

# Professional Preparation of Future Teachers of Vocational Training in the Transport Area of Expertise with Use of the Author's Educational Application

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**Keywords:** Future Teachers of Vocational Training, Vocational Training for the Transport Branch, Electronic Educational Resource, Special Educational Application, Electronic Educational Methodical Complex, Expert Assessment.


**Abstract:** The paper presents the content, as well as approaches to the use in the educational process of the author's Electronic educational methodical complex (EEMC) "Construction of car". The course is created for students of the speciality 015 Professional education (Transport, the operation and repairing of automobiles). Its content covers general topics including the study of a car engine, electrical equipment and automotive driveline. The created electronic course embraces, in addition to textual material, illustrations, dynamic models, instructions, manuals, textbooks, reference books and glossaries, test material for each topic. Its possibilities of application during lectures, in the course of performing 15 laboratory works, organizing test control of knowledge, as well as for managing students' independent study activities have been shown. Approaches to expert evaluation of the developed electronic study course by 11 criteria have been disclosed. The directions for further improvement of the content and methods of organizing the study and cognitive activity of students when using the course have been highlighted. These include the organization of level assimilation of the material, the creation of an individual educational trajectory of students. A rather high assessment of the developed author's course received from experts allows it to be used in the system of vocational preparation specialists in the transport area of expertise.


## 1 INTRODUCTION


Nowadays, among all problems, deeply troubling Ukrainian society, there are crucial issues, which concern the educational sphere, its reformation through the prism of perfection and even the fundamental change of approaches towards the study process and the rearing of the young generation. Changes involve all branches of the educational system and particularly the higher pedagogical education.


The fundamental transformation of contemporary educational space in Ukraine can be characterised by a principally different understanding of objectives and tasks of the high pedagogical education, awareness of the necessity of the switch towards the educational "lifelong learning" model, new conceptual approaches to the elaboration and implementation of innovative methodologies and techniques of efficient educational activity. The current state of experts' of pedagogical specialities preparation including for the vocational (vocational-and-technical) educational institutions conditions the rise of social worrying and preoccupation, as the further development of the educational system, sets the new level of requirements concerning personal and professional qualities of future teaching engineers and involves the finest degree


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of organizational, methodical and didactic support, as well as the application of modern information and communication technologies.

At the present-day stage, the crucial issue of learning of the upcoming generation concerning the usage of the information and communication technologies (ICT) with the objective of a solution of the wide range of actual personal and professional tasks is. The technological stage of scientific and technical progress requires the augmentation of the level of professional preparation of contemporary specialists, as well as the formation of their readiness for the wide application of ICT, that provides the effectiveness of their work in different spheres of human activity.

## 2 MATERIALS AND METHODS

At the present, ICT occupies a gradually more significant place in the educational system in general and particularly in vocational training. The introduction of computing systems and software tools with a different type of application caused the qualitative progress of the learning process, transforming all its components and extending the cognitive opportunities of its subjects.

Psychological and pedagogical issues of ICT application in the course of the educational process are described in (Bakhmat, 2017; Butcher, 2015; Bykov and Shyshkina, 2018; Denysenko, 2018; Gurevich et al., 2016; Kleiman, 1984; Mashbits, 1988; Orr et al., 2015; Ranieri et al., 2011; Williams and Maclean, 1985; Yashanov and Yashanov, 2017; Zhaldak, 2019; Zhaldak et al., 2021).

The problems of using electronic teaching materials and manuals are widely discussed in (Osadcha et al., 2020; Velychko et al., 2021; Zhenchenko et al., 2020). Certain issues of using electronic learning laboratories and guidelines for students of transport area of expertise were considered by us in our previous studies (Pavlenko et al., 2020; Pohorielov, 2020; Bondarenko, 2018).

The goal of the paper is to present the content, approaches to use in the educational process of the author's Electronic educational methodical complex (EEMC) "Construction of car", developed for students of speciality 015 Professional education (Transport, the operation and repairing of automobiles).

## 3 THEORETICAL BACKGROUND

Before proceeding to the presentation of the main content of the developed authoring software, it should

be considering the most important approaches to solving this problem.

UNESCO define ICS as s forms of technology that are used to transmit, store, create, share or exchange information. This broad definition of ICT includes such technologies as: radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, computer and network hardware and software, as well as the equipment and services associated with these technologies, such as video as well as the equipment and services associated with these technologies, such as video conferencing and electronic mail (Wachholz and Meleisea, 2006).

The "modern means of ICT" are interpreted by Robert (Robert, 2014) as programmatic and technical tools and devices, that function on the basis of micro-processing and calculating hardware, and also modern means and systems of informational exchange providing operations of collection, production, accumulation, storage, processing and transmission of information. According to particular researchers' opinion, new educational ICT means can be presented as the assemblage of tools and methods of information working up ensuring purposeful transmission, procession, storage and displaying of the informational product (e. g. data, ideas or knowledge). Additionally, ICT suppose for the application of different technical means, whose most crucial element can be represented as a computer.

It is open educational resources that one of the innovations in the digital educational system of the last decades. The term "open educational resources" or OER uses for denoting educational and scientific resources, which free access or released with authorisation of their usage or modification by third parties. Orr et al. (Orr et al., 2015) highlight the following most characteristic features of open educational resources:

- methodical, educational and scientific orientation of their materials;
- support of different formats and data carriers for the presentation of materials;
- the publication within of the license authorisation of educational and scientific materials, which became the objects of public ownership;
- free access, application, procession and allocation of materials by other users;
- minimal restrictions (or their absence) in the course of work with open educational resources.

Bakhmat (Bakhmat, 2017) considers the idea of the promising study of the issue of the usage of open educational resources in the state of ceaseless development of science and theoretical principles of com-

puterisation of the educational process. From the researcher's fair viewpoint, open educational resources have to unite the sites of all educational institutions and all electronic libraries, as well as provide the system of distance learning and advanced training; they also must have simplified instruments to develop students' IT competency.

Loboda (Loboda, 2012) classified the electronic learning tools as 4 types:

- the first type (the means of theoretical and technological mentoring) are electronic books, computed studying programme, computed system of knowledge assessment;
- the second type (the means of practical mentoring) is electronic task manager, computed trainer, SMART study system;
- the third type (auxiliary means) is computed laboratory workshops, computed reference book, multimedia study classes, service software for educational purpose;
- the fourth type (integrated means) is the computed studying course, the educational electronic resource.

Accordingly, the means of ICT include the hardware and software tools, such as digital devices, local computational networks, equipment performing input and output of information, the tools of archived storage of enormous amount of data, devices for the transformation of information, instruments for manipulation with audiovisual content (multimedia), the modern means for telecommunication performance, SMART systems, instruments of computed graphics, as well as programmatic complex of tools (machine languages, compilers, operational systems, packages of apps, etc.).

As it was indicated before, the application of ICT in the course of educational process realises the following opportunities (Horbatiuk, 2011):

- Firstly, it creates a new specific type of educational activity so-called "developing educational and informational environment", which combines the properties of cognitive, communicative, playing, intellectual, and creative activities.
- Secondly, the use of ICT provides for more complex and profound management of students' cognitive processes.
- Thirdly, the application of ICT leads to the qualitative transformation of students' study and cognitive activity according to contemporary principals, comparing to traditional methods of learning.

According to Verbitsky (Verbitsky, 1991), the introduction of ICT means into the educational process denotes the beginning of the systemic reformation of the complete studying technology, and, what is more important, the fundamental change of activity of subjects of the educational process – teachers and students. The possibility of a computer to display the state of educational activity in signing and symbolic form allows to learn of studying material with the aid of active means of cognitive interaction. The application of simulative capabilities of computers as an instrument provides not only the possibility of transformation of the substantive content to students but also the capacity to deliberately appeal to the bases of their actions, to perform their planning and analysis. This, finally, creates the circumstances for energetic and autonomous modelling by students' activity.

Further, the experience of creating and using an electronic educational complex in the study process will be presented. It combines the existing advantages of modern teaching tools and allows to solve the problem of vocational training specialists in the transport area of expertise.

## **4 EXPERIENCE OF LEARNING PROCESS ORGANISATION WITH USE OF AUTHORIAL EDUCATIONAL RESOURCES AND APPS**

### **4.1 The Content of the Electronic Course "Construction of Car"**

Let us examine the characteristics of realization of the basic types of students' study and cognitive activity with the use of the Electronic educational methodical complex (EEMC) "Construction of car" in the context of the formation of readiness of future teaching engineers in the transport branch for using ICT in their professional activity.

*Mastering of study material.* During the studying of discipline "Construction of car", students make acquaintance to the appropriation, construction and principle of operation of modern automobiles and learn how to analyse the structure and work of the main parts of vehicle.

By activating the study and methodical module of EEMC, students are granted access to the electronic textbook, whose material is clearly and logically structured according to the content of the educational programme of the course "Construction of car"

(figure 1).

As figure 1 shows, the left side of the window contains the list of educational units and topics, whose choice can be performed by pressing the left mouse button on the appropriate title (or name). The result of previous actions to the window of the programme leads to the appearance of necessary educational information, whose perception is greatly facilitated (or extended) with the aid of graphic components, footages, audio tracks, multimedia elements, etc. The upper part of the window of the electronic textbook contains the appropriate icons providing the transition to other components of EEMC (its controlling and diagnostic or informational and exploring modules), the transition to the main window of the software, the exit from the software, as well as the search of demanded information by using the keywords.

Figure 2 illustrates the window of the electronic textbook, which contain the study material from the topic "The general information about the automobile design". Text information is displayed in the window of the electronic textbook (figure 2) and illustrated with the full-colour graphic images (pictures) and complemented with footage to demonstrate the general arrangement of main automobile components.

The availability of additional buttons-icons ("Avi"; "Pdf"; "Globe"; "Book") allows students to move on to the appropriate informational resources of EEMC, such as a printed textbook, electronic glossary, pdf-document (the electronic copy of the printed textbook, which contains the homonymic study material), popular Internet resources concerning the topic of car structure, and electronic reference books.

The use of electronic textbook during the professional preparation process on speciality 015 "Professional education (Transport, the operation and repairing of automobiles)" can take place in follow ways:

- 1) in lecture classes for summarizing or illustration of main ideas of new study material,
- 2) for the realization of laboratory and research works with the objective of revision of study material and the search of necessary educational information,
- 3) in the process of students' extracurricular study and cognitive activity for autonomous acquaintance and deepening of professional knowledge, as well as during the preparation for classes (individual, independent and control works), for the composition of reference papers, term papers, qualifying papers, whatsoever).

*Execution of laboratory and practical research.* Laboratory and practical classes are aimed for revi-

sion of study material of the course "Construction of car", the shaping of practical skills and abilities to work with specialised equipment, hardware, computing devices with the appropriate (supplemental) software, the realisation of simple technical calculations and a lot of other interesting things. By working in specially equipped laboratories, cabinets and educational and productive workshops, students perform the tasks, related to the examination of design and principles of operating of main systems, single units and combined components of modern automobiles, particularly crank gear and gas distribution mechanisms of the engine, the systems of lubrication and refrigeration of automobile engines, the system of power supply to gasoline and diesel engines, storage batteries and generators, electric starters, systems of ignition of engines, lighting and signaling parts, clutches of coupling, speed-change gearboxes and transfer gears, drive axles, carriers of motor-cars, handwheels of automobiles, brake gears, etc.

Dealing with the authorial EEMC "Construction of car", students have the opportunity to activate the special module – "Laboratory training", which contains the system of laboratory and practical tasks, whose execution is compulsory. The course offers 15 topics (they showed in figure 3).

With the activation of the necessary laboratory and practical tasks (by clicking on the appropriate title), the instruction is displayed on the screen. It covers the list of the objectives of the work, the information concerning the material and technical means, which are necessary for the execution of the work, the brief algorithm of steps, the recommended literary resources and the system of control questions. One of the possibilities is shown in figure 4.

In the course of execution of laboratory and practical research, students are authorized to actively use all supplemental means of EEMC, such as electronic reference books, electronic textbooks, informational and exploratory modules, graphic images (drawings, schemas, images, etc.), audio and video files, i.e., everything that demonstrates the specificity of solution the put tasks, preparation of multimedia presentations and other things.

Completion of informational tables, the provision of demanded calculations, the construction of graphical charts and diagrams is realized exactly in the active window of software with the possibility to output the obtained result in a printed form.

*The inspection of students' academic achievements.* For the realization of the function of pedagogical control the structure of EEMC "Construction of car" provides for the controlling and diagnostic module with the automated system of textual verification

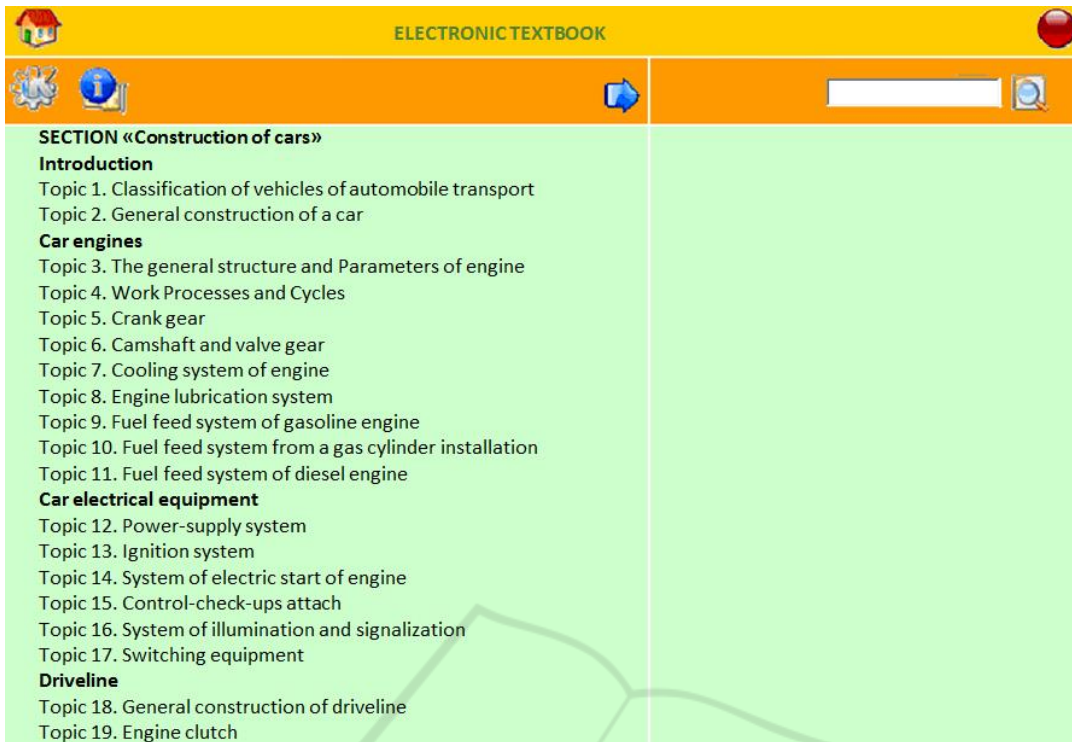


Figure 1: The content of the electronic textbook of EEMC “Construction of car”.

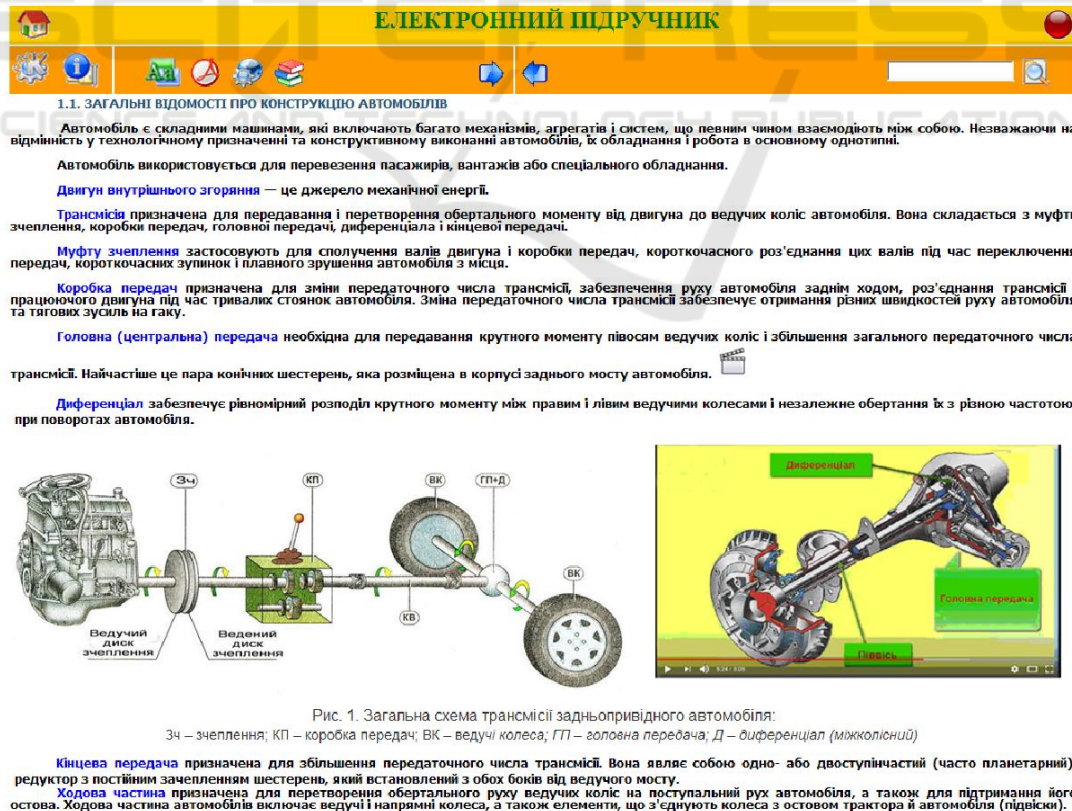


Figure 2: One of the pieces of study information by the course.

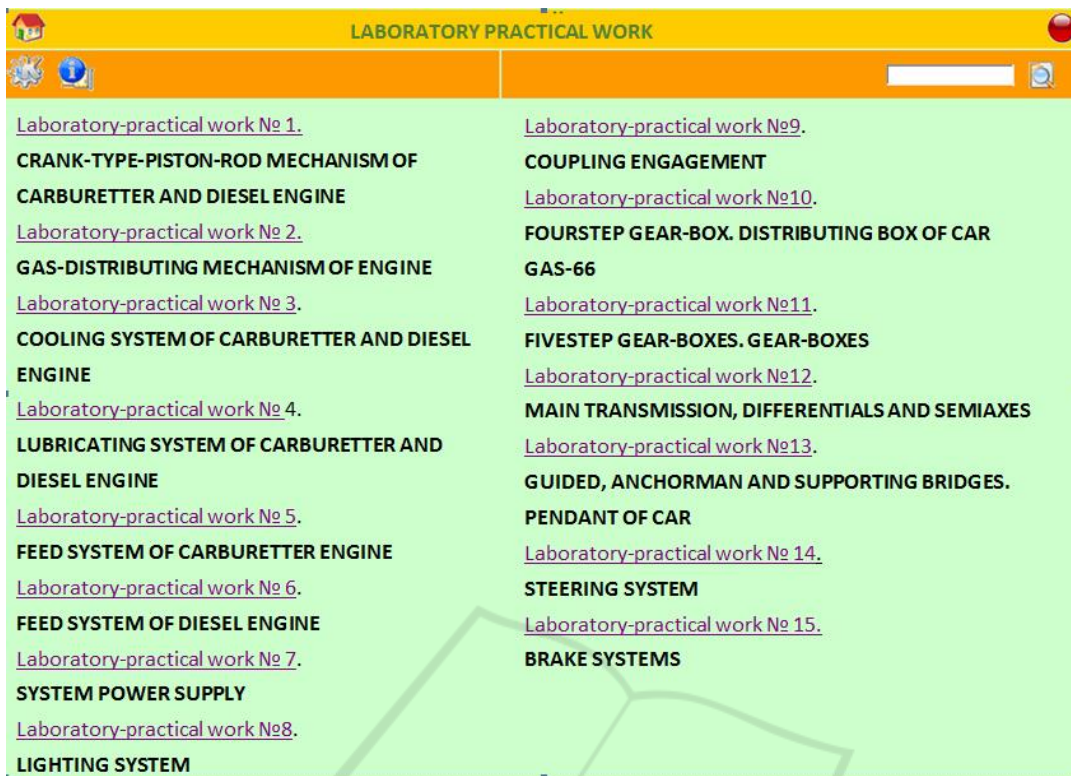


Figure 3: The window of laboratory training part, which contains the list of laboratory works concerning the course.

and the estimation of students' learning outcomes.

The implementation of the automated system of testing inspection allows dealing with different types of tasks (ones with singular and multiple-choice, accordance and ranking tests, ones with open answers) and various degrees of complexity. Work with the "computer tests" is possible at any stage of students' learning, but it is predominantly used for revision of academic achievements and also for the organization and realization of current and summarizing rating of knowledge. With the activation of the automated system of testing inspection user (a student or a lector) acquires the ability to choose the pedagogical test of the appropriate topic of the course "Construction of car" and indicate the aim of testing.

In this case, the following choice is possible:

1. *Preliminary testing* is for the revision of mastering educational information. During the testing, the system displays the message about the correctness (or incorrectness) of the answer and realises the educational function of pedagogical control. The estimation of the completion of the test is not granted and the result of the testing is accessible for all students for its further analysis.
2. *Test-controlling* is for the verification and rating of students' academic achievements concerning

the particular topic (or unit). Executing the testing tasks, the system does not notify a user of the correctness (or incorrectness) of submitted answers. After the completion of testing, the message reflecting the result is displayed (a quantity of correctly given answers and solved issues, duration of testing and a mark). Results of the testing are accessible only to a lecturer and are stored on the host-based computer (in case of working within the local network) or on a local PC and become accessible in case of submitting a special password.

The procedure of testing provides for the users' preliminary registration in the system (with the indication of their surname, name, father's name, and a number of their academic group) and acquaintance to the brief instruction concerning the particularities of dealing with the app (with the illustrated forms of testing tasks, the way of choosing the correct option, the duration of testing, the algorithm of estimation of results, etc.).

Figure 5 illustrates the active window of EEMC in the mode "Automated system of testing control", which contains one of the testing tasks concerning the topic "Crank gear mechanism".

As it can see in figure 5 the inferior part of the win-

**ЛАБОРАТОРНИЙ ПРАКТИКУМ**

Лабораторно-практична робота №2  
ГАЗОРОЗПОДІЛЬНИЙ МЕХАНІЗМ ДВИГУНА

**Завдання роботи:**

1. Вивчити загальну будову газорозподільного механізму, оглянути деталі механізму, вивчити їх конструктивні особливості, взаємодію між собою; звернути увагу на матеріал, з якого виготовлені дані деталі.
2. Виявити можливі відмінності у будові впускних і випускних клапанів; звернути увагу на будову та роботу механізму для прокручування випускних клапанів двигуна ЗИЛ-130.
3. Вивчити будову і роботу гідравлічного компенсатора зазору в механізмі, ознайомитися із послідовністю регулювання теплового зазору в клапанному механізмі.

**Таблиця 1.1. Характеристика газорозподільного механізму**

№ з/п	Найменування параметрів	Значення параметрів
1.	Двигун	
2.	Порядок роботи циліндрів	
3.	Тип механізму газорозподілу	
4.	Діаметр тарілки клапана: впускного; випускного	
5.	Заходи з охолодження випускного клапана	
6.	Зазор між стержнем клапана і коромислом: для впускних клапанів; для випускних клапанів	
7.	Тип штовхача	
8.	Спосіб обертання штовхача	
9.	Розподільний вал: кількість опорних шийок; спосіб фіксації від осьового зміщення; наявність елементів привода допоміжних	

Figure 4: The active window of laboratory work number 2 “Gas distributive mechanism of the engine”.

the window contains the information about the student, the indicated date and time of having the test, the counter of testing tasks with the dynamic scale of fixation of the duration of the completion of the testing event. Additionally, the window of the app covers the special controlling buttons, which allow skipping the current testing task, which will be able repeatedly loaded at the end of a diagnostic procedure, along with the possibility of abrupture of the testing procedure by quitting the mode of automated testing control.

*Independent study and cognitive activity of students.* Organization of autonomous (mentor-led or independent) work can be realized via different modes of interaction with the EEMC. Particularly, the autonomous working up of educational information for some specific topics of the course “Construction of car” by students can be performed with the usage of textbooks, reference books and glossaries in electronic format. The search for some additional information is provided with the usage of accessible internet resources and electronic copies of printed editions in pdf format.

Instructive and methodical materials (recommendation, directions, etc) concerning the usage of EEMC and the execution of illustrated tasks can be

viewed by students in the section “Regulatory and procedural materials”. The list of tasks for students’ independent work concerning the material from different units and topics of the course “Construction of car” are given in the homonymous tab of the learning software. Moreover, students are suggested to get acquainted with the list of recommended literary sources (or web sources), which are indispensable for autonomous studying. The information about the execution and formatting of individual tasks and the criteria of their estimation are also mentioned.

Among the individual tasks for students’ independent work, which are presented in EEMC, the following ones need to be highlighted:

- Complex description of appropriation, particularities of construction and operation of mechanisms, systems or integral units of automobiles. Particularly they are a) the overview of the construction of crank-and-rod mechanisms of automotive engines, b) range, type, and properties of oil for lubrication of automotive engines, c) systems of inflation of the engine, and other things.
- Preparation of reference papers on the following suggested topics: “Motorcar factories of

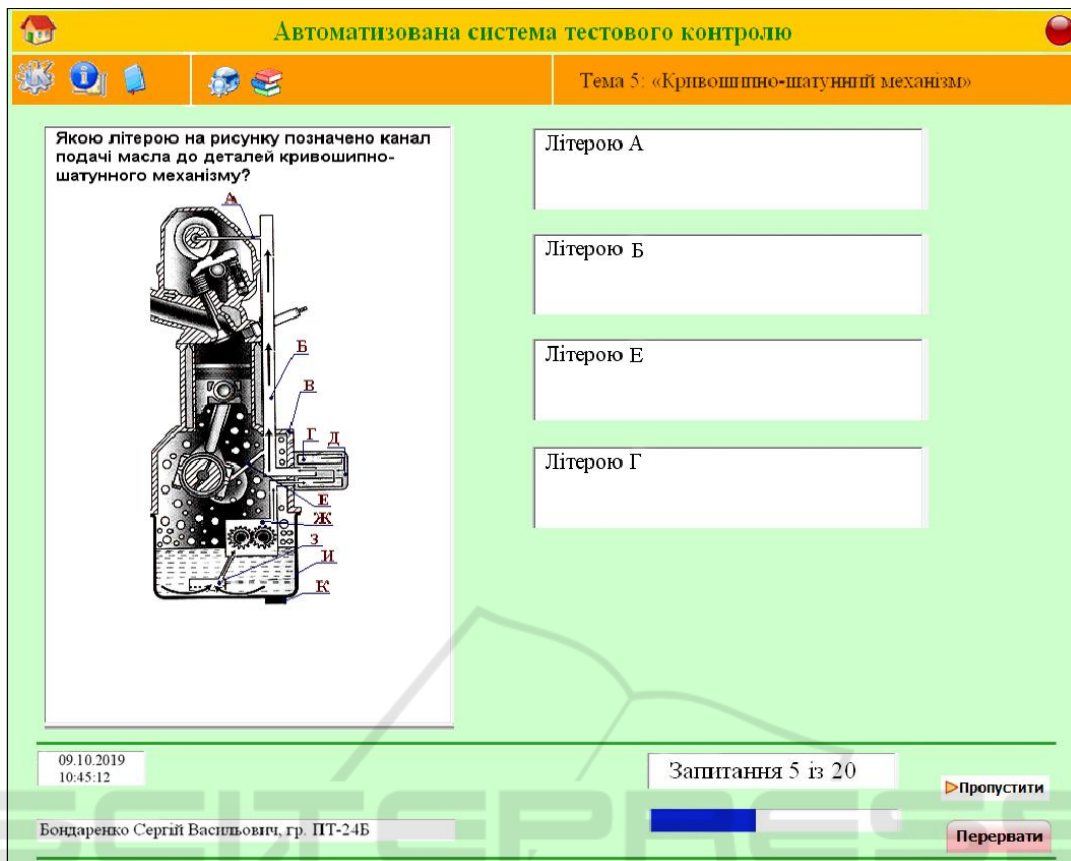


Figure 5: The active window of authorial EEMC in the mode “Automated system of testing control”.

Ukraine”, “Ignition plugs (their types, construction, marking, particularities of their working)”, “Injecting system of L-Jetronic fuel”, “Injecting system of Mono-Jetronic fuel”, “The system of direct fuel injection”, “Motion driveline of all-wheel-drive vehicles”, “Antilock braking systems”, etc.

- Creation of electronic presentations on some suggested topics: “Appropriation, classification and construction of ignition systems”, “Appropriation, classification and construction of friction clutch”, “Injection engines nozzles”, “Diesel engines nozzles”, “Common Rail feeding system”, etc.

#### 4.2 Expert Estimation of the Quality of Authorial EEMC “Construction of Car”

Analysis of contemporary scientific and pedagogical literature admits the detection of different approaches towards the rating of the quality of electronic educational editions, including via the researching and experimental, competent or complex type of estimation.

The rating of the quality of the authorial EEMC “Construction of car” was performed by means of the method of competent estimation. In the mentioned case, among the experts, who evaluated the material, were 12 scientific and pedagogical staffs of National Pedagogical Dragomanov University, Ukrainian Engineering Pedagogics Academy, Kryvyi Rih State Pedagogical University leading the classes concerning IT technologies (“The basic computer science”, “Information and communication technologies”, etc.) and professionally-oriented disciplines, related to transport sphere.

Experts were suggested to estimate the quality of the electronic educational and scientific complex, considering the following criteria:

- Appropriation of vocational preparation of the students to the particularities of the speciality 015 “Professional education (Transport, the operation and repairing of automobiles)”.
- The structure of study information.
- The availability of referential informational resources.
- The provision of the students’ individual study



trajectory.

- The possibility of the selection of the degree of complexity of study material and testing tasks.
- The availability of tips, instructions, and guidance.
- The possibility of giving feedback in the course of study.
- The availability of the intuitively comprehensible interface.
- The availability of simple means of navigation.
- The facility of using and management of multimedia means and other things.

The quality of electronic educational and methodical complex “Automobile design” was estimated according to every criterion within the range from 1 to 10 points. The general information concerning the estimation of authorial EEMC is displayed in table 1.

The results of the inspection of authorial EEMC “Construction of car” can be considered as reliable ones, only in the case of the availability of the satisfactory degree of coordination (the concordance of all experts’ estimation conclusions), which is characterised the appropriate index of concordance rate  $W$ . It can be calculated according to the formula:

$$W = \frac{S}{\frac{1}{12} \left[ m^2 (m^3 - n) - m \sum_{i=1}^m T_i \right]}$$

where  $n$  – is the general quantity of estimation criteria ( $n = 11$ );

$m$  – the general amount of experts ( $m = 12$ );

$S$  – the total sum of deviation squares of rank sums from the mid score;

$T_i$  – the complementary quantity, that causes the manner of experts’ estimations.

The last index  $T_i$  was calculated in line with the formula:

$$T_i = \sum_{l_i=1}^L (t_i^3 - t_i),$$

where  $L$  – is the total quantity of groups of the identical experts’ estimations;

$t_i$  – the quantity of the identical estimations of one expert in each group.

In line with the data of table 1, the number of groups of the identical estimations for the first expert is equal to  $L = 3$  (the score “10” for criteria 1, 2, 10; score “9” for criteria 4 and 9; the score “7” for criteria 3 and 7).

Therefore, the next formula must be the following one:  $t_{1-1} = 3$ ;  $t_{1-2} = 2$ ;  $t_{1-3} = 2$ .

Which is consequently equal to follow:

$$T_1 = (3^3 - 3) + (2^3 - 2) + (2^3 - 2) = 24 + 6 + 6 = 36.$$

In this way, all amounts of complementary quantity ( $T$ ) for all 12 experts were calculated.

The total amount of complementary quantity ( $T$ ) for all 12 experts was equal to:

$$\begin{aligned} T_i &= \sum_{i=1}^L (t_i^3 - t_i) = T_1 + T_2 + T_3 + T_4 + T_5 + T_6 + \\ &+ T_7 + T_8 + T_9 + T_{10} + T_{11} + T_{12} = \\ &= 36 + 30 + 30 + 30 + 30 + 54 + \\ &+ 36 + 30 + 36 + 54 + 54 + 30 = 450. \end{aligned}$$

For calculation of the total sum of deviation squares of rank sums from the mid score ( $S$ ), it is necessary to perform the preliminary calculation of intermediate quantities (table 1), particularly: of the sum of ranks ( $S_j$ ) for each one of the criteria of estimation, the mid score of the sum of ranks ( $\bar{X}$ ), the deviation of the sum of ranks from the mid score ( $d_j$ ) for each of criteria of the estimation and the square of deviation of the sum of the ranks from the mid score ( $d_j^2$ ) for each of the criteria of estimation.

All necessary intermediate quantities must be calculated in line with formulas:

$$S_j = \sum_{i=1}^m X_{ij}; \quad \bar{X} = \frac{\sum_{j=1}^n S_j}{n}; \quad d_j = S_j - \bar{X}.$$

Consequently, it can be taken:

$$S = \sum_{j=1}^n d_j^2 = 9744.73.$$

Concordance index of the experts was equal to:

$$W = \frac{9744.73}{\frac{1}{12} [12^2 (11^3 - 11) - 12 \cdot 450]} = 0.63.$$

The result confirms the high degree of concordance of all experts’ estimations of the authorial EEMC “Construction of car”.

Obtained index of concordance rate is the random quantity, which involves the necessity of the additional verification of its reliability with the aid of Pearson criterion ( $\chi^2$ ), which is calculated via the formula:

Table 1: The results of the quality estimation of authorial EEMC "Construction of car" by the expert group.

Experts	Criteria of EEMC estimation										
	Conformation to the aims of vocational preparation	Structure of study information	The availability of visualization means	The availability of referential informational resources	The provision of the individual study trajectory	The selection of complexity degree of the study material	The availability of tips, instructions and guidance	The function of giving feedback	The availability of the intuitively comprehensible interface	The availability of simple means of navigation	The management of multimedia tools
1	10	10	7	9	3	2	7	5	9	10	4
2	10	10	8	10	2	3	7	6	7	9	4
3	9	9	7	10	3	4	8	5	10	10	6
4	10	10	8	9	4	3	7	6	9	10	5
5	10	9	8	10	3	4	7	5	9	10	6
6	9	9	9	10	3	3	7	6	10	10	4
7	10	8	9	9	4	3	8	6	10	10	5
8	10	9	8	10	3	2	7	6	9	10	5
9	9	9	8	10	3	3	7	6	10	10	5
10	10	10	10	9	3	3	8	6	9	9	5
11	10	10	10	9	4	4	7	5	9	9	6
12	10	9	10	8	3	4	7	6	9	10	5
$S_j$	117	112	102	113	38	38	87	68	110	117	60
$\bar{X}$	87.45										
$d_j$	29.55	24.55	14.55	25.55	-49.45	-49.45	-0.45	-19.45	22.55	29.55	-27.45
$d_j^2$	872.93	602.48	211.57	652.57	2445.75	2445.75	0.21	378.48	508.30	872.93	753.75
$S$	9744.73										

$$\chi^2 = \frac{\sum_{j=1}^n d_j^2}{\frac{1}{12} \left[ m \cdot n \cdot (n+1) - \frac{1}{n-1} \sum_{i=1}^m T_i \right]} = \frac{9744.73}{\frac{1}{12} \left[ 12 \cdot 11 \cdot (11+1) - \frac{1}{11-1} \cdot 450 \right]} = 75.98.$$

The empiric amount of Pearson criterion surpasses the tabular one ( $\chi_m^2 = 19.68$ ) for  $n - 1$  degree of freedom ( $12 - 1 = 11$ ) and credible probability ( $p = 0.95$ ), which confirms (with a probability of 95%) the nonrandomness of the obtained amount of index of concordance rate and, consequently, the concordance of experts' estimations concerning the quality of the authorial electronic study complex.

The analysis of the data of table 1 certifies the appraising feedback of the experts about the quality of the authorial EEMC "Construction of car" according to the predominant majority of criteria (the mid

score for each one of them surpasses 7 points out of the maximal score "10"). Despite that, for four criteria of (1) the selection of complexity degree of the study materials, (2) the provision of the individual study trajectory, (3) the possibility of giving feedback, (4) the facility of using and management of multimedia means and other things, EEMC requires its further refinement and perfection. In this way, authors discover their subsequent studies.

## 5 CONCLUSIONS

It can be freely stated, that the application of modern ICT, the specified, supplementary, and pedagogical software (particularly EEMC "Construction of car") in the course of professional preparation of the future teachers of vocational training in the transport area of expertise provides the possibility of making the following generalization.

1. The use of ICT in the course of vocational preparation of future teaching engineers encourages the increase of their motivation to learning, particularly, because of the possibility of autonomous choice of the mode of working up with apps, the diversification of types of independent work, thanks to the computed visualisation of the study material.
2. The availability of programmatic means with the educational purposes and the capabilities of the modern computed graphics and various tools of demonstrativeness forms and develops the representational thought of future teaching engineers.
3. The application of pedagogical programmatic means, including EEMC, encourages the shaping of the informational culture of students and their readiness for the wide usage of ICT and tools in their future professional activity.

Developed authorial EEMC “Construction of car” was appraisingly estimated by the experts according to the majority of criteria. Prospects of its further enhancement suppose for the perfection of its following criteria: the possibility of selection of the degree of complexity of study material and testing tasks, the provision of the individual educational trajectory, the possibility of giving feedback during the learning process, the facility of using and management of multimedia tools, and the further approbation of the EEMC.

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