



# Using Moodle Platform in Evaluating the Electrical Engineering Practices

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**Abstract:** *In higher education, practical classes are very important since the quality of the achieved outcomes largely depends on its realization. In laboratories students work under the supervision of teachers and associates at defined terms and they do not have the opportunity to work independently without the supervision of teachers, associates or professional staff. Additionally, in almost all higher education institutions the staff is overloaded so students do not have the possibility to have additional terms. It is noticed that in the traditional laboratories, students are "lending" the results of certain measurements to colleagues from the other group or even to colleagues who will attend the same course next year. In addition to this problem, there has been a decline in motivation among students when it comes to the application of any classical method in both theoretical and practical teaching. This paper presents the evaluation process in higher education teaching and one approach to the forming of a model for the evaluation of practical Internet based teaching. This model was used to evaluate the practical work of the first-year students of electrical engineering.*

**Keywords:** *HE education, Moodle; model for evaluating; practical work*

## 1. INTRODUCTION

New technologies have a great impact on higher education, and the concept of e learning is very important in every segment. Changes in the educational process caused by the use of new technologies are evident, especially in the last decade. In classic classrooms new technologies have been used for quite some time, where various interesting tools are used to improve teaching and learning processes [1, 2]. During the COVID-19 pandemic, the classic classroom has been replaced by a virtual one, and new technologies have come to the fore [3, 4]. All these changes have affected both teachers and their way of teaching, and students and their way of learning. In addition to the classic way of teaching in higher education institutions, various tools are used, such as Moodle [5], web portals, video materials, video conferencing, etc.

The Moodle platform has been used for many years along with the traditional way of teaching at the faculties where the authors work [6 - 13]. Moodle makes work easier for teachers and their associates in a way that they use it as a source of teaching materials, as a bulletin board, for communication with students, testing and automatic generation of the testing results. Moodle is important for students for several reasons, of which we highlight unlimited

access to teaching materials, the ability to self-test their knowledge by taking quizzes composed of various types of questions, forums discussions and informing about classes and tests. The possibility to use all these resources via mobile phones is another good side of the Moodle platform which is especially important to students [14]. In addition to the traditional written materials, video materials can also be posted, as well as links to other activities such as online lectures. The use of the Moodle platform in the teaching process in higher education has become particularly important in recent months due to the transition to the online classroom caused by the COVID-19 pandemic. Moodle platform is significantly important because it enables sharing of resources with other higher education institutions.

In higher education, practical classes are one of the most important segments which affect the quality of learning outcomes and allow students to perform better in employment assessment tests. Practical classes are recognized by the law [15, 16] and by special criteria for education of engineers [17]. Practical classes are implemented through special teaching units (or subjects) and/or through exercises within teaching disciplines. Quality practical training on concrete practical examples

enables students to gain experience which is of great importance for their professional work after the graduation. As part of the teaching process, practical classes are evaluated in a way which depends on the area or subject.

The aim of this paper is to present a way of evaluating of higher education teaching with special emphasis on electrical engineering practices.

## 2. EVALUATION OF HE TEACHING PROCESS

The quality of the implementation of the higher education teaching process is monitored through various types of evaluations. Evaluation is a process of monitoring, measuring and evaluating effects and processes in education, and can be conducted through monitoring activities and processes (process evaluation) and determining the effects at the end of the process (effect evaluation) [18]. Evaluations can be internal or external depending on the evaluator, and aims to improve the education system and teaching process.

The theory and practice recognize three basic approaches for teaching in higher education. The first approach is lecture-oriented, often called traditional approach, and has the teacher in the center of the teaching process. In the second approach, the teacher can also appear as an organizer of learning-oriented activities. The third approach puts the student at the center of the teaching and learning process [19]. Assessment is a process where teacher performs verification and ranking the work of students, and is intended to continuously monitor students during the semester. Assessment of student learning outcomes is done through tests and various types of tasks. It includes the way teacher conducts the process as well as the communication with students. Thus, assessment aims to: check and evaluate learning, communicate to students, then motivate students to further work, learn, and organize the transition from one phase of study to another [20]. Checking and grading student work must be directly related to learning outcomes. It is important to emphasize that the verification and evaluation process should be objective, ie reliable, transparent and fair. A well-conducted assessment method will encourage students to further learn and improve, so it is important to pay attention to each segment of the teaching process.

It has already been pointed out that practical teaching is an integral part of engineering education. The evaluation of practical teaching in the education of engineers is very complex [13], [21-24]. Namely, if it is a question of realization of only one laboratory exercise, it is necessary to prepare it, both by teachers and assistant, and also by students. This is followed by the practical realization of the exercise in the laboratory where access is strictly limited, ie. a student cannot work

without the presence of a teacher or assistant. It is known that the workload of teachers and assistants is very high, so if students do not use the scheduled term for work, usually do not have another opportunity to perform the exercise. After successfully completing the practical exercise, student prepares a report. After all completed exercises, student prepares a practicum of laboratory exercises and at the end of the semester defends the exercises, usually orally. Such approach may not lead to an objective assessment of the practical work and real knowledge of the student.

In order to achieve objectivity, as well as to obtain a comprehensive picture of the student's practical work, we suggest that electronic tests should be used to evaluate practical work, which have been widely used for quite some time [25]. Electronic tests can be realized in two ways, namely to replace the classic test with a computer-supported version or by applying special testing software that enables the application of completely new forms of tasks [18]. The computer-aided test provides significant advantages [26] such as: simple test compilation process, possibility of randomly generated questions, time limit, reduced probability of scoring errors, obtaining results immediately after the electronic test, etc.

Given that Moodle platform is very common in the teaching process of higher education the logical choice is to use its possibilities in terms of creating electronic tests for testing knowledge [1, 2, 27 - 31]. The desire to achieve objectivity in the evaluation of practical classes has imposed the idea of using the possibilities of the Moodle platform in order to form a database of relevant questions that faithfully reflect the practical work in the laboratory of electrical engineering [13].

## 3. MODEL DESIGN FOR EVALUATION OF THE ELECTRICAL ENGINEERING PRACTICES

This study has been realized at the Faculty of Maritime Studies Kotor of the University of Montenegro and at the Faculty of Technical Sciences in Čačak of the University of Kragujevac through a work on a joint bilateral project "An approach to forming a model for evaluating a practical Internet based education related to evaluation of electrical engineering practices [32, 33]. This section shows how to use Moodle (Modular Object-Oriented Dynamic Learning Environment) platform in the assessment of practical work for courses in the field of electrical engineering.

The Moodle platform is a free, online Learning Management System that enables lecturers to create their own private website anytime, anywhere, consisted of dynamic courses that extend learning process [5, 13]. This platform offers full support in holding online courses. Some

of the more important features of the platform are: production of multiple courses, schedule the plan of the courses (calendar), leading the course tasks, uploading different types of teaching materials, student examination and evaluation etc.

Moodle users when signing in, get different objectives, depending on the course there are attending. The most important role of users can be systemized to:

- Lecturers (they can update their courses, upload materials, evaluate students, check statistics etc.);
- Students (they can access uploaded course materials, take tests and quizzes, use tools for communication and group assignments etc.);
- Guests (they can check information about courses and if they have access, they can check certain course materials).

Moodle platform can organize information for course that comprises of different sections or to present it in a weekly form. For the electrical engineering course, we considered the option of the section form. The first section is always reserved for general and administrative information. In addition, the second section is consisted of information such as lecturer data, course calendar, news, forums etc. [2]. This is quite important as this platform provides lecturers more time for creating questions and study materials of higher quality.

Other sections can be organized in different ways. In the observed course, sections are organized by its course topics according to the course catalogue with corresponding materials updated each week. These are followed by sections that are reserved for practical teaching, student examination and records during the semester. In this manner, students have updated information about activities that need to be completed, so they could permanently follow the course and laboratory exercises.

Model design for evaluation of the electrical engineering practices is based on the Moodle platform performances, so that students can follow lectures and laboratory exercises, as well as to be examined by the available activity, i.e. Quiz (electronic test). Quizzes are a useful tool for students to test their level of knowledge [2]. The Question bank is structured through categories that contain multiple subcategories which are related to the different topics. Each subcategory consists of a sufficient number of questions (different types of the tasks) that serve as practical assignments. It is formed in order to objectively evaluate students' practical work through these electronic tests.

It is important to differentiate Question bank and Quiz. Subcategory questions are created independently from quizzes (electronic tests). Upon

the creation of the appropriate Question bank we can form an electronic test as one of the Moodle platform available activity. Finally, the quizzes can contain different questions from subcategories using the option of random selection by the side of lecturer. In this way questions can be used wider in different electronic tests (quizzes).

Quizzes are a complex activity on the Moodle platform, with the possibility of using different kinds of questions. By forming quizzes from a Question bank (when creating questions, correct answers are provided) these can be objectively evaluated and students can see their results immediately after taking a quiz. In addition to these quizzes, there are parameters that can be set-up within the electronic test, such as: the date and time of the quiz availability, the number of attempts, the time for which the test should be solved, etc. If multiple attempts are allowed, the student will get different questions, respectively.

Also, Moodle platform provides a wide range of quiz types. For mentioned course in the electrical engineering, we chose the following types of questions: Multiple choice, True/False, Numerical and Drag and Drop items [5, 13]. Multiple choice questions are often created with four possible answers. When creating questions in the Question bank, one can choose to give negative points for answers that are not correct. One question (one correct answer) from the category Multiple choice questions is presented in Figure 1. The text of the question is: "The multimeter in the position from the Figure 1 is measuring:" where students can choose one of the four offered answers.

This question can be prepared in the form of True/False category (although this category of questions is consisted of two choices). The question can be reformulated to: "The multimeter in the position from the figure measures the direct current: "

When forming a question, the care should be taken how to clearly formulate it. We state that a certain question related to, for example, the connection of a measuring instrument can be asked within the same subcategory, but in different ways, so it implies different answer. For example, the question is: "Is the following statement true or false? In the circuit from Figure 2, the ammeter is correctly connected". The students can choose one of the two offered answers (True/False).

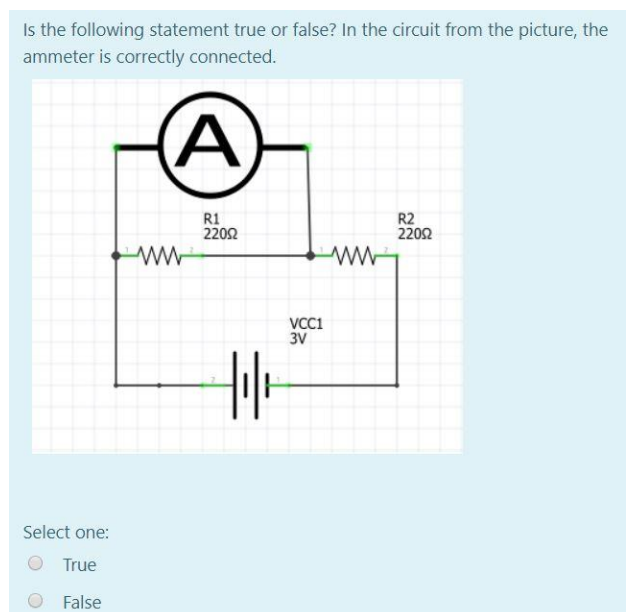
The image created for this task can also be used for the negative form question in the same subcategory: "Is the following statement true or false? In the circuit from the picture, the ammeter is not connected correctly".

A key aspect of the electrical engineering learning process is to develop the ability to solve practical problems and practices such as those encountered in the design of laboratory exercises. It is important to provide students with appropriate collections of

tasks/questions, electronic tests that will enable them to achieve the desired learning outcomes and continue with their studies.



**Figure 1.** Example of Multiple choice questions (one correct answer)



**Figure 2.** Example True/False question

#### 4. CASE STUDY: EXPERIENCE AND STUDENTS' FEEDBACK

This section presents the analysis of model design conducted for first year students of the Faculty of Maritime Studies Kotor, University of Montenegro within the subject Fundamentals of marine electrical engineering and electronics I (winter semester) and Fundamentals of marine electrical engineering and electronics II (summer semester) in the part related to the evaluation of practical classes .

The model was initially based on questions type MCQs with four answers offered. The reason for this choice was the common practice of using this type of question in tests organized for students and seafarers when checking their knowledge by future shipping companies (preparation for the labor market) [34]. During the development of the appropriate question base, project team members explored various types of questions within the Moodle platform. Thanks to the ability of the Moodle platform to export and import questions, members of both project teams were able to exchange the created questions and modified it. On this way we got new ideas for creating other quizzes

Before the "final test" - an electronic test for assessing the practice of electrical engineering in the winter semester, students had the opportunity to familiarize with this type of knowledge test. No points were deducted for wrong answers. Also, they were given the opportunity to do the test once more to achieve a better result. The final test is reflected in the Faculty.

After completing the "final test" at the end of the summer semester, we surveyed students (N = 59). Here we publish students' opinions on:

1. objectivity of assessment by electronic test and
2. difficulty of the types of questions used.

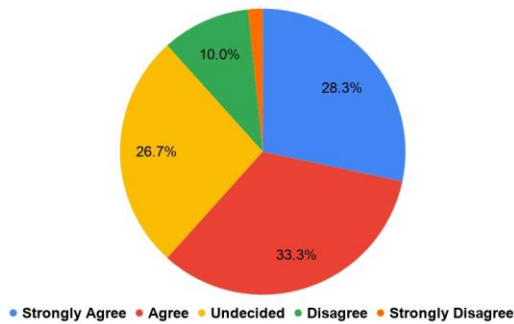
The offered answers related to the objective assessment of the use of the electronic test can be found in Figure 3. It is used in the form of the Likert scale.

- Electronic tests allow the grades obtained to be objective
- Strongly agree
  - Agree
  - Undecided
  - Disagree
  - Strongly disagree

**Figure 3.** Question related to the objectivity of the electronic test

In Figure 4, we present the students' feedback regarding the objectivity of the use of electronic test. As it can be seen, the students agree with the benefits of quiz (with a share of 61.6%).

Students' feedback for electronic test objectivity



**Figure 4.** Students' feedback for electronic test objectivity

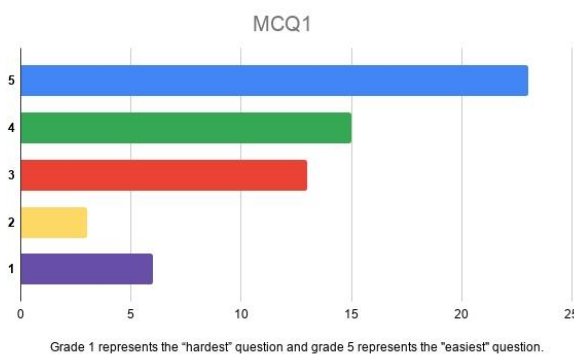
There are many types of questions on the Moodle platform that can be used to create a quiz (electrical test). Students 1 to 5 rated the difficulty of the questions: MCQ1-Multiple choice with one correct answer, MCQ2-Multiple choice with multiple correct answer, True/False, Numerical and Drag and Drop (grade 1 represents the "hardest" question and grade 5 the "easiest" question), as shown in Figure 5.

On the Moodle platform, there are many types of questions that can be used to create a quiz (electrical test). Rate the difficulty of the question from 1 to 5 (grade 1 is the "hardest" question, and grade 5 is the "easiest" question). MCQ 1 - multiple choice question with one correct answer; MCQ 2 - with multiple choice question correct answers

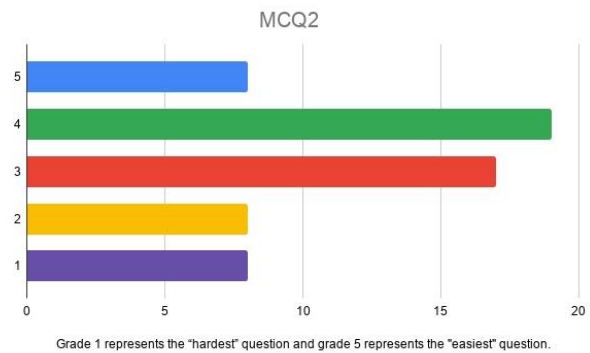
	1	2	3	4	5
MCQ 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
MCQ 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
True/False	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Short answer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drag and drop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure 5.** Question related to rated the difficulty of the different type of questions

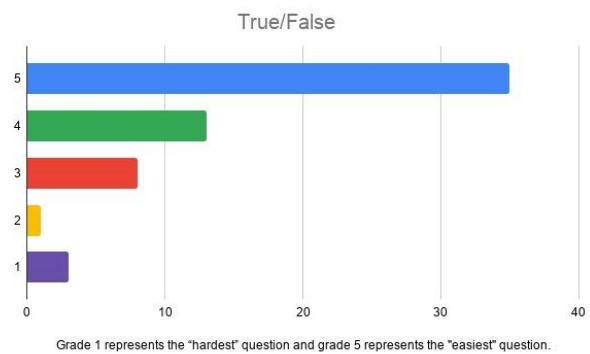
Students' feedback about difficulty of different types of questions is shown in Figures 6, 7, 8, 9, and 10.



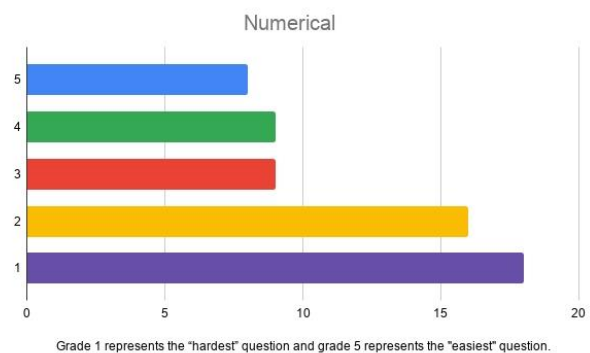
**Figure 6.** Students' feedback on the MCQ1



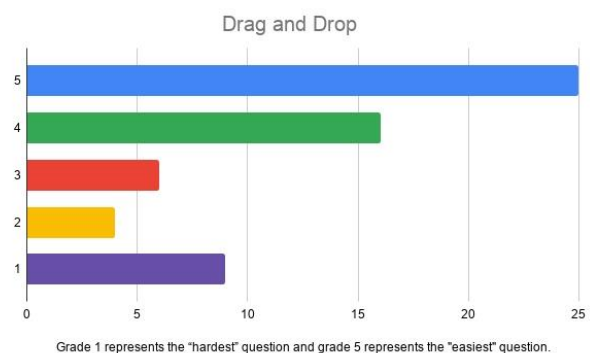
**Figure 7.** Students' feedback on the MCQ2



**Figure 8.** Students' feedback on the True/False question



**Figure 9.** Students' feedback on the Numerical



**Figure 10.** Students' feedback on the Drag and drop

According to the data shown in Figures 6-10, it can be seen that the easiest type of question for students was in the form of True / False, and the most difficult question type to understand and provide answer was Numerical question

#### 4. CONCLUSION

First of all, the Moodle platform allows teachers to organize and manage the formed course in a good way. By using the tools available in Moodle to create teaching activities, the learning process becomes more engaging and increases students' interest in a particular area. Moodle also facilitates interaction between teachers and students, as well as between students themselves.

This paper presents an approach to forming a model for evaluating electrical engineering practices. The model is based on the formation of an appropriate bank of questions in which subcategories are defined with a sufficient number of questions to create a test. Some questions that faithfully represent practical work in electrical engineering are presented.

In order to improve the grading of practical teaching after the final test, the numerous interviews with students have been realized. Therefore, the related opinions about the objectivity and weight of practical teaching have been reported.

The experience gained using the presented model, as well as the ideas obtained through conversation with students and mutual dialogue of project team members of both institutions, enriched the created bank of questions and gave an idea for future joint work.

#### ACKNOWLEDGEMENTS

These results are part of a bilateral project financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia and Ministry of Science, Montenegro.

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