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Case Study Albania**

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**Real and Virtual Physics Laboratories in High Schools,
Case Study Albania**

ABSTRACT

Laboratories play a very important role in the teaching modalities, in middle and high schools. In physics, they seem to be even more important, because they help students to better understand what happens, how nature works. In the physics curricula of the high schools in Albania, laboratories are part of the lessons and using them, teachers derive to what they want to teach and explain to the students. But, the question is: It really works like this? How are laboratories implemented in the teaching modality? Real or virtual experiments are used most? What's their impact on student performance? In this work, we present some results taken in the high schools of some principal cities in Albania, regarding the laboratories infrastructure, the use of real and virtual laboratories and the role of them in learning and understanding physics. We have performed a survey, in 10 different cities, in 40 high schools and then analyze the results. The main idea is to expand this attempt in more high schools and then make a proposal for the Ministry of Education, Sports and Youth for reforms in the actual curricula.

Keywords: *Physics laboratories, high school, Albania, virtual, STEM*

Introduction

In the last years, the curricula of middle and high schools in Albania, has changed continuously. The Ministry of Education, Sports and Youth has adapted the British curricula and textbooks in most of the subjects and levels of education (<https://arsimi.gov.al/>), an initiative that had a lot of discussions and objections. Nowadays, the textbooks are chosen by the ministry and translated in Albanian. In most of the important subjects learned in high school, is used the same textbook, a translated version of the British original textbook. This curricula and textbooks aim to develop the competences of the students, putting them in center of the learning process. Also, in most of the STEM subjects, laboratories are considered to be an important tool, because teachers have to guide students to derive conclusions and then explain the topic of the lesson, after performing some experiments in the lab. Laboratories are part of the lessons in the used textbooks and using them, teachers derive to what they want to teach and explain to the students.

In different workshops, conferences and meetings with middle and high school physics teachers organized by the Department of Physics and the National Institute of Physics (https://ikf-akad.al), we have faced with a lot of problems. Teachers have to give additional materials to the students and explain only the theory, because most of the schools don't have the proper laboratories infrastructure. In the absence of the laboratories, some of them use virtual laboratories to help students understand. Regarding the use of virtual laboratories we have performed a survey in high schools and published the results in an our previous work (Osmanaj et al, 2021).

Taking in consideration the discussions and debates between teachers, we decided to perform a survey and then analyze the results in the high schools of some principal cities in Albania, regarding the laboratories infrastructure, the use of real and virtual laboratories and the role of them in learning and understanding physics. We have performed a survey, in 10 different cities, in 40 high schools and then analyze the results. The main idea is to expand this attempt in more high schools and then make a proposal for the Ministry of Education, Sports and Youth for reforms in the actual curricula.

Literature Review

Nowadays seems to be very hard teaching science, especially natural sciences, without practical activities in the laboratory. The role and importance of the laboratory in teaching and learning natural sciences has been studied by many authors. (Bates, 1978; Çakiroglu, 2006; Sokołowska & Michelini, 2018). According to them, and not only, laboratories are an important tool for teaching natural sciences as understanding levels are improved when students are involved in learning in science labs in practical experiments.

According to the American Association of Physics Teacher (www.aapt.org; Tobin, 1990) physics laboratories should be projected in order to develop ability and self confidence in:

- Measurement of physical quantities with the proper accuracy
- Understanding the factors which can affect the reliability of the measures.
- Understanding how appliances work
- Clear description of measurements and observations
- Presentation of the taken information with exact terms, graphics and corresponding math
- Understanding the phenomenology and give conclusions
- Writing labs report in the correct manner
- Collaboration between students and teacher

Also, Sharpe & Abrahams (2019) state that conducting experiments is important in the learning of science subjects and motivates students to study science. Laboratory training is also frequently used to develop skills necessary for more advanced study or research. Therefore, the laboratory plays an essential role in the teaching process. In the absence of laboratories, a lot of teacher use virtual laboratories and numerical simulations in order to explain the topics of the lessons and help students understand better. (Perkins (2006); Paudel (2021); Osmanaj et al (2021))

The most of them conclude them virtual laboratories and numerical simulations can't replace the labs, but only can support and expand what laboratories learn.

Methodology

This survey based research was motivated by the meetings of physics teachers in different workshops/conferences, and the level of physics knowledge of high students, who come in universities. The new curricula and textbooks used in middle and high schools have created a lot of discussions. Educational experts, teachers, university professors wonder if this British copy curricula is the most appropriate in the context of Albania laboratories infrastructure and background. The main idea was to see how laboratories are implemented in the teaching modality, real or virtual experiments are used most and what's their impact to the student performance. Also we wanted to see if the new curricula and the translated book (*12 grade: Original: Sang D., Jones G., Chadha G. and Woodside R., Cambridge International AS and A level Physics Coursebook, second edition, 2014*) with 19/24 chapters with practical activities, is suitable for being used with the current laboratories infrastructure.

The research samples taken are teachers of natural sciences and students in high schools. The study was conducted in 10 different cities in Albania, at 40 high schools, with 35 teachers and 4800 students of the 12th grade. A survey was performed to evaluate the current situation of the natural sciences laboratory and teaching activities of natural sciences in the laboratory in high schools.

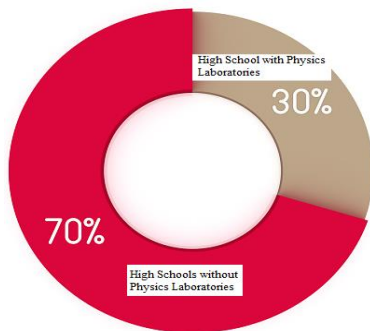
We prepared an online survey in Google forms for the teachers, shared in LinkedIn, in a public group on Facebook, "The platform "Mesuesi i fizikes online"(Online Physics teachers)", and directly to schools. The teachers shared the students' survey in all the 12th grade classes.

We collected data from March 2023 to June 2023 and then analyzed the results. The collected data were analyzed, discussed qualitatively and quantitatively, as indicated in the charts and reports.

Results

The results of our survey were analyzed and the most important parts of these results are presented in the figures below.

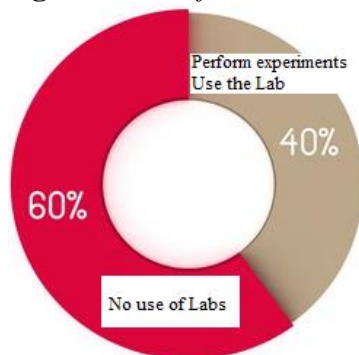
Figure 1. *Laboratories infrastructure in Albania. From 40 Schools Part of the Survey, only 30% of them have Physics Laboratories*



As can be seen by figure 1, 70% of the 40 schools taken as sample in 10 cities in Albania, don't have physics laboratories. The next question was if these 30% of schools with the proper laboratories infrastructure, use laboratories during the lessons and perform experiments?

The results taken were surprising..ascan be seen in figure 2. Only 40% of these high schools use the physics laboratory and perform some experiments. 60% of them don't use labs, even just for demostring simple experiments. This happened, because teachers don't have enough time to explain the lessons and perform experiments, because the topics to be explained are a lot. Let's remember that the physics textbook used in the 12th grade and the topics there, are explained in two years in the United Kingdom.

Figure 2. *Use of Laboratories in High Schools*



While in the schools that don't have physics laboratories, we asked if teachers use virtual laboratories, and what kind of virtual labs. From the 70% of the 40 high schools that didn't have laboratories, only 37% of them use virtual labs during the lessons (Figure 3) and 85% of them used PheT Simulations (Figure 4)

Figure 3. *Use of Virtual Laboratories in the Schools that don't have Physics Laboratories*

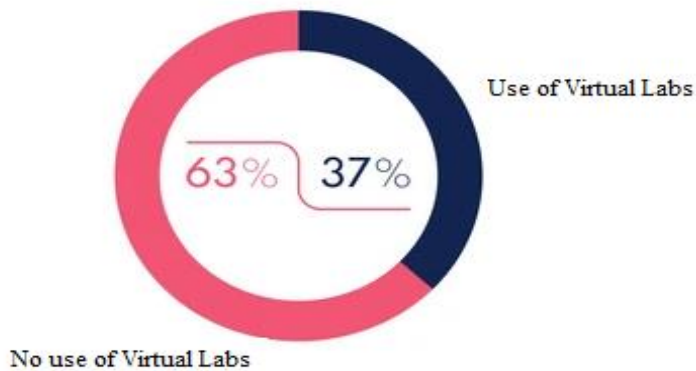
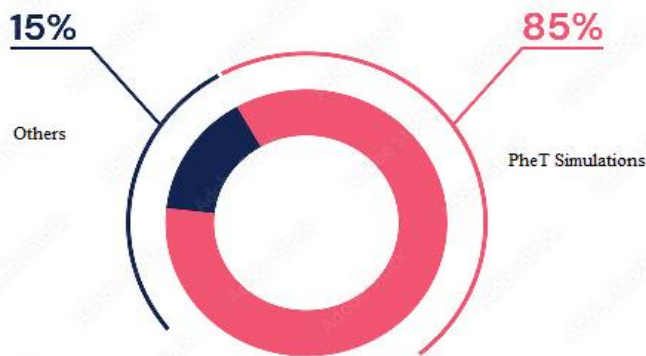


Figure 4. *Types of Virtual Labs used*



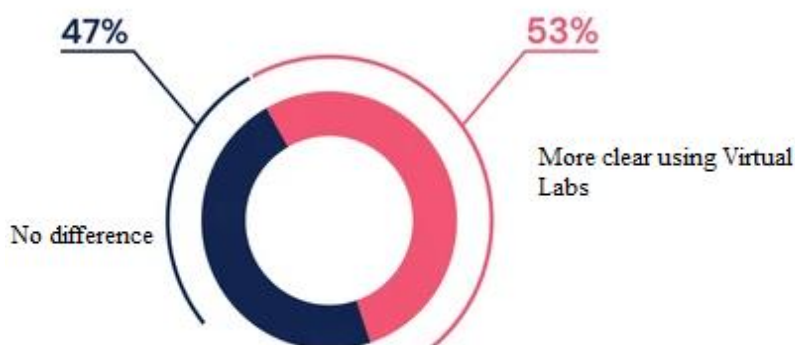
The use of PheT simulations in high schools in Albania has been published in another previous work of us (Osmanaj, 2021) but in a different point of view.

During this survey, we also asked about the level of understanding of the subject and student performance when laboratories (real or virtual) are used and when not. The results taken are presented in the graphics in figure 5 and 6.

Figure 5. *Understanding/Student Performance. 12 School with Physics Laboratories in Different Cities/ 1700 Students of the 12th Grade*



Figure 6. *Understanding/Student Performance 15 School using Virtual Laboratories in Different Cities/ 1850 Students of the 12th Grade*



As can be seen by the results presented in figure 5, the student performance and level of understanding is much more better when experiments and labs are used during the lessons. 80% of the students studying in high schools with the proper laboratories infrastructure, had a better understanding of the topics when labs are used.

While in the high schools which don't have laboratories, but teachers use virtual labs, 47% of the students said there was no difference if virtual labs were used or not.

Let's remember that the main idea of the work is to expand this attempt in more high schools and after taking and analyzing the results, make a proposal for the Ministry of Education, Sports and Youth for reforms in the actual curricula.

Conclusions

From this survey based research, some of the conclusions would be as follow: Real Laboratories are very important and play a key role in the actual curricula and with the actual textbooks used in the high schools. Unfortunately, more than 70% of the high school in Albania don't have physics laboratories with modern and suitable appliances for experiments. Even those schools that have labs, use them not to often. The virtual laboratories are just a support for teachers, but they don't substitute real labs. Most of them, just realize the theoretical part, without considering other elements, which make students think and analyze. With the actual textbooks and curricula, the teachers have to add materials for the students, in order to achieve a better performance, if they don't have labs. (Fact that makes unusable the textbooks) The performance of the students increase when laboratories are used and the books would be suitable for that level. The Ministry of Education should perform reforms: Improve the laboratories infrastructure in all cities, or change the actual textbooks

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