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# Features of the Use of Software and Hardware of the Educational Process in the Conditions of Blended Learning

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**Keywords:** Blended Learning, Complex, Innovations, Informatization, Quality of Education.

**Abstract:** The paper reveals the results of a study of the feasibility of using software and hardware for the educational process in a blended learning environment in secondary, higher and vocational education. The author conducted an analysis of domestic and international research on distance learning (distance learning needs, requirements for distance learning platforms, experience in implementing distance and blended learning). In the course of the research, the author revealed the standard composition of modern software and hardware of the educational process in the conditions of blended learning and analyzed the market of Ukraine for the availability of ready-made complexes of the company. Recommendations for approaches to teaching in each age group of students and approaches to choosing a complex for implementation in a mixed and distance learning environment, taking into account the individual needs of each educational institution or educational organization. The research is theoretical in nature and designed to create a basis for further research in a given vector.


## 1 INTRODUCTION


2020 was a year of testing in all areas of human activity, a year of renewal and strengthening the level of informatization of these areas (Fedorenko et al., 2019). The reason was the global pandemic of the COVID-19 virus (Semerikov et al., 2020), which served as a catalyst for the informatization of life. Speaking about the general informatization and problems of COVID-19, we can emphasize that the greatest impact was suffered by such areas of human activity as: education, medicine and industry. As part of our study, we will focus on identifying the problem of the education sector, as well as methods for solving them in full or partial quarantine.


Having conducted a preliminary analysis of the problem, we can already emphasize the significant tendency to increase the number of scientific papers that focused their research on the development and implementation of adaptive testing systems for students, the use of automated learning systems and development of quality learning environments (Osad-


cha et al., 2020; Pererva et al., 2020; Vlasenko et al., 2020b). However, we can emphasize that the development of such systems significantly improves the worldview of people in the study of theoretical or informational courses, but not in the context of teaching higher education students or high school students in subjects that require physical, creative or group work. We can say that the learning process, especially in secondary and vocational education requires closer contact with the teacher and creating conditions for full immersion in the educational process, which is the task of our study: to analyze the specific learning needs in blended learning and determine the appropriateness of the selected set techniques for creating a blended learning environment in secondary and vocational education.

The first stage of the work was the analysis of current research in a particular area. The leading tasks for the analysis were determined: in-depth analysis of modern needs of distance and blended learning processes; analysis of the experience of using the means of creating a quality educational process in terms of distance and blended learning. Defining these tasks for analysis, we expected to get a comprehensive and comprehensive vision of distance and blended learning and ways to solve it, as well as analyze the world and domestic experience of using tools

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to create a quality learning process in distance and blended learning.

Bobyliiev and Vihrova (Bobyliiev and Vihrova, 2021), Bondarenko et al. (Bondarenko et al., 2018), Gonchar (Gonchar, 2012), Osadchyi (Osadchyi, 2019), Osadchyi and Varina (Osadchyi and Varina, 2020), Tkachuk et al. (Tkachuk et al., 2020), Valko and Osadchyi (Valko and Osadchyi, 2020) focused on determining the fundamental foundations of development and conducting distance or blended learning. Important in the study was the analysis of works on the experience of developing and conducting training during blended learning in general quarantine, among these works, important in our study were noted works (Kruglyk et al., 2020; Lisachenko et al., 2020; Tkachuk et al., 2020). Exploring the world experience of using tools to create a quality learning process in distance and blended learning, we can note the works (Bliuc et al., 2012; O'Connor et al., 2011), in which scientists have described in detail the issues of blended learning, its problems and needs. Comas-Quinn (Comas-Quinn, 2011) analyzed in his work the experience of teachers in a blended course using the means of synchronous and asynchronous communication. Kirkley and Kirkley (Kirkley and Kirkley, 2005) conducted a detailed analysis of the processes of creating a mixed learning environment using mixed reality, video games and modeling the results of production processes.

After the analysis, it was decided to check the feasibility of use and develop recommendations for the use of the complex identified in the study.

## **2 FEATURES OF THE USE OF SOFTWARE AND HARDWARE OF THE EDUCATIONAL PROCESS IN THE CONDITIONS OF BLENDED LEARNING**

An important point in creating a system of learning in distance and blended learning is the motivating factor. In the modern psychological and pedagogical literature, the following elements of the motivating factor are allocated: creation of the accurate target installation; an indication of the need for action to study specific course topics and for professional activities; selection of educational content in accordance with the cognitive interests of students; providing professional orientation of this content; ensuring the optimal level of requirements for each course. To activate the cognitive processes of attention, perception, thinking,

there are a number of other requirements: to provide educational information with a high enough redundancy; use technical teaching aids; use computer technology; take into account the possibility of direct control of perception; take into account the emotional factor. According to scientists, the essence of creative psychological and pedagogical technology is a creative approach to solving the problem of pedagogical process, during which the interests and values of the individual are one of the dominant components of the organization and content of educational activities (Gonchar, 2012; Osadchyi and Varina, 2020; Lisachenko et al., 2020; Bliuc et al., 2012; Kirkley and Kirkley, 2005; Bukreiev, 2020; Vlasenko et al., 2020a). That is, we can say that creative psychological and pedagogical technology actually speaks of a paradigm shift in vocational education, where it will be necessary not to solve ready-made didactic tasks, but to generate, initiate, creatively formulate ideas, plans. In order to solve this problem, there is a need to analyze the existing software and hardware of the educational process in terms of blended learning and the development of methodological complexes for its use.

According to the current epidemiological situation, the needs of educational institutions and the problems of blended learning, we can note that in general the optimal performance of the blended learning class can be represented in the form of such a structure (figure 1).

The need of educational institutions in partial or complete quarantine leads to full or partial transfer of the educational process to the Internet, which in turn reduces the level of involvement, motivation and concentration of students in the educational process. The reason for this trend is, first of all, a decrease in the level of perception of information and a change in the classroom environment to a relaxing home atmosphere. To solve this problem, it is advisable to turn to the works of Kruglyk et al. (Kruglyk et al., 2020), Osadchyi and Varina (Osadchyi and Varina, 2020), Valko and Osadchyi (Valko and Osadchyi, 2020), who emphasized the need to create conditions for quality and in-depth communication between teacher and student in a blended learning environment. Kruglyk et al. (Kruglyk et al., 2020) conducted an experimental test of the implementation of the remote communication platform Discord and according to the results of the experiment stressed the significant positive trend of improving the quality of students' knowledge, after the introduction of a new platform for remote communication active synchronous communication, group work and individualized consultation with the teacher. Analyzing the results of the experiment, we can em-



Figure 1: Class model of an interactive lesson in the conditions of blended learning.

phasize that creating conditions for partial immersion of students in the initial process in distance education, by creating virtual classrooms, significantly increases the quality of information perception, by interacting with almost all organs of student information perception. Thus, the need to create conditions for expanding the reality of the educational process in terms of blended and distance learning is confirmed.

To create conditions for expanding the reality of the educational process in mixed and distance learning, between full-time and distance students, we analyzed the modern software and hardware of the educational process in mixed learning and the possibility of its implementation in the educational process. First of all, we analyzed the experience of conducting classes in quarantine on the basis of various educational organizations. It is worth noting three main approaches that were analyzed during the study, namely: full distance education on the basis of Bogdan Khmelnytsky Melitopol State Pedagogical University, mixed form of education on the basis of schools in Melitopol, full-time education on the basis of robotics class for students primary school and direct education of primary school students. In terms of age gradation, only within the study, we can conditionally divide students into three groups, respectively: junior students (full-time), middle school (mixed form of education) and senior students (distance learning). Accordingly, this distribution is quite logical and determined by current trends and experience of teachers, which we observed during 2019-2020 during the quarantine caused by COVID-19.

Having divided into groups of levels of education and age category, we can determine the main needs of each group, and analyze the experience of their satisfaction.

The first group was selected to conduct an analysis of younger students, due to the low level of changes that have been introduced into the educational process after the introduction of global quarantine. We can note that the main problem was and remains the low level of ability of primary school students to concentrate on the learning process, the need for constant active interaction and the use of game approaches. The current measures to increase the level of concentration are the use of animation and game interaction of students with the object of study. By solving this problem, we can note the special information and pedagogical tools of the New Ukrainian School. Based on the analyzed experience, we can note the active introduction into the educational process: interactive panels, electronic tablets, projectors with the ability to remotely control and combine into a single network and other means of game learning. Teachers, through the use of visualization technologies and interaction of the student with the object of study, create conditions for full deepening and concentration of the student's attention in learning, allowing the disclosure of all cognitive styles of the student through comprehensive interaction. In this case, the teacher acts as a moderator of the game and a judge on the quality of its performance, students act as players or observers, which significantly increases their concentration on learning and motivation to participate in the "learning game".

If we analyze the experience of robotics classes, we can note a number of specific needs caused by the peculiarities of the club, to them we can note the need for mobility (conducting classes on the basis of various educational institutions) and the availability of low-load mobile software to solve problems of insufficient capabilities of computers on the basis of small schools in the city. The solution to this problem may be to use a set of software and hardware, which consists of: a set of mobile computer tools (laptops or tablets) with software installed on them for robotics, sets of constructors for robots and means of displaying information (multimedia panel with fixed mobile rack or projector with screen).

The second group focuses its work on creating conditions for expanding the reality of students in blended learning. The reason for the problem is the practice of Ukrainian schools to conduct classes in the format of dividing the group into two parts that gradually replace each other. Summarizing the model of the lesson of this group, it is expedient to display it as a model of a spiral of two rays, in which the rays are constantly changing their position. This creates the conditions for reducing the number of students who are in the classroom at the same time and conducting classes for half of the students in a distance format. Each week the groups change places and the process moves from full-time and distance learning formats to general blended learning. This approach is highly appropriate in terms of maintaining the health of children, but imposes a significant reduction in the level of concentration of students in the learning process, which leads to a decrease in the level of knowledge of students in general. In order to solve this problem, we analyzed the possibilities of modern software and hardware in combination with the experience of Ukrainian schools. According to the analysis, we can emphasize the insufficient level of elaboration of a particular issue and the lack of a clear solution to the problem. One of the leading reasons, in our opinion, is the low level of motivation of students to learn. Constant work at home creates conditions for reducing the concentration of students, which leads to a complete lack of motivation and fatigue from tasks. To address the root cause, there is a need to fully modernize learning and create a comprehensive learning platform. In our opinion, it is advisable to use the means of augmenting reality and the introduction of a single face-to-face learning space, which is achieved through the use of: a single information platform with educational and methodological complex, permanent webcams for students studying at home, the introduction of constant intensification of their work over group projects with students in

the classroom. This approach significantly activates the cognitive processes of students and requires them to fully concentrate in order to achieve positive results of the group. However, the problem of a certain approach is a significant increase in the role of the teacher during classes, students will be able to fully unleash their potential only if the quality of development of teaching materials. In our opinion, teaching materials for blended learning should be based on three main postulates: dynamism, ease of understanding and group interaction. Thus, the software and hardware component of training must meet the conditions of dynamic visualization of information and the possibility of active interaction with it (the use of dynamic 3D models, learning animations, the ability to add and change control factors, etc.), examples of such existing initial software can be considered such programs as: ActivInspire, ClassFlow, mozaBook and others.

As part of the work of the third group, we can note a significant change in the format of the educational process with the transfer of the entire educational process to distance learning. This approach fully protects students from the possibility of further spread of the virus, but creates significant problems for the quality of education. The cause of these problems is the complete isolation of students from teachers, which creates conditions for emotional isolation of students, which leads to a complete or partial reduction in the level of concentration of students in the learning process. To a large extent, these processes are based on the insufficient level of development of students' self-awareness and their motivation for the process of acquiring knowledge. Unfortunately, we can say that there is no possibility of a complete solution to the problem due to the large age of students, while the process of self-awareness should develop from an early age, however, analyzing the experience of classes at the Department of Informatics and Cybernetics Bogdan Khmelnytsky Melitopol State Pedagogical University, we can emphasize the existence of a number of methods to improve the quality of knowledge and motivation of students to learn. In our opinion, the priority is to create conditions for quality and open communication between teacher and students during training and the possibility of simultaneous work (virtual classroom, platform or server) with a large number of information flows (desktop of each student), so in work (Kruglyk et al., 2020) reveals the features of the Discord platform implemented on the basis of the above mentioned department. Based on the results of the study, we can note that the main need for distance work is to create conditions for synchronous communication using a single database of



teaching materials (for example, the site of distance learning <https://dfn.mdpu.org.ua>), the availability of remote assessment and the ability to dynamically display the results of work. To increase the level of information visualization, it is advisable to use broadcasts of 3D models and examples of problem solving during lectures. For this purpose, on the basis of the Department of Informatics and Cybernetics, a multimedia panel with the mozaBook application installed on it was used, from which the broadcast for all students of the study group took place. The task of the teacher in terms of distance learning is the function of the developer of educational and methodological support and the lecturer during lectures. The main problem is the need to develop standardized tasks that would be interesting for “strong” students and with a sufficient level of complexity for “weak” students. It is important to take into account the cognitive styles of different groups of students, to create conditions for high-quality perception of information by all students and to solve problems in different ways. A separate problem is the problem of low level of technical support of students and problems with the Internet (Kruglyk et al., 2020). The solution to the problem is the use of the teacher, in the educational process embedded learning servers with the ability to teach learning materials for asynchronous interaction and perform or test tasks at a convenient time for the student and teacher. However, as we emphasized the need for synchronous interaction between teacher and student to improve the level of information perception and interaction with the cognitive styles of each student. This in turn creates a contradiction between the synchronous and asynchronous approach to learning. To resolve this contradiction, there is a need to combine both approaches and their parallel implementation in the educational process. This decision increases the requirements for the teacher in terms of psychological and pedagogical training, development of universal methodological complexes and the introduction of innovative pedagogical tools in the educational process. An additional problem is the need to determine the cognitive characteristics of students and adjust the learning process in accordance with the results of this definition, which has been studied by Sender (Sender, 2018).

Therefore, summing up the requirements of all approaches to learning in a mixed distance learning environment, we can say a partial or complete exclusion of methods and means of face-to-face interaction, in order to reduce the possibility of infection with the virus. The methodical work of the teacher should be focused on the issues of psychological and pedagogical preparation for the educational process,

development of universal methodical complexes and introduction of innovative pedagogical means in the educational process. When trying to determine the form of the general complex of software and hardware of the educational process in the conditions of mixed learning, it includes: means of information visualization (physical board in combination with a webcam, multimedia board, projector), means of training and control unit (laptop, computer computer, tablet, training server), means and methods of synchronization of the educational process (online testing, use of the general training server, screen demonstration), platform of synchronous and asynchronous communication (Discord, Zoom, Google Meet and others), educational and methodical complexes, training programs with Internet access (distance learning site, ActivInspire, ClassFlow, mozaBook and others). We can note that a certain set of software and hardware in different combinations of the composition in general solves the problem in the study. We have developed models of three sets of software and hardware for each of the approaches studied in the work. Each of their complexes aims to create conditions for a quality learning process in a blended learning environment, but each of them has a unique and narrow link of use and should be selected according to the unique needs of each type of educational activity.

Thus, the interactive multimedia complex for the younger group, which includes an interactive panel, laptop, webcam and training software, allows you to easily perform the lecture load in a distance and blended learning environment. However, determining the needs of professional education, which are noted in (Gonchar, 2012; Malchenko et al., 2021; Tkachuk, 2018; Valko and Osadchyi, 2020), the defined complex does not fully realize the possibilities of mobility and creative immersion in the educational process by the students themselves, which in turn significantly reduces the possibilities of its use. The use of a certain complex will require the teacher to develop more in-depth methodological materials in order to solve a certain problem, create conditions for group work and artificially expand the worldview of students during their studies. However, such a complex provides the minimum necessary functions that fully meet the needs of the younger group of students.

Interactive multimedia complex for the middle group, which includes an interactive panel, laptop, webcam, document camera, 4G modem, unlimited internet and training software. We can emphasize the high level of capabilities in the vector of classes in mixed or remote mode, provided that there is a static laboratory or office for classes. The presence of 4G Internet units and two types of cameras, create

conditions for partial immersion in the learning process, the student has the impression of actual presence in the classroom as close as possible to real events, which fully meets the needs of vocational education and solves the main problems of blended and distance learning, indicated in (Bliuc et al., 2012; O'Connor et al., 2011). Therefore, we can emphasize the feasibility of using a certain complex during the educational process of secondary, higher and vocational education in blended and distance learning. The introduction of a certain complex in higher education institutions in order to intensify learning, by increasing the level of visualization and direct immersion in the work process is a productive and promising area. We believe that the implementation of the complex will increase the level of motivation of students to learn and intensify their educational activities, which in turn will confirm the positive impact of reality on the quality of students' knowledge while studying in distance and blended learning.

Interactive multimedia complex for blended learning for the senior group, which includes an interactive panel, a stand on wheels, means of remote input of information, a virtual classroom, a separate operating system, means of screen demonstration. In a certain complex, we have the opportunity to note the high level of mobility and technical capabilities. A modern multimedia panel in combination with a computer module will create the conditions of a high-tech mobile learning station without the need for the physical presence of some participants in the learning process in a static audience. This, in turn, expands the opportunities for teachers and students and creates conditions for field trips, classes in conditions of constant partial lack of information, classes in the format of electives, after classes, training groups and more. This in turn will expand the age range of students and the range of approaches to learning, which is especially important for institutions of higher and non-formal education.

However, along with the problem of insufficient software and hardware base of modern educational institutions in Ukraine, there is a problem of insufficient funding. In this regard, we analyzed the most common ready-made complexes for blended learning, in order to determine the possibilities of solving the main problem of research through their use, which are freely distributed in Ukraine. The analysis highlighted that Promethean and EdPro are the leading companies. Thus, we marked the four most optimal educational complexes:

1. Interactive multimedia complex for blended learning 5 in 1 Promethean: interactive panel, laptop, webcam, ActivInspire, ClassFlow (96936 UAH)

(figure 2).

2. Interactive multimedia complex for blended learning 7 in 1 4G Promethean: interactive panel, laptop, webcam, document camera, 4G modem and unlimited internet, ActivInspire, ClassFlow (UAH 170,000) (figure 3).
3. Kit for blended learning 7 in 1 Mobile Promethean (UAH 175,000) (figure 4).
4. Interactive panel EdPro ETP65L52568 (UAH 132,444): Screen 65 " 4K, 20 Touch, Intel@ i5 8gen, 256 GB SSD, 8 GB RAM, stand on wheels, wireless combo keyboard, MozaBook Classroom, Windows 10 Pro UKR, Note & Connect & ScreenShare Pro (figure 5).

We emphasize that the complexes were developed by companies with the aim of maximum standardization, which can significantly affect the quality of education in each area of education. However, we can emphasize the expediency of using these complexes in the conditions of mixed and distance learning, only if the individual needs of each educational institution or educational organization are taken into account in advance. This creates a need for further study of a particular problem, in order to generalize a single productive complex within each of these approaches to learning in blended and distance learning.

### 3 CONCLUSIONS

According to the results of the study, we can say that the analysis of scientific sources in combination with the subsequent analysis of the capabilities identified in the work of interactive multimedia systems for blended learning gave us the opportunity to say that all identified systems are appropriate for implementation in the learning process training taking into account the individual needs of each educational institution or educational organization. As part of the study, students were divided into 3 conditional groups: junior students (full-time), middle school (mixed form of education) and senior students (distance learning) and developed recommendations and described the experience of learning in each of the identified groups. Then the standard structure of the software and hardware complex necessary for creation of conditions of qualitative training was analyzed and complexes for each of the certain groups were developed. In our opinion, the use of such complexes in higher education institutions in order to intensify learning will significantly improve the quality of students' knowledge through visualization and direct immersion in the work process. We believe that

### 5-in-1 blended learning kit

A comprehensive solution for blended learning. The multimedia kit combines an interactive panel, a modern teacher's laptop and a high-quality webcam for interactive lessons.



-  ActivPanel Cobalt interactive panel
-  15.6 laptop
-  Webcam
-  ActivInspire and ClassFlow software

Figure 2: Interactive multimedia complex for blended learning 5 in 1 Promethean.

### 7 in 1 4G blended learning kit

A comprehensive solution for blended learning. The multimedia kit combines an interactive panel with modern computer equipment, a webcam and a document camera for comfortable interactive lessons in a blended learning environment. The main helpers for you will be the ActivInspire software and the ClassFlow cloud service, which we provide for free.




-  Interactive panel - Titanium
-  15.6 laptop
-  Webcam and Document Camera
-  4G modem and annual unlimited internet
-  ActivInspire and ClassFlow software

Figure 3: Interactive multimedia complex for blended learning 7 in 1 4G Promethean.

### Kit for blended learning 7 in 1 Mobile

This is a comprehensive solution for blended learning. The multimedia kit combines an interactive Cobalt 65" 4K panel on mobile racks, a webcam and a document camera, as well as an OPS module for comfortable interactive lessons in a blended learning environment. The main helpers for you will be the ActivInspire software and the ClassFlow cloud service, which we provide for free.








-  Interactive panel - Cobalt 65" 4K
-  Computer module OPS-M I5 16G pro
-  Webcam and Document Camera
-  Fixed mobile rack
-  ActivInspire and ClassFlow software

Figure 4: Kit for blended learning 7 in 1 Mobile Promethean.





## EdPro Touch 65 "

Model: [ETP65L52568](#)  
 Diagonal: 65" (1.65 m)  
 4K UltraHD Display  
 20 touches  
 Tempered glass  
 i5 8th gen  
 256GB SSD  
 8GB DDR4  
 Windows 10 Pro, Android 8  
 Note & Connect & ScreenShare Pro  
 Warranty 24 months (repair up to 2 weeks or replacement)

Figure 5: Interactive panel EdPro ETP65L52568.

the implementation of the complex will increase the level of motivation of students and intensify their educational activities, which in turn will confirm the positive impact of augmented reality on the quality of students' knowledge during distance and blended learning. However, in the future a detailed study of the specific needs of each branch of education is needed in order to determine the optimal use of the analyzed complexes or the development of a new complex in order to maximize learning productivity. Thus, a system of full immersion of students in the educational process will be created and all the needs of educators will be covered to create a quality educational environment in the conditions of long-term blended or distance learning.

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