

The aim of the assessment guide for the quality of LOs produced at the UCI is to become an assessment instrument in order to improve the quality of LOs.

Formative aspect

The formative aspect takes into account a set of indicators (15) describing the behaviour of LOs from a pedagogical viewpoint. When assessing them, their contribution to the development of learning must be considered. Each indicator is described in detail below:

1. Presentation and explanation of the topic to be covered: this refers to the clarity of the content covered and the consistency of the ideas expressed.
2. Logical structuring of the content: the content should follow a logical sequence, based on the attainment of objectives.
3. Fostering the development of student skills and competencies: this refers to the LOs' ability to enable the development of certain skills, such as those relating to logic, calculus, the association of elements, and analysis and interpretation.
4. Reflection on acquired learning: this refers to the existence and quality of questions or issues of debate that allow students to perform a reflective analysis of the content shown in the LOs. Open questions are generally asked.
5. Self-assessment of the content shown in the LOs: this refers to the existence and quality of direct questions or interactive activities that allow students to self-assess their performance, thus enabling them to identify the acquisition of knowledge conveyed by the LOs.
6. Quality of the content: this refers to reliability, accuracy, topicality, the balanced presentation of ideas and the appropriate level of detail.

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7. Suitability of the learning objectives: this refers to the correspondence between the objectives pursued by the LOs and the content shown.
8. Feedback provided by the content shown: this is when, following the creation of the LOs, there is an opportunity to establish the degree to which the content shown in them contributes to learning.
9. Motivation: the impact of the content and the relationship with the students' knowledge needs.
10. Students' individual or collaborative work: this refers to the degree of impact that the LOs have on the formation of values and skills in individual and teamwork.
11. Relevance of audiovisual resources: this refers to the correspondence between the level of depth and detail of the audiovisual resources used, and the level of teaching targeted by the LOs.
12. Active participation during the learning process through interactive activities: the LOs offer students the chance to interact with the content. This is generally related to the opportunity to control the way in which materials are viewed, the order in which the components of the LOs appear, and the format in which they are displayed.
13. Meta-metadata indication: this refers to the existence of metadata describing the LOs, which serve to associate them with certain materials, content and teaching levels, among others.
14. Verification of sources of information used: this refers to the topicality and accuracy of the sources of information or references used in the LOs.
15. Reusability: this refers to the ability to use the LOs in different learning scenarios.

Design and presentation aspect

Described here is the design and presentation aspect. Assessed under this aspect are the indicators (9) that focus basically on the aesthetic design of the interface that students see when interacting with LOs. This includes their functionalities, the way content is organised and the quality of the resources used (audio, images and text). It should be noted that the quality of these indicators has a direct impact on the level of acceptance that LOs manage to attain. Hence, it is very important to bear them in mind in the review stage. Each indicator is described in detail below:

1. Correspondence between the audiovisual resources and the content shown: this refers to the fact that the resources should be closely related to the topics shown in the LOs (images, graphics, tables to support the topic covered, etc.).
2. Legibility of the text: this allows the font size, colour and format to be controlled when transitioning between texts.
3. Loading speed of audiovisual resources: this refers to the navigation speed between various components of the LOs, the response time between actions carried out, and the loading speed of internal and external elements such as links, resources, etc.
4. Proportion of text in relation to the layout of content within the LOs: this refers to the organisation and layout of text in relation to the display area within the LOs. Aesthetic harmony between texts and images.

5. The use of colours for content: the use of colours suited to the topic, to the formality of the content, and to the end user of the LOs.
6. Diversity in the representation of content shown: this refers to variety in the representation of content (use of images, graphics, text, audio, animations and other elements in a combined way).
7. Visibility within images:. this refers to the sharpness of the edges in texts and graphics contained within images.
8. Usability: this refers to the ease of navigation, predictive user interface and the quality of the resources.
9. Assessment of the level of organisation of the images and text: this refers to the alignment of text, fonts, colour load and the organisation of information.

Technological aspect

Listed below are the technological aspect indicators (11). Their level of importance is high because they refer directly to the functionalities of LOs and their ability to convey content to students. In conjunction with the other indicators from the formative, and design and presentation aspects, they enable the level of quality attained by LOs to be determined prior to publication. Each indicator is described in detail below:

1. Accessibility: this refers to the fact that the design of the controls and the presentation of information should be adapted to every user. The LOs are accessible to students with different psychomotor abilities.
2. Simplicity of LO indexing within a repository: ease of searching within a repository, based on the existence of the main metadata used in a search (title, author, keywords and date, among others).
3. Compatibility with different browsers: Internet Explorer, Mozilla, Netscape, etc.
4. Level of organisation of the file structure: folders are used to group together files relating to a particular topic.
5. Suitability of admissible video formats: this depends on the rules set in the repository where the LOs are stored (FLV for example).
6. Quality of the videos: the definition, display speed, brightness, sharpness and colour saturation.
7. Suitability of the image formats: this depends on the rules set in the repository where the LOs are stored (JPEG, JPG and PNG for example).
8. Integrity of the links within the didactic structure: each element of the didactic structure is checked to ensure that it refers to the files of the LOs.
9. Correspondence with the didactic structure: there is a correspondence between the name of the component in the didactic structure and its description.
10. Review of the metadata record: there is a match between the topics of the LOs and the assigned metadata values.

11. Quality of the drafting and spelling in the content presentation: accents (as used in Spanish for example), drafting inconsistencies, missing letters, etc.

The scale used for the 35 indicators grouped under these three aspects has the following ranges: excellent, good, average and poor. These are scored as 3, 2, 1 and 0, respectively. The basic purpose of these scores is to allow each indicator to be assessed independently, and then, using the metrics, to obtain a final assessment of the LOs on the defined scale, whose ranges are very suitable, suitable, not very suitable and unsuitable, thus determining the level of quality attained by the LOs.

Section 2. Metrics

As expounded by Briand in 1996 (cited in Calero, 2000), metrics are a good way of understanding, monitoring, controlling, predicting and testing software development and maintenance projects.

The metrics used in this study serve to measure the quality of LOs, based on the indicators for all three previously described aspects. All the indicators in the formative, design and presentation, and technological aspects are assessed as excellent, good, average or poor. These are scored as 3, 2, 1 and 0, respectively.

Definitions:

f: total number of indicators in the formative aspect.
d: total number of indicators in the design and presentation aspect.
t: total number of indicators in the technological aspect.

Assessment of the formative aspect

$$F = \sum_{i=1}^{f} F_i \quad (1)$$

Where: F_i corresponds to the value assigned to the i-th formative indicator.

Assessment of the design and presentation aspect

$$D = \sum_{i=1}^{d} D_i \quad (2)$$

Where: Di corresponds to the value assigned to the i-th design and presentation indicator.

Assessment of the technological aspect

$$T = \sum_{i=1}^{t} T_i \quad (3)$$

Where: T_i corresponds to the value assigned to the i-th technological indicator.

Maximum values

The maximum values of each aspect are reached when all their indicators are assessed as excellent (equivalent to a score of 3 points).

$$F_{max} = 3f \quad (4)$$
$$D_{max} = 3d \quad (5)$$
$$T_{max} = 3t \quad (6)$$

Weighting coefficients

$$K_f = \frac{F_{max}}{F_{max} + D_{max} + T_{max}} \quad (7)$$

$$K_d = \frac{D_{max}}{F_{max} + D_{max} + T_{max}} \quad (8)$$

$$K_t = \frac{T_{max}}{F_{max} + D_{max} + T_{max}} \quad (9)$$

'Total assessment' metric

$$E = K_f F + K_d D + K_t T \quad (10)$$

The maximum value of the previous expression is reached when the maximum value possible of each aspect is simultaneously obtained:

$$E_{max} = K_f F_{max} + K_d D_{max} + K_t T_{max} \quad (11)$$

Substituting expressions 7, 8 and 9 of the coefficients in expression 11 would give:

$$E_{max} = \frac{F_{max}^2 + D_{max}^2 + T_{max}^2}{F_{max} + D_{max} + T_{max}} \quad (12)$$

Section 3. Level of quality attained

Finally, the following conditions must be met for the LOs to attain the qualitative level of quality:

i) If $\left(F < \frac{60}{100} F_{max}\right) \wedge \left(D < \frac{60}{100} D_{max}\right) \wedge \left(T < \frac{60}{100} T_{max}\right)$ Then : Unsuitable

ii) If $\left(F \geq \frac{60}{100} F_{max}\right) \vee \left(D \geq \frac{60}{100} D_{max}\right) \vee \left(T \geq \frac{60}{100} T_{max}\right) \vee \left(\frac{60}{100} E_{max} \leq E < \frac{80}{100} E_{max}\right)$ Then : Not very suitable

iii) If $\left(F \geq \frac{80}{100} F_{max}\right) \vee \left(D \geq \frac{80}{100} D_{max}\right) \vee \left(T \geq \frac{80}{100} T_{max}\right) \vee \left(\frac{80}{100} E_{max} \leq E < \frac{90}{100} E_{max}\right)$ Then : Suitable

iv) If $\left(F \geq \frac{90}{100} F_{max}\right) \wedge \left(D \geq \frac{90}{100} D_{max}\right) \wedge \left(T \geq \frac{90}{100} T_{max}\right)$ Then : Very suitable

Figure 1 below shows the assessment scale with the following values: 0% to 60% would be in the range of unsuitable, 60% to 80% in the range of not very suitable, 80% to 90% in the range of suitable, and 90% to 100% in the range of very suitable.

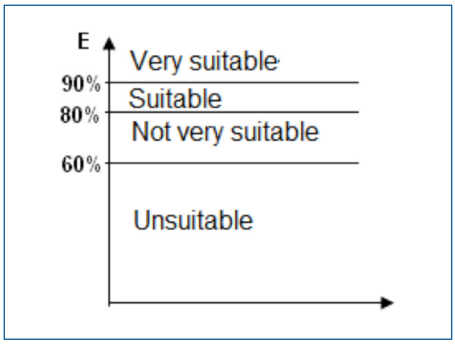

Fig. 1. Assessment scale

If the value obtained is below 60% of Emax, LOs are not accepted, if it is in the 60% to 80% interval, they are accepted, though their publication is still not permitted. To be published in a repository, the level of quality attained must be in the range of 80% to 100%. Thus, it is considered that LOs can be published when they are in the suitable or very suitable range on the defined scale.

3. Results obtained

The guide was applied to a sampling universe of 50 LOs produced by the UCI, and specifically to a sample of 20 LOs. All the LOs are reusable in other contexts, and have a proper didactic structure and metadata classification. They are available from the RHODA repository at the UCI.

The chart in Figure 2 shows the representative percentages following the assessment of the 20 LOs. Taking the ranges on the scale into account, it is possible to see that 1 LO (5%) was assessed as suitable and 3 LOs (15%) were assessed as not very suitable. The remaining 16 LOs (80%) were assessed as unsuitable. None fell within the highest range on the scale (very suitable). The results therefore demonstrate the importance of using the assessment guide to determine the level of quality of LOs at every stage of development and also when finalised, irrespective of the individual or collaborative production model used.

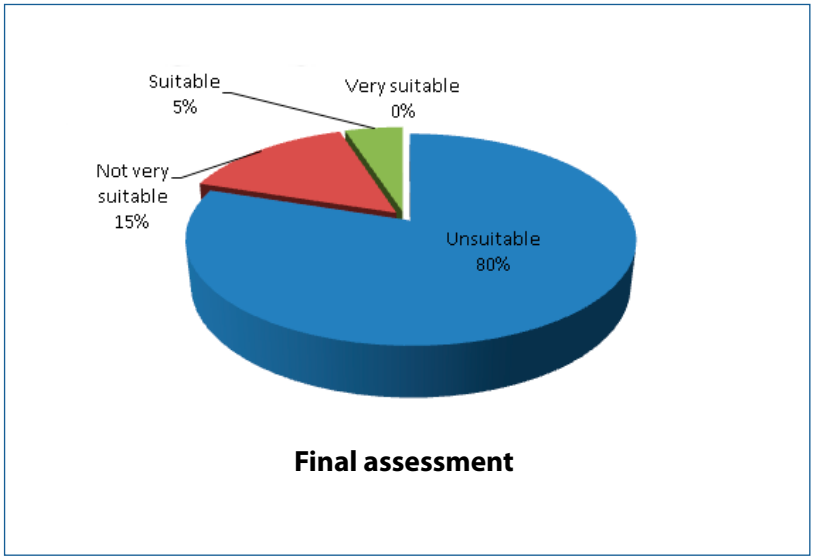

Fig. 2. Final assessment of the LOs, by scale range

Generally speaking, the strengths and weaknesses of the LO assessments provided by the indicators are noticeable. In the formative aspect, the strength came from the indicator for logical structuring of the content, and the weakness from the indicator for individual or collaborative work. In the technological aspect, the strength came from the indicator for reusability, and the weaknesses from the indicators for accessibility and image quality. In the design and presentation aspect, the strength came from the indicator for the level of organisation of the images, and the weakness from the indicator for the design of audiovisual information.

It should be noted that the strengths and weaknesses identified during the quality assessment process using the guide cannot be found in *LORI*, which is currently used by the reviewers, as it only includes the indicator for accessibility. This demonstrates that the assessment process using the guide allows the level of quality of the LOs to be raised prior to publication in the repository. The guide was validated by consulting with a group of experts on the topic, formed by three doctors, three master's degree holders and one engineer. They concurred on the degree of suitability of the proposal, as they considered that it had a high level of acceptance. Its application results in a 97.96% probability of success.

4. Future work

Following the production and application of the assessment guide, the automation of the assessment process began to be implemented using an information technology tool. In the future, it will be possible to integrate it into the university's RHODA LO repository as a module for reviewing the quality of LOs. Some of the functionalities that the module must have are the capacity: to automate the assessment instrument that LO reviewers use; to import and assess LOs complying with the SCORM and LOM standards; to make qualitative and quantitative assessments of LOs; and to delete or add

indicators to the system, as proposed by the reviewers, so that such indicators can be defined for reviews that need to be undertaken.

5. Limitations of the guide

One of the limitations that the assessment guide may have is the reviewers' subjectivity in the assessments. This limitation should become less of an issue once the module for assessing the quality of LOs has been implemented, as reviewers will be able to obtain information about educational and general metadata, which in turn will provide key information for assessing the indicators grouped under the technological aspect. In addition, it will provide reviewers with important elements for links to every component within the didactic structure of the information objects that form part of assessed LOs. Thus, both the scope for making mistakes and the subjectivity of indicator assessment will subsequently be minimised.

6. Conclusions

The assessment guide facilitates the assessment process and enables every aspect to be assessed rigorously, precisely and systematically, and helps to obtain satisfactory, compliant results. Having indicators for all three aspects – formative, design and presentation, and technological – enables not only quality to be raised, but also LOs to be assessed quickly on the defined scale, whose ranges are very suitable, suitable, not very suitable and unsuitable.

The strengths and weaknesses were identified during the quality assessment process by means of the indicators in all three aspects considered, which enabled the quality of the LOs to be determined. It is therefore crucial to have a quality assessment guide to assure the quality of LOs prior to publication for use by the university community.

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