The International Journal of Engineering and Science (IJES)
|| Volume || 9 || Issue || 04 || Series III || Pages || PP 34-43 || 2020 ||
ISSN (e): 2319-1813 ISSN (p): 20-24-1805

Logical Structure of Structure OrientedEvaluation for E-Learning

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----------ABSTRACT----------
This paper describes evaluation and its method for e-learning process at Mongolian University of Science and Technology (MUST). Main aim of this study is to develop the logical structure of structure oriented evaluation for e-learning at MUST. An e-learning is complex system where involved many different groups which has all own pre-defined roles, requirement and expectations in e-learning. For example: Professors are owners of contents, they present pedagogical aspect and more responsible for quality of e-learning contents. IT and multimedia personals are owners of technology, they present technology enhancement aspect and more responsible for added value of technology in the e-learning. University is owner of learning management system and plays role as main administration for whole process, responsible for general successful implementation of e-learning process. Students belong to target group, they are play role of users in e-learning. Without students any e-learning will be senseless for development and implementation. For evaluation process structure oriented evaluation model was selected as main model. Key advantage of structure oriented evaluation is connected evaluation goals which designed by logical structures. Therefore, development of logical structure for e-learning is essentially important. This paper focuses on logical structure for e-learning evaluation.

Keywords: *evaluation, evaluation model, SURE model, e-learning evaluation, structure of evaluation goal.*

Date of Submission: 23-04-2020 Date of Acceptance: 04-05-2020

I. INTRODUCTION

The quality of education is the conformity of education (as a result, as a process, as a social system) to diverse needs, interests of an individual, society, state; - it is a systematic collection of hierarchically organized, socially significant essential properties (characteristics, parameters) of education (as a result, as a process, as a social system) [1].

In the works of L. Harvey (director of the Center for Research in Quality, England) several approaches to assessing quality in the higher education system are considered: compliance with the goals, demands and requirements of consumers; investment result; changes associated with the provision of new opportunities or with the development of new knowledge for students [2]. Similar theoretical positions are observed in a number of other authors who are developing the concepts of education quality management. For example, D. Timmerman offers a three-phase model of quality management of the educational process, in which he selects the input phase (input), intermediate (throughput) and output phase (output), dividing the entire production process of services into separate phases, and considers the quality of each of them. The quality of institutions of higher education is currently rated based on ratings [3].

Lingyan Wang, Jian Li, Lulu Ding, Pengkun Li studied the application of data mining in e-learning evaluation to evaluate students' learning behavior. Students' learning behavior data collected and analyzed. With the support of data mining technology, the relationship between learning behavior and learning effect is studied and the decision tree model is established by using J4.8 algorithm on the Weka platform [8].

Muhammed Maruf Ozturk described in a paper different testing methods have been developed for e-learning testing and evaluation. In this study, authors have developed an e-learning testing and evaluation system which is supported with software testing techniques. Validation and verification methods have been used for developing such a system [9].

A.M.Guidy-Oulai, J.M.Tarn discussed study reviews the major existing e-learning evaluation models and develops a checklist model for e-learning evaluation based on the findings. This system hgve a two-

stage validity study is conducted, including an expert panel review for model refinement and a web survey to ensure the reliability and usefulness of the instrument. The proposed evaluation checklist has proven to be a useful and effective tool that can help guide professional evaluators as well as non-evaluators when conducting an e-learning evaluation [10].

Donatella Persico, Francesca Pozzi, Stefania Manca describes the approach adopted to carry out an evaluation of the STEEL e-learning system, developed for an Italian online university. This study was to identify the strengths and weaknesses of the system in view of innovative potential and impact. The core of the adopted approach is based on an adaptation of the Technology Acceptance Model (TAM), proposed by Davis (1989) as a theory to model how users of a new technological system accept it and take it on, and based on two main acceptance factors: perceived usefulness and perceived ease-of-use [11].

Jing Liu, Jun Han, Na Shu, Xiaodan Zhao describes the research for e-learning evaluation based on fuzzy theory. The aim of the study proposes a method based on fuzzy comprehensive evaluation system of e-learning, and design an evaluation system and solution in order to provide more valuable reference for education decision makers [12].

In assessing the quality of education and the education system, in addition to the learning environment, the level of teaching methods should be considered. If the country or the school are in conformity with quality criteria, the purpose of the educational institution is to provide quality education.

The quality of education depends on many factors (Fig. 1.)

Fig. 1. *The quality factors of e-learning*

- Quality of Training Management (education process and teaching method);
- Quality of Science and Teaching Staff;
- Quality of Educational Programs and Curriculum;
- Quality of CourseContent;
- Quality of Cloud Service (technical baseline, information and education environment;
- Quality of Applicants and Students;
- Quality of Evaluation Management;
- Quality of Researchers and Others.

Traditionally, "quality of education" is quality of educational content; quality of educational outcomes (quality of personal education); quality of education technology (the quality of teaching methodology).

II. CLOUD SERVICE FOR EDUCATION

This invisible digital world, which covers all our activities like a cloud over us, is called Cloud Computing. Cloud computing is the process by which computers and other devices process software, shared data, and information over the Internet. The technology allows networked universities, teachers and students to access the necessary hardware, software, and business models from a single source, regardless of location.

The use of "cloud" technology in the education system brings us the following benefits.

• Economic savings: reduced server costs, reduced number of school equipment, reduced number of engineers and technicians, and reduced duplication of training materials;

• Flexible training: Software innovation, teaching methods based on students' knowledge and skills, has a training program tailored to the specifics of the training;

• Real results: has an evaluation system that allows the school administration to monitor the collaboration of students, parents and teachers, the learning process, and the performance of staff tasks online on a regular basis;

• Sharing training resources: Equitable distribution of training content and knowledge;

• Training opportunities: high speed internet, reliable operation 24 hours a day, access from anywhere at any time;

• Green technology: Reduced paper consumption and environmental pollution.

Cloud computing brings the following benefits to teachers, students and educational institutions.

1. The following innovations have emerged in cloud-based schools.

- With the implementation of various new ideas in the education system, students have access to and use of course content with the help of smart devices and applications.
- Smart Classrooms: A smart learning system has been created with the help of complex software based on cloud technology.
- Virtual laboratories: Virtual simulation laboratories have been created.
- Virtual content: Schools will be able to use quality teaching materials as teachers will be able to share lesson content with each other.
- eTwinning for teachers and students: E-Twinning is a network for teachers entering Europe, unlike other social networks.
- AI: AI is used as a tool to facilitate a number of learning activities.
- Intelligent management: Cloud computing provides useful tools for management, performance evaluation, and resource management. [4]
- Innovative research environment: Researchers can share their research results in the cloud and share them to enhance their work.
- New learning tools: It is possible to develop a new learning environment. Examples include VR, 3D printers, IoT, Wearable, and Machine-Learning.

2. The school administration was able to monitor only the learning process, which created the following opportunities. These include:

- Student attendance, assessment, and lecturer teaching process can be monitored online;
- Focus on training through teacher and student evaluation systems;
- Monitor the performance of teachers and staff online;
- It has become easier to communicate with the student's parents;
- Support students with disabilities;
- Support students with high intellectual potential;
- Monitor the content for training materials and prevent duplication of course content;
- It is possible to Face-to-face discussions with students.

3. Teachers have the following opportunities:

- It's easier to share news, information and ideas with teachers and students;
- Get acquainted with the works of foreign and domestic scientists and participate in online conferences and seminars;
- Conduct online discussions with foreign and domestic scholars to exchange views and cooperate;
- Possible to objectively assess your knowledge and skills by the school administration;
- Teachers are able to prepare training materials using the cloud learning platform;
- Reliable operation of the student learning platform is ensured. This allows students to realistically assess their knowledge and skills;
- Organize online competitions;
- Support communication between students, teachers, parents and alumni;
- Provide virtual training materials;

4. Students have the following opportunities:

- Parents monitor their children's academic performance and attendance;
- Learn the essential training modules you want to master at any time, regardless of space or time, based on your mental and physical abilities and financial capabilities;
- Possible to learn one-on-one training and self-study;

- Read not only textbooks but also research articles, reports, dissertations and projects in all fields from the electronic library;
- Take exams online, take pre-test exams and improve your knowledge.;
- Attend online training of the best foreign and domestic teachers;
- Conduct online discussions with international and domestic students and exchange ideas;
- Participate in online competitions;
- It is possible to send homework electronically.

Figure 2 shows the following model of a university cloud-based portal site. The portal site acts as an access point to the university system. The main activities of the university include the Evaluation web, the University Management Information System, the Scientific Research web, the E-Library web, the University Finance Accounting web, and the Human Resource web. The Evaluation web is a system of indicators for teachers and researchers of higher education institutions to evaluate the results of training, research and community work, to improve the training work, and to activate the learning process.

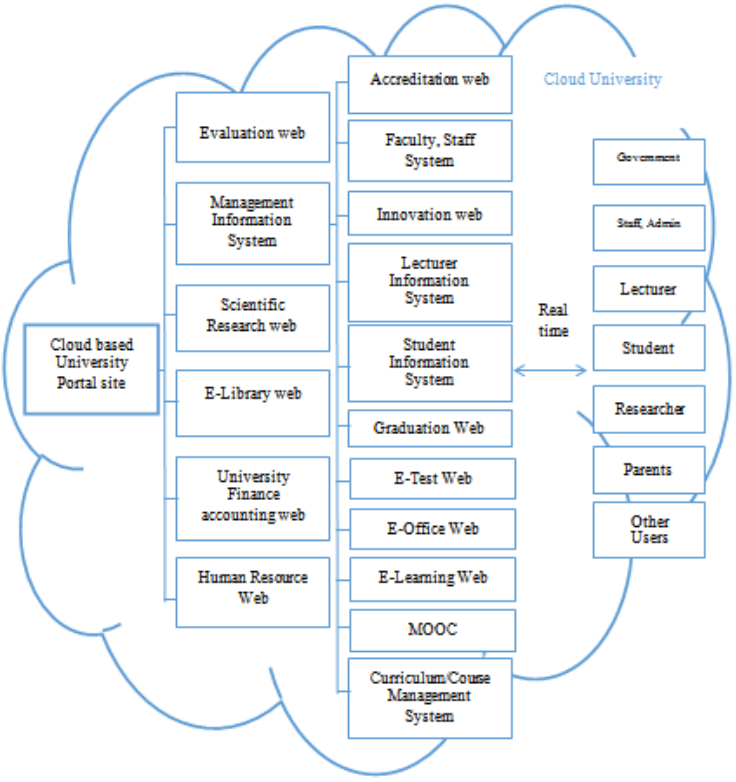

Fig.2.*Model of Cloud Based University Portal*

University Management Information system includes Accredition web, Faculty, Staff System, Innovation web, Lecturer Management Web / Information System, Student Management Web / Information System, Graduation Web, E-Office Web, E-Learning Web, MOOC, Curiculum / Course Management System. It is possible to access the portal site regardless of time and space, get the information you want and participate in e-learning. For example: Government, Staff, Admin, Lecturer, Student, Researcher, Parents can access the portal site to participate in training, research, research work, student achievement, new information, advertisement, publication, review of assignments, It is widely available for printing and self-assessment.

The most important advantage of Cloud School is that it saves a lot of time by collaboratively editing training documents, advising students, and talking live or in video or audio mode. Therefore, simplifying the training process and ensuring its implementation has a positive impact on the quality of training.

In cloud computing, there are usually three distinct categories or levels:

1. “Infrastructure as a service” (IaaS, infrastructure as a service). At this level, users receive basic computing resources - for example, processors and storage devices - and use them to create their own operating systems and applications.

2. "Platform as a service" (PaaS, platform as a service). Here, users have the opportunity to install their own applications on the platform provided by the service provider.

3. "Software as a service" (SaaS, software as a service). This level is of greatest interest to educational institutions. [5] At the same time, not only data, but also related applications are stored in the "cloud", and the user only needs a web browser to work.

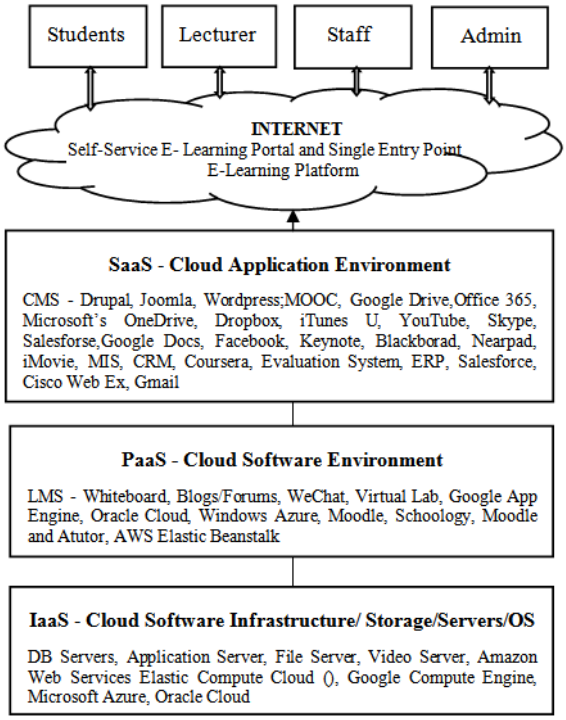

Fig. 3. *Model of Cloud service*

From Fig. 3 you can see that users can use cloud services through e-learning portal. The portal provides access to all e-learning systems in one single entry point.

As part of PaaS, the LMS contains the core features of distance learning, and the ability to use in-house services such as Forum, Chat, Virtual Lab, and E-mail to create and use remote courses. [6] However, methodological issues that cannot be resolved by standard LMSs can be resolved using a SaaS service. Depending on the IaaS and PaaS services, the SaaS software provides the most up-to-date and high-quality, non-essential products.

III. THE KEY GOAL STRUCTURE

The basic directions of quality of e-learning are:

- Quality of contents;
- Quality of education;
- Quality of technology.

Based on these directions defined four key goals for evaluation:

1. Quality of teaching stuffs (B_1);
2. Quality of curriculum (B_2);
3. Quality of students (B_3);
4. Quality of university management system (B_4).

Fig. 4. *Logical structure of key goals*

Each key goal divided into sub goals and its measurement scale.

B_1 : Quality of teaching stuffs

A_{11} – Social competence
A_{12} – Finance competence
A_{13} – Promotion system
A_{14} – Career development
A_{15} – Equality
A_{16} – Course content

B_2 : Quality of curriculum

A_{21} – Objective oriented
A_{22} – Society oriented
A_{23} – Student oriented
A_{24} – Pedagogy oriented
A_{25} – Teaching skill oriented

B_3 : Quality of students

A_{31} –Learning skills
A_{32} – Problem solving
A_{33} – Ability to learn independently
A_{34} – Creativity
A_{35} – Continues study

B_4 : Quality of university management system

A_{41} – Learning environment
A_{42} – Active learning
A_{43} – Cooperation with other universities

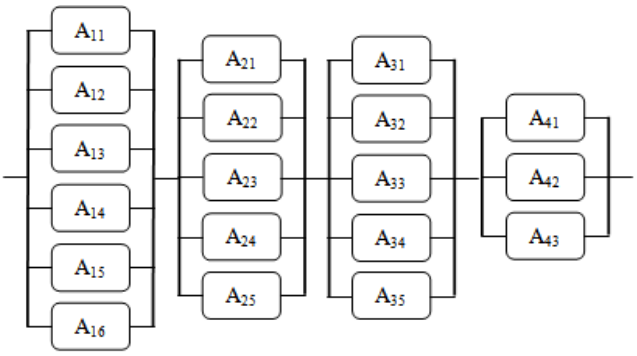

***Fig. 5**. Logical structure of sub goals*

Fig. 3 and Fig. 4 shows logical structure of evaluation goals for general case. The next sub section shows case for different universities depending on their local policy and requirements.

IV. LOGICAL STRUCTURE FOR E-LEARNING QUALITY EVALUATION

As a result, it is necessary to focus on the quality of internal and external infrastructure and to work with other local and foreign training institutions to ensure quality of training.It is important to develop an IT training methodology along with the common methods of quality evaluation in an e-learning system.

B_1 : Quality of teaching stuffs

- Teacher communication skills - (A_{11})
- Teacher's qualifications - (A_{12})
- Teacher's pedagogical skills - (A_{13})
- Cooperate with each other - (A_{14})

B_2 : Quality of course content

- The amount of knowledge gained by the content - (A_{21})
- The availability of materials to be used in training - (A_{22})
- Descriptive materials (graphics, animation, noise) - (A_{23})

B_3 : Quality of the curriculum

- Contains the theoretical concept of curriculum developers - (A_{31})
- Describe the level of goal to achieve the goals in the future - (A_{32})
- Encourage student cognitive activity - (A_{33})
- Regularly inspire students to learn - (A_{34})
- High degree of knowledge - (A_{35})

B_4 :Quality of students

- Possess of foreign language training materials - (A_{41})
- Respect students of culture, language, disabilities - (A_{42})
- The ability to prepare independently for the exam - (A_{43})
- The speed of the student's problem solving - (A_{44})
- Ability to self-study content - (A_{45})
- Self-learning opportunities - (A_{46})
- Use of teaching materials - (A_{47})
- Contact with teachers and students - (A_{48})
- Ability to use library resources - (A_{49})
- Ability to learn independently - (A_{410})

B_5 :Quality of LMS

- Opportunity to monitor training progress - (A_{51})
- Classification of students by knowledge and skills - (A_{52})
- The opportunity to document the progress and results of
- the training - (A_{53})
- Organization of training environment - (A_{54})
- Search engine - (A_{55})
- Working reliability and system integrity - (A_{56})
- The online chat, online help system - (A_{57})
- Solve technical issues - (A_{58})

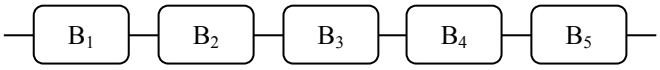

Fig 6. *Key goal structure*

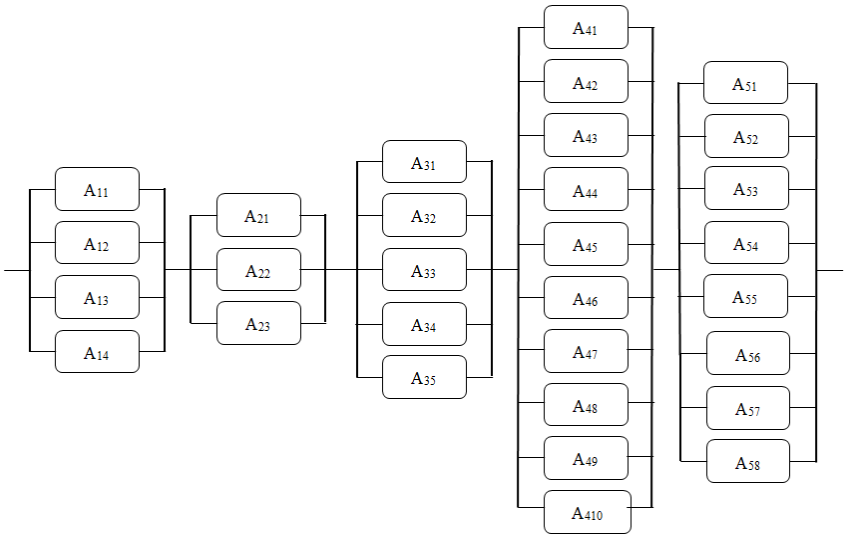

Fig 7. *Sub goal structure*

By this structure it becomes possible to evaluate for all involved groups how the corresponding group has achieved its target. Based on an adapted logical structure evaluator can see how successful the components of an e-learning process are running, where have to spend more attention and what should be improved for the next round. A further advantage of this structure is flexible for configuration and update. Simultaneously it becomes possible to evaluate in a consistent manner how special single targets were achieved. The formal details of this approach are presented by Tudevdagva (2014) [7].

V.DATA PROCESSING OF STRUCTURE ORIENTED EVALUATION

The measure theoretical description of a structured process starts with definition of elementary measure spaces for evaluation of involved sub processes. These measure spaces are base for a further product space by which a multidimensional view to evaluation is reached. The so obtained product measure is then a possibility to measure or to score how a given process will reach its goal. The score measure satisfies thereby the same calculation rules as any normalized measure where the series and parallel rule are of particular importance.

A process $B = \mathrm{A}_1,....\mathrm{A}_r \subseteq g$ is a series process if the goal of process is achieved if and only if each process component $\mathrm{A}_1,....\mathrm{A}_r$achieves its goal.

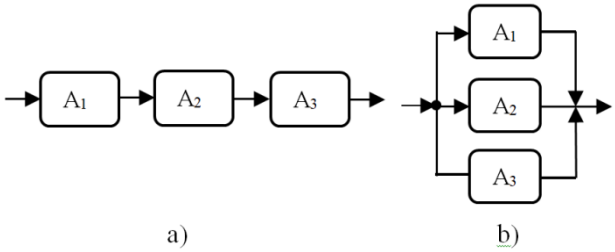

Fig8: *Series and parallel process.*

This property of a process can be described formally as follows. Let $B = \mathrm{A}_1,....\mathrm{A}_r \subseteq g$ be a series process consisting of r process components $\mathrm{A}_1,....\mathrm{A}_r$ Denote by B and the fact that the $\mathrm{A}_1,....\mathrm{A}_r$ process B and the process components $\mathrm{A}_1,....\mathrm{A}_r$achieve their goals, respectively. Then for a serial process the relation between B and $\mathrm{A}_1,....\mathrm{A}_r$can be formally represented by

$$B = \mathrm{A}_1 \cap \mathrm{A}_2 \cap ....\mathrm{A}_{r-1} \cap \mathrm{A}_r = \cap_{i=1}^{r} \mathrm{A}_i.$$

That means, a series process B achieves its total goal if all included process components achieve their goal. This can be emphasised graphically by a series scheme as it is shown in Figure 8a. The order of process components in a series scheme is without of significance. Beside series processes the following process type is of particular relevance.

A process $B = \mathrm{A}_1,....\mathrm{A}_s \subseteq g$ is a parallel process if the goal of process B is achieved if at least one of the process components $\mathrm{A}_1,....\mathrm{A}_s$achieves its goal. Formally then holds:

$$B = \mathrm{A}_1 \cap \mathrm{A}_2 \cap ....\mathrm{A}_{s-1} \cap \mathrm{A}_s = \cap_{i=1}^{s} \mathrm{A}_i.$$

This can be emphasised graphically by a parallel scheme like in Figure 8b. The total goal of a parallel process is already achieved if one of the process components has reached its goal.

By combination of series and parallel processes more complex process structures can be obtained.

We assume that the considered elementary processes $A_1,...,A_k$ can be observed via ordinal or metrical ordered observation variables$X_1,...,X_k$.

Let $X_i = [x_i', x_i'']$ be the domain or scale of i-th observation variable X_i, $i = 1,...,k$. High values of X_i in the neighbourhood of upper bound $x_i''$of evaluation scale are an indication of that the goal of process $A_i$hasbeen achieved, essentially. Small values in the neighborhood of x_i'a corresponding signal that the process goal has been failed, essentially. Observation values $X_i = x_i''$or $X_i = x_i'$indicate that the goal of process $A_i$has been completely achieved or failed, respectively. The scales which are used for observation variables $X_i$can be continuous or discrete, must be ordered and can be, for instance, rank places too.

Assume that n data are collected when $k = 1,...,n$. Then at first we to normalise our sample values $x_{ij}^{(k)}$ by transforming of these values to the interval $[0,1]$. Let $q_{ij}^{*\,(k)}$ for $k = 1,...,n, i = 1,...,r$ and $j = 1,...,...,s_i$ be defined by

$$q_{ij}^{*\,(k)} = \frac{x_{ij}^{(k)} - x'_{ij}}{x''_{ij} - x'_{ij}}.$$

Then $q_{ij}^{*\,(k)}$is an estimation value for score q_{ij} based on observation value $x_{ij}^{(k)}$. It holds $0 \leq q_{ij}^{*\,(k)} \leq 1$. We get

$$Q^{*\,(k)}(C) = \prod_{i=1}^{r}\left(1 - \prod_{j=1}^{s_i}\left(1 - (q_{ij}^{*\,(k)})\right)\right)$$

for k=1,...,n.

Hence, collecting these values together we obtain a sample $Q^{*\,(1)}(C),...,Q^{*\,(n)}(C)$of size n for score $Q(C)$. By the method of moments we obtain finally via the arithmetic mean an estimation function for the score $Q(C)$ by

$$Q^{*}(C) = \frac{1}{n}\sum_{k=1}^{n} Q^{*\,(k)}(C) = \frac{1}{n}\sum_{k=1}^{n}\prod_{i=1}^{r}\left(1 - \prod_{j=1}^{s_i}\left(1 - (q_{ij}^{*\,(k)})\right)\right).$$

This is the main formula for an estimation of score of a generalised series goal structure based on a sample of size n in context of an interrogation. Special cases are again the parallel and series goal structures. For a parallel goal structure $(B_i) = \bigcup_j^{S_i} A_{ij}$we get according the addition rule for parallel goal structures as estimation function for $Q(B_i)$:

$$Q^{*}(B_i) = Q^{*}\left(\bigcup_{j=1}^{s_i} A_{ij}\right) = \frac{1}{n}\sum_{k=1}^{n}\prod_{i=1}^{r}\left(1 - \prod_{j=1}^{s_i}\left(1 - (q_{ij}^{*\,(k)})\right)\right).$$

For series goal structures $(C_i) = \bigcap_{j=1}^{S_i} A_{ij}$we get bythe product rule for series goal structures as estimation for score $Q(C_i)$:

$$Q^{*}(C_i) = Q^{*}\left(\bigcap_{i=1}^{r} A_{ij}\right) = \frac{1}{n}\sum_{k=1}^{n}\prod_{j=1}^{r} q_{ij}^{*\,(k)}.$$

The score $q_{ij} = Q(A_{ij})$ of a single goal structure $A_{ij} \in A$ can be estimated by

$$Q^{*}(A_{ij})\frac{1}{n}\sum_{k=1}^{n} q_{ij}^{*\,(k)}.$$

In case of missing values in the sample the missing values for $q_{ij}^{*\,(k)}$can be substituted then by the estimation values$Q^{*}(A_{ij})$which are obtained via the arithmetic mean based on the incomplete sample. This corresponds a'neutral' evaluation of missing values in the sample.

On the basis of the obtained score calculation rules a statistical method for estimation of score values is developed using checklist data to get corresponding empirical scores, i.e. observation-based scores.

Depending on complexity of considered process to be evaluated, score values can become quite small. Therefore a calibration method for score values is developed which is helpfully for further interpretation of evaluation results. By means of an adapted statistical method for given checklist data corresponding estimation values can be obtained, the so-called empirical evaluation scores.

The precision of empirical scores can be estimated by means of asymptotic confidence intervals. For detailed review of data processing see Tudevdagva (2020) [8].

VI.CONCLUSION

Evaluation process allows university to identify the strengths and weaknesses of the course, to determine the needs of students. The structure oriented evaluation model covers in account the opinion of fellow teachers, external reviewers who have completed the course of students, as well as students who have not completed their studies, while guaranteeing anonymity.

This paper contains two versions of evaluation structures. First one is more general and next one is more focused for local need and requirement. There are many check list and questionnaire is developed and applied for e-learning evaluation. But no one is defined clear logical structure for their evaluation. Therefore this paper designed evaluation goals structures which can be used for e-learning evaluation.

Authors looking to feedback from educators and evaluators on those structures. In summary we offer to define your logical structures based on your checklist or questionnaire. In next paper authors plan to apply defined structures by simulated data.

REFERENCES:

[1]. Kirkpatrick, D. L. (1960b). Techniques for evaluating training programs: Journal of the American Society of Training Directors, Part 4-Results. Vol. 14(2), pp.28-32.

[2]. Gonzalez, D. W, Uttl, B. and White, C. A. (2017). Meta-analysis of faculty's teaching effectiveness: Student evaluation of teaching ratings and student learning are not related. Studies in Educational Evaluation, 54, pp.22-24.

[3]. Uranchimeg, T. and Hardt, W. (2011). A new evaluation model for eLearning programs: Technical Report CSR-11-03, Chemnitz University of Technology, Chemnitz, Germany.

[4]. B.Zorigtbaatar (2017). Education in the future: Our role in the development of the information and communication sector-2017, Proceedings of the scientific conference, Ulaambaatar, Mongolia.

[5]. Jun-Feng Zhao and Jian-Tao Zhou. (2014). Strategies and Methods for Cloud Migration: International Journal of Automation and Computing, pp.143-152.

[6]. Md. Anwar Hossain Masud and Xiaodi Huang, (2012).An E-learning System Architecture based on Cloud Computing: World Academy of Science, Engineering and Technology International Journal of Information and Communication Engineering Vol. 6 (2).

[7]. Uranchimeg Tudevdagva (July 2014.). Structure Oriented Evaluation Model for E-Learning: Wissenschaftliche Schriftenreihe Eingebettete Selbstorganisierende Systeme, Universitätsverlag Chemnitz, Chemnitz, Germany, 123 p., ISBN: 978-3-944640-20-4, ISSN: 2196-3932.

[8]. Uranchimeg Tudevdagva(2020). Structure Oriented Evaluation: Springer, ISBN 978-3-030-44806-6, 195p.

Web sites:

[9]. Jian Li, Lingyan Wang and Lulu Ding, "Pengkun Li. E-Learning Evaluation System Based on Data Mining," *Researchgate,* July 2010. [Online].Available at: https://www.researchgate.net/publication/251943373_E-Learning_ Evaluation_System_Based_on_Data_Mining

[10]. Muhammed Maruf Ozturk, "Design and Implementation of an E-Learning Evaliation System with Software Test Techniques,"*Researchgate*, November 2012. [Online]. Available at: https://www.researchgate.net/publication/258584858_Design_and_Implementation_of_an_E-Learning_Evaluation_System_with_ Software_ Test_Techniques

[11]. A.M.Guidy-Oulai and J.M.Tarn, "Organizational e-learning evaluation: The development of a checklist model," *Researchgate,* January 2012. [Online].Availabe: https://www.researchgate.net/publication/287638653_Organizational_e-learning_evaluation_The_development_of_a_checklist_model

[12]. Donatella Persico, Francesca Pozzi and Stefania Manca,"Three by Three by Three: a Model for E-Learning Evaluation," *Researchgate,* January 2012. [Online].Availabe: https://www.researchgate.net/publication/236012425_Three_by_Three_by_Three_a_Model_for_E-learning_Evaluation

[13]. Jing Liu, Jun Han, Na Shu and Xiaodan Zhao, "The Research for E-Learning Evaluation Based on Fuzzy Theory," *Researchgate,*June 2010.[Online].Availabe: https://www.researchgate.net/publication/232653272_The_Research_for_E-Learning_Evaluation_Based_on_Fuzzy_Theory