Chapter 3
Modern management technologies

APPLICATION OF INNOVATIVE SMART TECHNOLOGIES OF VIRTUAL REALITY IN BUSINESS EDUCATION AS THE BASIS OF QUALIFIED PROFESSIONAL PREPARATION OF FUTURE MANAGERS

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Abstract. *The article describes the possibilities of using one of the promising educational methods offered by modern informational technologies – virtual reality, which is modeled with special computer equipment. The authors of the article substantiate the possibility of using virtual reality technologies in the educational process to improve the quality of professional preparation of future managers. In the era of information and communications technology one of the modern needs is to create a virtual learning environment. Virtual learning environment is created and developed for effective communication of all participants in the educational process. Information and communication technologies now make it possible to use electronic versions of printed books, textbooks and manuals, or a new type of (multimedia tools that use a computer, a multimedia projector and sensor board) for the educational environment. The definition of the essence and classification of types of innovations in education are given. The notion of "smart-learning" is defined and the prospects of its application are described. The experience in using the virtual reality technologies in the educational process is systematized and generalized. In addition, the views of various scholars on the essence and characteristics of the virtual educational environment are analyzed in the article. The application of methods of modeling and management of business processes at practical classes of students-managers is substantiated. The author's definition of the concept of manager's readiness for professional activity is offered. The pedagogical model of application of smart technologies of virtual reality in the educational process is developed. The authors describe the main results of their pedagogical experiment on the possibilities of using smart-technologies of virtual reality in the educational process of professional preparation of students-managers. The results of the experiment are substantiated by statistical calculations, formulas, tables. It is proved that the usage of smart technology of virtual reality helps to increase the level of quality of future managers' professional preparation and their readiness to professional work.*

Keywords: *educational innovation; virtual reality; smart-learning; pedagogical technology; teaching method; student-manager.*

JEL Classification: A20, B40, C40

Formulas: 4; fig.: 1; tabl.: 3; bibl.: 25

Introduction. Reforming of the education field requires the reconsideration of classical pedagogical technology and the transition to the realization of smart-education ideology aimed at gaining professional competencies among young professionals.

Outdated pedagogical technologies do not allow developing professional skills, creativity skills, non-standard approaches to solving problems and professional issues of future specialists of economic specialties. It is necessary to teach future managers to model economic processes of production, marketing and logistics, to make management decisions in the conditions of choice of options of development of events.

To solve this problem it is proposed to apply one of the promising directions of modern innovative learning tools – creation of a new educational environment – virtual reality, which is modeled by special computer equipment and is considered as an informational environment in which all the objects are presented in three dimensions, and the user can interact with them. Virtual reality in studying simulates both the impact and the reaction to the impact of different phenomena, objects, processes that can be modeled and modified.

The usage of smart-technologies of virtual reality in business education will make practical lessons more engaging, visual for students and improve the quality of professional preparation of future managers.

Literature review. The problems of development of innovative processes and e-learning in the educational field are devoted to a considerable number of scientific works of domestic scientists: V.H. Kremen, V.I. Zahviazynskyi, M.V. Klarin, I.P. Pidlasyi, S.D. Poliakov, A.I. Pryhozhin, V.O. Slastionin, S.O. Sysoieva, P.I. Shchedrovytskyi and others.

The peculiarities of application of virtual education are considered in the works: S.V. Aksionova, N.M. Hnedko, A.A. Zasiekina, R.O. Pavliuk, A.N. Petrytsia, S.H. Lytvynova and others.

Opportunities for virtual educational technologies are being explored by foreign scientists as well: Abulrub A., Billinghurst M., Bricken M., Chee Y., Hsieh M. C., Mantovani F., McLellan H., Virvou M. and others.

McLellan H. [1] provides comprehensive and in-depth reviews of the literature related to the research and use of virtual reality for education and training in editions.

Mantovani F. [2] discusses these potential benefits of the use of VR in education and training: visualization and reification, an alternate method for presentation of material; learning in contexts impossible or difficult to experience in real life.

However, we have not found any scientific papers on the features of the usage of smart-technologies in the teaching of managers or virtual and augmented reality technologies in business education.

Aims. The aim of our research is to substantiate the possibilities of applying of innovative smart-technologies of virtual reality in business

education as means of improving the quality of professional preparation of future managers.

Methods. Methods of scientific researches which were used in the given work: general scientific – analysis, synthesis – to explore the problem of using virtual educational technologies; empirical – pedagogical experiment; modeling to build a model of virtual educational technologies in the training of student-managers; mathematical – graph-analytical and mathematical-statistical – to analyze the results of a pedagogical experiment, to evaluate the quality of teaching.

Results. Education and science are becoming the priority factors of the development of the socio-economic, spiritual and political life of any country. Today, the determining factor of the country's wealth is knowledge. Due to these conditions, the problem of innovation in the field of knowledge becomes especially important [3].

What is new in pedagogy is not only ideas, approaches, methods, technologies that have not been promoted or used in such combinations yet, but also that complex of elements or individual elements of the pedagogical process that have a progressive beginning that enables to solve the problems of upbringing and education effectively in the course of changing conditions and situations [4].

Innovation, in the context of pedagogical process, means the introduction of something new in goals, content, methods and forms of education and upbringing, organization of common activities of teacher and student.

Pedagogical innovation – innovations in pedagogical activity, changes in the content and technology of teaching and upbringing, aimed at increasing of their effectiveness [5].

Innovation in learning means new teaching methods, new ways of organizing of lessons, innovations in the organization of educational content (integration (cross-curricular) programs), methods of assessing of educational results.

There are eight ranks (orders) of innovations in education [3]:

- zero-order innovations that divine the practical regeneration of the primary character of the system (reproduction of the traditional educational system or its element);
- first-order innovations characterized by quantitative changes in the system with constant quality;
- second-order innovations, which are the regrouping of system elements and organizational changes (for example, a new combination of well-known pedagogical tools, changing of the sequence, rules of their usage, etc.);
- third-order innovations characterized by adaptive changes of the educational system in new conditions without going beyond the old model of education;
- fourth-order innovations that contain a new solution (these are often simple qualitative changes in individual components of the educational system, which provide some expansion of its functional possibilities);

– fifth-order innovations that initiate the creation of "new generation" educational systems (changing of all or the majority of the primary character of the system);
– sixth-order innovations that result in the creation of new-look educational systems with a qualitative change of the functional character of the system while maintaining the system-functional principle;
– Seventh-order innovation, which is a major, fundamental change in educational systems, during which the basic functional principle of the system changes [3].

Among the most famous innovations in education are the following: smart-education with the help of virtual and augmented reality technologies.

Let's consider the features of smart-education and its opportunities.

Smart-education is flexible learning in an interactive educational environment with the help of content from all over the world that is freely available. Therefore, knowledge is becoming widely available [6].

The purpose of smart-education is to make the learning process effective by transferring the learning process into the electronic environment, which in its turn provides the opportunity for everyone to access, expand the number of students from anywhere and at any time. With this aim, it is necessary to move from book to electronic content by placing it in the repository, to make it active [6].

As one of the promising educational methods, modern informational technologies offer a new educational environment – virtual reality (VR), which is modeled by computer and regarded as special informational environment in which all the objects are presented in three dimensions. A distinctive feature of this environment is the change of images in real time and the experience of the effect of presence. VR simulates both the impact and the response to that effect [7].

Education with the use of virtual reality enables you to give lectures and seminars, trainings, demonstrate to learners all the aspects of a real object or process, which in general has a tremendous effect, improves the quality and speed of educational processes and reduces their cost. Virtual reality technologies give the opportunity to use fully that a person receives 80% of information from the outside world through vision, herewith people remember 20% of what they see, 40% of what they see and hear, and 70% of what they see, hear and do. As a result, students are fully involved in the learning process that increases motivation and success in gaining knowledge [7].

Extensive opportunities also offer possibilities for self-education on-line, among which webinars – seminars, meetings, trainings online, the choice of a specific direction or topic; YouTube Business and Enterprise Video Channels (BigMoney) specialized free online courses on educational platforms [8].

Advantages of using computer informational technology at universities:

- increase of interest and general motivation for learning via new forms of work and involvement in the priority direction of scientific and technological progress;
- individualization of learning: everyone works in a mode that satisfies him/her;
- objectivity of control;
- forming of skills for creative activity;
- mastery of decision-making skills in some difficult situation;
- students' access to information banks, possibility to receive the necessary information promptly;
- the growth of completed tasks [9].

It is advisable to introduce methods of modeling and management of business processes at practical classes in the educational process of professional preparation of managers, which will allow to apply the acquired knowledge on real-life examples from the practice of entrepreneurial activity.

Modeling of business process is the process of graphically-analytical displaying of the flow of work, actions or situations in the form of a built model that consists of interrelated operations and reflects the real existing or future activity of the enterprise.

In the educational process, with the help of modeling, students-managers can analyze not only how the production of the product is organized, but how it interacts with customers and suppliers, how staff is managed in each workplace.

Modeling of business processes allows to show creativity, scientific approach, to systematize knowledge about the enterprise and existing business processes in a graphical visual form so that in the future these processes can be analyzed and improved.

Complex measures of modeling and managing of business processes are used in BPMS (Business Process Model System), including the following standards and programming tools [10]:

BPMN (Business Process Model and Notation) is a visual notation for business process modeling. Business process diagrams are the basis of BPMN. They are built approximately at the same principles as traditional flowcharts. In the process of execution, the business process model in BPMN notation is translated into the process description on BPEL, which is then loaded into the "engine" of the BPM system.

BPEL (Business Process Execution Language) is the XML language for executing of business processes. It describes the business process as a related sequence of web services [8].

IDEF0 – methodology of description of business processes (Business Process Modeling). The models in the IDEF0 notation are intended for a high-level description of the company's business [10].

IDEF3 – methodology of description of work flows (Work Flow Modeling). It is designed to describe work processes or, in other words, workflows.

DFD (Data Flow Diagramming) is designed to describe data flows. They allow you to display the sequence of work performed during the process and the flow of information that circulates between these works.

XPDL (XML Process Definition Language) is the format for communication between BPM systems. XPDL is offered as a standard for importing / exporting business process descriptions [10].

The main advantages of using BPM-systems in business process management are: efficiency of use, visualization and productivity; business and IT reconciliation, process improvement and rapid development; optimizing of the use of resources; rapid adaptation to changing conditions, compliance with requirements [11].

Therefore, the implementation of modern BPM-systems allows to meet the basic requirements of the business: rapid process deployment, decision making, adaptation to constant changing conditions, increasing productivity through efficient use of resources, minimizing of project risks, improving of service levels [11].

Immersive learning methods – virtual and augmented reality technologies are such interactive tools [12].

Bricken M. Identified three challenges by comparing VR to pedagogical practice and theories: cost, usability and fear of technology [13].

Augmented Reality (AR) technologies are capable to project digital information (images, videos, text, graphics) beyond the screens of devices and integrate virtual objects with the real world [12].

Virtual educational technologies are used in the education of students.

There are studies in the scientific literature linking virtual technologies with improvements in students' academic performance and motivation, students' social and collaborative skills. Augmented Reality (AR) superposes synthetic elements like 3D objects, multimedia contents or text information onto real-world images (Holley, Hobbs, & Menown [14]),

Five facts in favor of immersive technologies [12]:

Clearness. In virtual space, you can explore any process or object in a seamless way, which is much more interesting than looking at the pictures in the book. For example, through the Anatomyuo application you can study the structure of the body in the smallest detail, and Operation Apex will show all the wealth of the underwater world.

Concentration. In the virtual environment, a person will not be distracted by external stimuli, which will allow you to fully focus on the material.

Maximum engagement. Immersive technologies provide the ability to completely control and change the scenario of events. A student can witness historical events, conduct a physics or chemistry experiment on his own, or solve a problem in a playful and comprehensible form.

Security. With VR and AR technologies, it is possible to perform a complex operation, run a sports car or even a space shuttle, conduct experiments with hazardous chemicals without harming yourself or the environment.

Performance. Scientists at the University of Maryland conducted a study asking two groups of people to remember the location of the images. During the experiment, one of the groups used virtual reality helmets, the other used regular computers. In this case, the group that studied the image using VR helmets, showed a result 10% higher than participants in the other group [12].

In our opinion, promising application of virtual and augmented reality technologies can be in business education, which allows students to: model the processes of organization of production at a factory, develop advertising of goods, plan and design routes of delivery of goods to shops, build organizational structures of personnel management, etc.

Having analyzed the number of scientific works [1], [2], [4], [6], [7], [8], [9], [11], [12], [13], [22], [23], [24], [25] we believe that the quality of professional training of future managers at universities is determined by their level of readiness to work in their profession.

The future manager's readiness for professional activity should be understood as the system of values, attitudes and motivations that he has formed for his professional activity in the trade-production industry, as well as the developed personal capacity for managerial work.

The readiness of a young manager to work is determined by the ratio of the level of professional knowledge he / she has acquired, the skills with the level of his / her initial professional competence, the ability to solve managerial tasks, set and achieve goals, manage staff.

The readiness for professional activity indicates the ability of a young manager to make meaningful actions of the work, despite the influence of external (social, organizational, economic) and internal (psychological, motivational) factors of the working environment of the organization.

Young managers' readiness for professional activity is shaped by their preparation at higher educational institution.

However, the study of higher education standards (OKH and OPP, educational programs and plans) for the professional preparation of managers has shown that the modern pedagogical technologies and teaching methods of future managers used in domestic universities are outdated.

In particular, we identified the following weaknesses in the management training system: firstly, their knowledge and skills are detached from the business practice; secondly, you need to be able to make a forecast of the situation and make the right management decision, choosing the best from several possible developments; thirdly, the manager must learn how to manage the staff, warming up different situations; fourthly, the manager must be able to model real business processes in the enterprise (production technology, logistics supply channels, distribution of goods across trading networks).

Higher educational institutions in the countries of the European Union make extensive use of interactive teaching methods, multimedia computer technologies and, in recent years, virtual and augmented reality technologies in the process of training of business workers.

However, domestic higher educational institutions that prepare business workers are significantly inferior to European ones in terms of the quality of their graduates' vocational preparation, and therefore existing pedagogical technologies and teaching methods for students-managers need to be improved.

Discussion. The hypothesis of our study was the following assumption: it is possible to improve the quality of professional training of students-managers by introducing smart-virtual technologies into the educational process.

In order to test this hypothesis, we changed the pedagogical technology of teaching professionally oriented disciplines "Personnel Management", "Marketing", "Production Organization", introducing virtual and augmented reality into the educational process of students-managers.

We have developed the pedagogical model of the use of smart virtual technology in the educational process, which we implemented in 2018-2019 (see Figure 1).

To study qualitative changes in the educational process using smart-virtual technology in business education, we have selected students of the third course 073 "Management", who study at the following universities: Central Pedagogical University named after V. Vynnychenko, Central Ukrainian National Technical University, Kirovohrad Flight Academy of National Aviation University, Kirovohrad Human Development Institute.

The 78 respondents participated in the experiment. The students were selected so that their current learning results were approximately the same. For the sake of objectivity of scientific data, all the respondents were in equal conditions, all negative factors were eliminated as much as possible.

For mathematical processing of the results of the conducted pedagogical experiment among students-managers we used the following statistical indicators [15]:

$\bar{x}$ – arithmetic average;

σ – standard deviation;

m – the magnitude of standard error;

t – Student's t-test.

Arithmetic average mean $\bar{x}$, was determined by the formula 1:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad (1)$$

where x_i – corresponds to the means of the studied values; n – the sample volume.

Standard deviation σ was determined by the formula 2:

$$\sigma = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}} \qquad (2)$$

where $\bar{x}$ – arithmetic average means of the sample; x_i – i-th element of the sample; n – the sample volume.

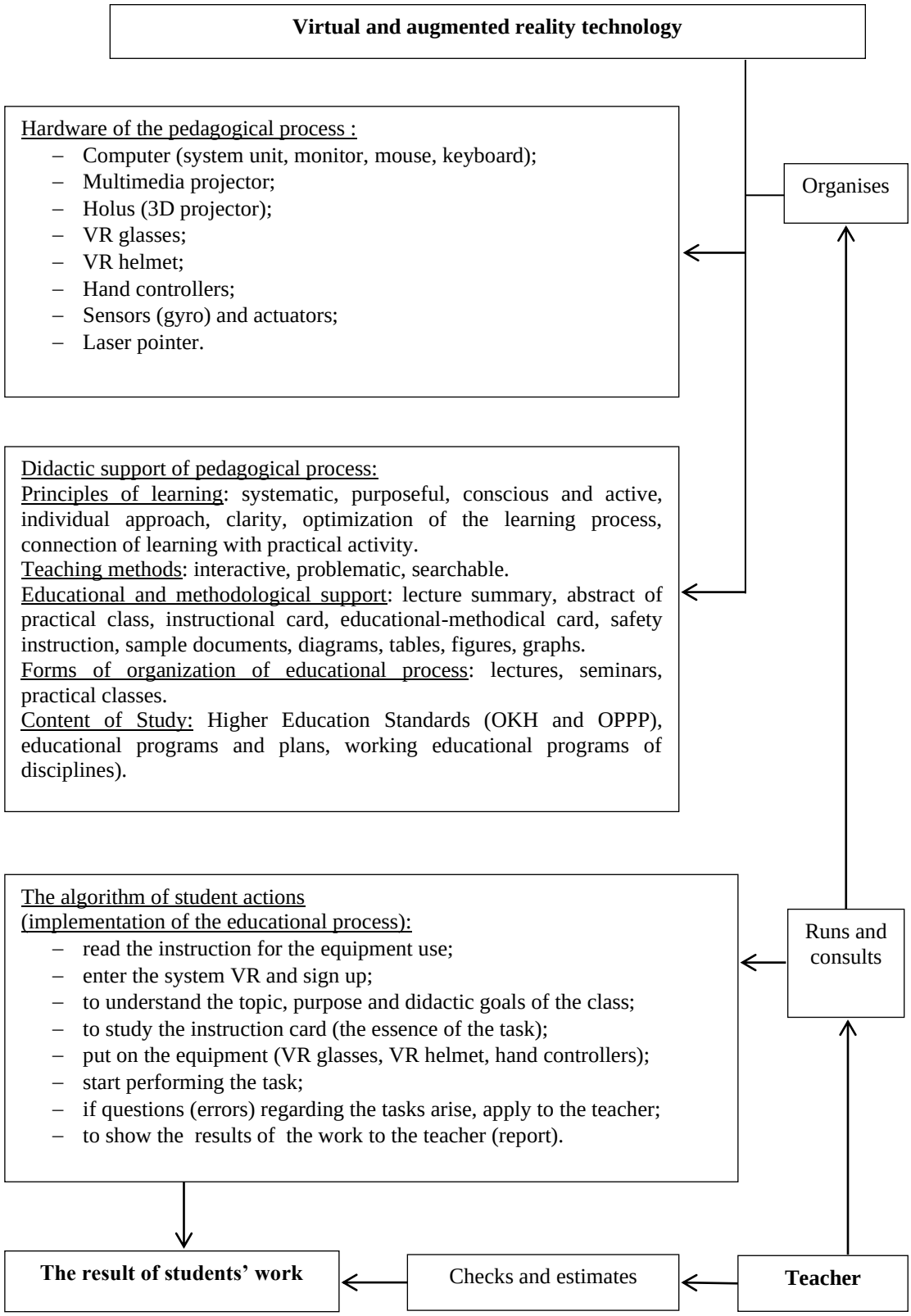

Figure 1. Pedagogical model of applying of smart virtual technology in the educational process

Source: developed by authors

The size of standard error *m* of the sample was determined by the formula 3:

$$m = \frac{\sigma}{\sqrt{n}} \qquad (3)$$

where σ – standard deviation; n – the sample volume.

The accuracy of the results of the pedagogical study was determined via Student's t-test.

We must note that in mathematical statistics Student's t-test is the method of statistical verification of the reliability of hypotheses (statistical criteria).

The Student's t-test is aimed at estimating the discrepancies between the values of the average two samples, which are distributed according to normal law [15].

If t_{emp} falls within the area of significance, it means that there are differences between the two samples.

If t_{emp} falls into the insignificance zone, it means that there are no differences between the two samples.

In the control group of students the teaching of professional disciplines was conducted according to the traditional pedagogical technology and methodology. The curriculum included lectures and practical classes in the fields of "Personnel Management", "Marketing" and "Production Organization".

The teaching process in the experimental group was carried out according to the new pedagogical technology, which was different from the usual (traditional) technology and methodology used by the teachers in the control group. The use of new smart virtual reality technology meant solving situational problems based on the analysis of managerial errors of managers; solving cases and marketing tasks; construction of models of organization of production process, sales management, theory of queues, logistical problems on planning and development of routes of transportation of goods to shops, that is especially important for the formation of students-managers' trade organization skills, consolidation of knowledge in specialty subjects.

A comprehensive test was compiled to assess respondents' knowledge. Table 1 presents the results of the assessment of knowledge of students-managers in the control modules of the professional disciplines "Personnel Management", "Marketing" and "Production Organization".

As can be seen from Table 1, the obtained results on the section of knowledge (test) allow to establish slight differences in the levels of knowledge of students of control and experimental groups in the professional-oriented disciplines "Personnel Management", "Marketing", "Production Organization".

Labs in engineering education are designed to improve the practical knowledge of the students and their ability to solve problems independently [16]

Chee Y. [17] Believes that virtual reality can be used to achieve this goal, "providing a foundation for students' conceptual and higher-order learning".

Educational software for smartphones benefits the education process and makes it more interesting for students. Especially if it follows the computer

game technology to render 3D graphics for the software and make it more amusing for the students while still deliver the necessary information [18].

Table 1. Analysis of knowledge of students of the 3rd year according to the results of testing in the disciplines "Personnel management", "Marketing", "Organization of production" (at the beginning of the forming experiment)

Students' grades		Experimental group		Control group	
National Scale	Scale ECTS	The number of students	% from quantity	The number of students	% from quantity
5	A	6	15,8	5	12,5
4	B; C	8	21	10	25
3	D; E	19	50	18	45
2	FX; F	5	13,2	7	17,5
Total:		38	100%	40	100%

Source: developed by authors

Billinghurst and Dunser [19] surveyed user studies concerning elementary and high school students to determine if AR enhances the learning experience.

From Table 2 we can see that the number of students in the experimental group studying for "excellent" and "good" is 14 people (the overall success rate is 36.8%), and the number of students in the control group is, respectively, 15 people (total 37.5% success rate).

The PIP indicator (see formula 4) characterizes the quality of students' learning and is 49.4% (low level) in the experimental group and 47.5% (low level) in the control group.

The degree of students' learning was determined by the formula of the scientist V.P. Simonov (formula 4):

$$PIP = \frac{100\% \times n_v + 64\% \times n_d + 36\% \times n_c + 16\% \times n_p}{N} \qquad (4)$$

Where PIP is the indicator of students' learning; n_v – the number of students who have high grades; n_d – number of students who have sufficient grades; n_c – number of students who have average grade; n_p – number of students who have beginner-level assessments; N – is the number of students evaluated [20].

The data obtained (according to formula 4) indicate the degree of education of a certain level: 0-44% – critical level; 45-49% – low; 50-74% is acceptable; 75% or more is optimal.

Consequently, the experimental and control groups of students in the professional-oriented disciplines of "Personnel Management", "Marketing", "Production Organization" are low. Such results testify the low quality of student's preparation.

Knowledge assessment in both groups of students was conducted before and after the introduction of smart virtual technology. We compared each

respondent of the experimental and control groups at the beginning and after the experiment.

Table 2 shows the results of the testing of students-managers of the third year from the control modules of professional disciplines.

Table 2. Analysis of knowledge of students of the third year on the results of testing in the disciplines "Personnel management", "Marketing" and "Organization of production"(before and after the forming experiment)

Student's grades		**Number of student managers**			
		Experimental group (38 people)		Control group (40 people)	
National scale	**Scale ECTS**	Before the experiment	After the experiment	Before the experiment	After the experiment
5	A	6	10	5	4
4	B; C	8	17	10	13
3	D; E	19	9	18	18
2	FX; F	5	2	7	5

Source: developed by authors

From Table 2 we can see that after the virtual reality smart technology, the grades of the experimental group in the professional disciplines have improved. In the control group of students, the learning results were almost unchanged.

The reliability of quantitative indicators was determined via the Student's t-test. The results are shown in Table 3.

Table 3. Analysis of academic achievement of students in experimental and control groups in professional disciplines (before and after the forming experiment)

Groups of students	**Indicators**	Mathematical indicators			
		$\bar{x}$	σ	m	t_{emp}
Experimental	Before the experiment	3,39	0,9	0,15	2,7
	After the experiment	3,92	0,84	0,14	
Control	Before the experiment	3,33	0,91	0,14	0,4
	After the experiment	3,4	0,83	0,13	

Source: developed by authors

As can be seen from Table 3, the empirical value of t_{emp}= 2.7 (t_{kr}, at $r \leq 0.05$ is 1.99 and at $r \leq 0.01$ is 2.64) is in the area of significance, which indicates the improvement in students' level of knowledge of the experimental group on professional disciplines after the experiment. The empirical value of temp = 0.4 (t_{kr}, at $r \leq 0.05$ is 1.99 and at $r \leq 0.01$ is 2.64) is in the insignificance zone, which indicates that there is no significant change in the level of knowledge of the students of the control group on professional disciplines after the forming experiment.

In the process of studying the attention of students of economic specialties should be directed to their further professional preparation, which involves the formation of:

– self-determination – the ability to develop their positions in life; to form their own outlook, ability to set and fulfill their tasks;
– self-realization – asserting oneself as a person; development of creative abilities (scientific, artistic, organizational and communicative);
– self-organization – the skills of elementary mental self-regulation; organization of student's lifestyle; ability to achieve this goal [21].

Thus, after the introduction of the new smart-technology of virtual reality, the level of knowledge in the professional disciplines of the students of the experimental group has significantly improved than the level of knowledge of the students of the control group.

Taking into account the above mentioned and the results of the pedagogical experiment, it is recommended that the teachers of higher educational establishments introduce into the educational process smart-technology of virtual reality when performing practical tasks by students-managers.

Conclusions. The basis for the construction of a qualitatively new system of economic education in Ukraine is the restructuring of the educational process by means of information-telecommunication technologies; in particular, it is advisable to introduce smart-technologies of virtual reality.

The readiness of the manager for professional activity is the ability of the manager to perform managerial functions (planning, organizing, motivating, regulating and controlling), making decisions and leading actions on the basis of their professional knowledge, skills and professional qualities.

It is found that improving of the quality of learning results contributes to increasing of the level of readiness of the manager for professional activity in a commercial organization. This can be achieved with the help of smart-technology of virtual reality.

Smart Education is flexible, adapted to the student's learning needs in an online learning environment with online content from all around the globe.

Virtual reality technology is an intangible educational environment designed on special computer equipment – digital information (images, videos, text, graphics) outside the screens of devices and integrate virtual objects with real objects, creating in the human mind an artificial world with which you can interact with the senses.

Five facts in favor of immersive technologies are highlighted: material clarity, focus on learning, maximum student engagement, safety of use, learning effectiveness.

The results of the pedagogical experiment of the students of the third course of specialty 073 Management showed that after the introduction into the educational process the smart-technology of virtual reality, the level of success in the professional-oriented disciplines "Personnel Management", "Marketing" and "Organization of Production" has significantly increased in the experimental group rather than the level of knowledge of students in the control group, as evidenced by the data temp 2,7> temp 0,4.

The accumulated experience of using smart-technologies of virtual reality in the professional training of students-managers, showed the effectiveness of their application in modeling the processes of organization of production of products at the factory, for the development of adverts of goods, in the design of routes of transportation of goods from the warehouse to the store, in the construction of organizational structures of personnel management, risk management and more.

Author contributions. The authors contributed equally.

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