Information And Communication Communication Technologies In The System Of Distance Education

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Summary
The purpose of this article is to consider the distance education system, its principles, features and means. One of its existing and promising tools is video conferencing. The article discusses the types of video conferencing, hardware and software, features and requirements for communication channels, types of information transmitted through these channels.

Key words:
multimedia technologies, communication technologies, education system, educational process.

1. Introduction

The use of information and communication technologies represents a new level of thinking, creative, communicative and performing activities and leads to a radical restructuring of various aspects of activities, including educational and training. In psychology, the fact of the connection between activity and communication is ascertained by researchers. It is known from psychology that through communication, activity is organized and developed. As a rule, in this case, three interrelated aspects of communication are considered: communicative (exchange of information), interactive (interaction) and perceptual (the fact of establishing mutual understanding).
The effectiveness of pedagogical influence in distance learning through computer telecommunication networks cannot be understood outside the peculiarities of communication between the teacher and the student. Ways to solve problems caused by the fact that:
• information in the process of communication is not only transmitted, but also formed, refined, and developed;
• verbal communication is realized using actual, informational, discussion and confessional types of dialogues;
• an organic complement to verbal speech is the use of non-verbal means of communication, such as gestures, facial expressions, voice quality, its range, tonality
• visual communication (eye contact);
• the interactive side of communication is manifested in joint activities;
• in the process of communication, there must be mutual understanding between its participants.
What drives the use of telecommunication systems in distance education?
It is attracted not only by the possibility of providing prompt feedback between the trainee and the trainer at a distance over the network, by means of providing knowledge, but also by the constant updating of the training material at the lowest cost. In connection with the ideas of individual and developmental education, the functionality of using information technology tools in teaching is of particular interest [4].
The purpose of the article is to consider the distance education system, its principles, features and means. One of its existing and promising tools is video conferencing. The article discusses the types of video conferencing, hardware and software, features and requirements for communication channels, types of information transmitted through these channels.

2. Theoretical Consideration

Education is a purposeful, systematic, organized process of acquiring knowledge, abilities, skills, and education is the result of a person's learning.
Distance learning is a distance learning method in which the teacher and the trainees are physically located in different places. Historically, distance learning has meant distance learning. However, it is now a teaching tool using audio, video and computer systems linked through communication channels. Distance learning is a form of education, along with full-time and part-time, in which the best traditional and innovative methods, means and forms of education based on computer and telecommunication technologies are used in the educational process [5].
Distance education is closely related to distance learning. It is generally accepted that distance education is a process of transferring knowledge (the teacher and the training center

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are responsible for it), and distance learning is a process of acquiring knowledge (the student is responsible for it).

The basis of the educational process in distance education is the purposeful and controlled intensive independent work of a student who can study in a place convenient for himself, according to an individual schedule, having a set of special teaching aids and an agreed opportunity to contact the teacher by phone, e-mail and regular mail, and also in person.

Distance education is a special, perfect form that combines elements of full-time, part-time, part-time and evening education based on new information technologies and multimedia systems. Modern means of telecommunications and electronic publications make it possible to overcome the disadvantages of traditional forms of education, while maintaining all their advantages.

Distance learning is associated with a new organization of the educational process, based on the principle of independent student learning. The learning environment is characterized by the fact that the trainees are mainly, and often completely, remote from the teacher in space and (or) in time, at the same time, they have the opportunity to maintain a dialogue at any time using telecommunication means. [6-9].

The distance education system (DL) is a system-organized set of data transmission facilities, information resources, interaction protocols, hardware-software and organizational-methodological support, focused on meeting the educational needs of users.

The distance learning system must ensure the performance of the following functions:

• delivery of the bulk of the studied material to the trainees using information technologies;
• interactive interaction of trainees and teachers in the learning process;
• providing trainees with the opportunity to work independently on the development of the studied educational material;
• assessment of the knowledge and skills of trainees in the learning process.

The creation of a distance education system is reduced to the organization of a specific pedagogical system, the elements of which are the following subsystems:

• learning objectives;
• content of training;
• teaching methods;
• teaching aids;
• organizational forms of training;
• identification and control;
• educational material;
• financial and economic;
• regulatory and legal;
• marketing.

The need for and the possibility of organizing additional education is due to the following factors:

• Restrictions on obtaining vocational education (in particular, limited availability in remote regions, high cost of training, restrictions on training time, etc.);
• Limitations on the throughput of universities, advanced training faculties and educational institutions of other types;
• An increase in the number of those wishing to receive a professional education due to the increase in the prestige of education and the need for retraining of specialists;
• The emergence and development of qualitatively new means of information technology and a pronounced process of informatization of telecommunication technologies [9].

1. The principle of the priority of the pedagogical approach in the design of the educational process in preschool education.

The essence of this principle is that the design of DOs must begin with the development of theoretical concepts, the creation of didactic models of those phenomena that are supposed to be realized. The experience of computerization allows us to assert that when the pedagogical side is a priority, the system turns out to be more effective.

2. The principle of pedagogical expediency of the use of new information technologies.

It requires a pedagogical assessment of the effectiveness of each step in the design and creation. Therefore, it is necessary to prioritize not the introduction of technology, but the corresponding content of training courses and educational services.

3. The principle of choosing the content of education.

The content of training courses and disciplines of the distance education system must comply with regulatory requirements.

4. The principle of ensuring the security of information circulating in DOs.

It is necessary to provide, if necessary, organizational and technical methods for the safe and confidential storage, transfer and use of the necessary information, ensuring its security during storage, transfer and use.

5. The principle of the starting level of education.

Effective education in preschool education requires a certain set of knowledge, skills, and abilities. For example, for productive learning, a candidate for study must be familiar with the scientific foundations of independent educational work, have certain skills in using a computer, etc.

6. The principle of conformity of learning technologies.

Teaching technologies should be adequate to models of distance education. So, in traditional disciplinary models of training, lectures, seminars and practical classes, imitation or business games, laboratory classes, independent work, industrial practice, term papers and theses, control of knowledge assimilation are used as organizational forms of training (types of classes). In the process of formation of DO, new models may appear, which, if necessary, should be included in it. Object-oriented or design information models are examples of such new models. Among the organizational forms of training in these models, computer conferences, teleconferences, information sessions, teleconsultations, project work, etc. can be used.

7. The principle of mobility of learning.
It consists in creating information networks, databases and knowledge and data banks for distance education, allowing the student to adjust or supplement his educational program in the required direction. This requires the preservation of information invariant education, which provides the possibility of transition to other areas of education.
8. The principle of non-antagonism of distance education to existing forms of education.
The designed DL will be able to give the necessary social and economic effect, provided that the created and implemented information technologies become not a foreign element in the traditional system of vocational education, but will be naturally integrated into it.
Features of distance education
1. Flexibility.
Students generally do not attend regular classes in the form of lectures and seminars. Everyone can study as much as he personally needs to master the course, discipline and obtain the necessary knowledge in the chosen specialty.
2. Modularity.
Distance education programs are based on a modular principle. Each individual discipline or series of disciplines that are mastered by a student creates a holistic view of a specific subject area. This allows a curriculum to be tailored to individual or group needs from a set of independent training courses.
3. Parallelism.
Training can be carried out by combining the main professional activity with study, i.e. "on the job."
4. Long-range action.
The distance from the student's location to the educational institution (subject to high-quality communication) is not an obstacle to an effective educational process.
5. Asynchrony.
It is understood that in the learning process, the teacher and the learner can implement the technology of teaching and learning independently in time, i.e. on a convenient schedule for everyone and at a convenient pace.
6. Coverage.
This feature is sometimes called "massiveness". The number of students in preschool education is not a critical parameter. They have access to many sources of educational information (electronic libraries, databases), and can also communicate with each other and with the teacher through communication networks or using other means of information technology.
7. Profitability.
This feature refers to the cost-effectiveness of distance education. The average assessment of foreign and domestic educational DL shows that they cost about 10-50% cheaper, mainly due to more efficient use of existing educational space and technical means of information technology, as well as the presentation of a more concentrated and unified content of educational materials and orientation of DL technologies. on a large number of students and other factors.
8. New information technologies.
In DOs, mainly new information technologies are used (computers, audio-video equipment, systems and means of telecommunications, etc.).
In the educational process of distance learning, the following teaching aids can be used:
• printed editions;
• electronic publications;
• computer training systems in conventional and multimedia versions;
• educational and informational audio materials;
• educational and informational video materials;
• laboratory remote workshops;
• simulators;
• databases and knowledge with remote access;
• electronic libraries with remote access;
• didactic materials based on expert training systems;
• didactic materials based on geographic information systems;
• computer networks [6].
According to the technology of data transmission over a distance, the following forms of distance learning can be distinguished:
• distribution of printed materials by mail (typical for traditional distance learning);
• distribution of audio and video cassettes;
• by means of audiography;
• through interactive TV and video conferencing;
• via teleconferences, IRC, MOO, MUD (based on the Internet);
• via e-mail and mailing lists (based on the Internet);
• via WWW (Internet)
Recently, Internet technology has been replacing other forms. This is due to three circumstances:
1. technical development of the Internet - technologies that make it possible to simulate any educational model with cheaper and more convenient means;
2. simplicity of connection to the Internet;
3. low cost of connection.
According to the method of obtaining educational information, they are distinguished:
1. Synchronous training systems
2. Asynchronous training systems.
Synchronous systems imply the simultaneous participation of the trainees and the teacher in the learning process. Such systems include: interactive television, video conferencing, audiography, computer teleconferencing, IRC, MUD, MOO.
Asynchronous systems do not require the simultaneous participation of the trainee and the teacher. The student himself chooses the time and plan of the lesson. Such systems in distance education include courses based on printed materials, audio / video tapes, e-mail, WWW, FTP.
Mixed systems that use elements of both synchronous and asynchronous systems.

When conducting educational and other types of classes, the distance education system must ensure the transmission of the following types of messages:

• audio information - transmission of voice accompaniment by the teacher of the outlined educational material, as well as the students' answers to the teacher's voice questions.

• text information - teacher's comments to the voice commentary, as well as the necessary reference, regulatory, legal, reference information, text control tasks as the teaching material is presented. The trainees should be able to send the teacher the answers to the control questions also in the form of a text file.

• static graphic images - still graphic images (diagrams, drawings, photographs) presented by the teacher in the course of a lecture or practical lesson. The student must be able to transmit a similar image to the teacher;

• dynamic graphic images - real-time presentation of information in the form of graphic symbols, formulas, small drawings, short text comments made by hand in the course of a training session ("electronic board");

• animation and multimedia - moving graphic objects illustrating the dynamics of educational material with audio accompaniment;

• video images of the teacher and trainees;

• educational videos.

Regardless of the type of system, a prerequisite for a video conference, of course, is the presence of a communication channel and the corresponding bandwidth in it. As a rule, such channels are provided by ISDN, LV networks. New different telephone lines. The latter attract with their availability and low cost, however, with a transmission rate of 28.8 Kbps and a small video window, it is almost impossible to obtain a frame rate higher than 10 frames / s, which inevitably affects the image quality (although the sound quality may be quite satisfactory for the video conference participants).

The most common network infrastructure for video conferencing systems is integrated services digital networks. With a bit rate of 128-512 Kbps, they can achieve a scan rate of 30 frames / s. Studies show that it is this frame rate that provides the most user-friendly video image. It is recommended to use 384 Kbps bandwidth for enterprise video conferencing, that is, three ISDN BRI channels, each of which provides a transmission rate of 128 Kbps.

Personal video conferencing systems operating within the same building can use the resources of a local area network. A local area network is capable of providing high bandwidth, and therefore high quality picture and sound. However, a wide bandwidth is used for the transmission of other data streams, and accordingly, transmission delays are possible, to which video streams are extremely sensitive, therefore, full-fledged videoconferencing sessions based on a LAN cannot be guaranteed.

It should be borne in mind that video conferencing is an application with high bandwidth requirements that creates a significant load on the local network. A number of companies, including Intel and PictureTel, offer dedicated LAN traffic management tools to support video conferencing. Intel LANDesk Conferencing Manager R3.0, for example, allows video conferencing only if the required bandwidth does not exceed a certain limit. The local network administrator sets and changes the values of these limits, as well as controls the allocation of bandwidth in real time and, if necessary, stops all video conferencing systems.

New networking technologies such as ATM and frame relay are driving video conferencing. The ATM network, like ISDN, integrates various types of data - text, graphic, audio and video. Implementation of the cell switching principle in ATM provides high throughput with scalability, practically eliminates the problem of delays and guarantees the quality of services provided. Therefore, ATM technology can be considered almost ideal for multimedia applications, in particular video conferencing. However, this is a rather expensive and not yet fully established technology, which hinders the application of this technology in practice.

Frame relay technology was developed primarily as a means of efficient transmission of data packets and is inferior to ATM in terms of optimizing network traffic and providing guaranteed service. However, frame relay networks are increasingly being used as a cost-effective means of transporting audio and video information to large corporations.

It should be noted that the Internet can also be used as a transmission medium for video conferencing. Of course, direct communication over the Internet looks very tempting and, in principle, it is possible using the Real-Time Transport Protocol (RTP, RFC 1889). However, due to the currently existing bandwidth limitations, the Internet cannot provide a high frame rate and absence of transmission delays, and, accordingly, does not guarantee against the loss of individual frames or parts of words. Therefore, at present, it is not possible to obtain high-quality video conferencing based on Internet resources.

Video conferencing is suitable for organizing effective interaction of large and medium-sized groups of users, and due to the significantly higher video quality, it is possible to exchange and view documents that are not possible to display in personal video conferencing. From this point of view, group videoconferences are most effective for conducting group classes (lectures, seminars, group consultations, etc.) in the distance education system. In addition, group video conferencing is ideal for discussions and speeches, that is, where the participant cannot be present in person.

Distance learning in remote mode requires high quality sound and screen images. For these purposes, group video conferencing is more suitable, where high-quality video cameras and audio communication devices are used, which provide Hi-Fi-quality sound and full-screen video. Accordingly, they require monitors of higher quality than the

display of a personal computer. Many systems at this level include these monitors as standard.

Group video conferencing allows members of different groups to see each other and discuss specific issues. When several participants are seated at the screen, the possibility of separating data may not be as relevant as in the case of a dialogue between two users, but the leading systems of this level include such means.

To ensure interoperability between products from different manufacturers, videoconferencing standards developed by the International Telecommunication Union (ITU) are called upon. This allows the corporation to create a unified video communications environment that can be expanded and upgraded while maintaining the same investment.

The main standard, more precisely the H.320 series of videoconferencing standards, defines the basic parameters of audio and video communication over channels with guaranteed bandwidth, in particular over ISDN lines. There are a significant number of systems on the market that meet the H.320 specifications.

Standard H.323 regulates videoconferencing in local and global networks using communication lines with non-guaranteed service. The H.324 standard is also intended for systems based on analogue telephone lines.

The H.320 family includes standards that define the basic requirements for audio and video performance of video conferencing systems. The quality of the transmitted image is determined by two basic parameters - image resolution and frame rate. H.320 specifies two resolution formats - CIF (Common Intermediate Format; 352x288, where the first number means the number of pixels per line, and the second - the number of lines per frame) and QCIF (Quarter Common Intermediate Format; 176x144). To achieve interoperability, a CIF capable system must reduce its resolution when connected to a QCIF system. The allowed frame rate for H.320-compliant systems is 7.5, 10, 15, or 30 fps.

H.320 includes three standards that regulate the level of audio transmission quality:

G.711 (PCM) - transmission of sound at a rate of 64 Kbps in the band of a standard SUN channel (up to 3.4 kHz);

G.722 (ADIKM) - audio transmission at a speed of 48 kbps in a band up to 7 kHz. Provides the highest sound quality, including stereo sound;

G.728 (CELP) is a fairly high-quality audio transmission at a rate of 16 kbps in a bandwidth up to 3.4 kHz.

In addition, high-end systems are usually equipped with echo cancellation [11-13].

There are a number of standards that are directly and indirectly based on H.320, such as H.310 (for ATM and broadband ISDN), H.322 (iso-Ethernet), H.323 (Ethernet) and H.324 (for analog lines) ... The H.321 standard adds the MPEG-2 specifications, which provide full-screen television quality video.

If the support of the standards of the H.320, H.323, H.324 series is declared by a large number of suppliers, then the largest number of problems arose with the T.120 standard, which regulates the separation of documents, applications, the use of bulletin boards and file transfer. A total of 6 products from over 60 products from leading desktop video conferencing vendors support this standard.

The videoconference system is, first of all, a means of teamwork, which is especially important for the distance education system. Therefore, in addition to the audio and video quality it provides, it is necessary to assess the level of the provided data collaboration capabilities. The latter include file transfer, whiteboard, document and application sharing.

Many video conferencing systems support the sharing of document-oriented applications such as word processors or spreadsheets, as well as collaboration with applications not directly related to document creation. Thanks to the ability to share data during a video conference, conditions are created for effective cooperation between project participants in the process of working on a particular task; and their physical distance from each other no longer hinders this work.

Given the importance of document collaboration, ITU-T has developed the T.120 standard, the support of which ensures the compatibility of equipment from different manufacturers. Many video conferencing systems include their own T.120 compliant software, or rely on a purely Microsoft Net-Meeting video conferencing application that complies with this standard. Microsoft is shipping NetMeeting software with its Internet Explorer Web browser and plans to make it a base component in future versions of Windows [1].

To provide video conferencing to several participants at the same time, as a rule, special devices are needed - Multipoint Conferencing Unit (MCU). A number of companies produce such systems, varying in technical characteristics and the number of supported participants. For example, VTEL MCU II allows video conferencing with more than 250 workstations, while PictureTel MCUs provide communication from 4 to 48 nodes.

Usually, during a multipoint video conference, you can see only one participant on the screen - the one who is speaking at the moment. However, in some systems released in recent years (for example, the MCU from PictureTel or the multimedia video server from Videoserver), the so-called "continuous presence" is implemented - the ability to see on the screen several or even all of the participants in a video conference. If MCUs support cascade connection, then with the help of a certain number of such devices, it is possible to cover an arbitrarily large number of users with video conferencing[1-3].

Until now, the most common transmission medium for video conferencing has been ISDN lines. However, in the coming years, it is planned to actively use desktop video conferencing in local networks. In this case, video conferencing support devices are used that implement the functions of a gateway between the LAN and the ISDN line. Such systems are produced, in particular, by PictureTel - its PC-server LiveGateway provides interaction between the

local network and ISDN, which makes it possible to do without a rather expensive connection of a PC directly to an ISDN line. Gateways will allow employees working in the company's local network to communicate via ISDN with remote branches or employees who are out of the office.

When deciding on the use of video conferencing tools in the distance education system, it is necessary to take into account a number of factors, among which the price and functionality of the product are by no means the first place.

At the heart of any modern video conferencing system is a device called a codec. It is responsible for encoding, decoding, compressing and decompressing audio and video signals. All other things being equal (for example, the quality of video cameras), the better the codec, the better the audio and video signal. Codec functions can be implemented both in software and hardware (using DSP), or based on a combination of software and hardware. The main factor affecting the cost of the system as a whole is the price and capabilities of the codec. Codecs implemented by means of software are sometimes several times cheaper than hardware ones, but their successful use requires significantly higher performance of a personal computer, more hard disk space and more capacious RAM.

Sometimes group and desktop systems are so close in capabilities and price that it can be difficult to position them correctly, especially since most vendors have both in their arsenal [4-7].

Personal systems usually run as Windows applications with a video image in a small window placed on the desktop. They also mainly use a single ISDN line (one or two 64 kbps channels). In addition to traditional two-way audio and video communications, these systems are typically equipped with capabilities that make it easier to share data, shared applications, and documents (for example, "two-way" editing of a document or spreadsheet). The term "talking heads" sometimes characterizes the quality of video and sound transmission in such systems. Fast movements result in significant image distortion, commonly referred to as the "shadow" effect, which arises from bandwidth limitations, codec implementation trade-offs, and the use of cheap video cameras and audio components. Therefore, although in such systems compatibility with the H.320 and G.261 standards is declared, in most cases the frame rate does not exceed 10, and CIF resolution is not available at all.

On the other hand, group conferencing systems sometimes offer full screen video, 25-30 frames per second, with the highest audio quality. This is achieved through the use of sophisticated codecs, high-quality audio and video components and a significant amount of bandwidth that exceeds the capabilities of single-channel ISDN. Therefore, it is not surprising that the cost of such systems can be several times higher than the price of a seemingly similar desktop system.

Therefore, if there is a need to use group videoconferencing facilities, then it is necessary to use E1 (both fractional and dedicated) or ISDN PRI connection, that is, at least 384 Kbps.

Another major issue is conferencing with more than 20 participants and sharing of incompletely compatible systems. To solve it, specialized MCUs (Multipoint Control Units) are used, which act as a kind of bridges for connecting devices compatible with the H.320 standard. The main functions of the MCU include encoding, decoding, mixing audio and video signals, as well as managing and monitoring video conferencing. However, the MCU name is now erroneously assigned to bridges that support multiparty conferences using only data or data combined with audio and are not H.320 compliant. The correct name for such devices is MCS (Multimedia Conferencing Server).

The MCU includes a network interface, an audio signal processor containing a codec and a mixer, a special switch for information flows between video conference participants, a data processor (T.120), a conference controller and means for managing traffic and conference modes, as well as saving the conference protocol[8].

The use of MCU is economically and technically justified in the case when it is necessary to connect a large number of dissimilar video conferencing equipment, which also operates at different speeds. MCU vendors include a number of VTel devices such as MCU II (more than 250 installations) and M3C, which support up to 74 ports and are expandable to 1200 ports with bandwidths ranging from 56 to 1920 Kbps.

Intel ProShare Personal Video Conferencing System 200 can be considered a typical example of personal video conferencing tools, which has all the advantages and disadvantages inherent in this class of systems, which, while not being the most common system, nevertheless represents one of the most functionally complete, hardware compatible and not very expensive video conferencing solutions based on Windows-compatible personal computers.

Conclusions

The informatization process is a natural and objective process characteristic of the entire world community. It manifests itself in all spheres of human activity, including education. Largely thanks to this process, a new synthetic form of education has become possible - distance learning, which incorporates the best features of traditional forms of education - full-time, part-time, external, and integrates well with them. One can draw attention to the tendency when all known forms of education will merge in the future into one single form with the predominance of the characteristics of modern distance learning. The use of video teleconferencing, the Internet and other data transmission systems as tools will "bring together" a teacher and a student who are far from each other, bring distance education closer to traditional, to direct communication between teacher and student, lecturer with the audience, group seminars, approved for centuries.

That is why distance learning is often referred to as a form of 21st century education.

Significant distance learning experience has been accumulated in Ukraine and abroad. It becomes obvious that research and practical work on the problems of distance learning, methodological, methodological and technical support of distance education should be constant and continuous. You can be sure that the results of such work will bring real results in the modern educational process, and at the same time in the development of telecommunication systems.

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