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Application of a remote experiment in elementary school teaching

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Abstract: *In an effort to track the rapid development of the technique and make their teaching more interesting and meet ever-increasing demands, technology and technology teachers need to be interconnected and in continuous cooperation with their faculties. This paper presents an example of cooperation and sharing knowledge and resources of faculties with students and teachers in elementary schools. The paper presents an experimental lesson held in a small village school, which participated in the competition "Digital Class" organized by the Ministry of Trade, Tourism and Telecommunications. Different methods and forms of teaching were applied at the same time, and at one time the students actively participated in the experiment at Faculty of Technical Sciences in Čačak.*

Keywords: *teaching; school; university; cooperation; resource sharing*

1. INTRODUCTION

No other scientific field is subject to such enormous changes as it is the field of technology. The problem that teachers have already encountered is how to harmonize the actual situation in this field with the curriculum framework and the contents of textbooks. Rapid changes can lead to a possibility that the textbook contents become outdated in relation to the features and performances of technical devices. For a long time it has been clear that teachers cannot rely solely on textbooks, but they must also enrich their teaching with more comprehensive materials using contemporary information communication technologies (ICTs). The access to remote laboratories and usage of remote resources have already come to life. Such opportunities exist in our education system as well, but they are long way from being exhausted. This paper presents a lesson in Technics and informatics realised using remote experiments within the teaching of problem solving skills in the elementary school "Petar Leković" in Požega.

2. LESSON DESCRIPTION

The unit "Construction and application of electromagnet" is taught in the 8th grade within the subject Technics and informatics, the topic "Electrical machines and devices".

The lesson was realized according to the model of teaching problem solving in the digital classroom, using:

- Moodle learning platform
- the Internet for finding the necessary information and for accessing remote resources
- an experimental set-up of Tesla's egg located in the hall of the Faculty of Technical Sciences in Čačak [1]
- Immediate participation of the Faculty professors

The objective of this lesson was to introduce the students into the concept and application of electromagnets by developing basic competences in science and technology, digital competences, entrepreneurship, etc.

2.1. Introductory part of the lesson

The lesson began by telling the students the first part of the anecdote about Columbus's Egg [2]. They were given eggs with the task of placing them in an upright position (in the same way that Columbus asked the Spanish nobles to do), (Figure 1). By setting up a problematic situation the attention of the students is activated and they are trying to solve the problem.

Figure 1. *Trial of the problem solving*

After a few minutes of unsuccessful attempts, the students were told how this story ended and that the term "Columbus's Egg" refers to an easily

solved problem, which is only apparently unsolvable.

A clip from the film "Nikola Tesla" [3] was shown in which it is explained how this great scientist managed to put a copper egg in an upright position by means of a rotating magnetic field and in that way, provided money for further research from American investors. The question for the students was: "Can we do something similar to this? To start the rotational magnetic field, set and hold the copper egg in an upright position? Before we try, we need to learn what the electromagnets are."

Through their accounts, the students accessed the prepared teaching materials on the Moodle platform [4] (Figure 2).

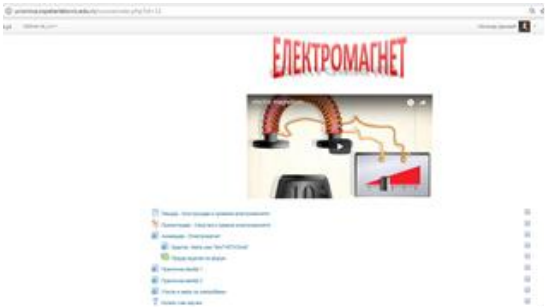

Figure 2. *Teaching materials on Moodle*

2.2. Main part of the lesson

In this part of the lesson, the students studied the prepared materials: the lesson "Construction and application of electromagnets", presentation and links to videos placed on the platform (Figure 3). The contents of this lesson are related to the contents that the students learn in physics. The links have also been set up for those students who want to learn more, so that teaching is modified in such a manner as to conform to the individual characteristics of students. In this way they learned how to learn, developing a positive and responsible attitude towards learning, independence and organization, knowledge improvement, research and use of different sources of knowledge.

Figure 3. *Studying the teaching materials on Moodle*

The students had a task to create their own mind map (Figure 4) in the mindmap tool [5]. Using the inexhaustible base of the Internet, they explored independently, found the necessary information, classifying, selecting and highlighting the most relevant parts. In this way, they developed the ability to use information and work with data from different sources.

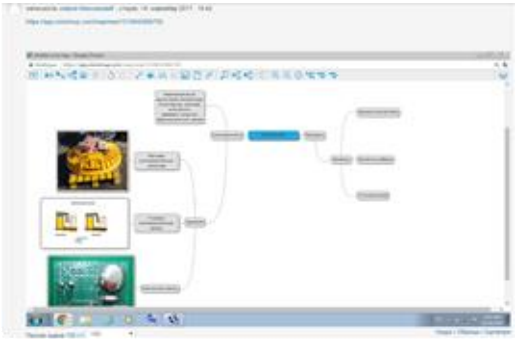

Figure 4. *Mind map*

The students also had a task to look at and evaluate other students' works based on the given criteria (Figure 5).

Figure 5. *Evaluation criteria*

In this way, students learn to evaluate quality of the work of others and to compare their own work with that of others.

The next part of the lesson was intended for group work (Figure 6). In groups, the students tried to make a model of an electromagnet by finding ideas on the Internet. By working in a group, students learn how to adhere to the rules of teamwork and how to distribute work and responsibilities. They also learn to be tolerant and to communicate with others. They tried to create a model that would be both functional and aesthetically pleasing.

Figure 6. *Model development in practice*

Students will be able to apply the knowledge obtained in this way in real environment.

2.3. Final part of the lesson

In the final part of the lesson, the teacher reminded the students of the question from the beginning of the lesson. They showed their electromagnet models and explained the way they operated. They concluded that they could not create the model of Tesla's egg, and therefore they were not able to start it.

The teacher accessed the Internet and opened a display of the hall at the Faculty of Technical Sciences in Čačak, where the experimental set up of Tesla's egg is located [6]. The students were directly addressed by prof. Miroslav Bjekić, who explained to them the principle of operation of the model and invited them to start the experiment by managing the remote model (Figure 7).

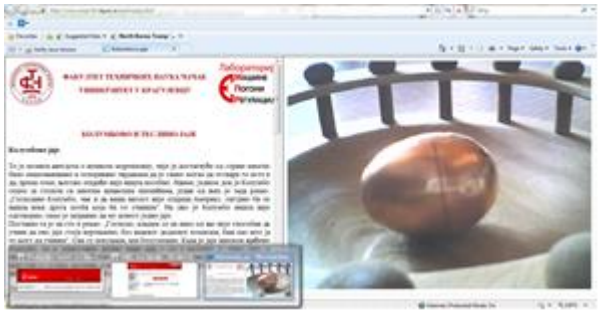

Figure 7. *Students start the experiment*

The students started the magnetic field within the experimental laboratory for electrical machines and drives at the Faculty of Technical Sciences in Čačak.

The students noted with enthusiasm that they managed to place the egg in an upright position. Each student could start the magnetic field, stop it, turn the direction of the magnetic forces, and therefore the direction of rotation of the egg. The video recording of the lesson can be found at [7].

In the final part of the lesson, the students were given a task to assess how satisfied they were with the amount of knowledge they had acquired, by highlighting one of the options offered in the "Choice" activity.

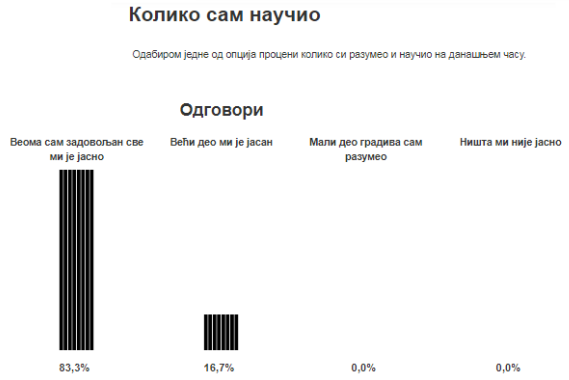

Figure 8. *Self-assessment of the amount of acquired knowledge*

83.33% of the students chose the option "I am very satisfied, I completely understand the lesson", while 16.74% of the students opted for "I mostly understand the lesson". Nobody marked the options "I understand the lesson to a lesser degree" or "I don't understand the lesson." The diagram clearly shows that the students understood the concept of electromagnet, how it is created and its operation and where it is used.

3. CONCLUSION

The lesson in question is based on a problem setting. The teacher presents the problem of the operation of Tesla's egg, a complex invention of the renown scientist Nikola Tesla. Students are faced with an apparently unsolvable problem, and the teacher guides them through the intricacies of the problem, suggesting possible solutions. In accordance with their abilities and past experiences, students use the Internet to find valuable information, classify it and select the most relevant data, building models based on theoretical knowledge. Finally, they figure out that, in accordance with their capabilities, they have made models that in a way represent an example of magnetic field, but that they are still incapable of solving the problem posed before them at the beginning of the lesson.

The availability of experiments of remote faculty labs was a great experience for the students, given low potentials of technical equipment in Primary schools.

The major objective of education is to prepare students for further education, work and production as well as for jobs that are yet to come. Today, more than ever, there are numerous ways to achieve this and make students participate and enjoy each part of the class.

REFERENCES

[1] Experimental set-up Tesla's egg, Laboratory for electrical machines and drives, Faculty of Technical Sciences Čačak, available at: http://www.empr.ftn.kg.ac.rs/teslinojaje.html
[2] https://www.opsteobrazovanje.in.rs/zasto-se-kaze/kolumbovo-jaje/
[3] https://www.youtube.com/watch?v=7zOo0YaurNQ (20 - 23 minute)
[4] http://ucionica.ospetarlekovic.edu.rs/course/view.php?id=13&notifyeditingon=1
[5] https://www.mindmup.com/#storage
[6] http://www.empr.ftn.kg.ac.rs/teslinojaje.html
[7] https://www.youtube.com/watch?v=DZ4LSJmhamQ&feature=youtu.be