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# Effectiveness of using digital interactive projection media systems in teaching vocational subjects and in professional activities

## Efectividad del uso de sistemas de medios de proyección digitales interactivos en la enseñanza de materias vocacionales y en actividades profesionales

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**Abstract**

The article shows the technology's effectiveness and reveals the students' readiness to use digital interactive projection media systems in educational and professional activities. The content of the

interactive education process and its components are disclosed. The essence and significance of digital interactive projection media systems in teaching professional subjects are shown. As an example of digital interactive projection systems, an effective interactive software-technological complex based on SMART Board is shown, the interactive functions of the interactive SMART Board software created specifically for the educational space in teaching vocational subjects and the advantages of the interactive panel in the educational space of a higher school are revealed. Ways of developing the teacher's professional competencies when using an interactive panel or blackboard in classes at a higher school are analyzed. The effectiveness of electronic textbooks, manuals electronic educational and methodological complexes, informative and reference multimedia publications, game educational and developmental publications, scientific research STEM centers, multimedia classes, virtual laboratories, virtual classes, etc. in teaching vocational subjects is shown.

**Keywords:** digital interactive projection media systems, education, professional activity, students, innovative activity, higher education institutions.

**Resumen**

El artículo muestra la eficacia de la tecnología y revela la disposición de los estudiantes para utilizar sistemas de medios de proyección digitales interactivos en actividades educativas y profesionales. Se divulga el contenido del proceso educativo interactivo y sus componentes. Se muestra la esencia y la importancia de los sistemas de medios de proyección interactivos digitales en la enseñanza de materias profesionales. Como ejemplo de sistemas de proyección interactivos digitales, se muestra un efectivo complejo tecnológico-software interactivo basado en SMART Board, las funciones interactivas del software interactivo SMART Board creado específicamente para el espacio educativo en la enseñanza de materias vocacionales y las ventajas del panel interactivo en Se revela el espacio educativo de una escuela superior. Se analizan formas de desarrollar las competencias profesionales del docente al utilizar un panel o pizarra interactiva en las clases de una escuela superior. Se muestra la efectividad de los libros de texto electrónicos, manuales de complejos educativos y metodológicos electrónicos, publicaciones multimedia informativas y de referencia, publicaciones educativas y de desarrollo de juegos, centros de investigación científica STEM, clases multimedia, laboratorios virtuales, clases virtuales, etc.

**Palabras clave:** sistemas de medios de proyección interactivos digitales, educación, actividad profesional, estudiantes, actividad innovadora, instituciones de educación superior.

## Introduction

The modern stage of informatization of society is the digitalization of the modern educational process of higher education, which involves the saturation of the learning space with electronic and digital devices, systems, means and the establishment of an electronic communication exchange of information and educational environment between them, which creates a cyber-physical educational space of higher education institutions (Spirin, 2021).

In the conditions of intensive progress of digital interactive projection media systems, in modern conditions of renewal of all spheres of the spiritual life of a person and the social life of society, the higher education system needs a new qualitative level of development of the educational universe, which would meet international standards. Therefore, innovative and developing digital interactive projection media systems are gaining more and more popularity. Personally oriented educational technologies of the organization of the educational space of the higher school come to the fore as a type of pedagogical activity, and the student is at the center of the innovative educational process (Bonch-Bruievych & Nosenko, 2010).

European organizations consider the development of new digital interactive projection media systems, interactive courses, their support and administration as a priority direction for improving the quality of education, in particular, distance education. 25% of the volume of the European market in the field of high-tech innovative distance education (according to research company IDC) is represented online (England,

the Netherlands, Sweden). More than 50% of master's degree programs in the UK in the field of management are conducted using interactive methods, and digital interactive projection media systems. The country in the world with the highest index of Internet activity is Iceland (98%), in the USA the Internet and digital interactive projection media systems are used by 77% of the population, and in Ukraine – 34% (Knysh et al., 2023).

In modern society, there is a corresponding shortage of highly qualified specialists, due to the growth of innovative technologies, and the volume of human knowledge, which is transformed into all aspects of the life of society. Therefore, in modern conditions, it is important to use digital interactive projection media systems when organizing the training of specialists.

And, as a result, digital interactive projection media systems for increasing the level of quality and efficiency of education have great potential and are dynamically developing. The main advantage of digital interactive projection media systems is to approach the real practical activities of specialists in the learning process. Digital interactive projection media systems help to correctly formulate one's own opinion, learn to solve problems, contribute to the optimization and intensification of the educational process, help to discuss, and analyze the information received, defend one's point of view, allow the student to be more independent and confident.

The use of digital interactive projection media systems allows you to relieve the nervous load of students in the learning process, makes it possible to switch attention to key issues when working on a certain topic, change forms of activity, promotes the development of communication skills and abilities (Hevko, 2018).

**Literature Review**

The effectiveness of the use of digital interactive projection media systems in education suggests that scientists have begun to pay due attention to them. Thus, scientists devote research to interactive technologies in education. I. Hevko (2018) examines the peculiarities of their application and distinguishes the varieties in the educational process. The scientist considered the main problems of the quality of education and considered the conditions for using interactive growth technologies as the main component of the professional issue. The necessity of using digital interactive projection media systems in education has been proven, which affects the improvement of the efficiency of the education system by introducing new approaches to the methodology of conducting seminars, practical classes, and lectures. It is proven that as a result of the optimal use of digital interactive projection media systems in education, positions in the educational process of the teacher and student change. The teacher turns into an organizer of students' cognitive activity, and students become equal subjects in education.

H. Bonch-Bruievych, & T. Nosenko (2010) reveal the importance of the SMART Board software-technological educational complex with software of the 10th version, providing information about tools, purposes, highlighting the main capabilities, practical recommendations, tools for creating interactive classes in the SMART Notebook software environment ™10. They prove that the use of digital interactive projection media systems in education contributes to the optimization and intensification of the educational process, helps to analyze the received information; correctly formulate one's own opinion, learn to solve problems; discuss, and defend one's point of view; to be more confident and independent.

P. Shevchuk, & P. Fenrich (2005) consider practical issues and theoretical principles of using interactive learning methods for the system of higher education institutions. Considerable attention is paid to the application of digital interactive projection media systems in education, organizational, and methodological approaches in the use of non-game and game simulation methods, aimed at consolidating and accumulating knowledge in the objects of the educational process and practicing sustainable skills and abilities.

S. Lytvynova (2011) raises the problem of modernizing the computer-oriented environment of the higher school for individual education of students with modern means; defines the concept of a virtual class, the place of a virtual class among modern computer-oriented teaching aids; analyzes possible systems of full-time education of students using ICT; the concept of web conference and video conference describes the role of online seminars, presents a model of integration of the virtual classroom as a computer-oriented learning environment in the educational process.

Modern education is focused on the development of the independent cognitive activity of students, therefore, K. Nikolenko, Y. Korneiko, & O. Dobrostan (2023), taking into account the individual characteristics of students, consider the use of effective pedagogical technologies, which one of the main directions of the development of the educational process on a grid scale. The scientists analyzed the application of digital interactive systems in education, the main aspects of mobile learning, and interactive technologies in it, which is a way of organizing the educational process, which uses forms based on the interaction of all learning participants and methods of collective scientific knowledge. It has been proven that interactive technologies should be introduced into the process of studying all disciplines to promote the effectiveness of mobile learning. Ways of using a combination of online platforms, interactive textbooks, mobile applications, social networks, QR codes, the project method, cooperative "inverted" learning, and their main advantages and disadvantages are shown. Also, I. Truskavetska (2023) considered the positive aspects and showed minor disadvantages of using various applications, mobile devices, and online services in the educational process of higher school, which allow teachers to create educational materials of augmented reality and interactive textbooks. The study shows the main paths of education seekers, which provide an opportunity to interact with animations and 3D models, virtual objects, which makes the process of higher education effective and interesting.

The use of interactive technologies and the use of digital interactive projection media systems in education have some challenges, which were analyzed by N. Shakun, O. Zivenko, & I. Salnyk (2023). The formation of digital literacy in a student and the formation of digital competence in him indicates the mandatory use of digital technologies in higher education and creates a basis for professional activity to be able to use digital technologies. It has been proven that digitalization in institutions of higher education ensures the formation of competitive specialists, and promotes the flexibility of the educational process, which enables a student, a future specialist, to quickly adapt to rapidly changing and unpredictable conditions.

An analysis of mobile technology and systems of the educational space of the higher school by V. Matsiuk, & I. Pryimak (2022) was made. It has been proven that m-learning is a necessary component of the modern educational process. It is difficult to imagine a modern occupation without the use of gadgets by students, in particular, during the implementation of distance education. the need to use BYOD technology is shown, which makes it possible to bypass the lack of equipment during the experiment and develop skills for similar experiments during independent reproduction by students while working at home.

M. Vykhrystiuk, & I. Salnyk (2022) revealed the history of the development of electronic learning (E-learning), examined the negative and positive sides of one of the forms of E-learning, showed the prerequisites for the emergence of a new educational technology, namely mobile learning m-learning. They proved that with the improvement of the technical part, the prospects for the development of such technologies can be overcome very quickly. The scientists characterized the expediency of implementing digitalization in education, systematized regulatory and legal documents proving the importance of this process; and revealed the essence of the concepts of "digitalization" and "professional training".

The need for digital transformation of the education system is substantiated by O. Tsiuniak, & L. Sultanova (2021), and ways of organizing an innovative educational process in higher education institutions with the introduction of digital and innovative technologies and systems are shown. It has been proven that in the conditions of digitalization, the primary tasks of the development of modern higher education should include not only the resource-filling of the educational environment with modern digital means of learning but also the preparation of higher education students and teachers for their effective use. Therefore, it is expedient in institutions of higher education to equip the premises with new models of technical means of education,

where classes are held. These are multimedia classrooms, and Internet classes, to conduct educational classes using digital and multimedia technologies. Digital transformation of education contributes to the achievement of new educational results and strengthens students' motivation for self-development and self-education.

Therefore, the analysis of scientific sources shows that scientists devote research to interactive technologies in education, consider the main problems of the quality of education and consider the conditions for using interactive technologies for personal growth as the main component of a professional issue; show the importance of the software-technological educational complex SMART Board with software of the 10th version, providing information about tools, purposes, highlighting the main capabilities, practical recommendations, tools for creating interactive classes in the SMART Notebook™10 software environment; define the concept and show the importance of the virtual class in education, the place of the virtual class among modern computer-oriented teaching aids; analyze possible training systems for education seekers using ICT; the use of effective pedagogical technologies, which is one of the main directions of the development of the educational process on a global scale; talk about the need to use various applications, mobile devices, online services in the educational process of a higher school, which allow teachers to create educational materials of augmented reality and interactive textbooks. Therefore, it is expedient in institutions of higher education to equip the premises with new models of technical means of education, where classes are held.

**The aim of the study:** to show the effectiveness and reveal the level of readiness of students to use digital interactive projection media systems in educational and professional activities

**Methodology**

During the study of the effectiveness of the use of digital interactive projection media systems in the teaching of vocational subjects, scientific research methods were used, such as:

- The method of analysis, which made it possible to consider the content of digital interactive projection media systems, and their main characteristics in education, to identify the impact on the educational process and to highlight their features;
- The synthesis method made it possible to highlight key aspects for further research and to summarize the obtained data.
- The method of systematization was used to structure information about the challenges and differences that students face in education;
- The decomposition method made it possible to divide complex tasks into smaller elements for detailed analysis;
- The method of generalization made it possible to formulate conclusions regarding the influence of digital interactive projection media systems on the effectiveness of education.

*Empirical methods*, in particular:

- *Prognostic*, which included the generalization of independent characteristics and expert assessments;
- *Diagnostic*, which included interviews, questionnaires, and surveys;
- *Observational* methods – self-observation, observation, self-assessment – to identify the level of readiness of future specialists to use digital interactive projection media systems;
- *Experimental* methods: experimenting to check the level of readiness of future specialists to use digital interactive projection media systems.

*Mathematical statistics methods* – for analyzing the obtained results based on establishing quantitative indicators for evaluating the phenomenon under study and confirming their probability.

With the possibility of quantitative and qualitative further analysis of the results, our study was based on an online survey. Respondents of the survey were those with higher education (127 respondents).

To check the effectiveness of the use of digital interactive projection media systems in higher schools in teaching vocational subjects, a pedagogical experiment was conducted in the real conditions of the educational process.

Preparation for the experiment involved the solution of the set tasks:

- Provision of equal initial conditions for the control and experimental groups (training of teachers, success results, number of students);
- Development and selection of diagnostic methods;
- Determining the duration of the experiment;
- Definition of the levels at which we talk about changes in experimental groups.

The purpose of the experiment is to identify the level of readiness of students to use digital interactive projection media systems in educational and professional activities
Levels of students' readiness to use digital interactive projection media systems in educational and professional activities have been established.

As a result of the study, the students of the experimental groups showed better results in terms of the formed readiness to use digital interactive projection media systems in educational and professional activities than the students of the control groups, which indicates an improvement in the results of the assimilation of the educational material by students, which was studied with the help of the use of digital interactive projection media systems, as well as that, that the implementation of the proposed course "Application of digital interactive projection media systems in the teaching of vocational subjects" with the use of innovative methods contributed to increasing the level of students' readiness to use digital interactive projection media systems in professional activities. A sign criterion was used to identify the level of formation of the application of digital interactive projection media systems.
In the study, we used the Student's t-test.

The results of the experiment make it possible to conclude that the introduction of the course "Application of digital interactive projection media systems in the teaching of professional subjects" in the training of future specialists contributed to increasing the level of students' readiness to use digital interactive projection media systems in professional activities.

## Results and Discussion

### The content of the interactive process in education and its content components.

An innovative modern educational system is a systemically organized set of educational and methodological, technical, informational, and digital support of the educational process, which is inextricably linked with a modern innovative person as a subject of education. An innovative modern educational system is emerging thanks to a set of conditions that ensure the educational process of a higher school: the presence of a system for independent work with information; cognitive educational activity; availability of a system of means of "communication" with information; the presence of intensive ties between the participants of the educational process. To ensure a high-quality, innovative, modern educational system, a higher education institution must have a modern technical base: computer classrooms, powerful computers, interactive whiteboards, multimedia projectors, etc. In the conditions of the organization of distance and mixed learning, in recent years, this is the main condition for educational practice – the introduction of new digital technologies (Hrytsenko, 2023).

Considering the role of digital interactive projection media systems in education, let's consider the essence of the interactive process. Interactive means capable of dialogue, interaction, and interactive technology of

the educational process is a specific model in the organization of cognitive activity, the scientific basis of which is person-oriented learning and its conceptual provisions. Interactive technology in the educational process has a predictable and specific goal, the achievement of which is possible by creating comfortable and innovative conditions of the educational process, under which every student feels intellectual ability and success. The essence of the interactive process is that in the institution of higher education, the educational process takes place under the condition of positive, active, constant interaction of all students of higher education. There is cooperative learning, group, collective, and individual learning when students and the teacher are equal subjects of the educational process (Bonch-Bruievych & Nosenko, 2010).

Services and products on digital computer systems include interactive media that constantly respond to meaningful learning of the user, to his actions, presenting the necessary innovative content, such as graphics, text, animation, audio, video, games, etc. (Marrero-Sánchez & Vergara-Romero, 2023).

The use of digital, interactive technologies, information and communication technologies, electronic interactive projection media systems, and online platforms in education have become the basic tools of mobile and distance learning. It is this innovative toolkit that constitutes the organization of a high-quality educational process, where methods and forms of scientific collective cognition are used, based on the interaction of all participants in the educational process of a higher school. This approach to education allows the creation of conditions for an innovative model of the modern educational process:

- Ensuring the equality of participants in the modern educational process;
- Ensuring free adoption of positions and free exchange of opinions;
- A positive and free atmosphere of learning and education;
- Awareness of the value of forming collective conclusions;
- Recognition of the teacher as an adviser and mentor, and not as a tool of "praise and punishment" (Zinoruk, 2022).

**The essence and significance of digital interactive projection media systems in teaching vocational subjects.**

Digital interactive projection media systems in the teaching of professional subjects with the use of various playback and recording devices allow you to organize a dialog exchange of various types of audiovisual information: display, audio system, TV, microphone, etc.; designing pleasant-to-use interactive systems that make people's lives easier and perform useful functions. The possibility of storing huge, interactive access to the elements of arrays of information is provided, and with the appropriate sound accompaniment of the reproduction of images.

The design of digital interactive projection media systems in the teaching of vocational subjects should be accessible, useful, and interesting – related to the development of interactive high-quality products that will fit people's lifestyles.

Digital interactive projection media systems are high-tech multimedia devices capable of transmitting images to various surfaces using a projector – horizontal table surfaces, glass screens, walls, floors, etc. You can combine images on the floor and the wall so that they logically complement each other. It is possible to scan human movement thanks to the installed infrared sensors, which the system responds to using numerous visual effects (the variety and number of which are unlimited) and attracts the attention of viewers because it instantly transforms the image.

Such processes are well visualized with the help of digitalization of interactive effects, such as the change of new and old, the transition from one state to another, and the emergence of new objects.

**Significance for the educational space of the interactive whiteboard.**

An example of a digital interactive projection system can be an interactive software and technology complex based on SMART Board, created by the Canadian company SMART Technologies Inc. (www.smartboard.com.ua), which is now the most common technical base in educational institutions and is used in teaching vocational subjects in an interactive educational environment, is an interactive educational complex, which is also called "interactive whiteboard", allows the use of innovative pedagogical technologies education along with traditional ones and to create an interactive information and communication environment of the educational space.

Interactive software and technology complex based on SMART Board consists of proprietary software and hardware. The component of the hardware part of the complex is based on the SMART Board interactive board. For the complex to become interactive, and the interactive board to perform its functions, a desktop or portable personal computer, communication equipment, and a multimedia projector are needed.

The basis of the work of the interactive software-technological complex is the software specially developed for training, the technological and software product SMART Board software. Its versions are constantly improved and updated. The basis of specialized Notebook software is the SMART Notebook™ 10th version application, which is important for the educational process of a higher school using SMART Technologies interactive devices (AirLiner™ wireless tablets, Sympodium™ tablets, SMART Board interactive boards, SENTEO™ survey system). SMART Board software provides the ability to create compositions from graphic fragments and text fragments, allows you to control applied computer programs by touching the surface of the screen, serves to store the created materials and reproduce them during the demonstration, provides a universal technology for working with various types of information, gives the teacher an effective means of applying and creating author's educational programs in the teaching of vocational subjects (Bonch-Bruievych & Nosenko, 2010).

The interactive whiteboard includes a large touch screen, a projector, and a computer as part of the system. From the image projected on the board, it is possible to make marks and changes while working. All changes are recorded in the corresponding files on the computer, which are saved and edited or copied to other media. In this case, the interactive whiteboard does not work as an information transformer, but as an information input device.

The design of digital interactive projection media systems is an exciting and complex field that influences and relies on the peculiarities of people's lives. There is a wide variety of digital interactive media systems and products, from websites to business applications. The design of digital interactive media systems should be primarily human-oriented. They are necessary for the era of digital technologies in which we live when bits are easily transmitted and transformed, applied in various subject areas.

An interactive whiteboard with a touch-sensitive screen is a computer peripheral device, that creates favorable conditions when working with a large audience and performs the innovative function of an additional, enlarged computer monitor (Tolochko et al., 2023).

Work with an interactive whiteboard is accompanied by the use of additional technical means (testing system) (Kozmenko et al., 2022). When teaching vocational subjects, the teacher asks a question or shows the text of the question on the blackboard with options for answers, students, by pressing the appropriate button on the remote control, choose the correct answer options. The answers are analyzed, and the results can be displayed visually (tables, diagrams) on an interactive whiteboard or entered in a journal. The document lamp allows you to display the image of any object or document directly on the screen. When analyzing homework, you can analyze the correctness of the task, and immediately demonstrate the students' work. You can bring small objects to the screen in an enlarged form and examine them in all detail. Interactive digital complexes can be equipped with other auxiliary devices: markers, styluses, tablets for remote control, etc. (Hevko, 2018).

**Interactive functions of SMART Board interactive whiteboard software created specifically for the educational space when teaching vocational subjects.**

Let's highlight the interactive functions of SMART Board interactive whiteboard software created specifically for education:

1. *Management from the surface of the board by applied computer programs.*
2. *Processing of graphic images, text information, video, and audio files on the touch surface of the board with the help of hand movement, which allows:*

   - Move around the axis, zoom in and out, clone, group, delete, ungroup, move to a new file page and back;
   - Move any image (screen with a video clip, printed or written word, number, letter, shape, line, photo, etc.) on the surface of the board to any place on the board;
   - From a network resource of any level to the surface of the board, move any files (graphics, text, hyperlinks, video, etc.) from the hard disk of the computer, perform and open any actions with the contents of the files by touching the icon with your finger these files;
   - By cutting out fragments of video films, to frame-by-frame coverage of materials, parts of printed text, and parts of photographs with the necessary objects, combine them with text and graphic information on the surface of the board, move to a new page file and back when teaching subjects of a professional direction;
   - Make and save in the computer memory, a complete video recording of the entire process of working on the board with information objects, creating your own collection of video recordings of the lessons.

3. *Creation of author's educational programs, which allow:*

   - Create educational material directly during the class using the simplicity of information technology, using the program tabs "Gallery", "Applications", "Page Sorter", "Properties", Internet and local network resources;
   - By adding or removing page files – to form the structure of a training session of a professional direction, using the "Page Sorter" program tab;
   - In advance, during the lesson, import or prepare hyperlinks, graphic objects, text files, videos, and photos in the structure of page files using the "Appendixes" program tab;
   - Using the "Gallery" program tab, by the lesson scenario, use a large number of different templates, drawings, information objects, etc. in teaching vocational subjects;
   - repare in advance, save the educational material, and demonstrate it on the board in the form of a series of slides with graphic comments (Dzhurynskyi et al., 2023).

In teaching professional subjects, it is very important that the creation and editing of objects can be carried out directly in Word, PowerPoint, Excel, etc. applications, and the entire process on the work screen can be recorded in a video file, then played back on the screen using a universal player or on a computer monitor. Manually entered text is automatically recognized electronically (Bonch-Bruievych & Nosenko, 2010).

**The advantages of an interactive panel in the educational space of a higher school.**

An interactive panel is a device that combines the functionality of a whiteboard, a computer, a projector, a tablet, and a modern TV in a shockproof, ultra-durable case.

The technologies used in the interactive panel are divided into the following types:

- Electromagnetic;
- Analog-resistive sensor;
- Laser;
- Ultrasonic (infrared) (Plakhotnik et al., 2023).

The advantages of using interactive panels in the educational process during classes include (Kuchai et al., 2022):

- Stimulation of professional growth;
- Possibility of animation and modeling of various phenomena and processes;
- Saving time in class;
- Demonstration of professional personal experience;
- Interactivity and visualization;
- Multiple uses of the material;
- Organization of test control of higher education applicants;
- Rational use during the educational process of the higher school.

We will analyze the development of the teacher's professional competencies when using an interactive panel or blackboard in classes at a higher school.

1. Competence of active involvement in the educational process of students of higher education. When conducting classes in the teaching of vocational subjects, the use of various dynamic resources contributes to a convenient test of students' knowledge, increases motivation, and develops discussion.
2. Competence in creating demonstrations, presentations, and models. In combination with an interactive panel, the use of resources and the necessary software helps the teaching staff to present information with the help of various multimedia resources, which provides an opportunity to study the material in maximum detail and comment on it. When explaining concepts and abstract ideas, it is a valuable tool for teachers, helping to explain solids and schemes. With this approach, students can comment on their actions, think aloud, gradually write down ideas on the board, and involve their colleagues in this.
3. Competence to improve the flow and pace of the lesson.

The teacher has the opportunity to simultaneously influence the auditory, visual, and kinesthetic systems of a person, and focuses on each student in the group when teaching vocational subjects. Therefore, a lesson using the panel helps the teacher to develop his competencies and professional skills, to solve such tasks as introducing novelty into the educational process, mobilizing the mental activity of students, increasing the possibility of involuntary memorization of the material, increasing interest in the lesson, systematizing and highlighting the main points in the material teaching vocational subjects (Kuchai et al., 2017).

**Electronic textbooks, manuals electronic educational and methodical complexes, informative and reference multimedia publications, game educational and developmental publications in the teaching of vocational subjects.**

Electronic textbooks, manuals, and electronic educational and methodological complexes using hypertext technologies include structured and interconnected hypermedia and multimedia texts, maps, biographies and portraits of historical figures, documents, dictionaries of concepts and terms, chronological tables, illustrative material, for testing knowledge and skills – test program by topic, video fragments studied in the training course. Several e-textbooks create an e-library. Electronic educational and methodical complexes of vocational subjects include all components of the educational course (working curriculum, discipline curriculum, models or materials of practical classes, lectures, illustrations, test forms of knowledge control, tasks for independent work, etc.).

Informational and reference multimedia publications – electronic galleries, Internet resources, encyclopedias, in particular, "Wikipedia", which contains illustrations and interesting information from the course, educational subjects, and educational field.

Game educational and development publications – increase interest in a game form to study the course and are created taking into account the age characteristics of the students of education (Hrytsenko, 2023).

**Development and implementation of equipment for creating an electronic digital educational environment, innovative computer, multimedia, and computer-oriented learning tools: research STEM centers, multimedia classrooms, virtual laboratories, virtual classrooms, etc.**

STEM research centers/laboratories use high-tech up-to-date equipment and teaching aids related to electrical engineering, scientific research in the field of nano-, bio-, energy-saving technologies, technical modeling, automation, IT technologies, robotics, telemechanics, radio engineering and electronics, intelligent systems, aerospace engineering, aviation, etc.

It is appropriate to use the resources of STEM centers/laboratories of scientific and technical stations/laboratories and higher education institutions, which contain a significant number of lectures, video recordings of experiments, methodical developments, and proposals for cooperation in researching while mastering professional subjects.

In addition to traditional means of education, there are open educational Internet resources that provide equal access to quality education for young people, provide learning opportunities for people with special needs, and also ensure the use of various forms of learning (group work, individual learning, project activities, frontal work).

Virtual laboratories, interactive museums, educational sites, and simulation simulators make the learning process creative and accessible – conducting research experiments. So, on the one hand, positive motivation is created for students to master STEM disciplines through the use of high-quality educational Internet resources, and on the other hand, all subjects of the educational process are given the opportunity for collective educational activity, in which the teacher can recommend various educational Internet resources to students for use in self-education.

With the development of technology, projection games, interactive projection with interactive modules, projectors, and other equipment are becoming more and more interesting and innovative. In particular, combined with the medium of creative interactive game content, interactive projection by interactive modules, projectors, and other equipment serves not only for entertainment but also to achieve communication and interaction with students. Interactive projection allows students to have fun and learn during the game. That is why it is preferred by educational institutions because the interactive mode of the game is full of creativity, is changeable and new, and allows you to better enter the game. The Mimio interactive learning system, and the ChariotTech interactive projection system, which consists of a 3D learning system, include the logic of numbers, letters, and interactive stories to help students learn are significant.

Recently, virtual classes for the organization of educational space have become widespread. This educational model of learning is as close as possible to online learning in a real classroom.

To form a virtual class, we use the latest technologies of conference communication. A new service for training provides us with such opportunities – a virtual platform that is being developed for training and holding webinars, and web conferences as a cross-platform.

According to all the indicators of expanded capabilities, cost, and accessibility, we chose the cross-platform WiZiQ for implementation in the educational plane of the higher school. This service provides an opportunity

to teach students online in real-time and create virtual classes. Teachers have the opportunity to create and fill profiles related to their educational activities, to create a library of presentations and books. Therefore, a virtual class is a student's face-to-face training, and it is not distance learning in the traditional sense, which is implemented in higher education using modern Internet technologies.

A virtual class is like a special educational environment, a community of a larger number of people or two people present virtually in a virtual classroom, who carry out educational and cognitive activities in real-time, integrating information and communication technologies and the Internet by jointly chosen goals of the educational space (Bykov, 2008) in which the educational process is carried out innovatively and unites students and the teacher with common educational tasks and goals, who does not need to know additional software products to use the virtual classroom. Such tools as the usual interactive whiteboard, web camera, chat, microphone, etc. are familiar to any teacher. Therefore, the training of the administration and teachers does not require the study of additional complex computer databases, computer platforms, and data that do not cause negative emotions, because in the provision of educational services, this is a new informational step.

The introduction of virtual classes into the system of higher education is an urgent solution to the problems of students who study under individual programs and is an indispensable factor for the development of gifted students, a means of strengthening the influence of specialization on the learning process (Lytvynova, 2011).

The creation of an electronic educational environment in institutions of higher education for the study of vocational subjects is carried out by:

- Automation of the processes of students' educational activities;
- Informatization in higher education institutions of the activities of individual structural divisions;
- Application of electronic learning elements in the educational environment;
- The use of interactive learning to form a new educational space;
- Provision of wide access to local services to those seeking higher education, etc.

In institutions of higher education, a technology based on the use of hi-tech has recently become more widespread, this is the technology of electronic education (e-learning), which includes:

- Use of audio and video accompaniment in educational activities;
- Educational and methodical provision of the educational process of the higher school with online means of information use, on electronic media;
- On-line and off-line multimedia training methods;
- Formation of an innovative environment for students to acquire knowledge.

Such an educational approach through the transition to the forms and principles of open educational communication allows for the modernization of higher education and leads to a comprehensive update of the entire information support system of the institution of higher education, which is based on providing education with flexible access, taking into account social, geographical, and time constraints (Budnyk et al., 2022).

The rapid development and introduction of computer technologies into the educational activities of higher education institutions confirms the need to solve a wide range of tasks related to both the improvement of the educational process itself and infrastructure support. Therefore, it is advisable to carry out the following steps of the institution of higher education when mastering the subjects of a professional direction:

1) Creation of new technical and technological, psychological and pedagogical services, information and analytical laboratories, educational and scientific information library centers, information technology centers, etc.;

2) To make innovative information and publishing activities: production of electronic resources, electronic educational products, heuristic educational programs, subject data banks, etc. (Tsukanova et al., 2023)

To support the educational process, practical experience in the use and implementation of new digital solutions in higher education, focused on the centralization of access to distance education and the spread of interactive learning, is necessary (Rojas-Bahamón & Arbeláez-Campillo, 2023). The process of implementing distance education in a higher education institution involves the use of a specialized environment, the individualization of curricula, the resolution of the following issues: the regulation of the educational process of higher education regarding the definition of blocks, topics of disciplines through the mutual exchange of information between students of higher education and teachers, the use of active educational communications by students of higher education education and elements of a specialized information environment; maximum access to objects and information resources, information about the higher school, units; publication of educational and methodological publications, electronic educational and methodological manuals; technical and technological transformation into a network communication platform; creation of electronic educational and methodical complexes; stimulating the creation of new educational tasks online; the use of cross-media communications (with the help of mass media information distribution service); providing with the help of any device and any communication channel the ability to communicate in a network technological specialized environment, which is the basis for voice, video and mobile communications, data convergence in an integrated, secure, unified architecture; the organization of a special social-communication, psychological-pedagogical unit of the higher school, which carries out:

- Planning step-by-step, step-by-step implementation of distance learning,
- Constant flexible financial methodical regulation in the educational process of systematic implementation of new forms and means and monitoring (Sulym et al., 2023).

Effective informativeness and effectiveness in providing the educational needs of students of higher education in the formation of an interactive educational environment in modern learning technologies are achieved through the consolidation of all participants in educational and pedagogical activities when teaching professional subjects (Lishchynska, 2018).

Digital interactive projection media systems in the teaching of vocational subjects allow:

- Rationally organize the educational process of the higher school;
- To develop research skills;
- To provide positive motivation for learning;
- To ensure a high degree of differentiation of education;
- Conduct classes at a high aesthetic and emotional level;
- Improve knowledge control;
- To increase the amount of work performed in class;
- Increase the effectiveness of the lesson;
- Provide access to electronic libraries, various reference systems, and other information sources (Bonch-Bruievych & Nosenko, 2010).

**Experiment.**

With the possibility of quantitative and qualitative further analysis of the results, our study was based on an online survey. The respondents of the survey were those who obtained higher education.

The results of the theoretical analysis show that the problem of using digital interactive projection media systems in the teaching of vocational subjects requires a deeper study due to insufficient study.

With the possibility of quantitative and qualitative further analysis of the results, our study was based on an online survey. Respondents of the survey were those with higher education (127 respondents).

To check the effectiveness of the use of digital interactive projection media systems in higher schools in teaching vocational subjects, a pedagogical experiment was conducted in the real conditions of the educational process.

Preparation for the experiment involved solving the following tasks:

- Provision of equal initial conditions for the control and experimental groups (training of teachers, success results, number of students);
- Development and selection of diagnostic methods;
- Determining the duration of the experiment;
- Definition of the levels at which we talk about changes in experimental groups.

The purpose of the experiment is to identify the level of readiness of students to use digital interactive projection media systems in educational and professional activities.

By students' readiness to use digital interactive projection media systems in educational and professional activities, we mean students' readiness to use digital interactive projection media systems, perception of information with their help during training, and readiness to implement them in their professional activities. Levels of students' readiness to use digital interactive projection media systems in educational and professional activities have been established:

***High level*** – students who have a persistent need for further professional self-improvement and self-discovery; have a persistent and purposeful attitude to learning; have rich fantasy and imagination; have the skills and ability to operate information electronically; show a long-lasting interest in learning with the use of digital interactive projection media systems, a creative attitude with the use of innovative technologies to the organization of the educational process; actively perceive information in electronic form; show creative approaches to the development of classes with elements of digital interactive projection media systems; can independently use digital interactive projection media systems in educational and professional activities.

***Intermediate level*** – students know the basics of digital interactive projection media systems in educational and professional activities; can select and analyze interactive products; are aware of the need to use them in professional activities; show an episodic interest in the application of digital interactive projection media systems in educational and professional activities, apply innovative teaching methods according to the proposed scheme, without showing creative approaches.

***Low level*** – inherent in students with user-level knowledge of digital interactive projection media systems, who are not able to independently work with this product, analyze and select educational material; show weak initiative in learning, do not show interest in classes using digital interactive projection media systems in educational and professional activities; learning is of a copying nature, knowledge, skills, and developed skills are applied when solving the same type of tasks; cannot perceive educational information in electronic form, students lack creative imagination.

The analysis of the criteria for students' readiness to use digital interactive projection media systems in educational and professional activities after and before the formative experiment proved that after the implementation of the courses developed by us for the use of digital interactive projection media systems in educational and professional activities of future specialists, where students had the opportunity to develop their works with the use of digital interactive projection media systems in educational and professional activities, presented them to the group during the study of vocational subjects, the quantitative indicators of the levels in the experimental group increased significantly, while in the control group, the changes were not significant.

In particular:

The formation of the personal and motivational attitude of students to the use of digital interactive projection media systems in mastering professional subjects and professional activities has increased:

- By 41.7% in the experimental groups,
- By 8.9% in control groups;

The formation of general awareness of the use of digital interactive projection media systems has increased:

- By 57% in experimental groups;
- By 5.1% in control groups;

The formation of literacy in the use of digital interactive projection media systems has increased:

- By 48.6% in the experimental groups,
- By 9.9% in control groups.

After the formative experiment, the levels of readiness of the students of the control group and the experimental group regarding the use of digital interactive projection media systems in educational and professional activities were as follows:

EG readiness levels (in %):

- Low 23.5%;
- Average 52.7%;
- High 23.8%.

CG readiness levels (in %):

- Low 51%;
- Average 36.4%;
- High 12.6%.

Therefore, the introduction of digital interactive projection media systems in the teaching of vocational subjects in experimental groups, as well as the introduction of the course "Application of digital interactive projection media systems in the teaching of vocational subjects" contributed to the creation of a positive mood in the class, diversification of forms of educational activity, formation of skills in students and new skill.

As a result of the study, the students of the experimental groups showed better results in terms of the formed readiness to use digital interactive projection media systems in educational and professional activities than the students of the control groups, which indicates an improvement in the results of the assimilation of the educational material by students, which was studied with the help of the use of digital interactive projection media systems, as well as that, that the implementation of the proposed course "Application of digital interactive projection media systems in the teaching of vocational subjects" with the use of innovative methods contributed to increasing the level of students' readiness to use digital interactive projection media systems in professional activities. This contributed to the formation of the creative personality of a specialist who needs further professional self-improvement, a persistent need for self-knowledge, an innovative attitude to the organization of the educational process using digital interactive

projection media systems, a rich creative imagination that can apply the acquired innovative knowledge in his professional activity.

A sign criterion was used to identify the level of formation of the application of digital interactive projection media systems.

In the study, we used the Student's t-test.

The results of the experiment make it possible to conclude that the introduction of the course "Application of digital interactive projection media systems in the teaching of professional subjects" in the training of future specialists contributed to increasing the level of students' readiness to use digital interactive projection media systems in professional activities. Students mastered the stages of using digital interactive projection media systems, learned to organize their study time in working with digital interactive projection media systems, acquired skills and abilities to operate innovative information in electronic form, and used digital interactive projection media systems in independent educational and cognitive activities.

**Conclusions**

The content of the interactive education process and its components are disclosed. The essence and significance of digital interactive projection media systems in teaching professional subjects are shown. As an example of digital interactive projection systems, an effective interactive software-technological complex based on SMART Board is shown, the interactive functions of the interactive SMART Board software created specifically for the educational space in teaching vocational subjects and the advantages of the interactive panel in the educational space of a higher school are revealed. Ways of developing the teacher's professional competencies when using an interactive panel or blackboard in classes at a higher school are analyzed.

The effectiveness of electronic textbooks, manuals electronic educational and methodological complexes, informative and reference multimedia publications, game educational and developmental publications, scientific research STEM centers, multimedia classes, virtual laboratories, virtual classes, etc. in teaching vocational subjects is shown.

To check the effectiveness of the use of digital interactive projection media systems in higher schools in teaching vocational subjects, a pedagogical experiment was conducted in the real conditions of the educational process.

The purpose of the experiment is to identify the level of readiness of students to use digital interactive projection media systems in educational and professional activities.

Levels of students' readiness to use digital interactive projection media systems in educational and professional activities have been established:

As a result of the study, the students of the experimental groups showed better results in terms of the formed readiness to use digital interactive projection media systems in educational and professional activities than the students of the control groups, which indicates an improvement in the results of the assimilation of the educational material by students, which was studied with the help of the use of digital interactive projection media systems, as well as that, that the implementation of the proposed course "Application of digital interactive projection media systems in the teaching of vocational subjects" with the use of innovative methods contributed to increasing the level of students' readiness to use digital interactive projection media systems in professional activities. Students mastered the stages of using digital interactive projection media systems, learned to organize their study time in working with digital interactive projection media systems, acquired skills and abilities to operate innovative information in electronic form, and used digital interactive projection media systems in independent educational and cognitive activities.

Further research is needed to clarify the ways of using online platforms, interactive textbooks, mobile applications, social networks, QR codes, the project method, and cooperative "inverted" learning, which is important in modern higher education.

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