Advanced practices: web technologies in the educational process and science

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Abstract— **advanced technologies for remote learning and science are very actual, especially in the case of epidemic or pandemic. Videoconference is an area of information technology that provides simultaneous two-way transmission, processing, conversion and presentation of interactive information at a distance in real time using hardware and software of computer technology.**

Using a web conference allows you to expand the capabilities of the communication form in which several computer users connected to the Internet constantly see the same screen in their web browsers. Some web conferencing systems include features such as text messaging, video recording, voice over Internet protocol (VoIP), and full video. However, despite all the advantages of this technology, there are also disadvantages to using the product.

Keywords—education, Big Blue Button, Zoom, Canvas, videoconferences, open source webinar.

I. INTRODUCTION

The rapid development of technology requires the promotion of the concept of education in practice. The industrial needs and prospects of the future carrier are not limited to the degree of electrical engineer at a college or university.

The exchange of advanced research results, the development of an IT platforms for education allows us to obtain a sufficient methodological base for the training of engineers at all stages of a career [10], [13]. The document covers the study of the Institute of Industrial Electronics and Electrical Engineering (IEEI) of Riga Technical University [12-15], [17-20]. At the Riga Technical University, the Faculty of Electrical Engineering and Electronics has a good practice of conducting remote seminars based on public networks, as evidenced by the work of the authors [25-28].

The purpose of this article is to analyze advanced technologies for distance learning that can be used in the event of an epidemic or pandemic, as well as to analyze platforms for conducting open web training.

The tasks of this paper is to analyzing the educational applications, platforms and resources, and compare platforms with different functionality for live classes.

The research methodology of several cases was applied.

Now we are facing the COVID 19 spread in the country and whole world. The education system is affected by this situation. Then how it will affect the teaching methods, patterns, classroom teaching etc.

The pandemic of COVID-19 brings a big challenge to all sectors of people's life. Talking about education and science - the impact is huge.

According to UNESCO, more than 100 countries have closed schools nationwide, affecting more than half of students worldwide. Some other countries have closed schools locally, and if these countries also order schools and universities to be closed nationwide, this will disrupt the learning process for millions of other students [1].

UNESCO provides direct support to countries in minimizing the negative effects of closure of educational institutions on the educational process and creating conditions for lifelong learning, especially for the most vulnerable **Error! Reference source not found.**.

Nevertheless, it is significant to hold education and science in sustainable and safe position also in the case of pandemic.

While workers are firing in some segments of the ICT sector, the demand for semiconductors and equipment used by data centers and high-speed next-generation mobile systems like 5G is growing steadily [16], [24].

The pandemic is likely to accelerate the development of technologies related to industry 4.0, such as robotics and artificial intelligence. Workers in the ICT, electrical and electronics sectors involved in telecommunications, energy and healthcare are reporting increased workloads [30-36]. The curriculum of the Department of Electronics and Electrical Engineering of Riga Technical University with great success provides the educational process during the period COVID – 19.

Current article, using UNESCO information, summarizes applications that can be used for education and science purposes in the case of remotely process.

This article also describes a comparison of two polar applications for video communications and videoconferences

Zoom and open source web conferencing application Big Blue Button (BBB). A comparative analysis identifies a number of advantages and disadvantages of these applications. On the applying of applications for video conferencing from an open source, the following conclusions were drawn that applications have a number of drawbacks for full use, which require significant improvements. In this connection, they are open for further improvements and updates in applications. In the article, research will show the most effective video conferencing application to use.

II. EDUCATIONAL APPLICATIONS, PLATFORMS AND RESOURCES OFFERED BY UNESCO

There are a huge number of applications and tools created in order to facilitate and diversify the work of the teacher.

Teaching and learning tools, parent-teacher communication apps, lesson planning software, home school websites **Error! Reference source not found.**.

2017 EdTech experts in education, training and new technologies compiled a list of proven tools that professionals cannot live without.

A. Resources to provide psychosocial support

As part of the public health response, WHO, together with its partners, is working on a set of new materials on mental health and psychosocial support in the context of the outbreak of COVID-19.

UNICEF guidance on how teachers should talk with children about coronavirus infection (COVID-19)?

UNICEF guidance on how parents and caregivers can talk children about COVID-19.

B. Digital learning management systems

Buncee - allows the use of multimedia lessons combined with another user, as well as create and show presentations of multimedia lessons [21-23].

Remind is a program that helps teachers, students and parents communicate quickly and effectively. It unites school communities.

Go Noodle- presents physical exercises in a playful way that activates children and allows them to be energetic and active.

Matific is a library of useful resources for teaching math to children ages 4 to 11.

Thinglink provides users with a wide variety of different types of content, such as links, videos, maps, images, social networks and so on. A very simple interface allows users to create interactive content in three steps and use an embedded link to share, easily distribute content to their students, wherever they are, and on any device that they use. It even integrates with Facebook!

Teachers can use *Book Creator* to develop interactive and educational learning resources that students can easily share and use.

Explain Everything is a collaborative interactive online whiteboard. The service with an easy-to-use design helps to create interactive boards for common work in real time, and makes it possible to use animation, sound, comments.

Quizizz gives you the opportunity to find amazing quizzes from other teachers, or create your own and share them with the world.

EducationCity covers English, Maths, Science, Computer, French and Spanish. Offering various types of content, it is suitable for both group and individual learning.

Padlet is the easiest way to collaborate. Microduino designs and manufactures digital building blocks that can be connected to a large number of digital input and digital / analog output devices, allowing children to be trained in engineering and coding.

C. Systems built for use on basic mobile phones

One of the important organizations involved in the development of learning through mobile applications and monitoring its application in practice is the Institute of Mobile Educational Systems (IMOS). The main activities of IMOS are:

-normative, scientific and educational-methodological support of the introduction and implementation of state educational standards of general education;

-professional examination of projects in the field of education;

-support of the management and pedagogical teams of educational organizations on the implementation of state educational standards of general education and international baccalaureate (IB) programs in various forms;

-development, testing and implementation of educational programs for all levels of general education;

-development and implementation of modern educational technologies (e-learning, distance learning

D. Massive Open Online Course (MOOC) Platforms

Massive online courses are extremely popular among educational platforms. Online education is gradually gaining user pain. Below is a list of popular and reliable online education platforms (MOOC - Massive open online courses).

EdX is a product of Harvard University and the Massachusetts Institute of Technology. It is an online learning center and provider of MOOC, which has high-quality courses from the best universities and institutions in the world for students around the world.

Coursera was created by two professors at Stanford Computer Science. Coursera has hosted over 500 courses from over 100 universities.

Khan Academy is a non-profit organization that provides free and high-quality education via the Internet. There are many interactive features in the courses to test the mastery of the material during the course.

Udemy - is a good tool for acquiring practical skills on a specific topic. The portal has about 20,000 courses, but the quality of the courses can be different, since everyone can post their own course.

Canvas contains courses not only from prestigious universities. It contains courses from a broader list of universities.

FutureLearn is a product from prestigious English universities. FL offers a diverse selection of courses from leading universities and institutions around the world.

Udacity - provides access to knowledge from the best universities in the world. Their courses focus on science and new technologies.

Open Education Europa was created by the European Commission itself, supplemented not only by MOOC, but also by articles on various topics. This platform contains the largest infobase [8].

Open University - A simple platform and affordable courses. People who are looking for advanced courses will need to find something interesting for themselves.

E. Collaboration platforms that support live-video communication

DingTalk is a product from the Internet giant Alibaba Group. This platform has a wide functionality: chats, video calls, task management tools, a synchronized calendar and much more. It is used not only by schools, but also by companies and organizations to solve business problems.

Lark (in China - Feishu) - an application for remote work.

Lark is a corporate messenger that has a calendar, video chat functionality, can store information in the cloud and edit documents online, personally, or jointly.

The Hangouts Meet service is now called Google Meet. This service has advanced features for video conferencing in Google Meet, such as the ability to connect many participants (up to 250), as well as conduct live broadcast and recording.

The Microsoft Teams platform is corporate, it has chat, online meetings, applications, sharing and file collaboration. The platform can replace Zoom, Google Docs, Slack, Trello and other tools. In addition, most applications can be integrated into Microsoft Teams. The number of active users of Microsoft Teams is now 44 million users.

Skype – Video and audio calls with talk, chat, and collaboration features.

Tencent created the corporate version of its messenger - WeChat Work.

WeChat Work- can track when an employee connected to office Wi-Fi and when they disconnected, how many latencies there were and how many hours of processing. Cloud storage. You can store up to 100 GB of information for free. Nothing is stored in WeChat Work itself; all transactions go through the employee's main WeChat account.

WhatsApp – Video and audio calls, messaging and content sharing mobile application.

Zoom has a service for hosting and recording high-definition video conferencing. In terms of functionality, Zoom stands out from competitors such as Clickmeeting, Teachbase and Bigmarker. Zoom is used for video conferencing of mobile devices: smartphones, tablets, iPhone and iPad. From these devices, you can completely control video conferencing in the same way as from a personal computer. Zoom is the optimal platform for conducting webinar classes or creating short instructional videos. Zoom has a clear and simple interface. It is quite easy for them to start using immediately after registration. On the Zoom website, a test room is available at any time, where you can try all the features.

One of the challenges when conducting online training seminars is connection security. In the next section of the article, we consider the characteristics of various platforms through which online training and seminars can be organized.

III. PLATFORMS FOR LIVE CLASSES VIA DIFFERENT TECHNOLOGIES. ZOOM VS BIG BLUE BUTTON (BBB)

Below platforms are described in detail. Different platforms with different functionality.

A. Big Blue Button

Big Blue Button is an incredibly popular solution that has been set up on nearly 7000 Moodle sites worldwide, with over 50% of installs happening recently on the latest versions of Moodle (3.5 and above). The Big Blue Button project began way back in 2008, and the first plugin was available on Moodle version 1.9 showing their commitment to the Moodle project.

Part of Big Blue Button's popularity comes from it sharing a similar core value with Moodle in keeping the software open source. This open-source nature means that Big Blue Button is constantly developing and releasing new features due to their dedicated network of developers. Included with all this are several great features such as a live whiteboard, slides and built-in polling.

Even though BBB an open source, it allows to conduct webinars, video conferences with high quality video stream, low system requirements for PC and Internet speed of participants [9]. The interface is very convenient and intuitive, has a wide range of tools that allows you to fully use the product for free. It was the base for MCONF and was supported by a large community of developers and users. This application is distributed under the Free GNU license and is installed on your (or third-party) web server. Easily integrates with LMS moodle. This application is very often used in universities and colleges for teaching distance students.

BigBlueButton is built on many amazing software components such as nginx, red5, FreeSWITCH, tomcat7, redis and others. The figure 1 describes the overall architecture of BigBlueButton and how the components work together. The following diagram provides a high-level architecture overview of the BigBlueButton.

Any sufficiently developed technology should be provided with strong protection of data transmission. The great detective Sherlock Holmes quote "The world's run on codes

and ciphers, From the million-pound security system at the bank, to the PIN machine you took exception to, cryptography inhabits our every waking moment ..."

Based on BigBlueButton data, we can conclude that this service uses protection levels as Datagram Transport Layer Security (DTLS), Secure Real-time Transport Protocol (SRTP). SRTP use Advanced Encryption Standard (AES) as the default cipher. AES is a symmetric block encryption algorithm this algorithm is well analyzed and is now widely used and also accepted as the encryption standard by the US government. The National Institute of Standards and Technology (NIST).

B. Zoom

One of the third-party webinar services is zoom. It has a limit of 100 participants and 40 minutes of the duration of the webinar. But he can record the webinar locally on the teacher's computer and then send the resulting recording to YouTube or to the cloud service. To connect to the webinar in zoom, you do not need to register, just install the client, and know the number of the meeting.

Zoom uses the 256-bit Advanced Encryption Standard (AES) application-level algorithm for data encryption. The public and private keys are used to encrypt the chat session, it is generated with a unique device identifier, which guarantees the security of the session. Also complied with GDPR requirements, and Zoom has other relevant features, despite of it, it is not open source software application.

The software Zoom, which is currently breaking all records of popularity in the world, found two critical vulnerabilities. One of the errors allows attackers to steal passwords of the Windows operating system. These vulnerabilities were published in the Bleeping Computer [2] report, which shows how to steal Windows hashes and crack them using appropriate tools (Hashcat, John the Ripper and others). The second vulnerability allows you to access the microphone and camera without requesting access from a MacOS user, which is more detailed on the Objective-see website [3-6].

After all this reports Zoom's meeting security has been drastically improved by enabling waiting rooms and meeting passwords by default for free Basic and single licensed Pro users. K-12 users will be required to enter a password on join by default.

C. Zoom and the Big Blue Button Conferencing Tools in Canvas

Applications Zoom and Big Blue Button are used in the training system Canvas (table 1).

TABLE 1. ZOOM VS. BIG BLUE BUTTON COMPARISON

Zoom	Big Blue Button
Has its own navigation link in Canvas labeled Zoom.	Listed under the Conferences link.
An instructor can create a meeting. The meeting can be made available to students (and non-students) via link.	An instructor can schedule a meeting and automatically invite students from the course.
Recordings can be saved without a time limit.	Recordings are saved for two weeks.
Students *cannot* create meetings in course groups.	Students *can* create meetings in course groups. Group members can automatically invite the group members to the meeting.
Available on mobile devices.	Not available on mobile devices.
Meetings are not automatically added to the course calendar.	Meetings are added to the course calendar. Notifications at the top of the Canvas screen indicate that a meeting is happening.
Recommended for	
Video interaction, community building, presentations and office hours	Small group collaboration, presentations and office hours
Selling Points	
Stable connections, clear video	No account needed if you have a Canvas site and recordings automatically appear in Canvas

Table 2 (below) provides software's Zoom vs. Big Blue Button feature description.

TABLE 2. ZOOM VS. BIG BLUE BUTTON. FEATURE DESCRIPTION

Feature Description	Zoom	Big Blue Button
Participant Maximum	100 (25 per screen)	100 (quality decreases as number of people increases)
Use with Canvas	Completely separate from Canvas	Integrated into Canvas
Account	Get from web Conference support team	Not needed if used with Canvas
Session Creation	Teaching staff creates 1 session for entire semester	Teaching staff creates session for each section meeting or office hour
Getting Session Links	Find link in Zoom account profile and paste into Canvas for students	Teaching staff sees join button in Canvas after session is created and students receive an email when session is created and can join via Canvas.
Breakout room	Must be in room to hear and see what's happening	Can listen without entering room
Co-host	Can start session and do most things hosts do	Not available
Layout	Everyone can choose gallery view or speaker view, no way to lock down	Everyone can rearrange own layout but Presenter can lock for participants
Desktop Client or Web Browser	Desktop client with frequent updates and one-time audio plug-in	Web browser based with no user updates install but occasional download for screen share

Table 3 (below) provides software's Zoom vs. Big Blue Button feature description.

TABLE 3. ZOOM VS. BIGBLUEBUTTON. TOOLS

Tools	Zoom	Big Blue Button
Video	yes	yes
Audio	yes	yes
Chat	yes	yes
Screen Share	yes	yes
Application Share	yes	not
Share computer sound	yes	yes
Record	yes	yes
Whiteboard	yes	yes
Annotate Shared Documents	yes	yes
Breakout Rooms	yes	yes
Co-hosts	yes	not

Polling	yes	yes
Virtual Hand Raise	yes	yes
Status Emoticons	yes	yes
File Transfer	yes	not
Dial in with phone if needed	yes	yes

In the tables above, the following parameters is compared to be used to choose the best solution.

BigBlueButton's main competitors are video conferencing solutions with features aimed at online learning like Jitsi and Zoom.

Zoom has recently gained popularity in classrooms because it has added integration with educational software like Canvas. It offers live streaming on YouTube and Facebook Live. As a hosted solution, Zoom is much easier to set up and maintain than BigBlueButton, but it costs $40 per month for meetings with up to 100 attendees.

IV. PRACTICAL WORK IN LABORATORIES

Among the challenge's students and universities face in the wake of the COVID-19 pandemic are practicum (practical application) requirements for some courses. Not always it is possible to use 100% remote learning and teaching. In some cases, students and researchers need to use laboratories for performing real experiments. In the case of pandemic – it is a challenge. But everything is possible if all the safety recommendations are taken in consideration.

Riga Technical University stay on track to complete her practicum hours through the flexibility of professors. Fig. 1 shows experimental work in laboratories, where students use facemasks and disinfectors as well as consider all the recommendations are given during the pandemic situation. After finishing theoretical course, students work with the practical implementation- in the laboratory they develop a smart traffic lights system in the frame of the course "Elements of Automatics".
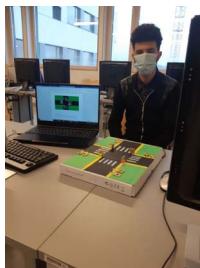

Fig. 1. Experimental work in laboratories under pandemic conditions

It is clear, that in the case of pandemic it is necessary to use multidisciplinary and comprehensive methods also in education and science. For example, the European Forum for Advanced Practices (EFAP) [29] proposes an open notion of Advanced Practices that deliberately combine methods and practices from numerous disciplines. Ever-more complex societal challenges across Europe demand new forms of knowledge exchange and transfer, as new research forms gain ground and new modes of research output become increasingly prominent. This requires multidisciplinary and comprehensive methods to capture and assess their quality and impact in advance rather than retrospectively [29].

V. CONCLUSION

Based on the research work on the finding for optimal software from open source, we can draw the following conclusion about the pros and cons of using these programs: despite the shortcomings in the programs, such as limiting the number of users, video recording, access to the desktop, we can conclude that the overwhelming amount advantages of using it. Based on this, it can be argued that the use of software from an open source is the best solution when implemented in many areas of activity. Overall, web conferencing is a step in the right direction. Even though there are problems here and there, web conferencing is still one of the best ways to transmit information.

The reasons for the transition of educational institutions from other solutions to BigBlueButton are:

Zoom has a data security vulnerability.

Blackboard Collaborate costs much more than others webinar software.

Microsoft Teams sometimes cause huge central processor unit's and memory spikes, and it can see the software lag on people's PC's seeming for no reason.

Cisco Webex has proprietary formats for media sharing and meeting recordings and initial download requires administrator privileges.

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