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EVALUATION OF E-ASSESSMENT: THE STUDENTS' PERSPECTIVE

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Abstract. *Learning analytics is a new evolving research area that deals with data generated during students' interactions with an online learning environment. The collected and analysed information chunks regarding their behaviour, performance and preferences could be used for improvement and optimization of teaching, learning and assessment.*
The aim of the current research is to present the developed model for evaluation the quality of online assessment activities in the form of quizzes considering the students' point of view that is published and discussed in scientific papers and the position of students from the Technical University of Sofia, College of Energy and Electronics (CEE). The evaluation of e-assessment tasks is still a challenging issue pointing out a wide variety of research problems similar to: a connection between content, structure and presentation of learning and assessment objects, the influence of learning styles on assessment objects, the type of provided feedback and its relevance to the received knowledge. Crossing the scientific repositories just several research papers were found on similar topics that is an indication for the necessity of further exploration and elaboration.
The assessment process as a very important part of the educational activities has to be designed correctly and precisely. The quizzes have to be developed, complemented and improved in order to be clearer, to give the students the possibility to show their knowledge to the fullest. When designing the online quizzes, it is necessary to take into account the fact that during their performance, the students cannot ask specific questions, nor get answers to them. Online quizzes are a challenge not only for the students – how to perform well, but also for the teachers – how and in what form to create assessment activities that will enable learners to show their knowledge without unnecessary obstacles and difficulties.
Some of our students work and study simultaneously. Also, at the CEE there are students of a wide age range, respectively with different levels of digital competences, learning background, preferences, etc. For this reason, their feedback is essential for a better perception and understanding of the quiz questions and, accordingly, for better student performance in this type of assessment.
The research methodology consists of the following procedures: (1) Exploration of scientific literature that is performed through utilization of searching queries in scientific search engines Google Scholar and Google Semantics and scientific databases Scopus and Web of Science. (2) Conduction of students' online testing from two Departments of the CEE in two different e-learning systems: open-source Moodle and cloud-based Edu20. The evaluated quizzes are two types: examination quizzes contributing to the final student mark and self-testing quizzes used for improvement of learning performance. (3) Development of a survey tool with an aim to gather students' evaluation regarding the online quizzes and taking into account a wide variety of questions, categorizing in several groups. The purpose is to obtain information for both: students' background and their assessment/perceptions about the implemented assessment activities. (4) Discussion and analysis of received results. (5) Development of a model for evaluating the quality of online assessment tasks in the forms of quizzes.
Students' answers give us possibilities to create an objective framework for evaluation of e-assessment that consists of several layers:
- *the first layer includes content, format style and type of questions and answers;*
- *the second layer reflects on adequate students' knowledge regarding the questions' content;*
- *the third layer describes the feedback role for students' learning;*
- *the fourth layer is about the relationship between learning styles and the question type and format.*

Keywords: *e-learning; online assessment; students' opinion; evaluation model; learning analytics.*

I. INTRODUCTION

Learning analytics is a research area that gives huge possibilities for better analysis, modelling and understanding the students' behaviour with aim the quality improvement of the educational process [1]. Data for analysis is gathered through log files that belong to utilized learning virtual environments, through internal or external for learning environment statistical tools, through students' activities observation, or survey tools. Behind learning analytics stays a wide variety of techniques and methods, including machine learning algorithms which precise usage reveal the current problem state, regularity in events and processes, as well as advanced classifications and predictions [2].

E-assessment with its diagnostic, summative and formative assessment forms also benefits from learning analytics and machine learning gathering suitable algorithms for solving educational cases or applying different approaches for improvement a wide variety of educational activities [3].

The Technical University of Sofia has been having traditions for many years in creating, encouraging and supporting lifelong learning. In modern dynamic life, people are faced with new demands and challenges, regardless of their field of work and development.

In the Technical University of Sofia, there are different types of education – full-time education and part-time training. Each of them strives for update and adaptation of the curricula and the methods of teachingand learning. The aim is to make the courses useful for different types of students, to give them a successful start and realization in a professional plan. Such training also includes the utilization of e-learning and assessment systems [4]-[9].

Previously in Bulgaria, the students were people who had just graduated from school or at most 2-3 years ago. The students who worked were an exception. Now that is more like a rule. This means that, in addition to the knowledge they receive at the university during their studies, students acquire additional knowledge and skills in their job, whether temporary or permanent. Understandings have changed, now students are between 19 and 55 years old, even older. Some of these students already have an internship in a particular area, and this is what motivates them to obtain an educational qualification or to retrain in order to develop their careers more successfully and in the desired direction. This, in turn, leads to higher expectations and different perceptions of the material taught, especially the one in digital mode.

New forms of training are a challenge for teachers too – how and in what form to present educational/study material that is comprehensible and logical, to conduct exams/tests with modern means and methods, without making it difficult for students.

Along with the adoption of modern teaching and learning forms, the assessment models also should be improved. They should reflect on the whole students' learning portfolio and on the proposed teaching style. Also, the best concepts from technological inventions should be used and applied to the creation of contemporary and context-based assessment scenarios. The assessment tasks should be designed very precisely because they are used as an important measure for students' knowledge and skills. Improvement of assessment activities should be performed not only by experts/teachers but also by students who are deeply involved in the assessment process.

So, it is very important to receive the students' feedback regarding e-learning and e-assessment. Their opinion is one of the main factors that would help to make appropriate adjustments and additions that will increase the quality of teaching, learning and assessment. The students' perspective will show the drawbacks and advantages of different assessment modes and will lead to a better understanding of the whole assessment process. The students' point of view will induce teachers with new ideas, new vision and modern approaches regarding the forms and types of assessment activities.

The purpose of the current research is to explore and analyse the students' opinion regarding the quality of provided online assessment tasks in the form of online quizzes that will support educators in the improvement of assessment preparation and will facilitate the students' learning. A framework for evaluation of online assessment tasks is proposed considering the students' point of view that is published and discussed in scientific papers and the position of students from Technical University of Sofia, College of Energy and Electronics is also taken into account.

II. ONLINE QUIZZ ESEVALUATION: THE-STATE-OF-THE-ART

Frankl and Bitter report the results of a survey performed by students from Alpen-Adria-Universität Klagenfurt regarding the evaluation of online testing [10]. The findings show the positive students attitude concerning the online examination. They prefer standardized questions and a mixture of standardized questions and do not like free-text questions. Among the benefits of online tests, the students point out: fast results, time-saving, improved structure, readability, possibilities for correction, interesting and convenient way for evaluation of their knowledge. The outlined obstacles are connected to the technical restrictions, need for more time, lack of structure and overview, problems with types of questions, typing difficulties.

Iahad et al. explore the opinion of students from University of Manchester, Institute of Science and Technology towards previews their experience in online examination, the role of the provided feedback in the online testing for learning enhancement, whether performed online test is effective and suitable for implementation in online courses, whether the students are prepared and ready for the current online test, whether the test is informative and easy for use [11]. Almost half of the surveyed students answered that they had experience with online testing, that they were ready for the test and that they do not interested too much from the feedback, that the questions are informative and easy for use, that the online test is effective and suitable for online utilization. The authors conclude that a direct dependence exists between achieved students' experience in e-learning systems and gained evaluation results.

Sorensen explores the vision of students from the Department of Chemical Engineering, University College London, regarding the e-assessment [12]. The respondents see the increased impact of online testing on chemical engineering and higher education. The students agree that the e-assessment improves their learning and that the quiz feedback is useful. They say that the randomization of questions does not influence their results and also that the correct answer cannot be obtained by guessing. The author concludes that the students perceive the advantages of e-assessment and they wish it also to be implemented in other courses. The quizzes are more useful for weaker students, giving them possibilities to explore again the key material points with their own speed. The male students are in greater favour of e-assessment in chemical engineering than female students.

Rostaminezhad researches the students' perception of online tests, the tests strengths and limitations as well as the role of the provided immediate results [13]. The students perceive online testing as a positive method for knowledge evaluation. They say that online tests are more difficult and more interesting than paper-based tests. Among the challenging issues of online testing are discussed: the benefits and disadvantages of receiving immediate results and higher students' stress because of the unfamiliarity with the used e-assessment technology. The author gives recommendations to teachers who will design e-tests to take into account the issues concerning the tests personalization based on the students' preferences about the type of provided feedback.

Soffer et al. examine the quality of online academic courses via students' opinion [14]. The students answer the questionnaire which includes an assessment of the design and contents of the course. It is used a Likert scale ranging from 1 (not at all) to 5 (to a very high degree) or in the form of multiple-choice. The authors receive the results in the range of 4.32 to 4.44 regarding: clear course guidelines; clear course structure and requirements; clearly presented learning units; comfortable navigation between the learning materials in the course website; logical and clear learning flow between the learning units, and "the availability of all contents from the beginning of the course helped me to manage my time". The authors' conclusion is that the students took part in this investigation will participate in online courses in the future because of their satisfaction with this type of courses.

Pezzino releases a survey among the advanced mathematics students to obtain feedback on their experience with MapleTA, an online assessment platform based on the software for mathematical analysis Maple [15]. In this survey, the students compared their experience with the use of a large set of Blackboard multiple-choice quiz. The results show that 59% of the students preferred MapleTA compare to other assessment methods (e.g. Blackboard online quizzes). The author concludes that some students may find confusing to access different platforms simultaneously.

III. METHODOLOGY

The methodology includes procedures related to: extensive literature search and review, online survey tool design and collection and analysis the students' opinion. All this lead to the construction of a framework for evaluating the online assessment quizzes.

The participants in the present study are students from two different Departments and different specialties at the College of Energy and Electronics. They are enrolled in blended courses.

The survey tools are designed through Google Forms and are delivered to students for anonymous vote.

Analysis of received results is done through utilization of supervised machine learning algorithm J48 that allows construction of predictive models in the form of pruned decision trees. For this purpose, the WEKA software that contains a set of machine learning algorithms for data mining is used. Through the algorithm J48 the classification trees are created concerning the several hypotheses that are defined by means of the input data. The classification procedures result in trees that facilitate the decision making and defining conclusions. Each tree consists of nodes that split into other nodes or leaves and leaves contain the decisions or inferences.

Data analysis is performed in four layers: the first layer outlines the importance of content, format style and type of questions and answers, the second layer reflects on adequate students' knowledge regarding the questions' content, the third layer describes the feedback role for students' learning, the fourth layer is about the relationship between learning styles and the question type and format, which integration leads to the development of the framework for evaluation of e-assessment tasks.

IV. RESULTS AND DISCUSSION

This section provides analysis and discussion of the received results which are divided into the above mentioned four layers.

The ***first layer*** gives notion about the *clearness* regarding the questions and answers' content (QA) – whether the questions and answers are understandable for students and whether they are presented and visualized in an appropriate manner. For this purpose, the *clearness* of the questions and answers is explored in connection to the *questions type* and *questions style*.

The *question style* is explained through the following attributes and their values:

- Text formatting (font, colour, highlight, underline) in the QA content – "qaformattedtext" with values: true, false;
- Video object in the QA content – "qavideo" with values: true, false;
- Audio object in the QA content – "qaaudio" with values: true, false;
- Diagrams/graphics/pictures in the QA content – "qadiagrams" with values: true, false;
- Animation objects – "qaanimations" with values: true, false;
- Combination1 that consists of video objects, formatted text and diagrams/graphics/pictures.

The *question type* is described through the following attributes and values:

- Multiple-choice questions with one true answer – "multiplechoiceonet" with values: true, false;
- Multiple-choice questions with many true answers – "multiplechoicemanyt" with values: true, false;
- True/False questions – "truefalse" with values: true, false;
- Questions with a free answer – "freeanswer" with values: true, false;
- Matching questions – "matching" with values: true, false;
- QA with mathematical formulas – "mathform" with values: true, false;
- Combination2 – a combination of matching questions, multiple-choice questions with many true answers, multiple-choice questions with one true answer, true/false questions, and questions with free answers.

The constructed tree consists of 9 nodes and 6 leaves (figure 1). The first split is done on the attribute "qavideo" that is divided into one leave "absagree" and one node "qatype". The leave "absagree" shows the students agreement (24% of them) regarding the clearness of the questions and answers content when they are presented with video objects. The node "qatype" represents the type of questions that can be: "mcalltype" – attribute that includes multiple-choice questions with many true answers and multiple-choice questions with one true answer; "mcmanyt" – attribute that shows multiple-choice questions with many true answers, "mconeans" – attribute that presents multiple-choice questions with one true answer and attribute "combination2" – that includes matching questions, multiple-choice questions with many true answers, multiple-choice questions with one true answer, true/false questions, questions with free answers. This node "qatype" is splitting into three leaves: (1) "na (1.0)"– pointing out that only 4% of the students consider the QA content for clear and understandable when it includes all question types, (2) "agree (2.0)" – showing that 10% of the students consider the QA content for clear when it is presented through multiple choice questions with many true answers, (3) "na (4.0/1.0)" – 19% of the students think that multiple-choice questions with one true answer very well contribute to the QA content clearness and one node "qadiagrams". The students who voted for "combination2" consider that the clearness is achieved through integration of diagrams/graphics/pictures in the QA content. The third split is done on the node "qadiagrams" into two leaves: "absagree" – the students absolutely agree (24% of them) that the visual presentation of QA content through diagrams/graphics/pictures leads to the QA content clearness and "agree" – the students agree (19% of them) that the QA content without diagrams/graphics/pictures could be clear.

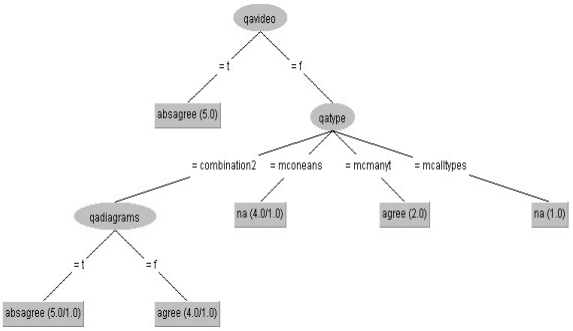

Figure 1. The constructed pruned tree corresponding to the first layer

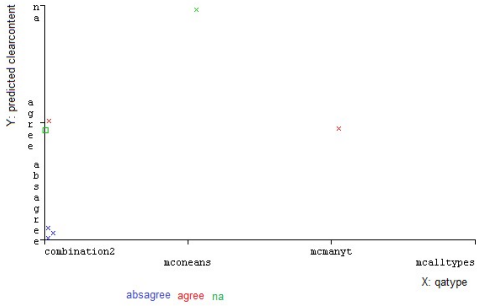

Figure 2. The predictive model regarding the dependency between QA type and content clearness

The created predictive model regarding the dependency between QA type and content clearnessis shown in figure 2 and it points out that: the QA content is clear and understandable when it is presented through combination2. Also, the content clearness depends on preferred QA style and the predictive model points out the combination1 that includes video objects, formatted text and diagrams/graphics/pictures as the best approach.

The ***second layer*** reflects on the dependence among the questions content and their number, the lessons structure and content presentation, the received new knowledge during the quizzes conductance and the correctness at evaluation the students' knowledge.

The following attributes and values are used:

- Presentation of the lessons in the course (whether they are well explained and visualized) – "lessonspresentation" with values: absolutely do not agree, do not agree, na, agree, absolutely agree;
- Questions scope (whether the questions cover the learning material included in all lessons) – "qscope" with values: absolutely do not agree, do not agree, na, agree, absolutely agree;
- New knowledge (whether the students receive new knowledge from QA)– "newknowledge" with values: absolutely do not agree, do not agree, na, agree, absolutely agree;
- Question numbers –"qnumbers" with values: absolutely do not agree, do not agree, na, agree, absolutely agree;

- Correct evaluation (whether the questions construction leads to correct knowledge evaluation) –"correcteval" with values: absolutely do not agree, do not agree, na, agree, absolutely agree;
- Knowledge evaluation (whether the students' knowledge is evaluated correctly) – "knowledgeeval" with values: correct, absolutely correct and incorrect.

The generated classification tree includes 11 nodes and 9 leaves (figure 3). It shows that the important attribute is "newknowledge" that reflects on the students' opinion regarding the new knowledge received from online quizzes, i.e. if the students learned new facts and theoretical statements. This attribute is divided into four leaves and one node. The second split is on the attribute "qscope" that presents the students' opinion about the scope of the online quiz questions – if they cover the study material included in the online course tutorials, partially, or not at all. 71% of the students agree that the constructed questions in qualitative and quantitative way correctly evaluate their knowledge.

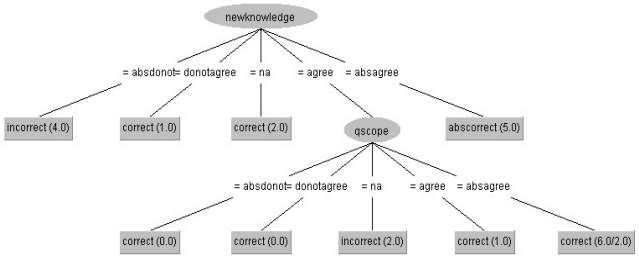

Figure 3. The decision tree for the second layer

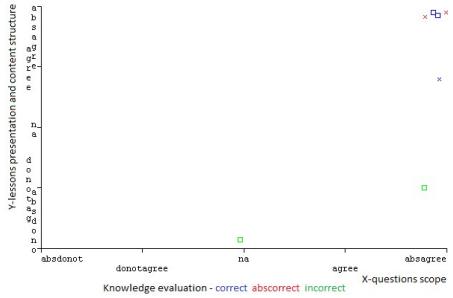

Figure 4. The predictive model of a second layer

The created predictive model (figure 4) reveals that IF the content of the lessons is well organized and presented AND the questions cover all aspects of the learning material in the lessons THEN the student's knowledge evaluation should be considered as correct and absolutely correct.

The ***third layer*** shows whether the provided feedback during the quizzes performance influences the students' learning; whether the students fill their knowledge gaps through the available feedback and whether they clear their understanding about theoretical and practical concepts, events and processes. The following attributes and values are involved:

- Gaps filling (whether the feedback contributes to knowledge gaps filling) – "gapfilling" with values: true, false, cannot answer;
- Feedback necessity (whether the feedback is necessity) – "feedbacknecessity" with values: true, false, cannot answer;
- Short answer (whether the feedback to be in the form of short answer) – "shortanswer" with values: true and false;
- Detailed answer (whether the feedback to be in the form of detailed answer) – "detailedanswer" with values: true and false;
- Detailed answer and references to knowledge sources – "detailedanswerref" with values: true and false;
- References (feedback in the form of references to the knowledge sources) – "reference" with values: true and false;
- Learning depth – "learning" with values: deep and smattering.

The result of the classification process is disclosed in figure 5. The first split is done on attribute "shortanswer". It represents the feedback form after each quiz question. 52% of the students do not prefer the short answer as feedback and this leads to the first leave – "deep" learning. The second split is on attribute "gapfilling" that contributes to clarifying the course material and filling the knowledge gaps. 71% of the students agree that the feedback provided after every question in the quizzes is necessary, 19% cannot appraise and the rest 10% don't think it is necessary. 76% of them prefer the feedback to be in the form of detailed explanation of the true answer or combination of detailed explanation and reference link to the learning materials that is an indicator for occurring of deep learning. The rest 48% of the students prefer the feedback to be in the form of short answer and it

means that they wish to understand the true answer, but not in details, that is a factor for receiving smattering knowledge and leads to not so deep learning.

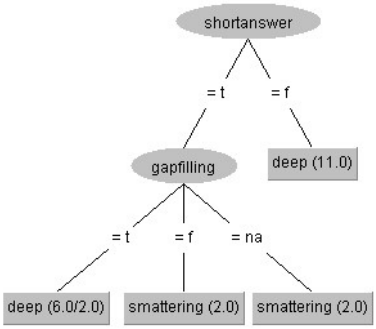

Figure 5. The decision tree for the third layer

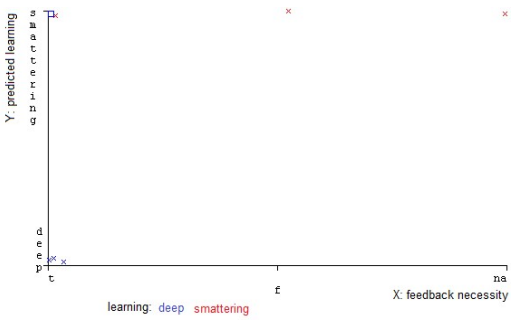

Figure 6. The predictive model of the third layer

The created predictive model (figure 6) shows that IF the students wish to achieve deep learning THEN the provided feedback is necessity AND it should be in the form of detailed answer or combination from detailed answer and reference to the learning material.

The ***fourth layer*** includes questions regarding the preferred learning style by students and preferred formatted style of the assessment quizzes. Students had to choose answers, describing how they better learn: with more images, graphics and diagrams in the learning material (attribute "visual" with values: true and false); with much textual explanations than pictorial ones (attribute "text" with values: true and false); the important text paragraphs to be coloured (attribute "coloredparsg" with values: true and false); the text with different importance to be formatted with different styles (attribute "textstyle" with values: true and false); learning through video objects (attribute "video" with values: true and false); learning through audio objects (attribute "audio" with values: true and false). The results from the classification process are presented in figure 7. The pruned tree consists of 9 nodes and 5 leaves. The first split is done on the "visual" attribute that conceptualizes the learning through more visual presentations of the learning material. The second split is realized on the attributes "coloredparag" that shows the preference for highlighting the important paragraphs through colours and "video"– learning through video objects. The third split is created on the attribute "video". The instances reached the leaves: "combination" – learning through formatted text and visual presentation or learning through formatted text and video objects; "images" – learning through more images, graphics and diagrams; "textformat" – learning through formatted text (different colours and text styles). 57% of the students choose learning through video objects, while the rest 43% have a preference for a combination of video objects and marking of the important paragraphs through colours. 48% of the students prefer combined style in the learning material.

The predictive model about learning styles includes learning through formatted text and a combination of formatted text and visual presentations (figure 8).

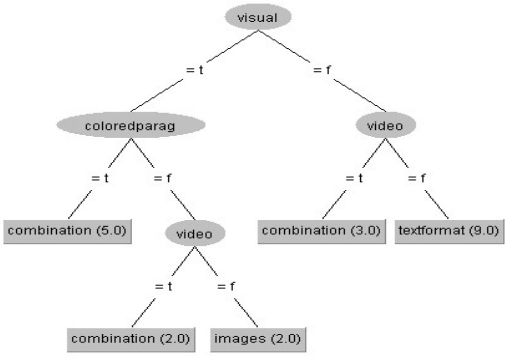

Figure 7. The decision tree for the fourth layer

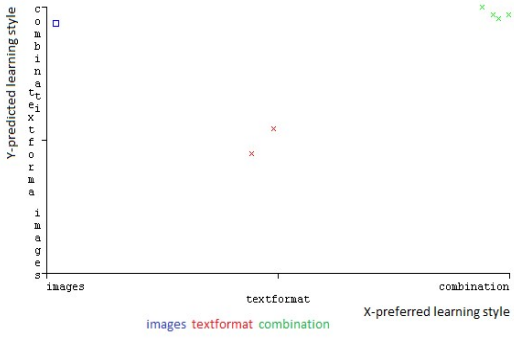

Figure 8. The predictive model for the fourth layer

V. CONCLUSIONS

The paper presents a framework and predictive models concerning the evaluation of e-assessment tasks. For this purpose, a research methodology for studying more completely the students' attitudes regarding the quality of online assessment and for data processing is developed. The obtained data is analyzed by WEKA software and machine learning algorithm J48. The obtained results at every level can be summarized as follows:

- The ***first layer*** is responsible for the *QA clearness* taking into account the *QA types* and *QA styles*. The created predictive models show that the QA content is clear and understandable when it is presented through a combination of a wide variety of questions AND when the QA style is presented through video objects, formatted text and diagrams/graphics/pictures.
- The ***second layer*** reveals the dependency among *lessons content*, the *questions scope* and *assessment correctness*. When the students are satisfied with the lessons content and its presentation and the questions cover all aspects of the learning material then the students' knowledge evaluation is objective and correct.
- The ***third layer*** reveals the role of the *feedback* for students' learning. The learning is deep when the students think that the feedback is a necessity and it should be in the form of detailed answer or combination from detailed answer and reference to the learning material.
- The ***fourth layer*** shows the connection between students' learning style and questions formatted style and type – the students prefer learning through formatted text and the combination of formatted text and visual presentations.

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