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SCIENTIFIC ACHIEVEMENTS IN ENVIROMENTAL AND LIFE SCIENCE

LEARNING AND TEACHING SUPPORT MATERIALS IN PROFESSIONAL DIRECTION OF PHYSICS COURSE FOR STUDENTS OF AGRARIAN AND TECHNICAL UNIVERSITIES

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SUMMARY

Advanced professional training for engineering staff and strategies for its effectiveness is an up-to-date issue in terms of labour market formation in Ukraine for both private and public sectors of agrarian production. A high level of engineering competences will stimulate guarantees and factors of future specialist social protection. Quality of professional trainings, confidence between the subjects of education process, strengthening their competitiveness both at Ukrainian and foreign markets are the basic tasks of agrarian and technical universities. The national strategy is specified in the law of Ukraine «On Higher Education», in the National Doctrine of Education Development in Ukraine, in the regulation on the Organization of the Educational Process in Higher Educational Institutions. It provides a personal orientation in educational process, improving its quality and updating the content. Moreover, the national strategy focuses on the need for creating up-to-date interactive educational and methodological guidelines that meet the actual demands of high education.

The organization of educational process in physics at agrarian and technical universities is primarily based on fundamental approaches. But physical knowledge skills in mastering agricultural and mechanical techniques are not fully implemented in technical institutions [1]. The student knowledge in physics should be the basis for studying the disciplines of

professional and practical training, as well as for exploring up-to-date agricultural machinery and technologies of the new generation, which have the peculiarity to be changed every 10 years. That is why the physics course for future agrarian specialists should contribute to the formation of student points of view in modern physical picture of the world, trends in science and technology. Such approaches stimulate the physical education in agrarian and technical universities to become the integral system based on multidiscipline connections. So teaching physics should be based not only on consideration of fundamental principles, but also the specific physical processes and phenomena, which will influence the professional activities of future expert of agrarian and technical industry.

As a result, the majority of the students don't realize the goal of studying physics. While studying they get the basic knowledge in physics without any connection to future professional activities. At the same time professional orientation of the course will help the students to adapt to a new workplace. Professional orientation of teaching physics changes the attitude of students to the theoretical training, helps them to find this deep interdependence of theoretical training and future professional activities [2]. A number of study guides, course books, guidance paper, and methodological recommendations were introduced to support the educational process of teaching physics in high school. However, the educational and methodological materials for agrarian and technical universities are almost absent. To provide the educational process teachers use course books, which are designed for higher technical, pedagogical and educational institutions and their content is based primarily on studying last century engineering and technologies. So there is unbalance between the development of agricultural machinery, agricultural technologies and learning and teaching support materials that meets the educational paradigm, which is characterized by fundamental character, professionalism, integrity, focusing on individual interests. This misbalance shows the existence of scientific problems to be solved. It requires the refining on the methods of studying physics with the help of realization of professional orientation principle in teaching physics for students of agrarian and technical universities and implementation of appropriate educational and methodical materials.

Among the great variety of higher educational institutions of industrial orientation agrarian and technical universities take the leading position in Ukraine, because they are responsible for educating future experts in economic sphere of Ukraine. The improvement and development of physical education takes one of the leading positions in the mainstream of advanced tasks of modern education. No doubt, training course in physics is the foundation of professional preparation of each technical employee of higher qualification. It’s not a secret that a graduate of agrarian and technical university deals with agricultural objects and processes,

which are based on physical laws [3]. Modernization of agroindustrial production, mechanization and automation, implementation of modern technologies require physics experts who can apply their knowledge practically.

The analysis of branch education standards and qualifying characteristics for the agrarian engineering and agronomy specialties allowed us to make the conclusion that future expert should have fundamental knowledge in natural science disciplines and in physics, in particular and to apply these skills in their professional activities. The issue of relation between fundamental and professional knowledge of physics is an up-to-date problem. High standards of university education contradict the existing practice of teaching physics in agricultural and technological universities and require the implementation of new educational and methodological support. Our research on this issue has shown that the course of physics in agricultural and technological universities is characterized by fragmentarity: the general methodology in content selection of educational material and its structure is absent. The content of high school course in physics doesn't differ from the content of course in physics for other universities. Such approach leads to insufficient student ideas about modern physical picture of the world and its relationship with the technical picture of the world.

The analysis of theoretical and practical aspects of teaching physics to students of agrarian and technical educational institutions allows us to confirm that:

- The course of physics for high agrarian and technical universities turned from fundamental into comprehensive subject;
- Agrarian and technical university students don't realize the purpose of the studying physics as the background of future professional activities;
- Future professionals don't operate the skills of transforming the basic knowledge of physics to discipline cycle of professional and practical training and to operate such skills in making different projects and thesis.
- Ukrainian universities don't have special educational programs, textbooks in physics for students of higher agrarian and technical schools confirmed by Ministry of Education and Science of Ukraine.

The educational process in agrarian and technical universities is a complex system that includes many components (fig. 1). In particular, the methodical training system of physics hierarchically belongs to the common system of professional agrarian and engineering training and must stimulate both basic knowledge of physics and the system of professional skills.

European credit transfer system of education process organization adapted by Ukrainian university leads to increasing the role of student self-study and, consequently, decreasing the

total amount of practical classes. That is why the learning process requires modernization that would meet the requirements of the present day. It is possible only with the help of introducing the educational and methodical support into practice. Up-to-date learning and teaching support materials will play an active part in mastering the social experience as a certain integrity, in the formation of students ' readiness for professional activities and in interaction between teachers and students.

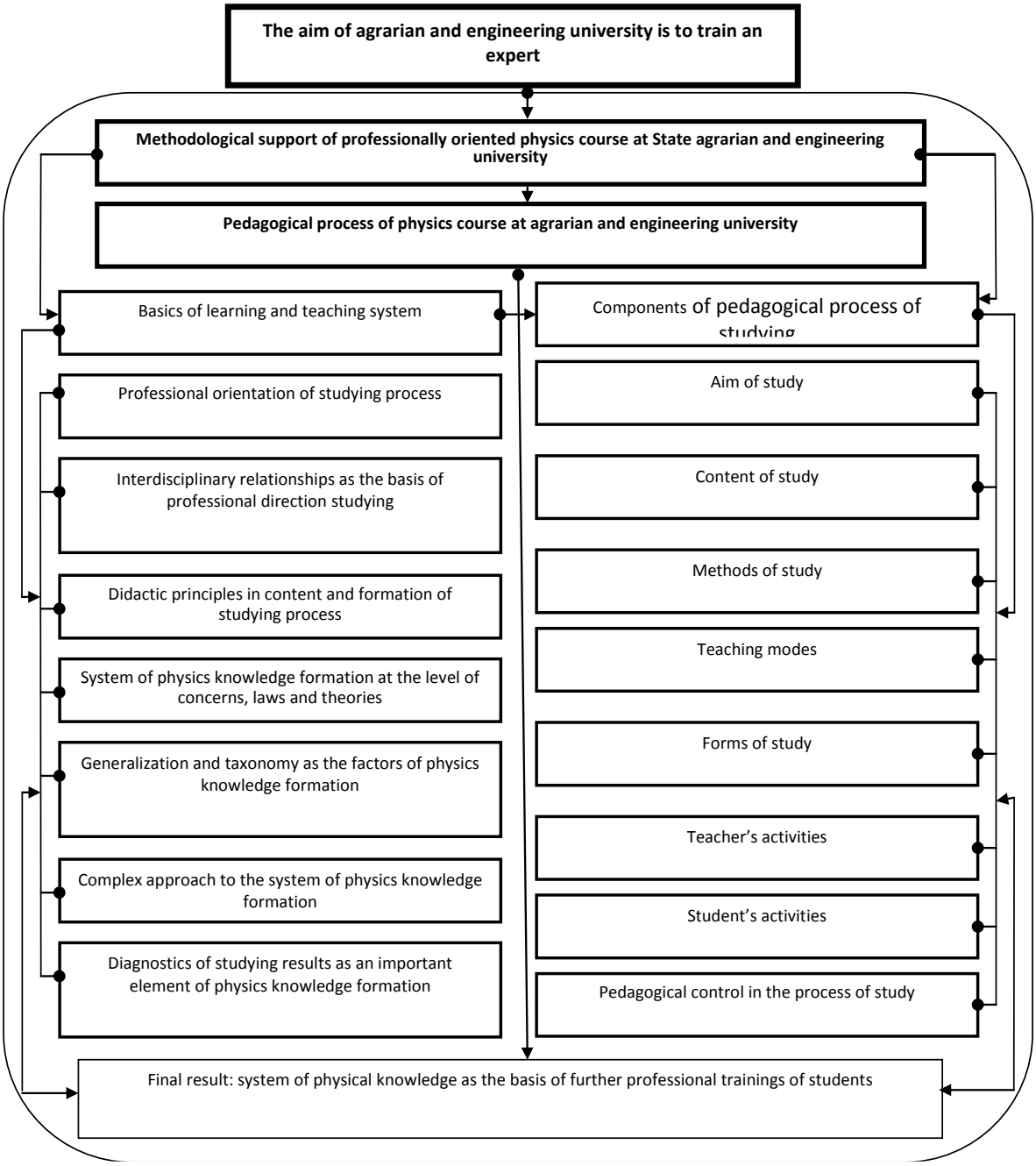

Fig. 1. THE MODEL OF METHODICAL LEARNING SYSTEM OF PHYSICS FOR STUDENTS OF AGRARIAN AND TECHNICAL UNIVERSITIES

We concern this issue with strategies for creating the educational and methodical materials that would provide the implementation of the projected methodical system integrity

that reflects the unity of the main elements, such as educational goals, content, didactic process and forms of training (fig. 2).

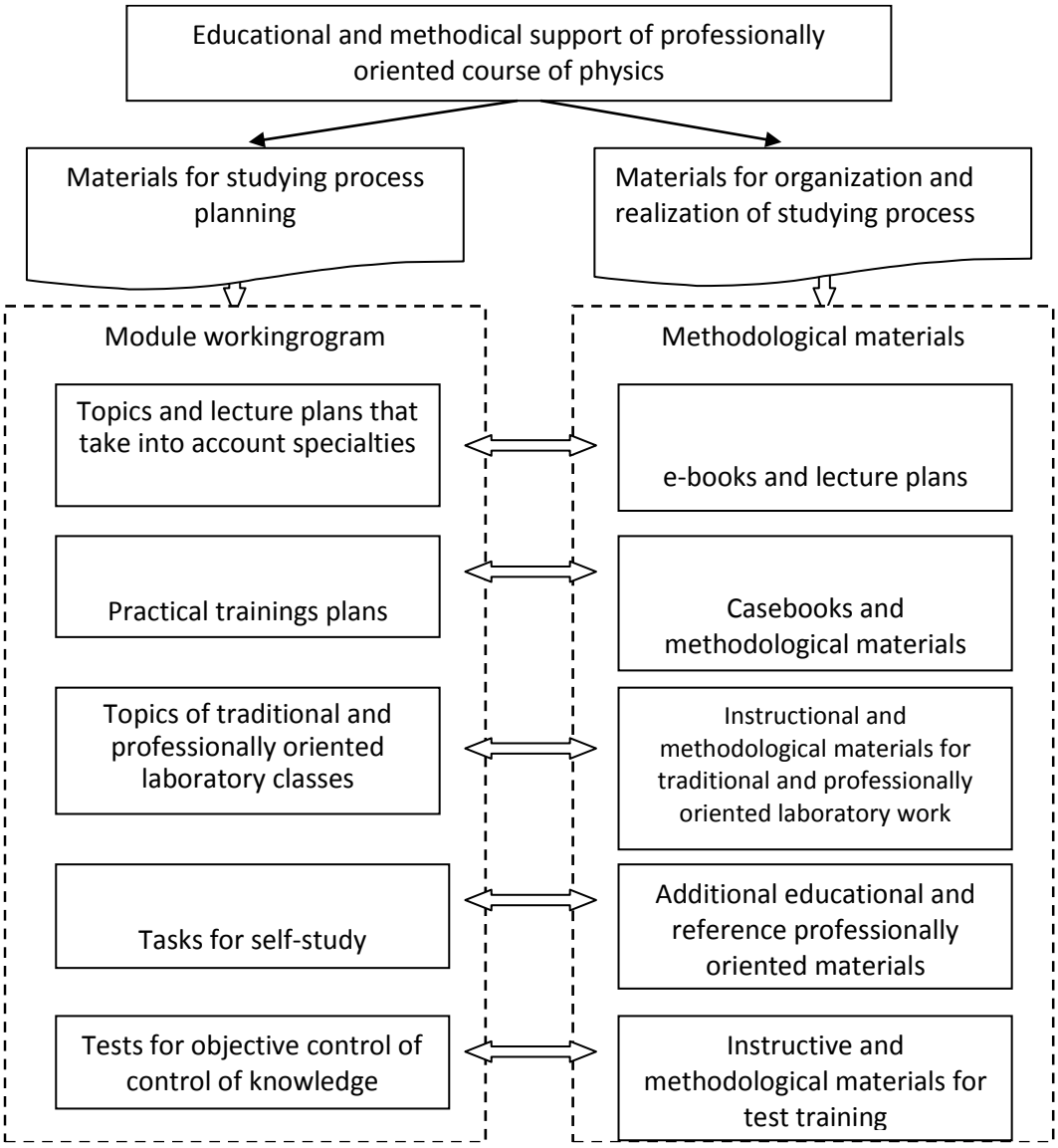

Fig. 2. THE STRUCTURE OF EDUCATIONAL AND METHODOLOGICAL COURSE OF PHYSICS

The content of the physics course should be the fundamental basis of successful professional activities of agrarian engineer. The analysis of inter disciplined relations of physics and professional disciplines helped to determine the content of applied issues of the course. Implementation of interdisciplinary relations contributed to the orderliness, systematic knowledge, its generalization, focusing on a specific profession. Interdisciplinary links in studying are based on identifying and preparing the means of their implementation; preparing students to awareness of the structure of relationship between fundamental natural science

disciplines of the curriculum and the disciplines of professional and practical training; using different methods of realization the interdisciplinary connection in studying physics [4].

We should admit that interdisciplinary links perform the professional function in agricultural and technical universities. Integrated knowledge based on interdisciplinary links is the foundation of professional thinking development, the ability to model real situations that are associated with the performance of professional tasks. Interdisciplinary knowledge is the basis of creative and independent student activities. The logical structure of links between the course in physics and the disciplines of the curriculum is shown in Fig. 3.

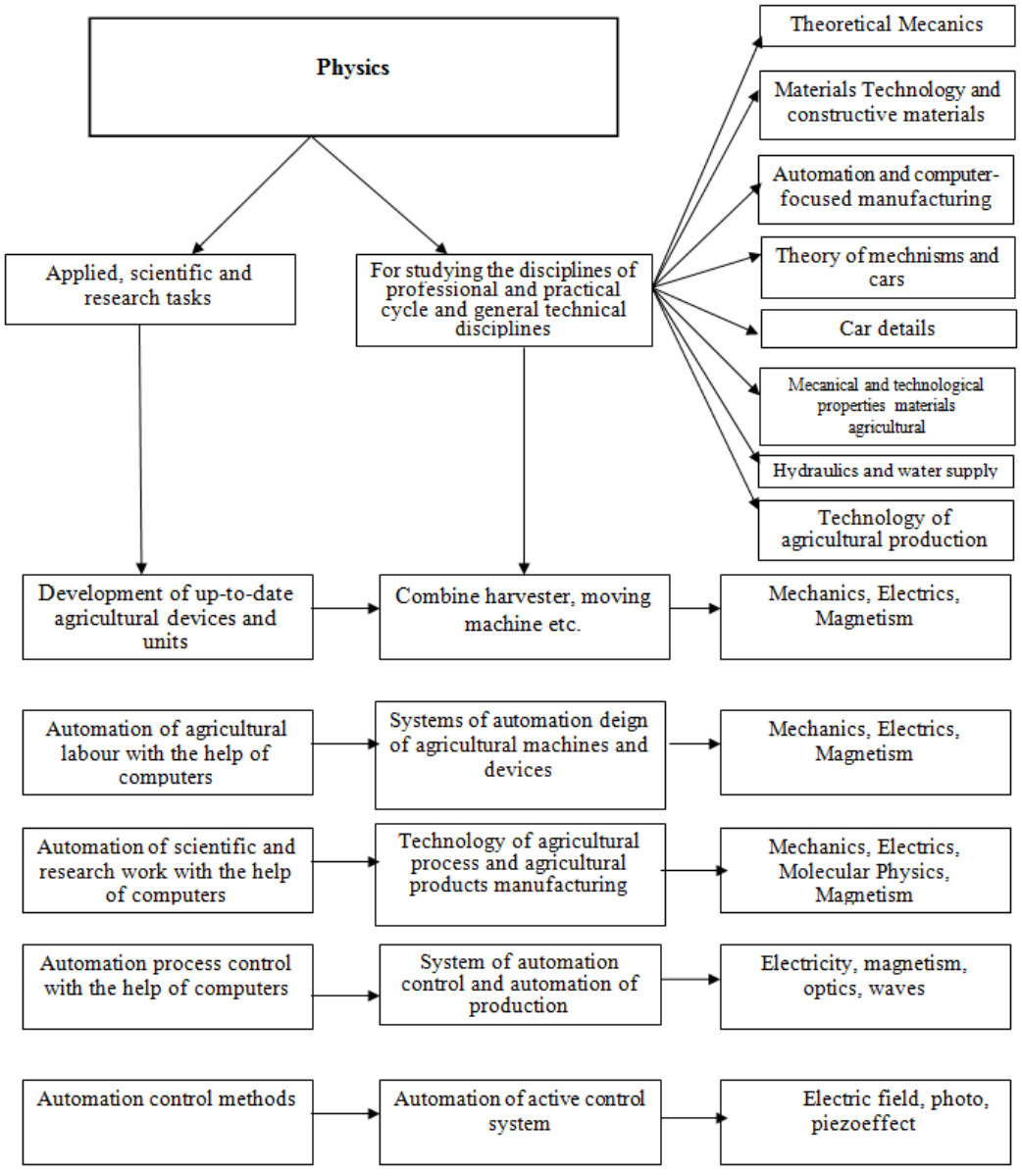

Fig. 3. THE STRUCTURAL AND LOGIC LINKS IN PHYSICS COURSE

For example, theoretical mechanics study is based, primarily, on the laws of kinematics and dynamics of material points, which are taught in the course of physics. A study of «Hydraulics and water supply», «Heat engineering and heating» and «Soil» is based on the

fundamentals of molecular physics (properties of solids, liquids and gases, ìsoprocess, transport phenomena, etc.). The course in «Material Science» is studied on the basis of already taught topics of physics course «Rotation of a rigid body around a fixed axis (torque, moment of inertia, the law of dynamics for rotary motion, etc.) and «Forces of elasticity (deformation, relative and absolute elongation). «Electricity and magnetism course» Physics is the base of «Electrical engineering», «Automation and Computer-focused manufacturing» study.

Analysis of the relations of physics with the disciplines of professional and practical training allowed us to develop the program, approved by the Ministry of Agrarian policy of Ukraine for agrarian and engineering specialty (208 «Agrarian engineering»). An invariant part of physics course contains the fundamental course of physics, and the variable part of this course is presented by material based on future professional activities. For example, in terms of studying the power of elasticity we divide the learning material into two parts (table 1).

Tab.1. THE THEME «THE POWER OF ELASTICITY» IN TERMS OF THE INVARIANT AND VARIABLE PARTS

Invariant part	Variable part
Overview of the power of elasticity. The concept of elastic deformation	Elastic deformation in agriculture machines and units. The effect of elastic deformation on quality of mechanical processes
The concept of rigidity. The coefficient of stiffness	Material tightening examples of elements and devices of agricultural machines
Law of Hooke. Proportionality between the force of elasticity and deformation	The ratio between the power of elasticity and deformation examples of agricultural machines
Modulus of elasticity. Mechanical stress	Mechanical tension in work and units
The concept of displacement. A relative offset. Displace module	Offset deformation. Calculation for strength, reliability and durability of the farm details

The content of physics course and its learning strategies for the students of agrarian and technical universities were formed in terms of:

1. The examples in the lecture course are connected with agricultural objects and technologies of future professional activities [5];
2. Physical workshop is based on both tasks from different sections of the physics and physical tasks and questions of professional direction [6];
3. Laboratory works are done with the help of traditional physics course instruments, and professional equipment.

The specific features of lecture course system are focused on professional content of physical theories [7]. Basic concepts and principles of physics were presented with the help of professionally based examples. The result of pedagogical experiment proved the fact that such modernization of lecture classes contributed to efficient development of professional skills.

Moreover, we developed an application system of questions and tasks except lecture course issues that illustrate the theoretical material. This system is aimed at mastering the students the fundamental courses, as well as the formation of them knowledge and skills of professional content [8]. The task demanded of students the comprehensive mental activity. Such applied content tasks require the application of physical concepts and laws, and they are based on productive activities. The tasks aimed at knowledge reproduction are not included to the proposed schemes. To perform some of the tasks you need to give examples that illustrate the physical concepts. For example:

1. That kind of movement is called uniform? Give the examples of uniform motion in agricultural machinery.
2. Give for examples of uniform motion of parts and units of agricultural machinery.
3. Give the examples of rotor movement of the parts, agricultural machine component.
4. Underline the pictures of oscillatory movements in agriculture.

The students should concern the concepts with the objects of their professional activity. For example:

1. What is the motion path of the plow, harrows, cultivator on small parts of path?
2. That type of motion is typical for straw separator, thrashing machine, and winnower?
3. What type of friction is used in bearings?
4. What types of deformation is observed in agricultural machines and mechanisms?

To choose the content of the lecture course in physics for future agrarian engineers, it is necessary to take into account the modern tendencies of engineering education development and integration character of the course and engineering and professional disciplines.

The principle of professional orientation of teaching physics was realized during the students' laboratory trainings, based on a combination of the following approaches:

1. Development of question system of applied character in the context of traditional laboratory trainings.
2. To organize the laboratory trainings with the help of traditional installations.
3. To organize the laboratory trainings with the help of agricultural objects and devices.

Here we have the list of traditional laboratory works in «Physical foundations of mechanics»:

1. The definition of the modulus of elasticity rod by method of deflection.
2. Determination of the coefficient of internal friction by Stokes' method.
3. Dry friction. Determination of friction coefficient.
4. Determination of inertia moment by method of trifoliate suspension.
5. Study of uniformly accelerated motion on Atvud's car.
6. Monitoring of the basic law of rotational motion of a rigid body with the help of Oberbek pendulum.

The formation of the specialized physical knowledge during laboratory trainings depends on the list of tests that are offered to students for self-study to defend the laboratory work. For example, after carrying out laboratory work «Dry friction. Determination of the coefficient of friction», students must answer the following questions:

1. Reveal the location and value of friction force of agricultural machines.
2. How does the friction force influence on the rotating parts of agricultural machines?
3. Explain the process of corn mixture separation at canvas belt.

Both the traditional laboratory trainings in physics and professional laboratory trainings were done. The following laboratory trainings were proposed:

1. Determination of the friction coefficient of soil.
2. Determination of the friction coefficient of plant seeds.
3. A study of the motion path and the main physical characteristics of reeling frame.
4. The definition of inertia moment of the connecting rod.
5. Determination of kinematic and dynamic characteristics of crank-type connecting-rod gear.
6. Determination of water rise height in terms of soil vessels.

7. Determination of the coefficient of liquid surface tension (vegetable juice and fruit) by drops.
8. Determination of the moisture content of the soil.
9. Measurement of biological tissue resistance.
10. Determination of the coefficient of thermal diffusivity of soil.

Nowadays the process of studying physics is characterized by lack of illustrating and laboratory equipment. The out-dated equipment does not allow to be in the mainstream of the educational process. Due to limited capabilities of a traditional workshop, a number of issues of applied character are not realized. Computer technologies compensate the complexity of the experiment, the absence of complex and valuable equipment, as well as access to the real objects of research. To represent and study the physical phenomena and physical devices that facilitate the visual cognition of their essence and widen choices for experimentation, increase the limits of parameter change of the instruments that is impossible in real conditions we should provide computer technologies. Computer based classes were productive; we had the possibility to repeat the experiment with other parameters, on the bases of other materials and in other conditions.

For example, to explain some of the topics in the section «Dynamics», we showed the students illustrating experiment. The students had to determine the motion path of grain, heap, etc., and their tracing characteristics [9]. The students mastered professional skills due to variable component of course in physics. (fig. 4).

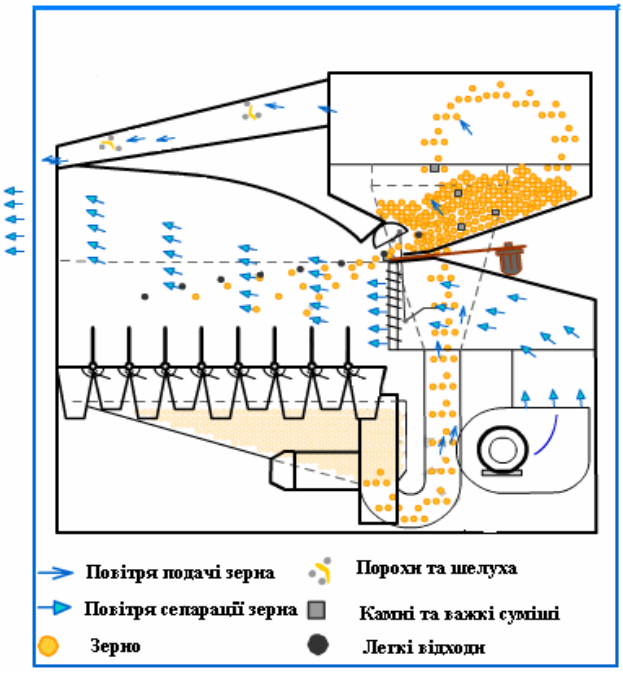

Fig. 4. COMPUTER ILLUSTRATION OF GRAIN SEPARATION

Despite the significance of the electronic laboratory workshop, we can't but admit that experience based on experimental equipment and digital proficiency skills can't be replaced by true-to-life working situations. We believe that the introduction of computer experiment methods should not completely replace research practice in laboratory trainings in physics. Computer based experiments should be included to the semester cycle: part of the work should be done according to the traditional scheme, the rest of the material should contain computer based tasks. It was beneficial to combine traditional workshop with computer based study.

For example, the students were given the task on decomposition of the applied effort on the components of the engine while studying the structure and operation cycles of internal combustion engine. This work is done with the help of the following animation (fig. 5)

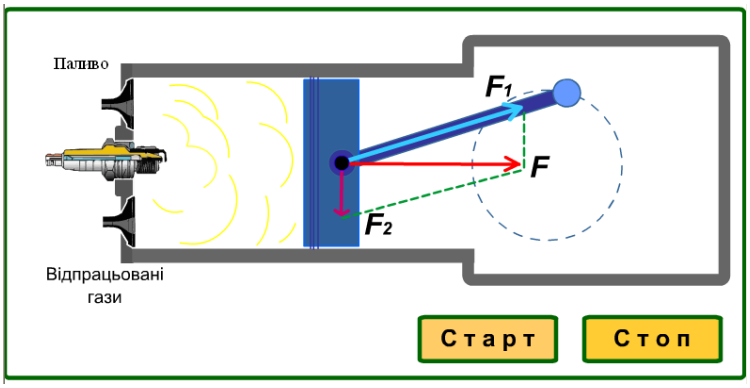

Fig. 5. DEMONSTRATION OF FORCE DECOMPOSITION IN THE ENGINE

The counterpart to this task in a traditional laboratory is the homemade model of sliders that move in horizontal directions with the least friction (fig. 6).

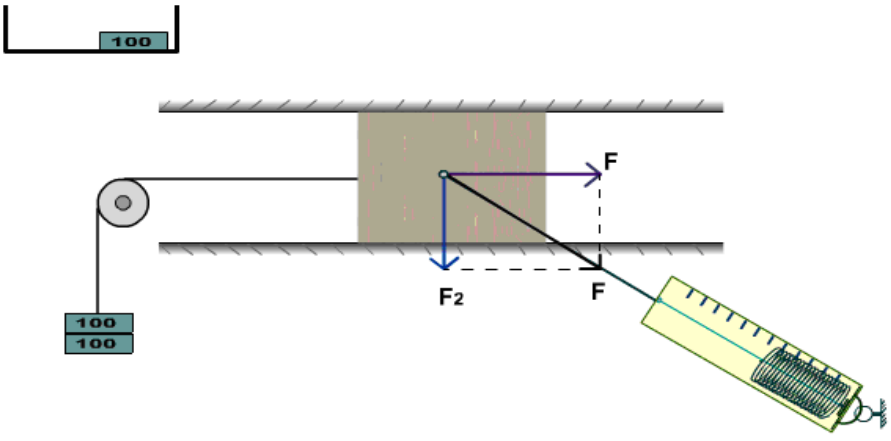

Fig. 6. ILLUSTRATION OF FORCE RESOLUTION THAT INFLUENCE ON SLIDE BLOCK

So, correctly organized laboratory workshop becomes a reliable tool in the process of learning physics. It helps to overcome the gap between theory and practice, to demonstrate

the relationship of physics and engineering; to promote the development of logical thinking; to consolidate, expand and deepen the system of variable tasks and increase the efficiency of the formation of natural knowledge and professional skills of the future specialist.

Physics based issues connected with the future profession of agrarian engineer influenced the professional integrity. Their solution creates the preconditions for the successful application of the theoretical knowledge in the practice of agricultural production, the quality of educational tasks, course projects, etc. Professionally based tasks help to deeper understanding the physical entity of the processes that take place in agricultural machines, mechanisms, devices [10].

To conclude, the use of educational and methodical support of professionally based course in physics in the teaching process benefits in mastering physical knowledge of experts in agrarian and technical industry. Implementation of such educational and methodological support will create a holistic and systemic knowledge about the structure and content of physics course and its importance for the future professional activities and to form the initial professional knowledge, skills and abilities in the process of studying physics.

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