

# The Organization of the Use of Audiovisual Recordings of Synchronous Lessons in the Process of Distance Learning

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**Abstract.** Modern network video conferencing services provide a variety of opportunities for conducting synchronous lessons in a distance learning system. The article summarizes the results of 20 years of experience in creating and using audiovisual recordings of full-time and distance learning lessons in university and school class-rooms, combining high-tech and high-touch approaches to increase the effectiveness of teaching. Video recordings of lessons in the process of full-time study can be successfully used in remote form for repetition and consolidation of training materials. A method of rational organization of the information space of synchronous remote high-touch sessions in mini-groups is proposed. The software applications are described that contribute to increasing the attractiveness of the primary presentation of information to students of the “Y” generation in the distance learning process. It is recommended to use the capabilities of “Microsoft Whiteboard” and “Snip & Sketch” applications to illustrate the discussed information and then publish illustrations in online albums of the training groups of specialized sites. The advantages and disadvantages of various software and hardware configurations when organizing remote sessions with their video recording are analyzed. It is recommended to publish distance-learning videos on the Vimeo service in order to increase the effectiveness of repetition, consolidation, control, systematization and generalization of educational information through the use of targeted collective notes associated with illustrations and additional educational materials.

**Keywords:** Audiovisual Recording, Video, Distance Learning, Full-Time Learning, Internet, Skype, Vimeo, High-Touch, High-Tech, Synchronous Lessons.

## 1 Introduction

Modern teaching combines two methodological approaches [1]: high-tech (minimizing teacher communication with students) and high-touch (ensuring personalized teacher attention to students' perception of information). The high-tech approach to the initial presentation of teaching materials minimizes the communication of students with teachers by organizing asynchronous information transfer to numerous students and automating independent progress along the educational path according to the

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results of activity monitoring and control tests. The high-tech form of training is effective for representatives of the Baby-Boomers and X-generation who are inclined toward independent work (born in 1943-1966 and 1967-1990, respectively) [2]. High-touch methods, providing constant personalized attention of the teacher to students, are advisable to apply for children with disabilities [3] and representatives of the modern generation “Y” (born in 1991-2014), which was formed against the backdrop of the transition to the global infocentric world, the formation of web services and social networks [2]. Adapted to an overabundance of available information, students of the “Y” generation with “clip” thinking preferably learn authoritatively announced information transmitted through the screen during synchronous communication, implemented in a dynamic multimedia form.

As a result of the 15-year evolution, hardware-software tools and online services for recording network broadcasting of media resources have reached a professional level [4], which allows us to switch to the didactically targeted use of the audiovisual form of knowledge transfer both in full-time and distance learning.

## **2 Organization of Webinars and their Audiovisual Recording in the Process of Distance Learning by High-Tech Methodology**

In modern systems with the prevailing high-tech form of distance learning, students interacting with each other, as well as with teachers and facilitators, combines asynchronous e-mail messaging, communication programs (instant messengers), forums, blogs and comments using synchronous services video conferences (webinars) of a professional level [5, 6]. The information environment of such webinars is adapted for broadcasting PowerPoint presentations by teachers to hundreds and thousands of students, circular file sharing and receiving feedback through surveys and voting with visualization of the results in real time.

The information space of high-tech webinars is determined by the application interface for video conferencing and, as a rule, includes the main window with a presentation, a middle window with the image of the teacher or video next to his webcam, and a small messenger window for all participants of the webinar with the ability to enter text messages. Most services provide users with the ability to resize and position windows. Recently, more and more high-tech webinars are encountered, during which only the messenger and the slide show functionality with voice accompaniment are used.

Potential problems during high-tech webinars are the conflicts of Adobe Flash Player and similar browser add-ons with the security system of the operating system and the specific information environment of the user's computer. In order to identify and fix problems of professional video conferencing services in advance, participants are required to test the equipment used before the webinar.

Video recording of high-tech webinars through the resources of the video conferencing service is optional and may be associated with additional payment. Video recordings of high-tech webinars are usually distributed by the organizers through pub-

licly accessible file hosting services and video services. An alternative to the formation of high-tech webinar audiovisual recordings is the independent capture of video screen and system audio using specialized software on the student side [7].

### **3 Organization of High-Touch Lessons Audiovisual Recording in the Full-time Education System for the use in Distance Learning**

The modern information environment of most classes in the system of full-time education is formed by means of a screen demonstration of visual materials, commented by the teacher through oral and graphic explanations (in the presence of an electronic board or additional tools, such as flipcharts, etc.). Automated tools for creating video lectures (Sonic Foundry Mediasite, Echo360, etc.), which in real time combined the teacher's image with visual materials and formed media products for publication on the Internet, did not find mass application due to the high cost of acquisition and ownership, as well as due to loss of compatibility with a rapidly evolving information environment (elimination of Flash-video, inconsistency with the requirements of new data exchange security protocols, etc.).

The modern abundance and technical level of audiovisual equipment makes it possible to organize audiovisual recordings of full-time classes by each teacher, who at the same time becomes a producer and acquires property rights to media products created by him in the course of his career after three years. To create didactically attractive audiovisual materials, audiovisual capture of the screen of the electronic board and / or video recording with a stand camera, as well as an independent close-up recording of the teacher's image in combination with the soundtrack from the lavalier microphone are required. It is convenient to carry out audiovisual capture of electronic board content using the Microsoft Power Point slide recording functionality. Practical experience shows that the exported audiovisual row of the Power Point presentation, as a rule, contains high-frequency interference noise induced in the sound card of the motherboard of the computer by closely located electromagnetically unshielded RAM chips. Thus, for high-quality sound recording, the computer must be equipped with a discrete internal or external sound card with power supply different from the power source of the computer. An alternative way to get high-quality sound recording of the teacher's voice is to output the scale from the lavalier microphone to a voice recorder or video camera (if there is appropriate functionality). Another option is the lecturer's voice recording with an independent video camera with a directional microphone.

Based on practical experience, we recommend placing a camera for video recording of a teacher's close-up (N1) to the left of the blackboard at an angle of 45 degrees and recording sound on it using a directional microphone. It is advisable to install a stand camera for recording the contents of the screen and the background plan with the teacher (N2) in the back left corner of the auditorium and record sound on it from the lavalier microphone using a radio system operating in the range that does not interfere with Bluetooth. For video recording, you can now use not only professional

equipment, but also sports cameras with 4K recording quality and correction of barrel-shaped distortions of a wide-angle lens in real time (Ambarella chip and the like).

The video sequence with the presentation (aspect of the 4x3 frame) during video editing is located on the left side of the editing window (aspect of the 16x9 frame), and the teacher's image is placed on the right side, which can be varied during editing according to need (close-up view from camera N1 or far plan from camera N2). The main sound when editing is taken from the N2 camera, and the rest are used to synchronize video sequences. To facilitate synchronization, before the start of the lesson, it is advisable to give a "Motor" signal in the form of a pair of loud pops (with a special clapper board or clap with your hands). Experience shows that the systematic use of the initial synchronization signal is positively perceived by the students and further disciplines them.

#### **4 Organization of High-Touch Lessons Video Broadcast**

The educational environment for high-touch distance learning can be formed by organizing video conferences in mini-groups, provided that the teacher and facilitator have the ability to monitor students' reactions, emotionally comment on the information being taught and promptly adjust the learning path and modify the displayed media resources in accordance with the interests of the audience. Creating a favorable information environment for training high-touch video conferences is possible thanks to special methodological approaches to the use of high-tech tools [8].

In 2013, UNESCO specialists developed the BYOD (Bring Your Own Device) didactic standard that takes into account the specifics of the "Y" generation, which uses educational materials in the cross-platform environment of personal mobile devices such as laptops, ultrabooks, netbooks, tablets, smartphones, media players, micro-computers, etc. [9]. Thanks to the practical implementation of the BYOD standard, all modern devices have a basic set of hardware for participating in video conferencing (high-resolution video cameras, sensitive microphones and acoustic outputs for connecting headphones). To organize a high-touch form of training, it is important to provide high quality audiovisual information from the teacher and facilitator. The devices they use should provide the ability to connect an external webcam. Experience shows that external equipment forms audiovisual series with 4K-image quality in intelligible sound, even 1-3 meters from the source, which is important when demonstrating practical experiments based on material technologies.

When choosing a webcam for broadcasting, it is advisable to give preference to devices with hardware encoding of the audiovisual row streaming, which allows you to free up the resources of the teacher's information environment, which are intensively consumed in the high-touch process. For example, the responsiveness of dynamic media resources improves noticeably when replacing a Logitech C920 HD Pro webcam with software processing of media data on a Logitech BRIO device with hardware adaptation of audiovisual data to streaming broadcasting [10].

To maintain the psychological atmosphere of constant attention to students, it is advisable to position the teacher's external webcam on a mini tripod in front of the

screen, where the video conferencing application window is located, showing the teacher. The facilitator's webcam should be installed just like the teacher's webcam or directly above the window stack of the lesson participants.

Network audiovisual broadcasting can be organized by means of messengers with the functions of video telephony [11], the functionality of social networks [12] or specialized video services [13]. The hardware properties of all modern personal computers, starting from the lower price range (processor with a frequency of 1 GHz, RAM from 2 GB, data storage size from 32 GB), allow you to organize a basic level video network broadcast with a small number of simultaneously running applications. To demonstrate dynamic multimedia resources (associative cards, etc.), draw in multi-layer mode, open multiple windows of Internet browsers, switch between multiple web cameras, etc., it is recommended to use a computer with 8 GB of RAM, data storage of at least 64 GB and hardware graphics accelerator. Minimum Internet connection requirements: 4 Mbps for reception and transmission.

## **5 Information Space of the Synchronous High-Touch Lesson in the Process of Distance Learning**

Characteristic representatives of the "Y" generation ignore the form and the declared content, paying attention to the timely submitted content [8]. During synchronous high-touch lessons, it is impractical to use high-tech methods to illustrate the information discussed using pre-formed presentations with a linear structure (Microsoft Power Point, Adobe Presenter), which significantly limits the freedom of teaching. A comparative analysis of the demand for video recordings of lectures shows that classical lectures with illustrations created by the teacher in real time are of interest to the network audience more than commented PowerPoint slides. It is noted that the teacher's personal characteristics that are essential for high-touch classes are more pronounced with the non-linear structure of the presentation of educational materials.

In unpredictable conditions of high-touch forms of training, an information space should be formed that allows real-time supplementing with graphic comments primary media resources (pdf-publications, static and animated images, sound and video), which are conveniently managed using dynamic associative maps [14]. The demonstrated media resources are conveniently located in the windows of the left half of the screen field, the right part of which is occupied by the video-conferencing application with the set of windows of the lesson participants (see Fig. 1).

If one needs a consistent demonstration of media resources in different windows, it is more convenient to use the translation mode of the entire desktop than switch the broadcast between windows. Our experiments show that the window mode of video broadcasting is not utilitarian, because the image displayed to the lesson participants is limited to the area of the original broadcast window and for the rest of the windows the teacher is deprived of the opportunity to use the cursor as an attractor of attention, and students have opportunity to distract from lesson during the process of broadcast switching between windows [8]. It is convenient to quickly distribute windows between parts of the screen using devices that support gestures, such as multi-touch

panels of laptops and keyboards (Logitech Wireless Touch Keyboard K400), as well as some mice (Logitech MX Master, etc.).

It should be noted that the use of outdated software applications (HyperChem molecular modeling program, ChemWin chemical formula editor, etc.) may be available only in the 32-bit version of the Windows 10 operating system or is prohibited due to incompatibility with the basic components of the system (vector graphics editor CorelDraw 13).

When preparing objects that are supposed to be demonstrated in the desktop translation mode, it is necessary to take into account that the image of the presenter is formed in the form of mirror reflection.

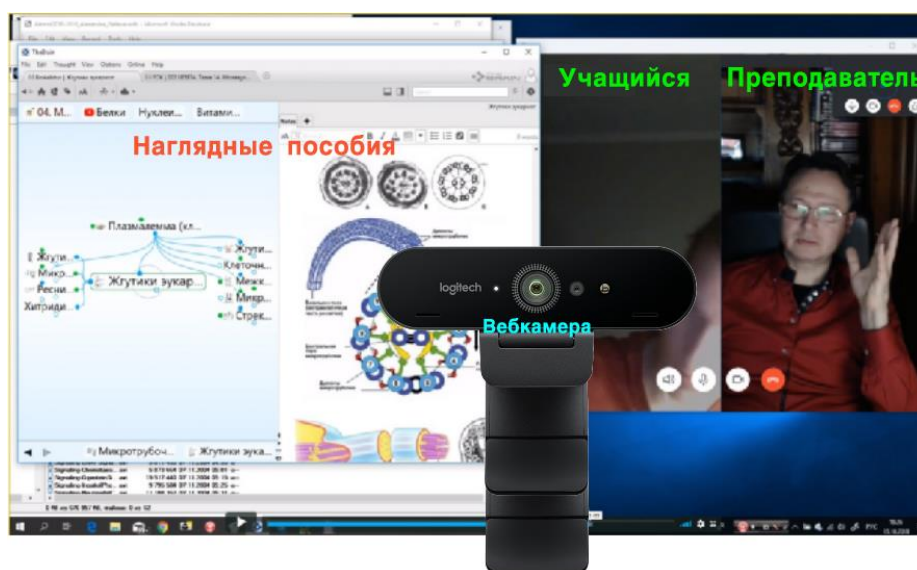


Fig. 1. Screen space allocation during a high-touch lesson

## 6 Information Toolkit of the Synchronous High-Touch Lesson in the Process of Distance Learning

Demonstration of primary media resources (pdf-compilation, graphics, sound, video) in the Microsoft Windows 10 environment is provided by the basic set of applications ("Edge" browser, "Photos", "Groove Music", "Cinema and TV", respectively).

An effective way to keep the attention of the audience of the "Y" generation in the illustrations of the taught information is to draw on the board, flipchart, in the frame field of a document camera or using the stylus of a graphic tablet (mouse) in conjunction with compatible vector or raster image editors. Prior to the development of Windows 10, commercial programs such as Corel Painter, Corel DRAW, Adobe Photoshop, Adobe Illustrator, ArtRage, Micrografx Picture Publisher and free (MyPaint, GIMP, Artweaver, Inkscape, etc.) were used for drawing. A modern alternative to the

above programs is the free Microsoft Whiteboard application from the Microsoft Store [15]. Free-format vector digital canvases allow you to create professional-looking charts and figures on an unlimited area with an interface optimized for working with gestures, a pen, and a keyboard. Real-time canvas content is stored in the cloud and synchronized on all computers in one Microsoft account. A particularly valuable feature of Microsoft Whiteboard canvases is the connection of all participants to the simultaneous work. If necessary, the contents of the canvas are exported to various graphic formats.

To supplement the existing media resources with explanatory and inscriptions and images, specific software for graphic tablets (Wacom JustWrite Office, etc.) was previously used. The modern basic set of programs of the Windows 10 operating system contains the “Snip & Sketch” application [16], which allows you to quickly add vector notes to screenshots, photographs, and other images using a pen, touch panel, or mouse and save, insert, or send them to other applications. In the “Slideshow Record” mode, the “Microsoft Power Point 360” application provides overlay slide additions with various graphic tools (pen, marker) or focusing on important elements (imitation of a laser pointer).

## **7 Primary Information Presentation and Knowledge Control During Synchronous High-Touch Lessons**

The productivity of high-touch lessons increases if they are conducted according to the “flip lesson” methodology, when students get basic ideas about the subject of discussion during self-training on materials provided in the form of high-tech resources [1]. Experience shows that a set of 20 questions covering all the supporting topics of the 1.5-hour lesson is necessary and sufficient to control the results of self-training and the motivation for an in-depth joint consideration of additional materials. Control questions are appropriately sequentially distributed among the students present at the lesson. Students' responses to questions are visible in real time in the video conferencing application windows, any of which can be maximized at the right time.

If necessary, the enlargement of the window with the video sequence of the teacher's camera can be used to demonstrate models, draw attention to facial expressions, gestures, etc.

## **8 Organization of Audiovisual Recording of the Infospace During Synchronous High-Touch Lessons**

At the beginning of the lesson, the set of cameras used by the teacher is connected to the broadcast space and / or the desktop demonstration is turned on. When using specialized video services or social networks, it may not be possible to demonstrate the teacher's desktop to the lesson, in which case a multi-camera configuration is used. Designed for streaming HD and 4K-resolution webcams using the appropriate software (Personify's ChromaCam), you can replace the background in real time with

presentation slides or images with various optical effects without using physical Chroma key. There are applications (ManyCam, etc.) that allow you to use a lot of webcams during a live broadcast (replacing a plan, synchronous demonstration of many video sequences, etc.).

It is recommended that a video camera transmitting a frontal image of the teacher's face be placed at the mid-height of the screen being displayed using a mini tripod mounted opposite the vertical dividing line of the left and right sides of the screen field with visual (or control) materials and a video conferencing application, respectively (see **Fig. 1**).

When organizing broadcasting through the functionality of social networks (Facebook, etc.), it is possible, during preparation for broadcasting, to provide it with the necessary and additional details of the primary document (author and participants, title, annotation, place and time of creation, links to additional materials). The option to save and subsequently publish live recordings is available on Facebook, YouTube and Vimeo. Since 2017, the social network Facebook has been providing the opportunity to publish live recordings of its users in the form of a multiscript that maintains a synchronized demonstration of the video sequence, the comments of viewers with texts and images, as well as the reactions of the user audience in the form of displaying moving emoji over the video sequence [12].

Audiovisual recording of classes through specialized software can be carried out on a teaching computer with a sufficient supply of hardware resources (processor frequency 2-3 MHz, at least 8 GB of RAM, the presence of a graphic coprocessor with its own RAM and active cooling system) . We tested the performance of a dozen applications for video capture (Sketchman Studio Rylstim Screen Recorder, SourceForge CamStudio, Webinaria, Softronic Apowersoft Screen Recorder, Icecream Screen Recorder, FlashBack Blueberry screen recorder, Screencast-O-Matic Screen Recorder, Movavi Screen Capture Studio, Corel VideoStudio Pro Screen Capture, SolveigMultimedia HyperCam). HyperCam application [7] turned out to be the least resource-intensive and most reliable, allowing you to supplement the image with overlay inscriptions, voicing variously animated mouse clicks, etc.

The utilitarian way of conducting audiovisual recordings of synchronized lessons is the free Skype messenger functionality, available since 2018 [11]. After connecting all the participants to the lesson, you can activate the circular screen demonstration of the teacher's computer, and then turn on the recording, the timing of which is displayed on the frieze of the window of the messenger of the recording initiator. The rest of the participants will receive notifications when recording begins. After the end of the communication session, the records are automatically saved and published in the ribbons of the messengers of all the participants in a form that is accessible for online viewing and downloading for 30 days (mp4 format). The main advantage of this type of video recording is its high reliability and quick formation of a file with a video recording (several minutes after the end of the recording).

Convenient video recording of presentations with sound and graphic comments (pointer in "laser pointer" mode, drawing a slide on top of the pen with a pen or marker) in combination with the optional audiovisual webcam series (640x480) is provided by the modern Microsoft Power Point 360 presentation application. When



one selects the “Record Slideshow” option, the presentation window switches to the slide show mode along with the base palette and drawing tools. The display of the webcam footage during the presentation may be turned off. After the recording is completed, it is stored in a compact form in a presentation file. Recorded voice and graphic comments in combination with synchronized video recording of webcam can be played directly from a presentation or exported to a mp4 video file with various quality options (Ultra HD, Full HD, HD and SD). Before exporting, the frame of the webcam footage can be moved to the optimal location on the screen or disabled. Taking into account the subsequent editing, it is advisable to use a presentation with a 4x3 aspect ratio, which can be positioned from the left edge of the editing editor's editing table using a 16x9 aspect ratio, while the space remaining on the right is used to place the teacher's video recording. The disadvantage of lessons recording through Power Point is the slow export of audiovisual recordings to the mp4 video file format.

## **9 Publication of Video Records and Visual Aids of the Lesson**

Lesson videos created using specialized services [13], social media functionality [12] and presentation applications after the lesson are converted into a format suitable for network publishing (mp4), which automatically adapts to user devices in accordance with the BYOD standard [4, 9]. The time for converting audiovisual recordings is determined by the plan for subscribing to the service and can exceed the recording duration by several times. Converting 1.5-hour recordings of webinars in the Skype messenger takes 3 minutes, after which the audiovisual series in mp4 format are available for viewing and downloading. Exporting 1.5-hour Power Point presentations takes several hours.

During breaks in the lesson, several audiovisual rows are formed that can be quickly combined without transcoding in the HyperCam Media Editor application, which is included in the HyperCam 5 video capture program package [7].

It is convenient to publish audiovisual recordings created on the local computer or downloaded from the Skype messenger in the albums (Showcase) of the Vimeo video hosting (see Fig. 2), which provides advanced options for didactically targeted use in open and controlled user access [17].

Images of Microsoft Whiteboard canvases exported at the end of the lesson and saved sketches on screen fragments should be concentrated in network albums of sites adapted for educational work using high-tech distance learning methods [18]. Vimeo video albums can be used directly or published on training sites [19].

When forming a set of media resources for students to work independently, it should be borne in mind that the information environment of most Apple devices does not support the playback of Flash-videos and swf-animations, which should be replaced in advance with analogues using HTML-5 technologies.

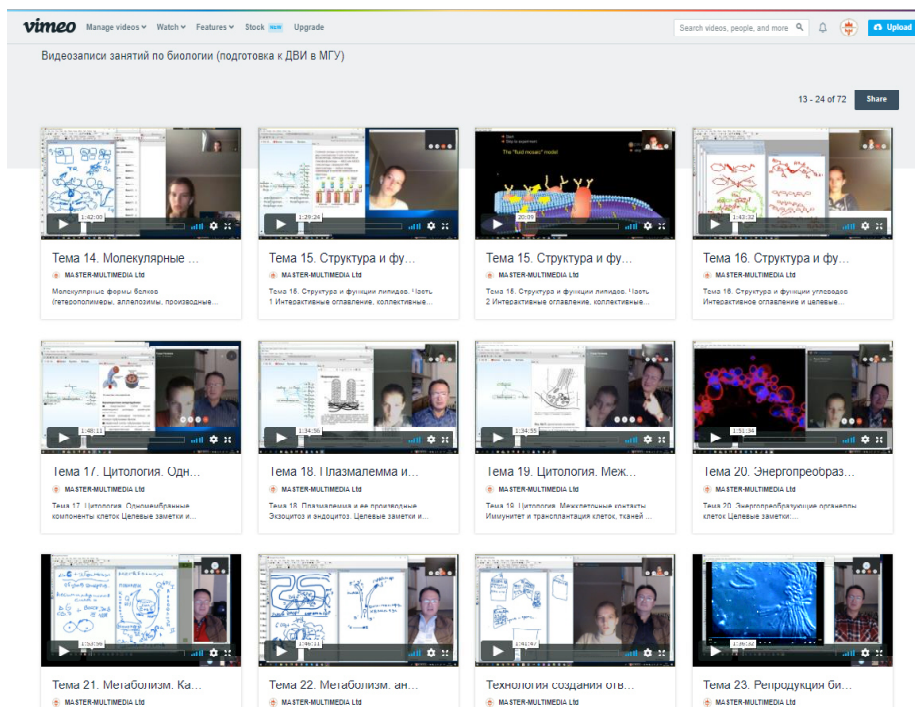


Fig. 2. Vimeo Hosted High-touch Lessons Online Video Album.

## 10 Organization of the Processes of Repetition and Consolidation of the Materials of the Recorded Lessons

Audiovisual recordings published on the Vimeo video service can be used in a special mode that allows you to create targeted notes that focus on the desired location on any frame of the video series by placing an interactive tag [17]. On the timeline, frames with marks are indicated by bright vertical stripes, which facilitates navigation (see Fig. 3). Hyperlinks to the corresponding images created during the lesson and published in the albums of training sites can be attached to the target notes. During the creation of the mark, the corresponding paragraph of the interactive table of contents of the audiovisual series is formed, clicking on which subsequently provides the transition to the desired frame and visualization of the marker. The length of the name and the number of paragraphs of such a table of contents are unlimited.

Users have the opportunity to comment on the text that accompanies the label, which creates a wonderful perspective for a collective discussion of the marked contents of the video in the framework of scientific, educational, business, public and any other activity. Notifications of new notes and user reactions to them are sent by e-mail to all participants in the discussion.

Surveys and comments can be published in the live stream of the high-tech study group of the distance learning resource, discussions of didactically significant frames of high-touch lesson audio-visual recordings can be organized, direct links to which are formed by the target notes functionality.

## 11 Systematization and Summarization of Educational Materials Using Audiovisual Records of High-Touch Lessons

The collective target note service used by Vimeo video hosting [17] allows, by activating hyperlinks, go to any frame of the video recording and pay attention to its specific place (see Fig. 3). Target notes provide an opportunity to systematize the contents of each video of the course and to combine fragments of different videos with a common theme.

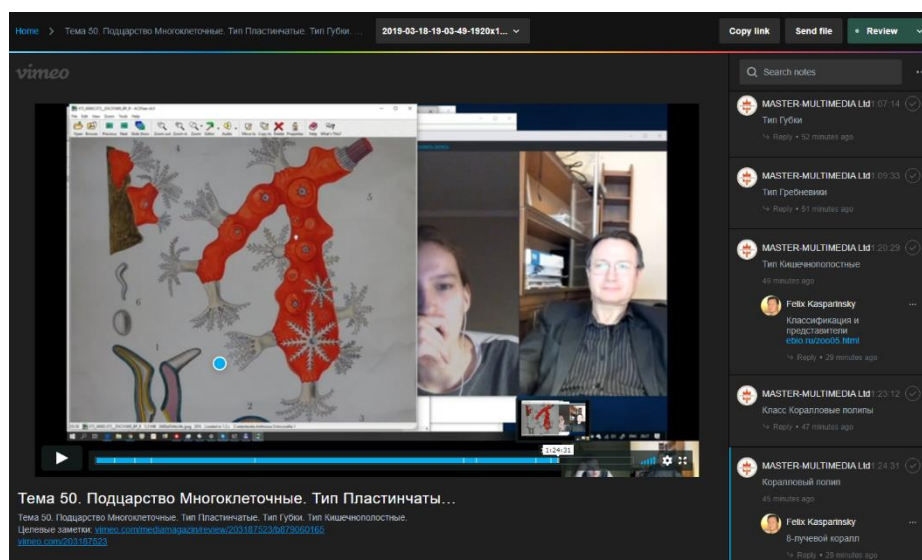


Fig. 3. Targeted notes of Vimeo hosted distance learning lesson video record

## 12 Conclusion

The high quality of audiovisual materials obtained with the help of modern publicly available hardware and software, combined with the interactive functionality of network services, creates the prerequisites for the emergence of a new trend: improving the quality of education through the general didactically targeted creation and use of

video recordings of synchronous lessons in the course of full-time and distance learning.

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