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Electronic educational methodical complex "Construction of car" in vocational training of future teachers of professional education

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Abstract. The paper presents the content, structure and approaches to using the author's electronic educational methodical complex (EEMC) "Construction of car" in vocational training of future professional education teachers in the transport field. The EEMC combines electronic educational resources – electronic textbooks, laboratories, tests, guidelines, reference books, etc. This allows students to organise various learning activities – studying theoretical material, performing lab experiments, knowledge assessment, and independent work. The quality of the EEMC was evaluated by 12 experts in the field using a competent estimation method. The high concordance index confirmed the good quality of the EEMC. Using the EEMC in vocational training increased students' learning motivation, developed representational thinking, shaped informational culture, and prepared them to apply ICT in future professional work. Prospects for further improvement of the EEMC are outlined.

Keywords: information and communication technologies (ICT), open educational resources, electronic educational methodical complex (EEMC), vocational training, future teachers, professional education, transport education

1. Introduction

In the modern world, the educational sphere is undergoing significant transformations to keep up with the rapid pace of technological and social changes. This is especially true for higher pedagogical education, which aims to train new teachers. In Ukraine, the reforms touch upon all aspects of the educational system, prompting updates in the goals, objectives, content and methods of teacher training.

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One of the main priorities is the switch to a lifelong learning model that emphasises the need for continuous self-education and professional development of teachers [13, 28, 35]. There is also a push towards more learner-centred and competence-based approaches in education. The traditional teacher-centered model needs to be updated.

Another major trend is the rapid integration of information and communication technologies (ICT) into learning. Modern ICT tools like computers, multimedia, the Internet, and online platforms provide vast opportunities to make education more efficient, diverse, flexible and tailored to individual needs. However, the effective use of ICT requires teachers to obtain proper training.

Preparing future vocational training teachers for the transport field faces particular challenges. Their professional activities presuppose mastering complex technical knowledge and skills related to vehicle design, operation, repair, etc. At the same time, they need to apply modern ICT tools competently in their teaching practice. This necessitates the development of specialised electronic learning resources that combine substantive professional information with multimedia capabilities.

The paper presents the experience of creating and implementing the author's electronic educational methodical complex "Construction of car" in the learning process. It is aimed at vocational training of future professional education teachers in the transport field. The complex allows for organising active learning activities, studying professional knowledge, and forming ICT competencies. The prospects of improving such electronic resources are discussed. Their role in the modernisation of vocational teacher training is highlighted.

2. Theoretical background

The application of ICT in education has become an established research area. Many scholars have studied the pedagogical and psychological aspects of using information technologies in learning.

Kleiman [14] focused on the general theoretical principles and models of computerisation in education. The works by Mashbits [20] were dedicated to the psychology of computer-based learning activities.

A significant trend is the development of open educational resources (OER), which provide free access to learning materials. The concepts and features of OER were analysed by Butcher [4], Orr, Rimini and van Damme [27]. Bakhmat [2], Bykov and Shyshkina [5] studied the application of OER in teacher training.

Abdula et al. [1], Bilousova and Zhytienova [3], Fedorenko, Havrysh and Velychko [6], Hranovska and Laptyeva [8], Hrynevych et al. [9], Kazhan et al. [10], Kazhan and Karpiuk [11], Khomutenko [12], Kyslova and Slovak [15], Lavrentieva et al. [16], Leshko and Rykova [17], Markova [19], Merzlykin [21], Modlo and Semerikov [22], Nechypurenko et al. [23, 24], Neroda, Slipchyshyn and Muzyka [25], Nezhyva, Palamar and Marienko [26], Ovcharuk et al. [29], Prykhodko et al. [32], Rassovytska and Striuk [33], Shapovalov et al. [36], Sikora et al. [37], Striuk [38], Striuk and Striuk [39], Teplytskyi [40], Zhorova et al. [43] explored the classification and functions of electronic learning tools.

Many works focused explicitly on ICT use in vocational and engineering education. The

experience of implementing electronic textbooks, simulators, labs, and testing systems in vocational training was presented by Pavlenko et al. [30], Pohorielov [31].

However, developing and applying integrated electronic learning systems combining different digital resources for vocational teacher training requires further research.

This study aims to present the original electronic educational methodical complex (EEMC) "Construction of car" designed by the authors for training future vocational education teachers.

3. Theoretical background

Before presenting the main content of the developed authoring software, the most important approaches to solving this problem should be considered.

UNESCO defines ICT as technology 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 [42].

The "modern means of ICT" are interpreted by Robert [34] as programmatic and technical tools and devices that function based on microprocessing 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, new educational ICT means can be presented as the assemblage of tools and methods of information to ensure purposeful transmission, processing, storage, and display of the informational product (e.g., data, ideas, or knowledge). Additionally, ICT is supposed to be the application of different technical means, whose most crucial element can be represented as a computer.

Open educational resources are one of the innovations in the digital educational system of the last decades. The term "open educational resources" or OER denotes educational and scientific resources that are free to access or released with authorisation of their usage or modification by third parties. Orr, Rimini and van Damme [27] 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 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 work with open educational resources.

Bakhmat [2] 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 computerisation of the educational process. From the researcher's fair viewpoint, open educational resources have to unite the sites of all educational institutions and electronic

libraries and provide a system of distance learning and advanced training; they also must have simplified instruments to develop students' IT competency.

Loboda [18] classified the electronic learning tools into four types:

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

Accordingly, the means of ICT include hardware and software tools, such as digital devices, local computational networks, equipment performing input and output of information, the tools for archived storage of enormous amounts 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 the educational process realises the following opportunities [7]:

- Firstly, it creates a new specific type of educational activity, the so-called "developing educational and informational environment", which combines the properties of cognitive, communicative, playing, intellectual, and creative activities.
- Secondly, ICT provides 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 principles, compared to traditional learning methods.

According to Verbitsky [41], the introduction of ICT into the educational process denotes the beginning of the systemic reformation of the complete studying technology and, more importantly, 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 one to learn by studying material with the aid of active cognitive interaction. The application of simulative capabilities of computers as an instrument provides the possibility of transforming the substantive content to students and the capacity to deliberately appeal to the basis 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 advantages of modern teaching tools and solves the problem of vocational training specialists in the transport area of expertise.

4. Experience of learning process organisation with the use of authorial educational resources and apps

4.1. The content of the electronic course "Construction of car"

Let us examine the characteristics of realisation 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 study of the discipline "Construction of car", students make acquaintance with the appropriation, construction and principle of operation of modern automobiles and learn how to analyse the structure and work of the main parts of a 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).

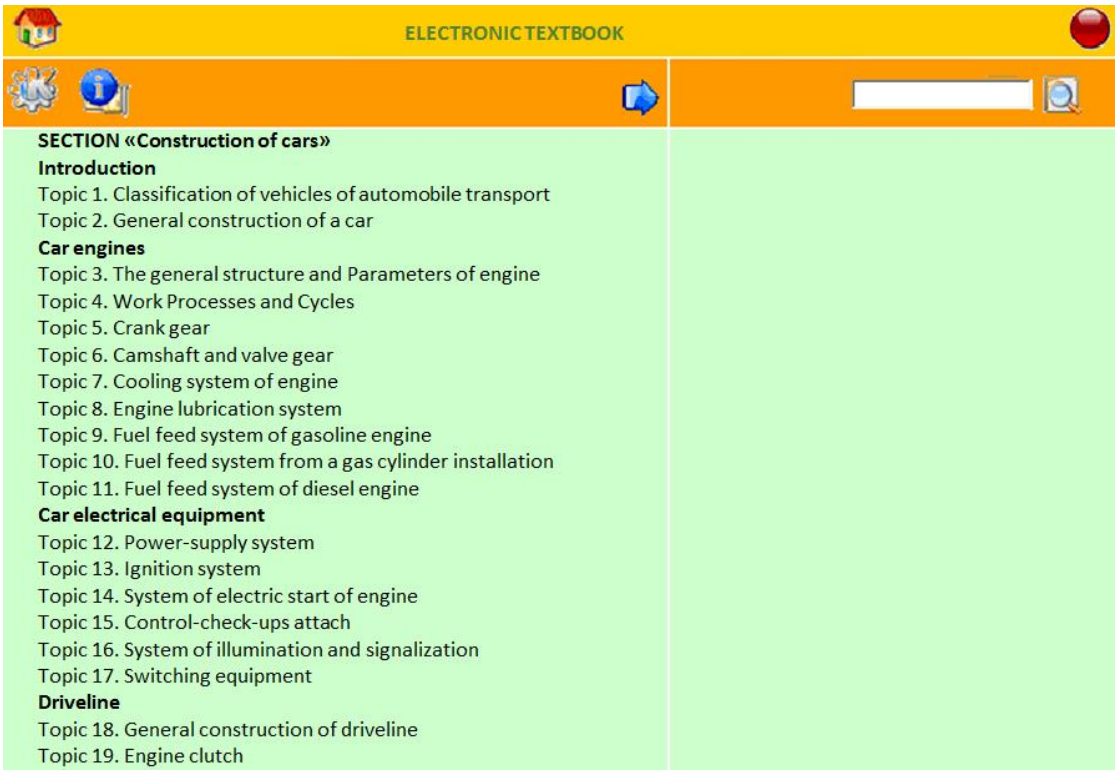

Figure 1: The content of the electronic textbook of EEMC "Construction of car".

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 programme window leads to the appearance of necessary educational information, whose perception is greatly facilitated (or extended) with

graphic components, footage, 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 contains 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), illustrated with full-colour graphic images (pictures), and complemented with footage to demonstrate the general arrangement of main automobile components.

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

The availability of additional buttons-icons (" "; " "; " "; " ") 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 the following ways:

1) in lecture classes for summarising or illustration of main ideas of new study material,
2) for the realisation 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 work), for the composition of reference papers, term papers, qualifying papers, whatsoever).

Execution of laboratory and practical research. Laboratory and practical classes are aimed at the revision of study material of the course "Construction of car", the shaping of practical skills and abilities to work with specialised equipment, hardware, and 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 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 signalising parts, clutches of coupling, speed-change gearboxes and transfer gears, drive axles, carriers of motorcars, handwheels of automobiles, brake gears, etc.

Dealing with the authorial EEMC "Construction of car", students have the opportunity to activate the particular 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).

The instruction is displayed on the screen with the activation of the necessary laboratory and practical tasks (by clicking on the appropriate title). It covers the list of the objectives of the work, the information concerning the material and technical means 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 authorised 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.

The completion of informational tables, the provision of demanded calculations, and the construction of graphical charts and diagrams are realised precisely in the active window of software with the possibility of outputting the obtained result in a printed form.

The inspection of students' academic achievements. For the realisation of the function of pedagogical control the structure of EEMC "Construction of car" provides for the controlling

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

and diagnostic module with the automated system of textual verification and the estimation of students' learning outcomes.

The implementation of the automated system of testing inspection allows for dealing with different types of tasks (ones with singular and multiple-choice, accordance and ranking tests, and ones with open answers) and various degrees of complexity. Work with the "computer tests" is possible at any stage of students' learning. However, it is predominantly used for revising academic achievements and the organisation and realising current and summarising knowledge ratings. With the activation of the automated testing inspection system, the user (a student or a lector) can 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 to all students for further analysis.
2. *Test-controlling* is for verifying and rating students' academic achievements concerning a

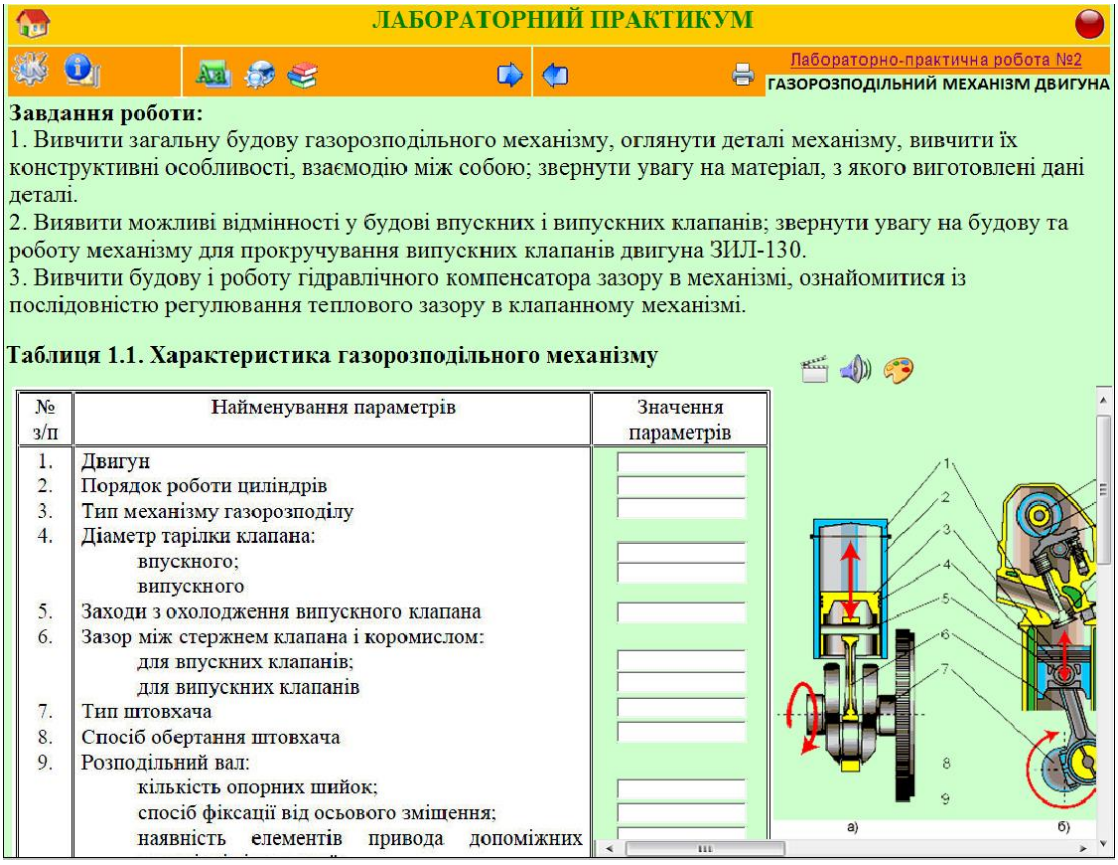

Figure 4: The active window of laboratory work number 2 “Gas distributive mechanism of the engine”.

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

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 with the brief instructions 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 can be seen in figure 5, the inferior part of 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,

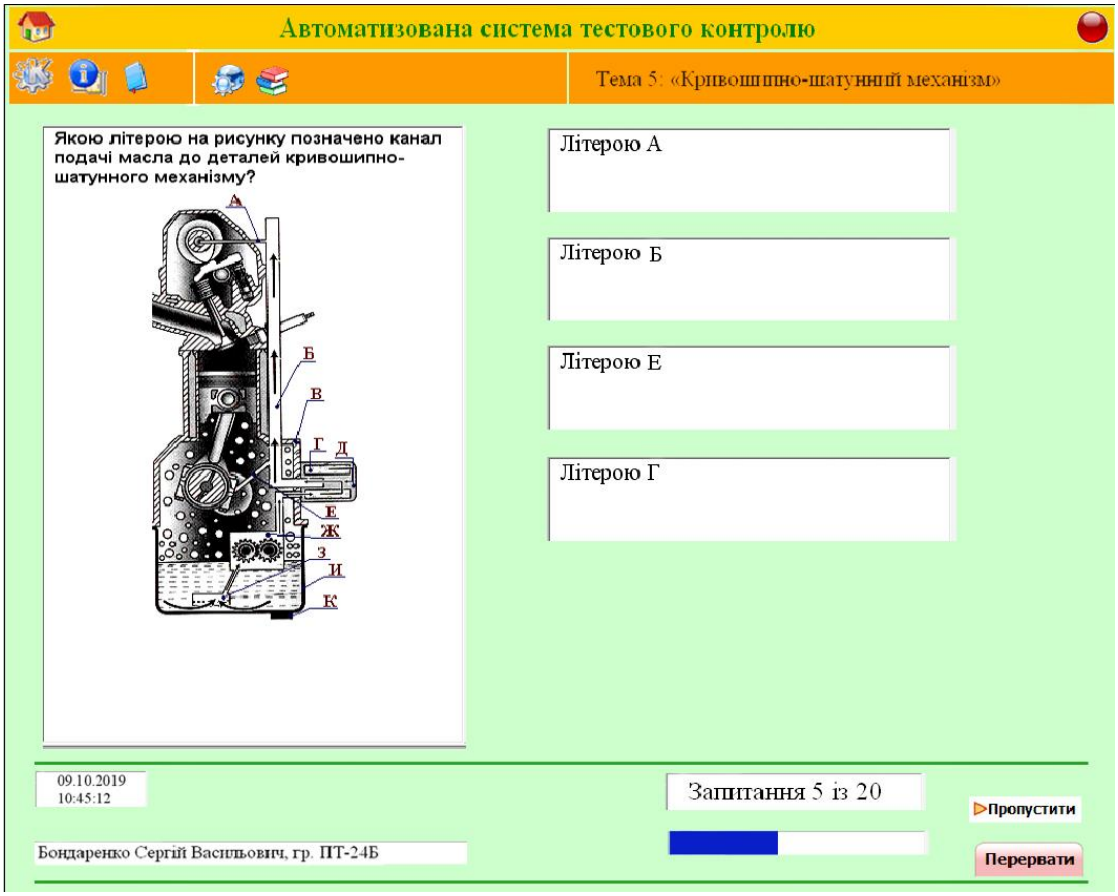

Figure 5: The active window of authorial EEMC in the mode "Automated system of testing control".

the app's window covers the special controlling buttons, which allow skipping the current testing task, which will be repeatedly loaded at the end of a diagnostic procedure, along with the possibility of abruption of the testing procedure by quitting the mode of automated testing control.

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

Instructive and methodical materials (recommendations, 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 advised to get acquainted

with the recommended literary sources (or web sources), 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 student's 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. Mainly, they are a) the overview of the construction of crank-and-rod mechanisms of automotive engines, b) the 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 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 rating the quality of electronic educational editions, including via research and experimental, competent, or complex types of estimation.

The quality of the authorial EEMC "Construction of car" was rated using the method of competent estimation. In the mentioned case, among the experts who evaluated the material were 12 scientific and pedagogical staff of Dragomanov Ukrainian State 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 student's individual study trajectory.
- The possibility of selecting 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 managing multimedia means and other things.

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

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

	Criteria of EEMC estimation										
Experts	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
$\overline{X}$						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					

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

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

where n is the general quantity of estimation criteria ($n = 11$);
m is the general amount of experts ($m = 12$);
S is the total sum of deviation squares of rank sums from the mid score;
T_i is the complementary quantity that causes the manner of experts' estimations.
The last index T_i was calculated in line with the formula:

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

where L is the total quantity of groups of the identical experts' estimations;
t_i is the number of 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 the following:

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

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:

$$T_i = \sum\nolimits_{l_i=1}^{L}\left(t_i^3 - t_i\right) = T_1 + T_2 + T_3 + T_4 + T_5 + T_6 + T_7 + T_8 + T_9 + T_{10} + T_{11} + T_{12} =$$
$$= 36 + 30 + 30 + 30 + 30 + 54 + 36 + 30 + 36 + 54 + 54 + 30 = 450.$$

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), remarkably: of the sum of ranks (S_j) for each one of the criteria of estimation, the mid score of the sum of ranks $\left(\overline{X}\right)$, 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 the formulas:

$$S_j = \sum_{i=1}^{m} X_{ij}; \qquad \overline{X} = \frac{\sum\limits_{j=1}^{n} S_i}{n}; \qquad d_j = S_j - \overline{X}.$$

Consequently, it can be taken:

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

The concordance index of the experts was equal to the:

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

The result confirms the high degree of concordance of all experts' estimations of the authorial EEMC "Construction of car".

The 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 (χ^2), which is calculated via the formula:

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

The empiric amount of Pearson criterion surpasses the tabular one $\left(\chi_m^2 = 19.68\right)$ 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

The research allowed making several key conclusions about the application of the author's electronic educational methodical complex "Construction of car" in vocational training of future vocational education teachers:

- Using the EEMC increases students' motivation and engagement in learning activities due to the interactive multimedia format, autonomous work features, and visualised presentation of study materials.

- The EEMC develops future teachers' representational thinking through computer graphics, animations, videos and other visual aids that facilitate the comprehension of complex technical concepts.
- Working with the EEMC contributes to building students' informational culture, their skills in navigating and processing digital resources, and their readiness to creatively apply ICT in teaching.
- The competent estimation method confirmed the overall high quality of the EEMC according to the criteria of content, structure, interactivity, multimedia capabilities, and navigation.
- Prospects for further enhancement of the EEMC include adding more possibilities for differentiated learning, individual learning paths, feedback tools, and advanced multimedia features.

The obtained results highlight the benefits of using integrated electronic learning systems like the EEMC in training future vocational education teachers on transport specialities. This improves the effectiveness of mastering professional competencies and builds readiness for using ICT in teaching practice, which is crucial in the digital world. The practical experience described in the paper can serve as a model for developing similar e-learning resources and courses in vocational teacher education.

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