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THE INTRODUCTION OF THE ELECTRONIC FORM OF CONTROL MEASURES AS A MEANS OF CORRUPTION PREVENTION IN HIGHER EDUCATION

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УПРОВАДЖЕННЯ ЕЛЕКТРОННОЇ ФОРМИ КОНТРОЛЬНИХ ЗАХОДІВ ЯК ЗАСОБУ ЗАПОБІГАННЯ ПРОЯВАМ КОРУПЦІЇ У ВИЩІЙ ШКОЛІ

Purpose. To prove the necessity of introduction of the electronic testing and examination system as an effective means of the corruption prevention in higher educational institutions; description of the methods of computer-aided system of summative assessment of knowledge for students receiving higher education in different disciplines, which allows comprehensive estimating of the degree of knowledge of academic material and ability to solve creative problems.

Methodology. Theoretical methods: psychological-pedagogical and theoretical-methodological analysis. Empirical methods: modeling, research and generalization of educational experience, experiment, survey.

Findings. The method of electronic examinations and tests has been developed. The computer-aided system of students' academic progress summative assessment developed by the authors has been introduced in the learning process of the university. The system is cost-effective, user friendly, has low system requirements for hardware, and allows documenting examination results and saving the documents to archives. The system allows avoiding the influence of a teacher's attitude on students' marks through anonymous assessment of creative tasks of different kind. It provides the comprehensive and objective control and estimation of students' knowledge, encourages the self-discipline of both students and professors, motivates the students to work harder, and prevents corruption during the examinations.

Originality. The computer-aided system of students' knowledge control in different disciplines, which provides the ability to perform creative tasks with optional degree of complexity, has been designed.

Practical value. The introduction of the results into educational activities of higher educational institutions may improve students' educational progress.

Keywords: *electronic examinations and tests, electronic examination card, computer-aided system, summative assessment of knowledge*

Statement of the problem. Nowadays, the corruption in the higher educational institutions is one of the most pressing problems of higher education in Ukraine. Traditional methods of control of corruption appeared ineffective as applied to this sphere. In Ukraine, quite a few higher educational institutions are venal. "Young people who have passed through a corrupt education system in the future will use the corruption principles in their lives; they will consider them as normal means of business; they will teach their children, in doing so they will create a kind of

vicious circle in the state" [1]. At the state level, the corruption in the higher educational institutions is caused by the failure in fulfillment of several laws of Ukraine, in particular, Articles 57 and 61 of the Law "On Education" concerning the medium salaries of teaching staff of higher educational institutions, public provision of budgetary allocations for education and for scientific researches, programs and projects.

There can be differentiated three stages of corruption in higher educational institutions in: 1) at entry; 2) during study period; 3) during postgraduate studies, obtaining academic degrees and academic titles. At the first and the

third stages, the problems are solved at national level through introduction of the independent external evaluation and through reorganization of the Higher Attestation Commission (НАС) into the Personnel Certification Department and introduction of a new order of scientific degrees awarding. While the second stage remains out of control due to the ineffectiveness of the corruption therapy at the level of university. Summarizing foreign and domestic experience in solving this problem, we believe that the main role in the fight against corruption at the level of higher educational institutions should be played by the modernization of the control over the academic progress of future specialists. We offer an experimentally proven way to prevent corruption at the university level, which is the introduction of the automated system of students' knowledge control during exams and tests.

The analysis of previous researches. Many domestic and Russian scientists focused their researches on the determination of the causes that give rise to the corruption in the sphere of higher education and the methods of corruption therapy. According to them the main ways to control the problem in the system of higher education are: enhancement of the value and quality of higher education (I. Hrynova, V. Kipen, A. Pishchulina); action of society against corruption (O. Hryvtsova, B. Dovnych, V. Doroshenko, O. Pishchulina, O. Safronova); harsher punishment for corrupt practices (V. Herasymchuk, I. Minetska, O. Medvedko); arranging the government orders to meet the market demand (M. Boikova, O. Dluhopolskyi, A. Yu. Zhukovska, A. Meleshevych); higher educational institution network optimization (Ye. Halytskyi, V. Dobrenkov, M. Levin, K. Chukhlib); improvement of teaching staff financial security (A. Vronska, I. Hrinova, V. Zavinovskiyi); changes in the educational process of higher educational institutions (D. Vysotskyi, A. Voiko, B. Dovnych, S. Zhydko, Ye. Sulyma). IIEP leading experts, Zh. Allak and M. Poisson, devoted 356-page recommendations on fulfillment of the above-mentioned solutions. [2] However, Ukraine lacks effective mechanisms for their implementation. One of those mechanisms is the introduction of electronic forms of knowledge control into the educational process.

This mechanism is quite popular abroad, but still is not widespread enough. In particular, in Germany, at the Universities of Mainz and Bremen the share of electronic examinations makes 25 and 16 % respectively. Moreover, in 2011, the University of Hamburg closed its project of implementation of electronic forms of control. Holger Fischer, the Vice-President of the institution, gave weight to electronic exams, but reasoned that the project had been terminated due to the lack of funds for the expensive software purchase and the creation of new jobs for technical staff.

Ukrainian scientists, A. Biloshchytskyi, V. Hohunskyi, Ye. Kataieva, I. Merkusheva, Yu. Popovskiy, Yu. Teslia, V. Khmelnytskyi, O. Yakovenko and others worked on the implementation of the technologies of knowledge control by means of modern computer systems. Ukrainian universities started using the advanced scientific developments actively in their educational process. At the Cherkasy State Technological University, they created the software

for the information management system for training and monitoring of students' knowledge, the typical electronic test system called TEST. At Vasyl Stefanyk Precarpathian National University, they developed the program of computer adaptive testing based on the Rasch model. At the Vinnytsia National Agrarian University, they use the "Thesaurus" automated system of education and knowledge control. The system was designed for self-training and automated testing in the "Intranet VSAU" educational network and on the Internet. At Petro Mohyla Black Sea State University, they have developed and use the VOLKON intelligent information system for final control of students' knowledge, containing the module for tests preparation, administration module, the module for test sessions, the module for statistical analysis of the test results, help module and the module for tests quality verification. Lviv Polytechnic National University, Alfred Nobel University, Kherson State Technical University, Kharkiv National University of Radio Electronics, Odessa National Polytechnic University and other universities of Ukraine are developing their software for knowledge control.

Formulation of the unsolved problem. Existing means of automated control of knowledge can be used in universities more or less effectively. However, they are mainly used for the intermediate control of knowledge on specific topics, courses or exams (tests), mostly for humanitarian subjects. The preparation of the electronic examination cards for nature, math and technical sciences, which contain large amount of information that is difficult to formalize, is the most challenging task. In addition, available systems of automated control of knowledge are mostly focused on the execution of different types of tests, and have limited opportunities to perform different types of creative tasks.

The formulation of the research objectives. Substantiation of the necessity of introduction of the electronic testing and examination systems as an effective means of the corruption prevention in higher educational institutions; description of the methods of computer-aided system of summative assessment of knowledge for the students receiving higher education in different disciplines, which allows comprehensive estimating of the degree of knowledge of academic material and ability to solve creative problems.

The main material. The existing traditional system of knowledge control is subjective, which causes corruption at this stage of the learning process. The introduction of the automated knowledge control systems may allow significant reduce of the professors' personal influence on students' grades in the higher educational institutions.

The methodology of implementation of the automated knowledge control systems requires the following stages: preparation stage (preparation of exercises and tests); work stage (summative assessment of knowledge using the prepared tasks or the existing basic functions); and the results analysis stage. The result produced by the automated system is an academic progress record.

The automated knowledge control system consists of:

1. Dataware, a set of uniform system of classification and coding of messages, unified documentation systems, schemes of information flows that circulate in the system, and methodology of database creation.

2. Hardware, technical facilities intended for information system together with the appropriate documentation for these processes and tools.

3. Orgware, a set of tools and methods that regulate the interaction of employees with technical facilities and to each other during the development and exploitation of the information system.

4. Software, a set of programs, algorithms for the implementation of the objectives and tasks of the information system and the proper functioning of the hardware [3].

To ensure the universality of the automated knowledge control system we have paid much attention to the software selection. It has to allow the automated knowledge control system to meet the following requirements:

- economic expediency of introduction;
- low hardware requirements;
- openness of the system and accessibility for users;
- passwords setting to prevent unauthorized access to the system;
- wide applicability (the possibility to prepare examination cards on different disciplines);
- ease of knowledge monitoring management in the educational process and usability for teachers and students;
- convenience in the management of tests databases and ability to create tests of different types and content, using audio, video files and formulas of any complexity;
- availability of the systems for collecting and processing of statistical information on test results;
- confidentiality of the knowledge control;
- control over the time spent on the fulfillment of each task or an examination card in whole;
- allow for both automatic or manual estimation of fulfilled tasks depending on the goals;
- convenient marking scale (of any kind, including 5-point, 100-point scale) and display of the results as a percentage of correct answers;
- allow a moderator to comment on the completed tasks;
- allow for the students' access to the results of assessment of all tasks of their examination cards;
- execution of the knowledge control records and archive storage.

According to the listed requirements and being supported by the researches of B. Demyda, S. Sahaidak, I. Kopyl, S. Sysoieva, and K. Osadcha [4; 5], we carried out the comparative analysis of the most frequently used open source systems of distance learning: ATutor, Claroline, Live@EDU, Moodle, SharePointLMS, eFront, Lotus Learning Space, Blackboard Learning System, e-University, Redclass, Prometei, Virtualnyi Universytet, Web-class KhPI, Hekadem. We have analyzed the methodological support and the possibilities of the existing automated knowledge control systems, expenses on their implementation and have chosen the Moodle freeware. It was employed to create examination and test cards.

In 2014, the developed automated knowledge control system was implemented at Vinnytsia Institute of Trade and Economics of KNTEU during summative assessment of 1–5-year intramural students' knowledge in all subjects (Economic Cybernetics, Operation Research, Mathematical Modeling in Economics, Information Systems and

Technologies, etc.), which were taught at the department of Economic Cybernetics and Information Systems. Teaching staff of the department took part in the development of electronic examination cards; they were engaged in anonymous verification of certain tasks, and served as consultants during the electronic examinations and tests.

We specified the following requirements to the electronic examination card: excellent visual perception, ease of work with computer program, ensuring thorough testing of knowledge in a discipline, ability to perform creative tasks depending on the characteristics of the course. All these requirements have been effectively implemented by the system Moodle. Since the Moodle technical documentation is open to public, the only thing we have to describe is what we have implemented using its capabilities.

The process of the electronic examination card creation started with the compilation of the Question Bank. The questions were organized into Categories. Before entering a question, one had to choose the proper Category and the Question Type. The Moodle system allows using several types of questions [6]:

1. Multiple Choice, a question that requires selecting one or more correct answers (its working title is 'choise from a variety').

2. True/False question, gives only two choices for an answer: "true" or "false".

3. Short-Answer question, it requires filling in the gaps; one should enter a short phrase in response to a question; it may allow for several acceptable answers (with different grade).

4. Numerical question, the answer to this type of question is a number; it can have a preset interval of the accepted error or deviation from the correct value.

5. Calculated question, it requires calculation of a value by a given formula with wildcards, which are substituted with random values from a preset range when the quiz is taken.

6. Gap-fill question, it requires filling in the gaps in the text of the question.

7. Substitution question, where a student receives a text or a formula, in which he/she should substitute words, numerical values or symbols.

8. Matching question, it has a list of names or statements, which must be correctly matched against another list of names or statements.

9. Essay question, the answer can be a link or a file uploaded (its working title is 'manually graded exercise'); questions of this type have to be reviewed and graded manually.

By virtue of the 'manually graded exercises', students were able to fulfill creative tasks by uploading files with answers, which contain figures, screenshots, mathematical expressions, audio and video, diagrams, etc.

After the Question Bank was filled, the creation of electronic examination cards started. The variety of question types allowed us to consider characteristics of each discipline taught at the department.

To ensure thorough testing of knowledge in a discipline, the structure of the electronic examination card consisted of four parts: close-end questions test, open-end questions test, matching question, creative task. An examiner determined the number of exercises of each type considering the

individual characteristics of the discipline. The examiner selected only the Type and the Category of the question, and in course of the summative assessment, the computer generated the very question randomly. Consequently, the structure of all examination cards of a discipline was similar but the content was different. The examiner also determined the number of points for each exercise (a student received the maximum number of points for the fulfillment of the creative task) and the way of assessment (automatically or by the examiner). In order to avoid the token approach to the acquisition of knowledge, the examiner graded the creative task and some open-end questions tests. In Fig. 1, there is the screenshot of the process of grading of an open-end questions test in the discipline Mathematics for Economists by the examiner. A student enters his solution of the task in the box under the task. In the process of verification, the examiner can enter his comments on the student's solution and type his mark into the Mark box, next to which the maximum number of points for the task is specified. The marking process was anonymous.

The Fig. 2 presents an example of automatic marking of a student's solution of a Matching question.

The results of the electronic examinations and tests were added to the Moodle database archive. When the verification was completed, students were able to look

through their results and analyze the errors made whenever convenient to them.

Because of a large variety of tasks, the created electronic examination card appears less monotonous for students. Thus it meets the requirements of the world's leading experts (including the specialist in psychodiagnostics, Paul Kline), who highlight the necessity of the combination of the tasks of different kind when estimating the knowledge level. However, the time spent on the electronic examination was the same as for the traditional written examination, one class, regardless that it is harder to perceive the information from the screen than from the paper. The properly organized navigate on through the examination card allows preventing the time loss.

The Fig. 3 presents a piece of an electronic examination card that contains 20 tasks; a student can solve them in a random order by clicking the number of a question in the Quiz Navigation window. The labels of the fulfilled tasks become colored while the rest remains white. The Fig. 3 shows an example of the verified examination card. None of the verification work is done until the quiz is completed. The results of the examination become available for students only after the moderator finishes verification. The labels of the tasks with correct solutions become green, same with incorrect, red, partially solved ones become yellow.

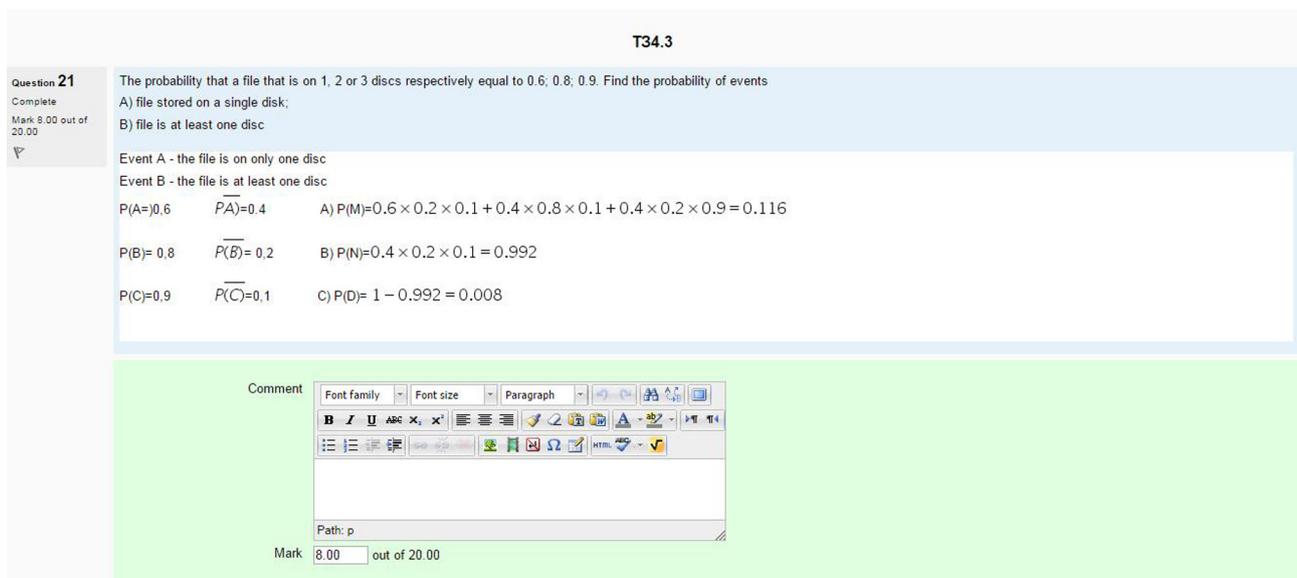


Fig. 1. Manual marking of a test by an examiner

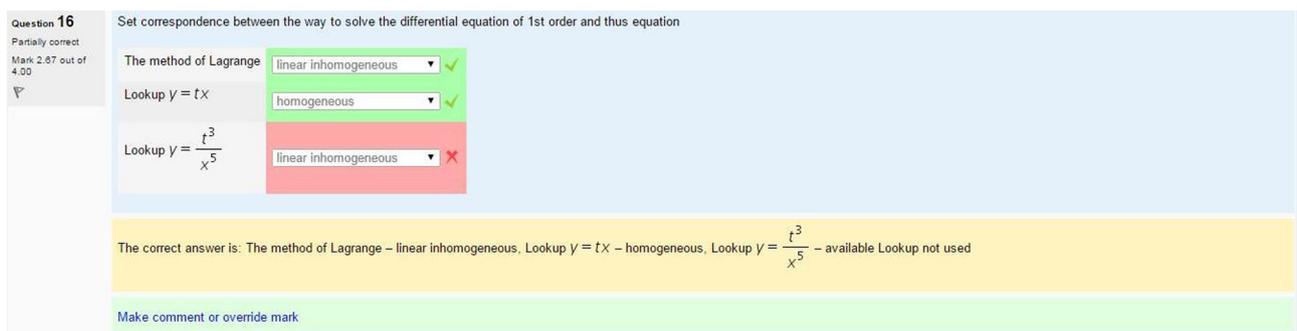


Fig. 2. Computer-marked test

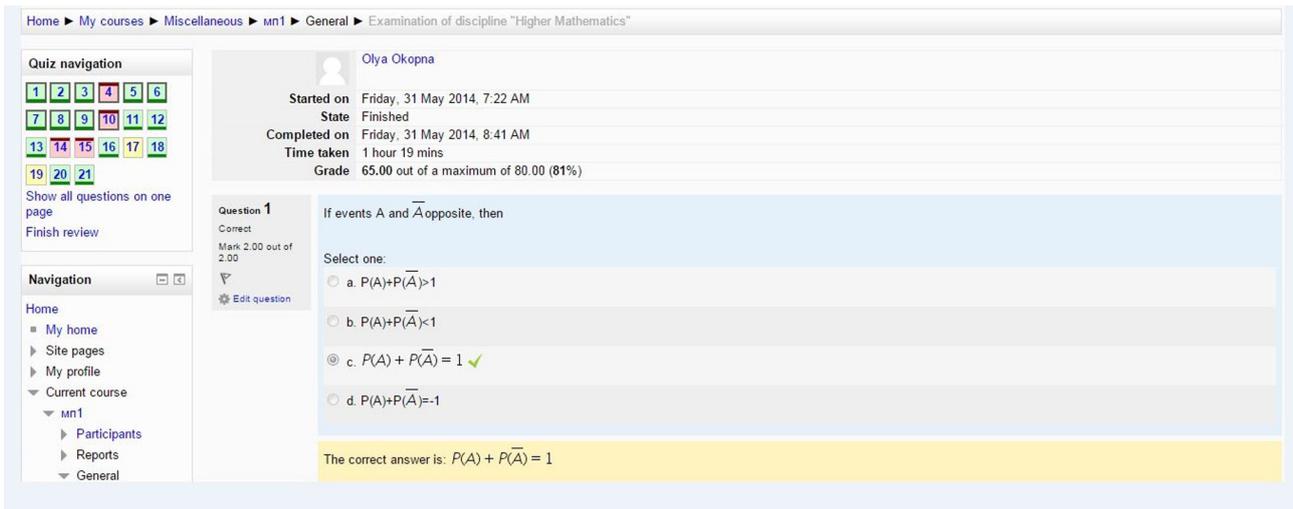


Fig. 3. Examination card navigation

Students have 1h 20 min to solve all tasks. When the time is over the card is closed up and saved automatically (this function should be preset on the stage of the card creation otherwise all information will be lost) and is sent to the main computer.

Thus, the suggested navigation system is quite user-friendly.

The software of the electronic examination card is simple; it is enough for a student to have basic computer skills.

After the examination period was over, a private poll has been held between the students, who were quizzed by means of the automated knowledge control system. The private poll has found that 94 % of students were satisfied with the suggested form of examines and tests and confirmed that it gave an unbiased assessment of their knowledge, regardless the personality of the examiner.

There should be mentioned that the comparative analysis of the academic performance (according to the data of the examination and test records of the current and the previous examination periods) showed that the values of the academic progress increased by 2–8 % and those for the quality of knowledge increased by 3–12 % almost in all disciplines, although, during the period of examination by the automated knowledge control system, there were no additional efforts on the students' knowledge improvement. Fig. 4 compares the quality of knowledge in the Mathematics for Economists discipline of the students, whose major subject is Finance and Credit, Accounting and Audit, and Economic Cybernetics by the data obtained in the experimental year (2014) and the previous year.

The stated improvements may be caused by the following:

From the students' side: they were aware that at the exam or test, there would not be an opportunity to cheat, bribe, rely on the fellow students' help, and they have to lot upon their own knowledge.

From the professors' side; they were excited about the coming electronic summative assessment of knowledge and interested in the good results of the students, so they taught the material well during the semester.

Thus the introduction of the electronic examinations and tests, in our opinion, has many advantages, namely:

- anonymous estimation of creative tasks of different type;
- comprehensive and objective control and estimation of students' knowledge;
- encouragement of the self-discipline of both students and professors;
- motivation of the students to work harder;
- prevention of the corruption at the corresponding stage of education process.

Conclusions and prospects for further research. The experience of the introduction of the automated knowledge control system has proved its effectiveness. It allowed for rising the summative assessment of knowledge to a new level (through maximum automatization of the process), creating the electronic examination cards for different disciplines, providing anonymous and objective estimation of creative tasks of different types. Since examination results were not affected by the personal attitude of an examiner, the approach contributed to the corruption prevention at the stage of summative assessment of students' knowledge.

Further research may concern the development of the high-quality cost-efficient open source software with the involvement of artificial intelligence in the creative tasks estimation process.

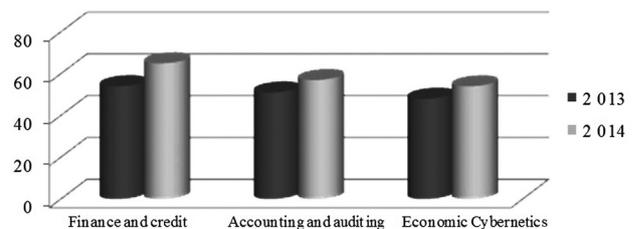


Fig. 4. Comparison of the quality of knowledge (%) by the results of the examination in the discipline Mathematics for Economists passed by the students of the Finance and Accounting faculty

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Мета. Обґрунтування необхідності введення системи електронного прийняття іспитів та заліків як дієвого засобу запобігання проявам корупції у ВНЗ, опис методики проведення автоматизованого підсумкового контролю знань здобувачів вищої освіти з різних дисциплін, що дозволяє здійснити всебічну перевірку ступеня засвоєння навчального матеріалу та вміння розв'язувати творчі задачі.

Методика. Теоретичні методи: психолого-педагогічний та теоретико-методологічний аналіз. Емпіричні: моделювання, дослідження та узагальнення педагогічного досвіду, експеримент, анкетування.

Результати. Розроблена методика проведення електронних іспитів та заліків. Впроваджена до навчального процесу авторська автоматизована система підсумкового контролю знань студентів ВНЗ, що є економічно доцільною, зручною у використанні, має низькі системні вимоги до технічного забезпечення, дозволяє оформлювати документацію з контролю знань і зберігати її в архівах. Дана система запобігає можливості впливу викладача на виставлення оцінки завдяки наявності анонімної перевірки різного виду творчих завдань, забезпечує системність і об'єктивність контролю та оцінювання знань, організовує та дисциплінує як студента, так і викладача, спонукає студента сумлінно працювати та запобігає проявам корупції під час екзаменаційної сесії.

Наукова новизна. Полягає в розробці автоматизованої системи контролю знань студентів з різних дисциплін, що забезпечує можливість виконання творчих завдань довільного ступеня складності.

Практична значимість. Використання отриманих результатів у практиці ВНЗ дозволяє підвищити навчальний рівень студентів.

Ключові слова: електронні іспити та заліки, електронний білет, автоматизована система, підсумковий контроль знань

Цель. Обоснование необходимости введения системы электронной сдачи экзаменов и зачетов как действенного метода предотвращения проявления коррупции в ВУЗах, описание методики проведения автоматизированного итогового контроля знаний студентов по разным дисциплинам, которая позволяет осуществлять проверку степени усвоения учебного материала и умений решать творческие задания.

Методика. Теоретические: психолого-педагогический и теоретико-методологический анализ. Эмпирические: моделирование, исследование и обобщение педагогического опыта, эксперимент, анкетирование.

Результаты. Разработана методика проведения электронных экзаменов и зачетов. Внедрена в учебный процесс авторская автоматизированная система итогового контроля знаний студентов ВУЗов, которая является экономически целесообразной, удобной в использовании, имеет низкие системные требования к техническому обеспечению, позволяет оформлять документацию по контролю знаний и сохранять ее в архивах. Данная система предотвращает возможность влияния преподавателя на выставление оценки благодаря наличию анонимной проверки различного вида творческих задач, обеспечивает системность и объективность контроля и оценки знаний, организует и дисциплинирует как студента, так и преподавателя, побуждает студента добросовестно работать и предотвращает проявления коррупции во время экзаменационной сессии.

Научная новизна. Состоит в разработке автоматизированной системы контроля знаний студентов по

различным дисциплинам, которая обеспечивает возможность выполнения творческих заданий различной степени сложности.

Практическая значимость. Использование полученных результатов в практике ВУЗов позволяет повысить образовательный уровень студентов.

Ключевые слова: электронные экзамены и зачеты, электронный билет, автоматизированная система, итоговый контроль знаний

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ENCHANTMENT OF THE INFORMATION COMPONENT OF INNOVATION DEVELOPMENT OF INDUSTRY

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ПІДСИЛЕННЯ ІНФОРМАЦІЙНОЇ СКЛАДОВОЇ ІННОВАЦІЙНОГО РОЗВИТКУ ПРОМИСЛОВОСТІ

Purpose. Definition of the complex of formal and informal measures, the implementation of which requires enhancement of an information security mechanism for innovation processes, the application of which contributes to the development of intellectual capital of enterprises, improvement of employees knowledge, and activation of management processes.

Methodology. To achieve this goal we applied the theoretical generalization and systematization (for specification of enterprises' innovation investment pattern and significance of information security of innovation processes); theoretical and methodological analysis and expert assessment (for determination of the measures intended to enhance the information component of innovation and develop the mechanism on their basis); method of expert evaluations, induction and deduction, analysis and synthesis (for determination of the results expected from the implementation of a range of formal and informal activities).

Findings. Summarizing the role of the information security of the innovative processes at enterprises and determining the measures for its enhancement, which suit the current trends in the information support of the industry innovation processes and consider the motivational effect on the employees, the mechanism of strengthening the information component of innovation has been developed.

Originality. The mechanism of enhancement of the information component of innovative development has been substantiated. It takes into account the improvement trends for information support of industrial innovative development based on the use of investment resources.

Practical value. The mechanisms of enhancement of the information component of innovative development and the recommendations on the use of cloud platforms for information storage, software development and information systems, choice of reliable providers, formation of training programs for innovators, network expansion for Patent centres, integration of security and marketing teams for information-analytical work, insurance of career and education based on legislative changes complying with applicable laws and regulation requirements and standards of the EU, can be used in the enterprise management practice.

Keywords: *innovative development, mechanism, information security, investment, cloud platform, providers, motivation*

Introduction. To revitalize the innovation development, the process of attracting investments and their rational use are becoming of great importance. As it is known, every company has the right to attract and use investment resources. Whether the objectives of investment projects will be achieved, whether real and financial assets will develop, whether the innovative process will be supported etc. depends on the investment level. Nevertheless, the process of attracting investments becomes a priority for domestic enterprises; it has been studied in detail in the literature in terms

of the economy, the impact of crisis and other negative phenomena on it, virtual investment objects etc. Therefore, the process of using investment resources and search for ways of its improvement in terms of innovative development of the national economy should be carefully examined.

Analysis of the recent research and publications. The issues regarding innovative development have been thoroughly investigated and processed in the publications of domestic and foreign scientists. Among them are Ponomarenko V.S., Grinyova V.N., Lyubimov V.I., Petrovich J.M., Feier O.V. and others. In particular, the scientists studied areas of innovation development mechanism and uses of investment resources etc.