An approach for quality assessment and effectiveness of web based information system

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Introduction

- Web Based Educational Systems have to be well designed, well developed, and well implemented to enhance learning outcomes.

- The quality assessment and effectiveness of the web-based educational systems is essential both in its overall analysis and to improve it.

- An approach for quality assessment and effectiveness of web-based system for distance learning is proposed.

- The Web-based system is designed for teachers from different medical disciplines in the Medical University – Sofia (MUS) to facilitate them in uploading traditional and interactive teaching resources.

- The results of the assessment will be used to improve the functionality of the processes in the system to meet the requirements of users.

Description of the System

The system:

- Is based on open source products: Linux, Apache Web server, MySQL database, and PHP;

- Is based on three hierarchical tier client-server architecture: representation tier, application tier and data processing tier.

- Has two separate interfaces – for students and administrative one for teachers.

- User friendly interfaces, easy and interactive for all users – guests, students, teachers, administrators

- Flexible and open system – independent of the operation system, compatible with the widely used browsers, compatible with other Web applications, plug-ins, etc.

- Independent of the discipline specific content

- Quick and easy access to any part of the system

Students Module
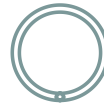
This interface gives the students a possibility of (self) evaluation of the theoretical knowledge and a possibility of creation and improvement of their professional skills to solve clinical cases.

Administrative Module

An Approach

Stages of implementation:

- *First stage* - This assessment is done by experts in the field of software engineering (software developer, front-end web developer, web application developer). The list of indicators to assess the quality system based on ISO 9126 standard is determined. After that their level of importance (weight coefficients) are determined. Technological and structural improvement of the system is done based on the obtained results.

- *Second stage* - This assessment is done by teachers from the institution that offers the system. Based on the selected list of didactical indicators an assessment of effectiveness of the system is done.

An Approach

Two groups of indicators are defined (table 1):

- Indicators for assessing the system quality based on ISO 9126 standard.

- Didactical indicators for evaluating the effectiveness of the system.

Indicators based on ISO 9126 standard	Didactical indicators
Functionality (Suitability, Accuracy, Interoperability, Security, Functionality Compliance)	- Degree of logical consistency of the content;
Reliability (Maturity, Fault Tolerance, Recoverability, Reliability Compliance)	- Connectivity of the components of the content; - Degree of intensity with examples upon submission of new information;
Usability (Understandability, Learnability, Operability, Attractiveness, Usability Compliance)	- Encouraging critical thinking and creativity; - Relation to other resources for further information on studying the problem;
Efficiency (Time Behaviour, Resource Utilisation, Efficiency Compliance)	- Use of various multimedia components; - Existence of a glossary of terms used in the lectures;
Maintainability (Analyzability, Changeability, Stability, Testability, Maintainability Compliance)	- Accessible style of presentation of educational content; - Presence of search engine core modules.
Portability (Adaptability, Installability, Co-Existence, Replaceability, Portability Compliance)	

An Approach

The method of expert assessment:

- Learning process and choice of indicators of quality and efficiency of the system.
- Drawing up of questionnaires, which include:
  - List of indicators (characteristics) for assessing the quality and effectiveness of the system;
  - Four fields from check box type in which each interviewee gives his/her assessment (Scale: I cannot decide = 0, Low = 2, Good = 4, Strong=6) and one text field in which the interviewee gives his/her opinion or recommendation;
  - Information competency and source of argument between experts participating in the interviews;
- Determining the circle of specialists and conducting interviews;
- Create a table of priorities;
- Calculation of coefficient of agreement between interviewees and verification of its importance;
- Calculation of weight coefficients of the indicators of quality and efficiency;
- Processing results and their graphical representation by diagrams.

Calculation

R available experts are invited to give their opinion about m target parameters by questionnaire sheet. The results are recorded in the weight matrix (table 2). Each number in the weight matrix a_{ij} determines weight (assessment), which the expert i ascribe the target parameter (indicator) j.

Table 2 Weight matrix

Experts	Ex_1	Ex_2	Ex_3	….	i	….	R	S_j	δ_j	V_j	W_j
Indicators	points	points	points	points	points	points	points				
y_1	a_{11}	a_{21}	a_{31}	….	a_{i1}	….	a_{R1}	S_{i1}	δ_1	V_1	W_1
y_2	a_{12}	a_{22}	a_{32}	….	a_{i2}	….	a_{R2}	S_{i2}	δ_2	V_2	W_2
….	….	….	….	….	….	….	….	….	….	….	….
y_j	a_{1j}	a_{2j}	a_{3j}	….	a_{ij}		a_{Rj}	S_{ij}	δ_j	V_j	W_j
….	….	….	….	….	….	….	….	….	….	….	….
y_m	y_{1m}	y_{2m}	y_{3m}	….	y_{im}	….	y_{Rm}	S_{im}	δ_m	V_m	W_m

Calculation

- Calculation of the average score of the group of experts S_j of the degree of importance of each indicator is done by: (1)

$$S_j = \sum_{j=1}^{R} a_{ij}$$

Where a_{ij} is the evaluation of the *i*-th expert on the importance of the *j*-th indicator, *R*-number of experts.
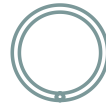
- To determine the degree of agreement of the views of expert's deviation δ_j is defined by the formula: (2)

$$\delta_j = S_j - S_{av}$$

Where S_{av} is average amount of all points. $\qquad S_{av} = \dfrac{R(m+1)}{2}$

- Calculateion the coefficient of agreement w_k, by formula proposed by Maurice Kendall: (3)

$$w_k = \frac{12 \sum_{j=1}^{m} \delta_j^2}{R^2(m^3 - m)}$$

Calculation

- Calculateion the coefficient of variation V_j, characterized the agreement of assessments of the experts participating in the survey, the importance of the individual parameters: (4)

$$V_j = \frac{(Rm - S_j)}{Rm - R}$$

- If there is agreement in the subjective views of experts the weight is calculated by: (5)

$$W_j = \frac{V_j}{\sum_{j=1}^{m} V_j}$$

- The results using diagrams are displayed graphically.
- The aim is to optimize the system based on the results.

Results

Experts	Ex₁	Ex₂	Ex₃	Ex₄	Ex₅	Ex₆	Ex₇	Ex₈	Ex₉	Ex₁₀	Ex₁₁	Ex₁₂	Ex₁₃	Ex₁₄	Ex₁₅	S_j	δ_j	V_j	W_j
Indicators																			
Functionality	4,4	5,6	6	6	5,6	6	6	5,2	4,8	3,2	3,2	3,2	3,2	5,6	5,2	73,2	20,7	0,224	0,130
Reliability	5,5	5,5	3	4	5,5	6	5	4,5	4,5	2	3,5	3	5	0	4,5	61,5	9	0,38	0,221
Usability	5,2	5,6	6	5,6	5,6	5,6	6	5,6	5,2	5,2	4,4	4	4,4	5,2	4,4	78	25,5	0,16	0,093
Efficiency	5,333	5,333	4,666	4	5,999	5,333	5,999	4	2,666	2,666	2,666	4,666	4,666	2	2,666	62,659	10,159	0,364	0,212
Maintainability	5,6	5,6	3,6	5,2	5,6	5,6	5,2	4,4	3,2	2,4	2,4	2,8	3,6	1,6	5,2	62	9,5	0,373	0,217
Portability	4	5,6	2,4	5,6	6	5,6	6	5,2	4,8	5,2	4	2,8	5,2	6	5,6	74	21,5	0,213	0,124

- R=15
- m=6
- S_{av}=52,5
- W_k= 41,27
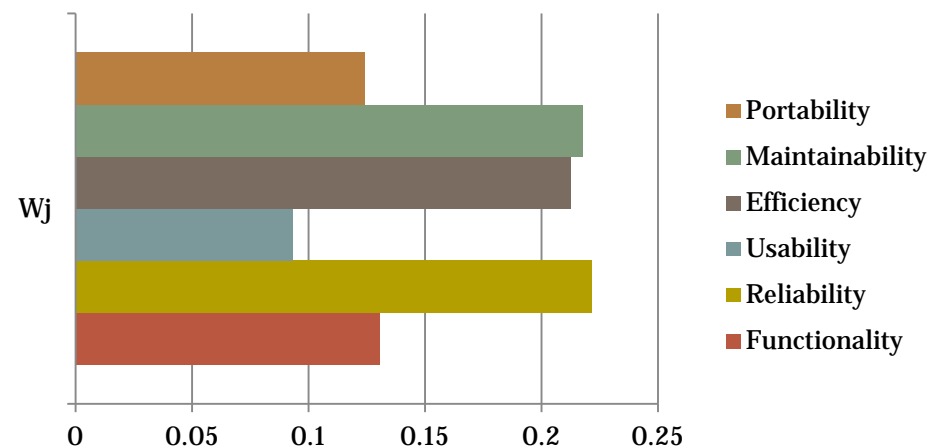
Conclusions

The idea of the presented approach for assessing the quality and effectiveness is to optimize the web-based educational system on the basis of the results obtained and to meet the user requirements.

This approach can be applied to various software products in the field of web-based applications, taking into account the peculiarities of each of them.

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