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The problem solving method and the research needed to transmit the new sets of knowledge in physics

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If the basic principle defining that "Science gets valued from organized knowledge" is properly respected, then the levels of a whole set of student work outcomes like motivation, interest, differentiated work and effectiveness regarding physics classwork, will increase significantly. From this point of view the results achieved by each student, cultivated during the learning process, will arise to a whole new degree. Cultivating the will to study natural sciences, especially physics, means organizing class work throughout independent student work, stimulating a sense of discovery for each student, not an inventorial one. The traditional type of lectures transmits only basic knowledge, without evaluating the real life situations. Also, it doesn't take into consideration a full scale analysis of the elements presented by a specific model, as well as extracting the needed equations for calculating the quantitative aspect of physical phenomena and their place in the laws of physics. Averaging doesn't count when evidencing knowledge. The use of interactive methods is supported by presenting a problematic or experimental case and its solution. The teacher, as a moderator, and the student, as an explorer, interact to discover the analysis of a specific problem, along with its ways of solving. This also includes hypothesis formulation, raising arguments and verifying them. Finally, a balanced report is created between the work of the student and that of a teacher. This report helps the student transform, from a simple listener, to an analyzer and determinant of the correct knowledge. The texts used in this branch of science should allow the use of such teaching methods. Such a method shapes consistent and connected knowledge to students by preparing the underlying foundation on which to develop in-depth studies in areas where physics has a priority role.

Keywords: Motivation, Differentiated work, Independent work, Problematic situation, Research, Knowledge.

INTRODUCTION

Around us there is a reality that exists regardless of us. Physics is a human effort whose ideas were discovered and developed by people really engaged in a battle of real life issues.

The case that needs to be studied is determined by observing natural phenomena, through senses or instruments, followed by curiosity and re-examining the underlying observations. A simple description allows us to build models through which the nature laws, conditions and boundaries of their application are discovered and experimentally verified to the configuration of a sophisticated yet elegant reality model.

Under these conditions, building up hypotheses and certifying them allows us to build an independent theory that summarizes many observations in the general laws of physics. No method, no matter how perfect it is, can produce a qualitative result if the content of the material studied in the subject of physics is not treated organically and with all the necessary elements as it has been developed.

But what is really happening today with the teaching material that the students of the general secondary schools in Albania have to prepare?

Does this material meet the need for qualitative and sustainable learning of students after finishing high school? Does this material meet in the 3-year high school cycle, a continuation for the in-depth study of applied physics and theoretical knowledge in further undergraduate studies?

For our modest opinion, but based on a real analysis, we can painfully affirm that this teaching material provided by the governing bodies of Education in Albania leaves much to be desired. From 2009 until today, it has been operated with an old text that was implemented for the first time in the 2009-2010 academic year and continues to be in use today and onwards. This teaching material in physics in general secondary schools is more characterized by demand-supply market trends rather than by the content and the quality necessary for treating knowledge in physics. With the revision of the very large range and very low scientific quality of the articles in the market, in 2013-2014 only three texts were presented in English, with a non-appropriate language standard, for the content, quality and need of Learners to gain steady learning, to form habits and skills, to apply the

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learning knowledge in experimental practice, or applications in everyday life in the subject of physics. One of them is the text "Fizika 10-11, Prof. Dr. Zenun Mulaj, Dr. Bledar Myrtaj, "Erik" printing company, based on the original title: Complete Physics for IGCSE Student Book, Stephen Pople, 2014 (Part: 1,2).

In a general comparison we conclude that the quality of scientific, methodological and content treatment is lacking, evaluated in the possibility of scientific formation of a student at secondary school. The teaching material is not completely clear, to allow the preparation of a methodical structure planned to increase the effectiveness of the treatment of scientific knowledge in the classroom. The facts, concepts, rules, laws, theories, formulas, basic physical principles, to be elaborated to develop skills and concrete skills acquired by students are lacking. There is no logical connection between new and previous knowledge. In the working conditions with all students, a differentiated lesson cannot be organized.

There is no possibility of preparing a physics teacher to build a scientific and methodical teaching lesson whereby the logical connection of experimental facts, laws, principles and applications is realized that would enable the analysis of a problematic situation where the focus is action, conversation, differentiated work, accurate and correct presentation on the white board of all stages of the learning process.

Just read the note at the bottom of the entry that says:

When you are using this book, keep a look out for these marks:

A line down the side of the text means that the material is only required for Extended level. For simplicity, lines like this have *not* been put next for related diagrams or panels in the margin [1].

Our assessment is based on:

1. The syllabus and textbooks that have been developed in the subject of general physics in high school until 2006, [2-5] which:

Increase interest and motivate students;

Increase the effectiveness of each teaching lesson in physics in function of the purpose and objective of teaching;

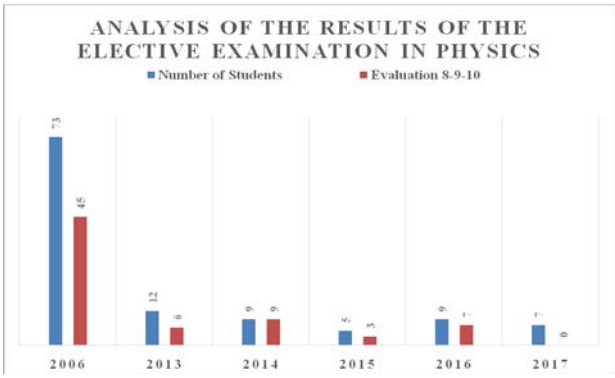
Enable the implementation of differentiated work in addressing new knowledge and solving problematic situations with implementing character;

Provide an hour to encourage, satisfy, focus and evaluate the achievements of each student during the learning process;

Provide a satisfactory and qualitative assessment of students based on the merit-preference principle.

2. In the analysis of the results of the elective examination in physics, at the end of the senior year [6].

The data to analyze the results of the students in the subject of physics, at the end of the high school, on the State Matura exam, were taken referring to the first year of this procedure and the last three years. This choice is based on the fact that the teaching structure has undergone the changes listed below:



✓ For the academic year 2005-2006, the examination procedure was changed in the subject of physics without changing the curriculum. (*From 1988-1989 until 2004-2005 academic year, the appraisal of the graduates was done in written and oral examination in front of a school-based commission*).

✓ From the academic year 2007-2009, the assessment was done by the State Matura Exam but with the change of the teaching structure by dividing the students into classes directed towards social sciences and classes directed towards natural sciences.

✓ From 2009 to 2013, there was a curriculum for physics but many alternative texts with different content.

✓ From 2013 until now there are only three alternative texts, of which two are often chosen to be studied.

✓ Year after year, fewer students are choosing to pass the state exam in physics. This is due to fears of poor preparation in this subject, conditional preparation from the inappropriate text and the low amount of teaching hours dictated by the curriculum for this subject.

3. In the experience of teaching and learning by the authors of the preparation of this paper.

In the curriculum in accordance with the specific teaching material being considered, the presentation of the problematic situation, the discovery of contradiction, the formulation of the hypothesis, the determination of the ways of solution and the solution and control of the results, can be done by the teacher with a minimal activation of the students, creating an almost equal ratio between the work of the teacher and the work of the students or by the students themselves.

In modern didactics, a learning model is understood as a certain mode of action, which attempts to put the learner in a study situation, more or less as a recipe of accurate and scientific knowledge, observing all the steps of scientific research, up to finalizing implementation in practice. Physics should be treated as a science where the student gets full, intelligent, logical and attractive knowledge.

Without pretending that we will define the key points regarding the application of teaching and learning methods in the subject of physics, we would first point out the undisputed role of those methods that rely on:

a. Processing of material and technique of drafting and conducting questions;
b. Teaching Discussion;
c. Exploration Teaching, etc.

Naturally the question arises: Do these methods apply to all component elements, independent of each other, or combine their particular elements to run and organize a more effective and quality learning lesson?

To answer, we will try to analyze the lessons developed or prepared in practical form and elements of the methods described above:

Topic: The Uniform Circular Motion, Centripetal Acceleration [7]

1. After creating a working situation that has crowned the discussion of the concepts discussed in the previous topic and the application of knowledge gained in it, the teacher presents a very significant motive before the audience:

You know how to calculate (measure experimentally) the rate of free fall of a body on the Earth's surface. Can we determine the acceleration of the moon movement around the Earth?

2. After this, a problematic situation is created, coupled with the procedures to be pursued by the student.

We need to determine the acceleration value $|\vec{a}|$ of a material point that performs uniform circular motion.

For this you build a radius of *r*. Determine the location of a material point moving by the circular trajectory at t_0= 0 at point A and point B at time t, recognizing that the time interval of the body's location during the arc development of the (AB) circle is infinitely small. By accepting the movement of the material point as a uniform circular motion, construct the vectors $\vec{v}_1$ and $\vec{v}_2$, respectively points A and B.

3. The student works independently by being checked by the teacher and at the same time the teacher reflects this situation in the table.

a) What do you think about acceleration?

b) What should we determine to find the numerical value of acceleration?

4. After receiving the answers and escalating the questions, for the student asked by the teacher, a new situation is created.

5. Determine the difference $\vec{v}_2 - \vec{v}_1$, present the vector $\vec{v}_2 - \vec{v}_1$ and its module. To find the module compare the triangles ΔOAB, ΔBCD (in the figure). What is the result achieved?

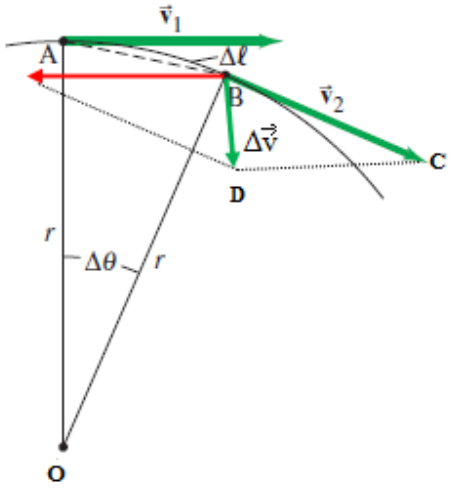


Fig. 1

6. After receiving and analyzing the result, the teacher compiles the questions:

7. Acceleration as physical size, how is it characterized?

8. What should we determine after getting the numeric value?

The situation flows freely without strain, with the student's activation led by the teacher with patience and creating situations.

9. Based on the figure, compare the angles formed by $\left(\Delta\vec{v}\ \hat{}\ \vec{r}\right)$ and the central angle. What will happen if $\Delta t <<<$? Where will B go? What

about the central angle? What about its half? What about $\Delta\vec{v}$ -s direction?

After a long-term discussion and timing of what is required, the conclusion is drawn and formulated.

10. A new situation is followed by the teacher.

Present the vectors $\vec{v}_1$ and $\vec{v}_2$ for a rectilinear motion and then build $\Delta\vec{v}$. What can be said about the direction of the $\Delta\vec{v}$ during full motion. Can you derive a classification criterion for motion based on $\Delta\vec{v}$? A very valuable discussion is being started.

11. Then we build the vector $\vec{a}_{qs}$ for curved movements, as well as the solution to the example, so the motivation for this class and its respective objectives find a good answer.

Naturally, the answer is: In this class, all the elements of the methods described below are distinguished:

- Encouraging the curiosity and thinking of the student.
- Build a clear, comprehensible situation with cognitive and implementing elements. (Exploration Teaching); (2-5, 6)
- Rotate around the classroom, observe independent work, communicate individually, make sure students focus on their tasks, and check their work independently with relevant notes (Exploration Teaching).
- "If you want a smart answer, ask the right question."

✓ The response mode should be specified (not in the chorus). Use question, pause, call technique, and allow students time to respond, escalate the question according to the level of knowledge and according to the students.

✓ Do not judge the answer given by the student (do not give the correct answer to your question).

✓ Ask for a summary of the conclusions reached to help the active hearing:

- Please, can you generalize X's response?
- Freely seek the student's opinion.
- Allow and stimulate students to ask themselves questions (Processing of material and technique of drafting and conducting questions).

- Stimulating creative situations, raising interest, creating student leadership situations, student learning to protect the conclusion or discuss it, student learning to evaluate others' responses (Teaching Discussion).
- The teacher intervenes:

- when the next question is needed according to the specific situation and the purpose sought;
- when generalization is needed; when certain thoughts need to be interpreted without the judgment and discontinuation of students who are unable to give the right answer (Teaching Discussion);

- Designing and conducting challenging questions and situations (not "yes", "no" but "why" and "how many") (Processing of material and technique of drafting and conducting questions, Teaching Discussion).

In conclusion:

✓ The deeply scientific content organically associated with all the steps of scientific formation of students from the texts used in this branch of science;

✓ Uniformity and distribution of load and degree of difficulty without creating burdens on teaching and learning;

The structure of scientific material treated in Physics 1, 2, 3, 4 [2-5] which was used in four courses of "Raqi Qirinxhi" high school during 2002-2006, is matched with the most successful models such as: Frish, General Physics, Vol.1-2-3, I. V. Savelyev: A general Course Mechanics Molecular Physics I, Electricity and Magnetism Waves Optics II, Quantum Optics, Atomic Physics, Solid State Physics, Physics of the Atomic Nucleus and Elementary Particles, III, Mir Publishers Moscow.

This structure allowed the creation of sustainable knowledge of the students and this is evident in the results shown in Table 1.

Table 1. The number of students who have chosen, the State Matura exam, the science of physics from the two compulsory elective exams.

Student Book	School year	No. of Students.	General Physics	Core Physics	Class C Total students.	Evaluation 8-9-10
F1-F2-F3-F4	2006	73	73	0	17	45
F1-F2-F3-F4	2013	12	0	12	0	6
3 - Student Book (Translating)	2014	9	0	9	0	9
3-Student Book (Translating)	2015	5	0	5	0	3
3-Student Book (Translating)	2016	9	0	9	0	7
The Complete Physics for Cambridge IGCSE Student Book	2017	7	0	7	-	-

This results show that out of 73 students who opted for the exam physics that year, 17 are top grade students (converted to grade) nationwide. Yes, with the same dedication, a considerable part of them continue their studies at the best Universities in Europe such as the University of Rome-La Sapienza, Russia and so on.

What happens in the coming years? The results show a drastic drop in students choosing to give physics as an exam and a drastic drop in their structured knowledge also.

CONCLUSIONS

Physics is not about "facts", not that the facts are irrelevant, but physics is more focused on discovering relationships and models than teaching the facts for their own sake.

Physics allows teacher independence in choosing the method that would unify:

- Postponing a problematic situation, clearly defining the objectives to be addressed in the lesson;
- The way of solving this situation in the contradiction between the knowledgeable and the unknown, which necessarily requires a combination of the student's independent work and the one led by the teacher;
- The way of discussion and conclusion, by stimulating the speech and the argument that the student gives;
- The practical application of physical knowledge in certain situations in solving the problems posed by the respective calculations and the interpretation of quantitative values found;
- Physical reasoning of the data (conditions) and results obtained (conclusions).

Creating a unique system in controlling students' knowledge, skills and habits as an important and necessary element of the physical teaching process.

Training to solve any task in physics, whether theoretical or practical, as a miniaturized scientific research process, a modest creative act, cultivating thinking and reasoning.

The ability to interpret knowledge in physics comes from practice, repetition, and effort until we "master" them, apply them in new situations. Often during the physics study the student will be confused, surprised to experience difficulties, but when success is achieved, excitement will be revealed with the joy of discovery.

Physics, as a technical body of knowledge, is important to many professions, but also physics is an exciting adventure of the human mind [8].

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