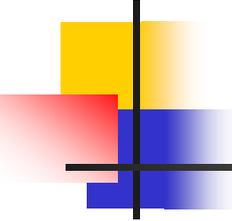


HYBRID MODEL FOR E-LEARNING QUALITY EVALUATION

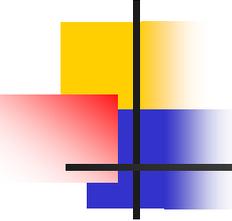
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eLearning 2011, Belgrade, 29.09.-30.09.2011.



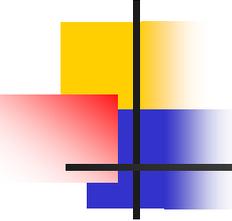
Introduction

- Education and knowledge are increasingly becoming primary developmental resources for the competitive advantage of an organization (ranging from a company, nation, country, to a region and economic integrations).
- While estimating the quality of higher education institutions, it is necessary to use the systems approach.
- This means that a higher education institution must be viewed as a complex system.
- The paper examines e-learning quality characteristics, standards, criteria and indicators, and presents a multi-criteria hybrid model for evaluating the quality of e-learning based on the method of Analytic Hierarchy Process – AHP, trend analysis, and data comparison.



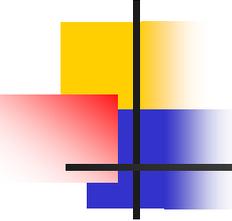
E-learning quality...

- Different aspects of e-learning research include qualifications and competences of students and teaching staff, the culture of teaching and education, new forms of student-teacher interaction, flexibility of curricula and education, personalization, student awards etc.
- E-learning quality development involves defining a quality strategy, as well as defining the processes of quality analysis, design, realisation, evaluation, and continuous improvement within the system of e-learning
- The process of adopting, realising and adjusting e-learning quality can be viewed at three levels: the level of the individual, the level of the institution and the level of the integration of all stakeholders.
- The importance of e-learning quality assurance has been recognised by the European Commission, which has introduced three different initiatives involving the policies of e-learning development: eEurope, Education and Training 2010 and eLearning Initiative.



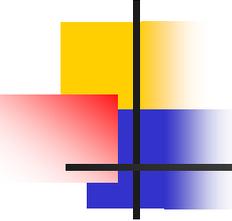
...E-learning quality...

- In EC action plan for e-learning are defined four fields (infrastructure and equipment; quality, content and services; training at all levels; European co-operation and networking)
- Accordingly, four strategic projects analysing different aspects of e-learning quality have been carried out: Supporting Excellence in E-Learning – SEEL, Sustainable Environment for the Evaluation of Quality in E-Learning – SEEQUEL, The quality of e-learning: evaluation of training effectiveness and impact measures - Qual E-learning; The European Quality Observatory (EQO) Model: A Conceptual Model for Classification of Quality Approaches.
- The European Commission has supported a number of projects through other programmes and initiatives, among others: Quality, Interoperability and Standards in e-learning (QUIS); European University Quality in eLearning (UNIQUE); E-Quality in E-Learning Research Laboratorie – EQUEL; Benchmarking of Virtual Campuses – BENVIC; Referring Innovative Technologies and Solutions for Ubiquitous Learning – CHIRON; E-xellence, E-xcellence⁺; E-Learning Maturity Model (eMM) benchmarking



...E-learning quality...

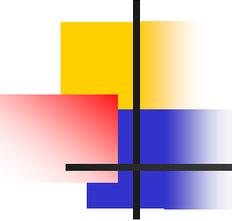
- There are a lot of international associations and national agencies taking part in creating mechanisms, guidelines and instruments for e-learning quality assurance, as well as strategies, processes and standards for the accreditation of e-learning curricula. Some of the most important organisations in Europe are: European Association for Quality Assurance in Higher Education (ENQA), European Association for Distance Learning (EADL), European Association of Distance Teaching Universities (EADTU), European Foundation for Quality in eLearning (EFQUEL), International Network for Quality Assurance Agencies in Higher Education (INQAAHE), Open and Distance Learning Quality Council (ODLQC), Council for Higher Education Accreditation (CHEA), British Quality Assurance Agency for Higher Education (QAA), Norwegian Association for Distance and Flexible Education (NADE), Swedish National Agency for Higher Education, Deutsches Institut für Normung (DIN), Educational Modelling Language, Open university of the Netherlands (EML)
- Also, important organizations are: UNESCO/OECD, Centre for Educational Research and Innovation (CERI), and International Organization for Standardization (ISO)



E-learning quality standards...

Quality standards offer special benefits for organisations, processes and products. Generally, seven main advantages of e-learning quality standards can be identified:

- Competitiveness (quality standards can increase competitiveness by making it possible to compare e-learning performances);
- Cost-effectiveness (by clearly defining processes, quality standards can reduce failure in the process of e-learning analysis, design, implementation and realisation);
- Motivation (it can be improved through the transparent participation of all stakeholders in formulating the demands of the quality system);
- Image (quality standards facilitate international acceptance and recognition and increase the reputation of the institution and the e-learning programme);
- Planning reliability (quality standards enable quality testing and evaluation and business excellence of the e-learning system, as well as their re-evaluation);
- Customer orientation (e-learning based on quality standards makes it possible to establish an equal partnership between teaching staff and students, better understanding and greater customer satisfaction);
- Continuous improvement (e-learning organisations, processes and products should continuously strive for high quality and business excellence in e-learning).

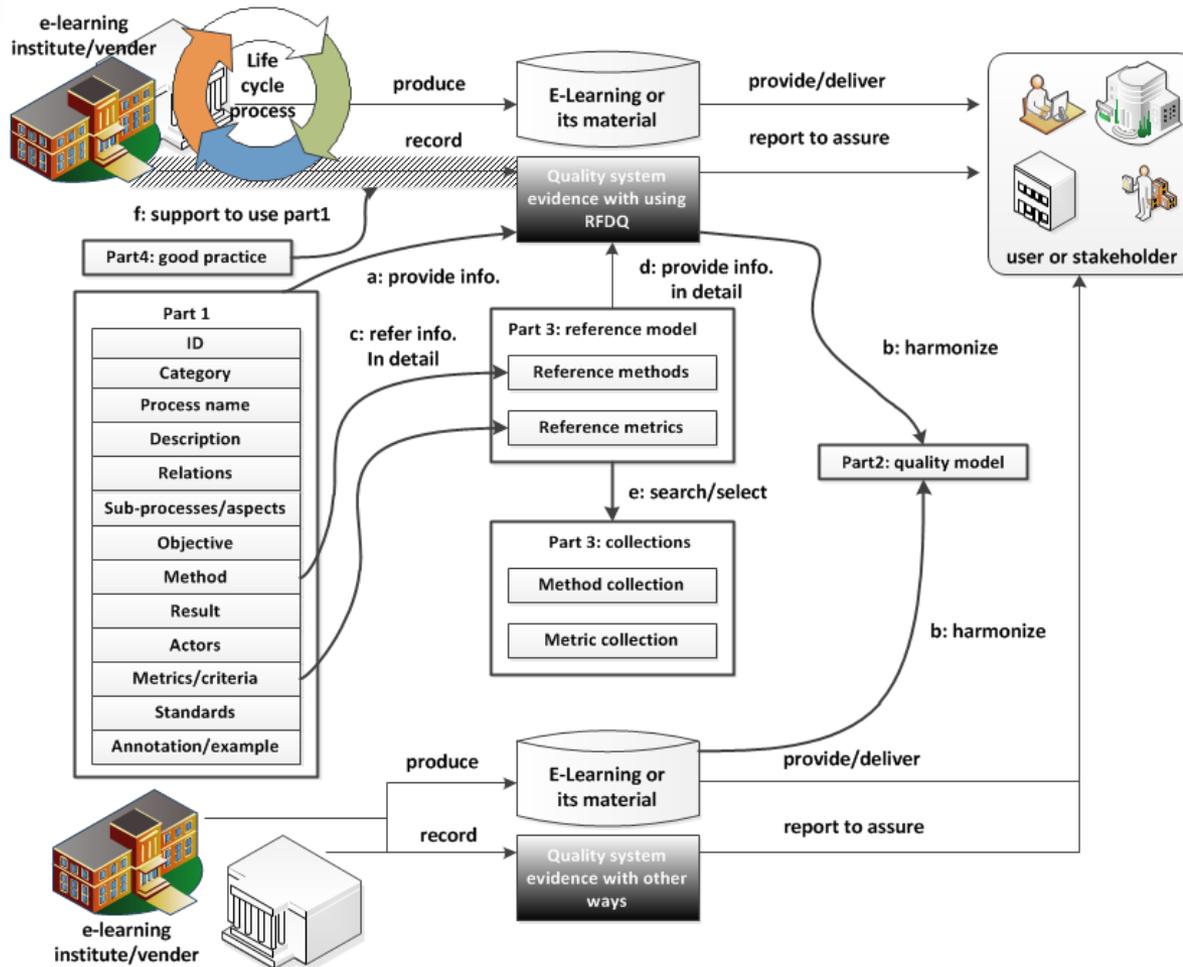


...E-learning quality standards...

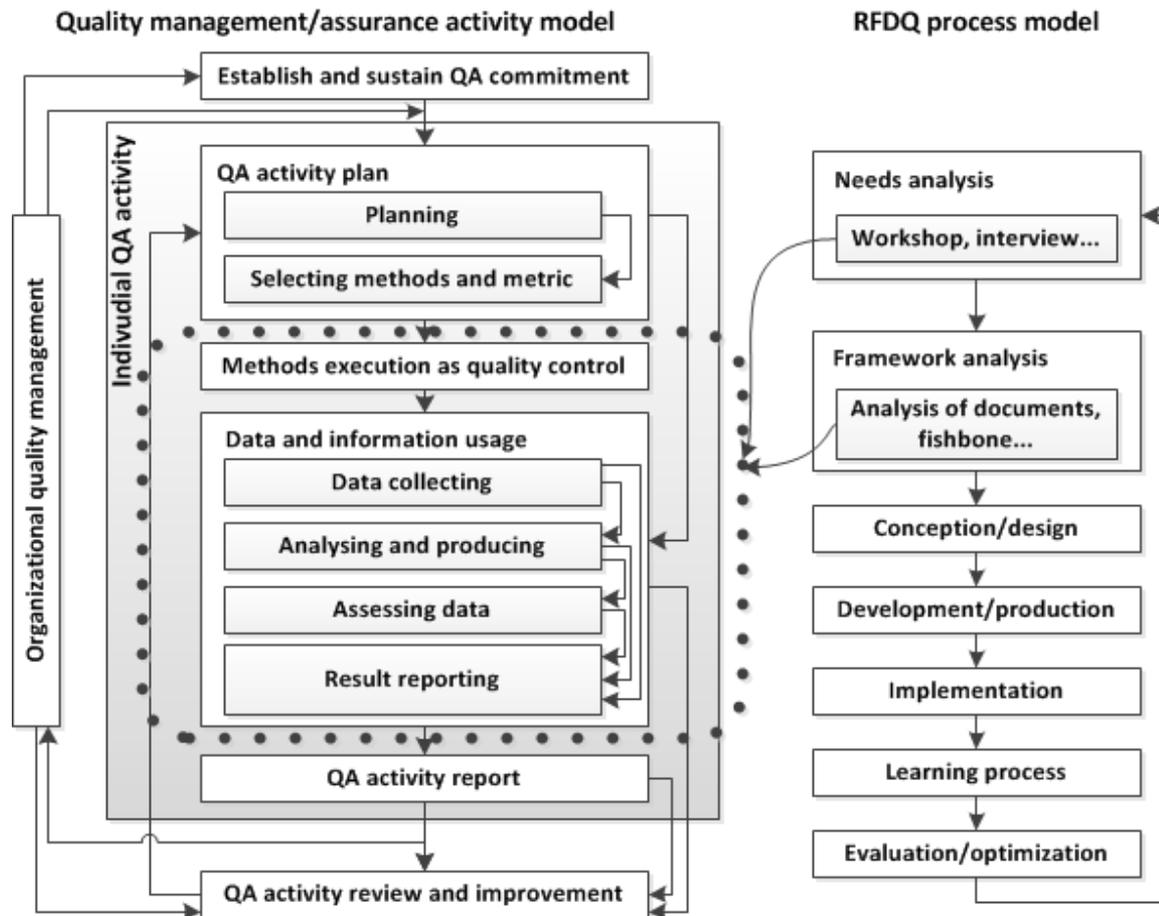
Although a number of e-learning standards have been established, only one series of standards is related to e-learning quality (ISO/IEC 19796).

- The ISO/IEC 19796 series of standards provides a framework for identifying types of data, harmonizing different quality management systems, identifying quality metrics and methods, and providing examples of the best practice for quality e-learning.
- It contains the reference process model "Reference Framework for the Description of Quality Approaches" (RFDQ), which supports stakeholders in learning, education and training, especially regarding e-learning.
- The reference process model is an integration of two reference models: the generic process model and the generic description model
- The generic process model contains 38 processes grouped into seven categories (Needs Analysis, Framework Analysis, Conception/Design, Development/Production, Implementation, Learning Process and Evaluation/ Optimization). This model describes the structure of the learning process lifecycle, but it does not contain any instructions or procedures for the realisation of the above mentioned processes.

Quality approaches and ISO/IEC19796



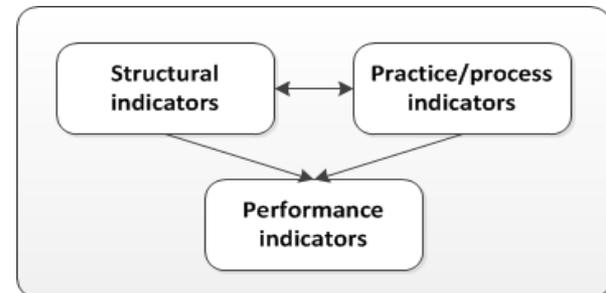
Quality management/assurance activity model and relationship with RFDQ



E-learning quality criteria and indicators

There are three types of indicators: structural indicators, practice indicators and performance indicators.

- Structural indicators assess 'enablers'. Enablers are essentially the resources available to the institution to enable it to carry out its mission and objectives. They include: institutional and human competences; technology platforms and tools; governance and management structure.
- Practice indicators evaluate the ways in which the institution utilizes its resources. They assess the work practices and processes of the institution. They focus on: the business strategy of the organization; its targeting and access policies; its pedagogic approach.
- Performance indicators assess the results of the interaction between work practices and enablers. They focus on outcomes and impacts, such as: learning outcomes; cost-benefits; technical effectiveness.



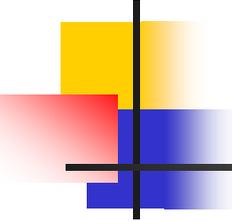
Different projects, different e-learning quality criteria and indicators/sub-criteria

Project	Criteria	No. of indicators or sub-criteria
B E N V I C (1999-2001)	1. Learner Support Services	17
	2. Learning Delivery Services	15
	3. Learning Development	16
	4. Teaching Capability	9
	5. Evaluation	10
	6. Accessibility	12
	7. Technical Capability	10
	8. Institutional Capability	13
S E E Q U E L	1. Supporting staff	19
	2. Teaching staff	12
	3. Learning materials	31
	4. Learning infrastructure	15
	5. Guidance/training needs analysis	7
	6. Recruitment	2
(2002-2004)	7. Learning design	24
	8. Learning delivery	12
	9. Evaluation of the course	11
	10. Assessment of the learners	9
	11. Institutional setting	22
	12. Cultural setting (national, organisational, professional, general)	7
	13. Learning environment	12
	14. Legislation	4
	15. Financial setting	5
	16. Value systems	16

S E E L (2002-2004)	1. Centrality of eLearning quality in policy agenda	3
	2. Commitment of resources	2
	3. Extension and solidity of the partnership and collaboration of actors within and outside the regional system	2
	4. Selection of eLearning activities/actions to be funded/ supported/ accredited	3
	5. Programming the eLearning activities/actions	1
	6. Delivery of eLearning activities/actions	2
	7. Monitoring eLearning activities/actions	4
	8. Degree of development of eLearning within the Region	5
	9. Knowledge sharing	2
	10. Increase access to disadvantaged groups	1
	11. Reputation	2
	12. Export of know-how, expertise products and services	3

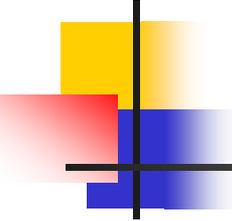
C H I R O N (2004-2006)	1. Goals and Objectives	12
	2. Institutional Support	14
	3. Course Development	50
	4. Course Structure	12
	5. Course Content	25
	6. Teaching/Learning	19
	7. Student Support	18
	8. Faculty Support	4
	9. Evaluation and Assessment	24
	10. Accessibility	26
	11. Language	12

E L Q (2008)	1. Material/content	4
	2. Structure/virtual environment	3
	3. Communication, cooperation and interactivity	3
	4. Student assessment	4
	5. Flexibility and adaptability	3
	6. Support (student and staff)	4
	7. Staff qualifications and experience	3
	8. Vision and institutional leadership	3
	9. Resource allocation	3
	10. The holistic and process aspect	10



Model for e-learning quality evaluation...

- One of the models that can be applied to evaluate e-learning quality is a hybrid model based on the AHP method, trend analysis and data comparison. This model involves three steps: Application of the AHP method, Trend analysis and data comparison, and Quality index determination
- **Application of the AHP method**
- The AHP method involves the following steps:
 - **Goal identification.** The goal is e-learning quality evaluation.
 - **Identification of criteria and alternatives.** Criteria can be identified according to the national standard for the accreditation of e-learning curricula, or they can be taken from international publications, that is, technical reports about the projects involving research on e-learning quality (Table 2). As there are a lot of indicators of e-learning quality (Table 2), it is necessary to define the key performance indicators, which can be done by the expert group.
 - **Hierarchical structure formation.** The AHP method presents a problem in the form of hierarchy: the first level or the top level represents e-learning quality; the second level considers relevant criteria; the third level defines key performance indicators. Image 4 shows the hierarchy scheme for e-learning quality evaluation.



...Model for e-learning quality evaluation...

- (continued) The AHP method involves the following steps:
 - **Pairwise comparison.** Pairs of elements of a problem at each level are compared according to their relative contribution to the elements at the hierarchical level above. The decision maker or expert group estimates the relative contribution of each pair to the objective, or to the criterion, using the 1-9 comparison scale, as shown in Table. Pairwise comparisons at each level, starting from the top of the hierarchy, are presented in the square matrix form.

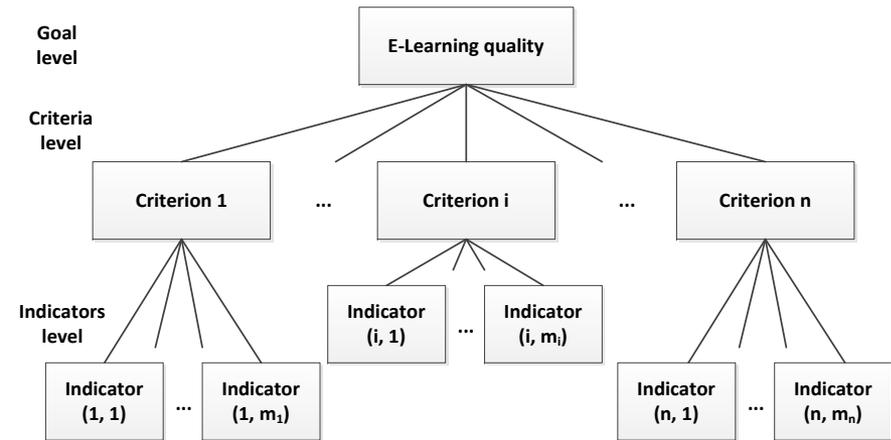
$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}$$

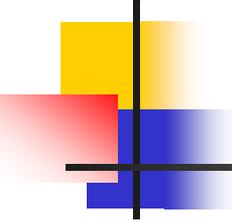
- **Relative weights determination.** The procedure, which is called an eigenvector approach, is based on a special type of matrix called a reciprocal matrix. The objective is to find w

$$w = (w_1, w_2, \dots, w_n)$$

...Model for e-learning quality evaluation...

Relative importance	Definition	Explanation
1	Equal importance	Two actions contribute equally to the objective
3	Moderate importance	Experience and judgement slightly favour one action over another
5	Essential or strong importance	Experience and judgement strongly favour one action over another
7	Very strong importance	One action is strongly favoured and its dominance is demonstrated in practice
9	Extremely important	The evidence favours one action over another and it is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgements	These values are used when compromise is needed
Reciprocals of above non-zero numbers		If action i has one of the above non-zero numbers assigned to it when compared with action j , then j has reciprocal value when compared with i





...Model for e-learning quality evaluation...

- The procedure for obtaining the eigenvector involves the following steps: (1) The sum of all elements in each column is calculated; (2) Elements of each column are divided by the sum obtained in the previous step; and (3) The average value of each row is determined. A column consisting of the average values is a normalized vector (or an eigenvector, or a priority weights vector) [3].
- As a result of applying the procedures for determining relative weights, the following vectors are defined:
- Eigenvector of criteria: $w = (w_1, \dots, w_i, \dots, w_n)$, where w_i is the weight of i -th criterion, n is the number of criteria, and $w_1 + \dots + w_i + \dots + w_n = 1$.
- Eigenvectors of alternatives for every single criterion (or local scores):

$$S_1 = (S_{1,1}, \dots, S_{1,m_1})$$

.....

$$S_n = (S_{n,1}, \dots, S_{n,m_n})$$

where S_i is an alternative eigenvector for the i -th criterion, $S_{i,k}$ is the local priority (score, weight) of the k -th alternative in relation to the i -th criterion and m_i is the number of alternatives for the i -th criterion.

...Model for e-learning quality evaluation...

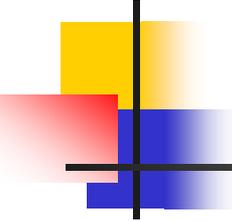
- **Checking results consistency.** Consistency means that the decision making procedure involves coherent judgements in the process of specifying the pairwise comparison of the criteria or alternatives.
- However, given the above characteristics of the matrix (reciprocal and regular diagonal matrix with elements $a_{ij}=1$), small changes in the values of a_{ij} retain the highest eigenvalue, λ_{max} , while other eigenvalues are nearly zero. Therefore, the deviation of λ_{max} from n is used to determine the level of consistency. The procedure for obtaining a consistency value is as follows:

- The matrix equation is solved $Aw = \lambda w$

$$\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \dots \\ w_n \end{bmatrix} = \begin{bmatrix} \lambda_1 w_1 \\ \lambda_2 w_2 \\ \dots \\ \lambda_n w_n \end{bmatrix}$$

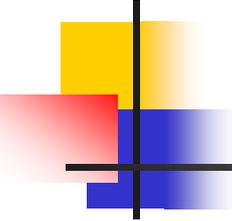
- Eigenvalue λ_{max} is determined as follows $\lambda_{max} = \max(\lambda_1, \lambda_2, \dots, \lambda_n)$
- The consistency index is calculated as follows $CI = (\lambda_{max} - n) / (n - 1)$
- The consistency ratio is calculated as follows $CR = CI / RI$
- A value of a random index, RI, is selected according to the matrix size.
- If a consistency ratio is 0.10 or less, it can be considered acceptable; otherwise, the judgements should be improved.

n	1	2	3	4	5	6	7	8
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4



...Model for e-learning quality evaluation...

- **Global priority determination.** The final stage of the AHP method involves finding a composite normalized vector (or a vector of global priority), which shows the contribution of certain alternatives to the achievement of the goal. However, this step is replaced by trend analysis and data comparison in the suggested model.
- **Trend analysis and data comparison.** In order to measure e-learning quality indicators, trend analysis is done and data are compared. The weight (or the contribution) of each indicator is modified by a coefficient (score) whose value depends on the indicator trend compared to the previous year, as well as on its current value which is compared to the value of the benchmark.
- The following decision rule is basic for the scoring mechanism: (1) If the indicator trend is growing and the current level is higher than the benchmark, then score is 100; (2) If the indicator trend is growing and the current level is lower than the benchmark, or if the indicator trend is declining and the current level is higher than the benchmark, then the score is 50; (3) If the indicator trend is declining and the current level is lower than the benchmark, then the score is 0.

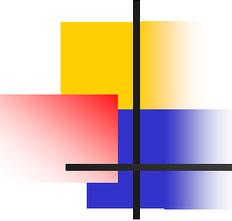


...Model for e-learning quality evaluation

- **Quality index determination.** E-learning quality index is calculated by the following formula:

$$QIe = \sum_{i=1}^n w_i \sum_{k=1}^{m_i} s_{ik} S_{i,k}$$

- where i is the index for e-learning quality criteria, k is the index for alternatives (e-learning quality performance indicators), w_i is the weight of the i -th criterion (the second level); $S_{i,k}$ is the weight of the k -th alternative (e-learning quality performance indicator) related to the i -th criterion (the third level); s_{ik} is the score which modifies the weight of the k -th alternative (e-learning quality performance indicator) related to the i -th criterion.



Conclusion

- A number of international and national documents and projects emphasize the importance of e-learning quality. The analysis of these documents and project results shows different aspects of researching this problem, a number of different criteria and sub-criteria, and especially a large number of e-learning quality indicators.
- This implies a non-systems approach to research, that is, the decomposition of a problem and partial research on its individual parts. However, e-learning quality requires a systems approach to research and problem solving within knowledge management quality, and more broadly, within the institution's quality management
- A good basis for this kind of approach is provided by the ISO/IEC 19796 series of standards. It defines e-learning processes, the structure of the learning lifecycle, as well as methods and metrics necessary for the implementation and application of quality management and the quality assurance system in the processes of learning, education and training.
- The paper presents the methodology for estimating e-learning quality based on a hybrid model which involves the AHP method, trend analysis and data comparison.