Development of the external control model of online courses quality indicators

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Abstract. An analytical survey of internationally accepted samples of assessment of online courses, is conducted. An approach for construction of the system of quality indicators of electronic courses on the basis of aggregating simple numeric values and fuzzy linguistic variables on the basis of fuzzy logic, is proposed.

1. Introduction

There are many problems in forestry education. Russian forests cover over 800 million hectares. Most of which are sparsely populated areas, so it is necessary to introduce e-learning.

The issue is that presently there are no norms regulating how the content of an online course is organized by the way of presenting information and is verified by a corresponding control form of the knowledge received, in the Russian Federation. The absence of norms is tied to the absence of a good model, which would help to assess the efficiency of online courses to the full extent [1, 2].

Apparently, in order to create an appropriate system of quality assessment of online courses, one needs to be based upon well-proven and internationally accepted samples. Some of the above-mentioned systems of quality monitoring may be adopted for assessments of electronic courses in Russia as they include extended documentation, examples and recommendations for various components of online courses.

In accordance with the most of the approaches, the organizational methodology of electronic courses quality indices is based upon hierarchical concept [3]. The top of the hierarchy (the tree graph of indices) is a complex index which reflects the quality of the course. Subsequently, the indices of the higher level are decomposed to those detailed which reflect certain specifics. Having said that, in creation of the system of an online course quality indices, one should take into account that such courses do not normally have a “severe” final edition as far as structure and content are concerned, and these are subject to constant change during their lifecycle, as being adapted to changing requirements of the academic activity and to the results of the education.

That way, any assessment procedure should be finally based upon quantitative and qualitative indices. In order to formally complete such a procedure, the basis of key indices reflecting the quality of the course, should be formed. The formal assessment procedure is based upon a scientific assessment. In this regard, a council managing the assessment is formed; it should consist of various master hands: experts in the evaluated area, methodologists, designers, psychologists and programmers. The assessment may imply the contraction function which would unite many indices into a number.

In view of the results of the expert evaluation made, a final expert report can be written, on the ground of which an electronic course can be assigned a status: “To be improved” – the course should
be modernized in accordance with criticism of the expert panel and re-examined; “Online course for mixed and online education” – the course is granted a right to be placed into electronic information and educational environment of the university (EEU); “Online course for open education” – the quality of the course is sufficient for inter-academic exchange and representation in MOOC, with the consideration of obligatory formal requirements.

The qualimetric approach used alone is limited in the sense that some indices (for instance, “The visibility and availability of the material”) are of qualitative character and cannot be formalized by a single number. A danger of running into extremes can be proposed, that initially indefinite criteria may be represented by conventional precise values and, vice versa, all input indicators, including precise, may be formalized in the form of fuzzy variables.

2. Methods and Materials

In this article, it is suggested to divide the set of input factors into two subsets: precise values that can be formalized and handled with as simple numbers and fuzzy linguistic variables (LV) [4-5].

The example system of indicators assessing an electronic course at the design phase [3] is represented by table 1.

| Indicators | The description of the comparison test, score |
|------------|---------------------------------------------|
| **1. The group of structured and objective indicators** | |
| 1.1. The existence and justification of the aim | 3 – The working programme of the course exists, the requirements to the input training level and results of education declared as competences being formed in the capacity of a single element and detailed in the methodological support for selected types of educational and individual studies, are defined |
| | 2 – The working programme of the course exists, the requirements to the input training level and results of education are defined to some extent |
| | 1 – The working programme of the course exists |
| | 0 – No materials covering this component |
| 1.2. The modular structure of electronic training course | 3 – The course has a distinct structure, which corresponds to the logic of studying of the material and the working programme of the course. In the structure, all topics and academic activities are reflected |
| | 2 – The course has a modular structure, which reflects the logic of studying of the material and academic activities not to full extent |
| | 1 – The course is structured but not in accordance with a modular principle of studying of material |
| | 0 – The course is not structured |
| **2. The group of indicators describing the content quality** | |
| 2.1. The scientific character and innovation level of the presented educational and methodological material | About 3 – The quality of the presented educational and methodological materials is high, the course is based upon proprietary scientific, training, methodological developments of the author, the references whereto are made in the course |
| | About 2 – The presented material is up-to-date |
and corresponds to the scientific and technological level in the sub discipline under consideration
About 1 – Materials presented in the course are references to other works
About 0 – No materials

| 2.2. The visibility and availability of the material | About 3 – Materials of the course are given in a language known to the target audience, full of illustrative material (tables, pictures et.), well structured; the main ideas and conclusions are clearly identified
About 2 – Materials of the course are given in a language known to the target audience, but not illustrated enough; the main points are not clearly identified
About 1 – Materials of the course are given in a language which does not match the target audience, not enough illustrated and structured
About 0 – No materials |

3. The group of indicators of informational, methodological and organisational supply

| 3.1. Taking into account the personal characteristics of students | 3 – Various types and ways of intermediary and final tasks depending of their difficulty level, are presented; the comments to the evaluation of final results are presented
2 – Various ways of intermediary and final tasks depending of their difficulty level, are presented; the comments to the evaluation of final results are presented
1 – Various ways of intermediary and final tasks not distinguished on their difficulty level, are presented
0 – The learning path is universal for all students |

| 3.2. The existence and sufficiency of informational and methodological materials and comments to various types of academic activity | 3 – Informational and methodological instructions clarifying the sequence of studying the material, the order on execution on tasks, working with literature etc., accompany all modules. Materials are presented as single elements
2 – Informational and methodological instructions accompany some modules. However, materials are presented as single elements
1 – Informational and methodological instructions for studying single elements are not separated as single elements
0 – Informational and methodical materials are not presented |

| 3.3. The sufficiency of auxiliary materials | 3 – Represented: The reference list, the glossary, the references to Internet sources
2 – Represented: The reference list, the glossary
1 – Represented: The reference list
0 – No auxiliary materials |
4. The group of indicators describing the controlling functions

4.1. The diagnostics of educational results

| Value | Description |
|-------|-------------|
| 3     | The diagnostics of the input training level, the execution results of various tasks and the final academic rating, are accomplished |
| 2     | The diagnostics of the input training level and the final academic rating, are accomplished |
| 1     | The diagnostics of the input training level and the final academic rating is completed, are accomplished |
| 0     | The component is not presented |

4.2. Provision of controlling and measurement materials

| Value | Description |
|-------|-------------|
| 3     | The number of controlling tasks is sufficient for the educational material to be understood and acquire and is more than 200 units |
| 2     | The number of controlling tasks is sufficient for the educational material to be understood and acquire and is more than 100 units |
| 1     | Only testing tasks are presented, in a number less 100 units |
| 0     | Controlling and measurement materials are insufficient |

Structured and objective indicators, as well as indicators of informational, methodological and organisational supply together with indicators describing the controlling functions can be represented by usual numeric values. Having considered all the indicators equivalent, the aggregate value of convolution can be formalized as a simple sum (from 0 to 21). This value will then further be handled as the precisely defined LV. The group of indicators, characterizing the quality, given in italics, is of explicitly qualitative nature. Such factors may easily be presented by experts in the form of fuzzy LV.

In accordance with the above listed classification, we have three input LV: “The convolution of numeric criteria” (‘convolution’); “The scientific character and innovation level of the presented educational and methodological material” (‘science’); “The visibility and availability of the material” (‘design’) and one output LV: “The evaluation of the course quality” (‘quality’) (figure 1).

![Figure 1. The external quality control model of online courses on the basis of fuzzy logic.](image)

The foundation stone of the performance of any fuzzy logical induction is the rule database containing fuzzy statements in the form “IF – THEN”. On the basis of the proposed control algorithm, the rule database can be composed, as follows:

- IF (convolution is low) AND (scientific is zero) AND (design is zero) THEN (quality is to improve);
- IF (convolution is middle) AND (scientific is high) AND (design is middle) THEN (quality is to publish into EEU);
IF (convolution is high) AND (scientific is high) AND (design is middle) THEN (quality is to publish into MOOC);

Let us draw out “input-out” surfaces, which correspond to the fuzzy system being composed (figure 2).

Figure 2. Dependence of the output variable “The evaluation of the course quality” from the input variables.
3. Conclusion
Consequently, in this article an approach for construction of the system of quality indicators of electronic courses on the basis of aggregating simple numeric values and fuzzy linguistic variables and subsequent development of the control model on the basis of fuzzy logic, are proposed. Further developments should be aimed at increasing the number of factors considered, gathering of statistic and expert information in order to draw up membership functions of linguistic variables and to compose the rule database connecting input and output variables.

References
[1] Lihachev I P, Shifrin B M and Churakov A V 2019 Introduction of e-learning for forestry education Topical issues in forestry [Aktual'nye voprosy v lesnom hozjajstve – in Russian] pp 113-115
[2] Lihachev I P and Shifrin B M 2019 Research on the e-learning problems for forestry workers Actual problems of the forestry industry [Aktual'nye problemy razvitija lesnogo komplekса – in Russian] pp 156-158
[3] Shalkina T N 2015 Indicators and criteria for the online course quality Educational technology and society [Obrazovatel'nne tehnikii i obshhestvo – in Russian]
[4] Shifrin B M 2018 Fuzzy logic optimization of the grinding process Machines, units and processes [Mashiny, agregaty i processsy – in Russian]. (St. Petersburg: SPbF NIC MS), vol 1 p 237
[5] Shifrin B M 2017 Development of a model for the process of quality control of the surface of particle boards based on fuzzy logic Computer-aided design in mechanical engineering [Avtomatizirovannoe proektirovanie v mashinostroenii – in Russian], vol 5 pp 39-43