

Methods of Multiple Criteria Evaluation of the Quality of Learning Management Systems for Personalised Learners Needs

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Outline

- The main notions
- Related work: several well-known LMS quality evaluation models and literature analysis results
- Proposed LMS evaluation model
- LMS evaluation and optimisation method
- Evaluation example
- Conclusion and results

The main notions

- *Learning object* (LO) is referred to as “any digital resource that can be reused to support learning”
- *LO repositories* (LORs) are considered here as properly constituted systems (i.e., organised LOs collections) consisting of LOs, their metadata and tools / services to manage them
- *Learning Management Systems* (LMSs) are considered here as specific information systems which provide the possibility to create and use different learning scenarios and methods
- *Metadata* is considered here as “structured data about data”

The main notions

- *Quality evaluation* is defined as the systematic examination of the extent to which an entity (part, product, service or organisation) is capable of meeting specified requirements
- *Multiple criteria evaluation method* is referred to as the experts' additive utility function including the alternatives' evaluation criteria, their ratings (values) and weights
- *Expert evaluation* is referred hereafter to as the multiple criteria evaluation of the software packages (LMSs in our case) aimed at the selection of the best alternative based on score-ranking results

The main notions

- The software engineering *Principle*: we can evaluate the software using the two types of evaluation criteria – ‘internal quality’ and ‘quality in use’ criteria
- ‘*Internal quality*’ is a descriptive characteristic that describes the quality of software independently from any particular context of its use
- ‘*Quality in use*’ is evaluative characteristic of software obtained by making a judgment based on criteria that determine the worthiness of software for a particular project

Existing LMS evaluation models (sets of criteria)

- Methodology of Technical Evaluation of LMSs: a part of the Evaluation of Learning Management Software activity undertaken as part of the New Zealand Open Source LMSs project.
“Technical Evaluation of selected Learning Management Systems”, 2004
<https://eduforge.org/docman/view.php/7/18/LMS%20Technical%20Evaluation%20-%20May04.pdf>
- Graf, S., List, B. (2005).
“An Evaluation of Open Source E-Learning Platforms Stressing Adaptation Issues”.
Presented at [ICALT \(2005\)](#)

Existing LMS evaluation models (sets of criteria)

Methodology of Technical Evaluation of LMS (2004):

- **Overall architecture and implementation** – Scalability of the system; System modularity and extensibility; Possibility of multiple installations on a single platform; Reasonable performance optimisations; Look and feel is configurable; Security; Modular authentication; Robustness and stability; Installation, dependencies and portability
- **Interoperability** – Integration is straightforward; LMS standards support (IMS Content Packaging, SCORM)
- **Internationalisation and localisation** – Localisable user interface; Localisation to relevant languages; Unicode text editing and storage; Time zones and date localisation; Alternative language support
- **Accessibility** – Text-only navigation support; Scalable fonts and graphics

Existing LMS evaluation models (sets of criteria)

Methodology of Technical Evaluation of LMS (2004):

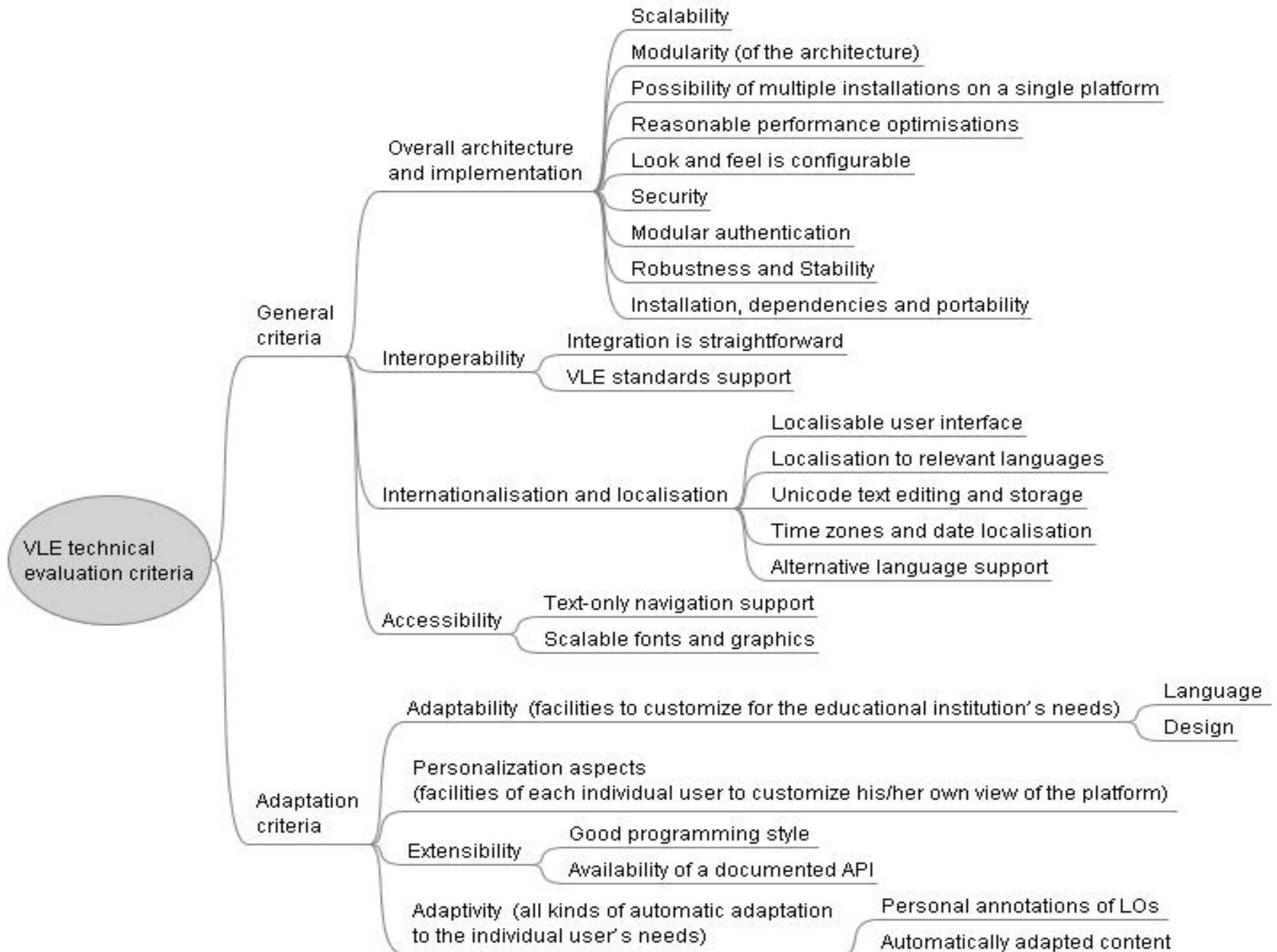
- **Cost of ownership**
- **Strength of the development community** (for open source products) – Installed base and longevity; Documentation; End-user community; Developer community; Open development process; Commercial support community
- **Licensing**
- **Document transformation**

Existing LMS evaluation models (sets of criteria)

LMS adaptation criteria (Graf, List, 2005):

- **Adaptability** – includes all facilities to customise the platform / LMS for the educational institution needs (e.g., the language or the design)
- **Personalisation aspects** – indicate the facilities of each individual user to customise his / her own view of the platform
- **Extensibility** – is, in principle, possible for all open source products. Nevertheless, there can be big differences. For example, a good programming style or the availability of a documented application programming interfaces are helpful
- **Adaptivity** – indicates all kinds of automatic adaptation to the individual user's needs (e.g., personal annotations of LOs or automatically adapted content)

Proposed LMS/VLE technological evaluation model



Proposed LMS technological evaluation model

- The proposed model includes criteria developed in the both presented models.
- All criteria are grouped here according to the *Principle*.
- ‘Internal quality’ criteria are the area of interest of the scientists and software engineers.
‘Quality in use’ criteria are mostly to be analysed by the programmers and users taking into account the users’ feedback on the usability of software.
- The proposed model is comprehensive.
- The proposed criteria do not overlap.

Proposed LMS technological evaluation method

Evaluation criteria ratings (values)

Linguistic variables conversion into non-fuzzy values E:

E,*	(5)	(<i>Excellent</i>)	0.850
#	(4)	(<i>Good</i>)	0.675
+	(3)	(<i>Fair</i>)	0.500
	(2)	(<i>Poor</i>)	0.325
0	(1)	(<i>Bad</i>)	0.150

Proposed LMS technological evaluation method

Evaluation criteria ratings (values) - example

Rating (value)	Explanation
0.150 Bad = 0(1) = 0 = Not valuable	Failed or feature does not exist
0.325 Poor = 1(2) = = Marginally valuable	Has poor support and / or it can be done but with significant effort
0.500 Fair = 2(3) = + = Valuable	Fair support but needs modification to reach the desired level of support
0.675 Good = 3(4) = # = Very valuable	Good support and needs a minimal amount of effort
0.850 Excellent = 4(5) = E = Essential, or * = Extremely valuable	Excellent support and meets the criteria out of the box, minimal effort

Based on the analysis of the level of feature's support and the level of modification needed to reach the desired level of support

Proposed LMS technological evaluation method

The proposed LMS quality evaluation method represented by the experts' additive utility function is based on the transformation of the multiple criteria task into the one-criterion task obtained by adding all criteria values together with their weights.

The major is the meaning of the utility function the better LMS meets the particular learner needs.

$$f(X) = \sum_{i=1}^m a_i f_i(X),$$

$$\sum_{i=1}^m a_i = 1, \quad a_i > 0$$

$$X$$
$$i = \{1, \dots, 8\}$$

$$f_i(X)$$
$$a_i > 0$$

where

- LMS alternative
- LMS evaluation criteria
- evaluation criteria ratings
- normalised weights

LMS technological evaluation results (equal weights)

LMS evaluation criteria	ATutor	Ilias	Moodle
<i>General (internal quality) criteria</i>			
Architecture and implementation	0.500	0.325	0.850
Interoperability	0.675	0.675	0.500
Internationalisation and localisation	0.325	0.500	0.675
Accessibility	0.850	0.325	0.500
<i>Interim evaluation rating:</i>	2.350	1.825	2.525
<i>Adaptation (quality in use) criteria</i>			
Adaptability	0.325	0.500	0.675
Personalisation	0.675	0.675	0.500
Extensibility	0.675	0.850	0.850
Adaptivity	0.325	0.150	0.325
<i>Interim evaluation rating:</i>	2.000	2.175	2.350
<i>All weights = 0.125</i>			
<i>Total evaluation rating:</i>	0.5437	0.5000	0.6093

Proposed LMS technological evaluation method

For example, if we want to select the most suitable LMS for the students with special education needs / disabilities, we should choose the higher weights for the particular criteria:

- Accessibility ($a_4 = 0.02$)
- Personalisation ($a_6 = 0.02$)

In this case all the other criteria weights according to normalization requirement $\sum_{i=1}^m a_i = 1$

should be $a_i = 0.01$

LMS technological evaluation results (different weights)

LMS evaluation criteria	ATutor	Ilias	Moodle
<i>General (internal quality) criteria</i>			
Architecture and implementation (weight = 0.1)	0.0500	0.0325	0.0850
Interoperability (0.1)	0.0675	0.0675	0.0500
Internationalisation and localisation (0.1)	0.0325	0.0500	0.0675
Accessibility (weight = 0.2)	0.1700	0.0650	0.1000
<i>Interim evaluation rating:</i>	0.3200	0.2150	0.3025
<i>Adaptation (quality in use) criteria</i>			
Adaptability (0.1)	0.0325	0.0500	0.0675
Personalisation (weight = 0.2)	0.1350	0.1350	0.1000
Extensibility (0.1)	0.0675	0.0850	0.0850
Adaptivity (0.1)	0.0325	0.0150	0.0325
<i>Interim evaluation rating:</i>	0.2675	0.2850	0.2850
<i>Total evaluation rating:</i>	0.5875	0.5000	0.5875

Conclusion and results

- The proposed LMS quality evaluation method represented by the experts' additive utility function is based on the transformation of the multiple criteria task into the one-criterion task obtained by adding all criteria values together with their weights.
- This method is suitable to apply for the practical expert evaluation of LMS to meet the particular learner needs.
- Therefore, it is of practical importance for public and private sectors' experts (decision makers), software engineers, programmers and users.
- Such approach has never been applied for solving the learning software packages evaluation and optimisation tasks before.

Thank you for
your attention!

Questions?

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