

## Methods for Distance Learning in Technical Courses

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### Abstract

*In the beginning of 2020 the humanity was struck by an unprecedented pandemic. The universities stopped conducting face-to-face classes and they had to switch very quickly to distance learning and assessment. The report presents the results of a study among students studying in various technical programs at Trakia University – Stara Zagora, Bulgaria. The aim of the study is to determine the most appropriate technologies and methods for distance learning and assessment in technical courses in times of crisis - in the absence of pre-prepared materials, using only available means - the Internet and available free resources, e-learning system Moodle and etc. The results show that the majority of students prefer the lecturers to provide them video recordings of the lectures, of the conducted experiments from the laboratory exercises, of solved sample tasks, etc. The reasons for this are the ability to watch the videos as many times as necessary to master the learning content and inability to attend at the time of the scheduled classes. As for the exams, the most preferred form is the test conducted in the e-learning system. After analyzing the attitudes of the students, appropriate techniques for conducting online teaching in the technical courses are proposed.*

**Keywords:** Distance learning, e-learning, e-assessment

### 1. Introduction

The emergency situation that arose in early 2020, due to the rapid spread of COVID-19, posed a major challenge to education systems. All universities were forced to stop face-to-face classes and very quickly move to distance learning and assessment. This happened so unexpectedly that most universities and lecturers did not have pre-prepared materials suitable for distance learning. Many of them considered that distance exams were not suitable for higher education.

The emergency situation helped to “the majority of people working in academia and higher education not only to complete their personal transition to the fully functional and operational online tuition, but also to understand that online defences, online entrance and final exams, as well as online academic jobs are as effective and meaningful as those conducted “in real life”. Due to the crisis induced by the coronavirus epidemic, innovations in academia and higher education that would have normally taken several years due to the various contradictory administrative regulations are now introduced promptly in a matter of days.” (Strielkowski, 2020)

The students adapted more quickly to online forms of learning than lecturers, because this is their way of communicating. Very good results were obtained and the training kept its quality. One reason for this is the fact that new methods bring diversity to training, and each diversity leads to better efficiency.

Because with modern technologies modern things must be taught, this naturally stimulates lecturers to update the educational content.

Distance learning is not just adaptation of traditional teaching methods to new technologies. Under normal circumstances, students who were born and raised with new technologies expect them to be used in other ways.

“Distance education has evolved to the point where technology is no longer a major concern to distance educators and students. For the most part, technology used in the delivery of distance courses is stable and reliable. Ironically, it is the human factors that most greatly influence

distance teaching and learning thus, the importance of appropriate pedagogy and course design.” (Dehler, 2004)

“Meeting students’ learning needs, through creative and innovative teaching/learning pedagogical processes, is the goal of any educator. Being able to have an active presence, guide students through the learning process, and enhance their comprehension of the content while fostering a sense of proactive and student-centered learning is the true essence of teaching.” (Sharoff, 2019)

Researches in the scientific literature on distance learning can be divided into two groups - research methods in distance learning and teaching methods in order to obtain greater effectiveness of learning. Naturally, all of them refer to moments in which the lecturers have enough time and resources to prepare and conduct the courses.

A detailed overview of research in the field of distance education is made in (Kline, 2020; Saba, 2014). Researches are discussed, which refers to the effectiveness of distance education compared to the traditional, the shortcomings and gaps in the research of distance education and others.

(Koper, 2014) presents a new educational model in which predesigned materials have a smaller role, and the role of dialogue between teachers and students, due to the possibilities of new synchronous and asynchronous communication technologies is strengthened. “The perception of online and distance education as an integral part of powerful teaching and learning, and not as a poor mans variant that is only preferred by people who are not able to follow regular (‘good’) education” is changing.

The selection of educational methods must take into account the specifics of the courses taught. The purpose of training in technical courses is not only to learn the definitions and dependencies and master the rules for their application. Students should acquire more complex skills related to comparing research data, explaining situations, forecasting events according to current conditions, formulating and proposing their own solutions in a given situation, summarizing results, planning and implementing ideas and more. To achieve this goal, it is not enough for students to have a presentation or lecture on the topic and the teacher to introduce their content. It is necessary to derive complex dependencies, to explain complex schemes, to develop projects and software products. This requires the application of complex distance learning techniques.

Another important element that must be taken into account when choosing a method and technology for training are the characteristics of the learners - age, work experience, educational level, demographic characteristics, individual differences and attitudes.

No method can meet all the requirements for learning and teaching. If possible, more methods should be applied (Kline, 2020).

In the conditions of state of emergency and need for a quick response, finding the best form of teaching, which will be most effective, coordinated and adapted to the level of students is a great challenge.

In order to determine the most appropriate technologies and methods for online training for the conditions of the Faculty of Technics and Technologies - Yambol and the most preferred by students studying in technical programs, a survey was conducted among students from different programs and years of training.

The aim of the paper is to find the most effective technologies and methods for distance learning in technical courses in times of crisis - in the absence of pre-prepared materials, lack of sufficient equipment for each lecturer, using only available means - the Internet and available free resources, Moodle e-learning system, telephones, emails and other means of communication.

## 2. Methods

A survey was conducted with 83 first and second year students from the Faculty of Technics and Technologies - Yambol, studying in different technical programs. The survey was located in 2 electronic courses - "Electrical Engineering and Electronics" and "Theoretical Electrical Engineering" in the learning management system Moodle of the Trakia University - Stara Zagora. In these courses, different tools have already been used and different methods for conducting distance learning have been applied. Thus, students have the opportunity to competently express their opinions and preferences.

The survey includes 13 questions. They refer to the methods for remote lectures, seminars, laboratory and practical exercises in the technical courses. The attitude of the students was also studied on the issues of providing feedback to the students and making a final grade in the disciplines. In addition to the questions with answers for selection, open questions were included, in which students could add their opinion.

## 3. Results

Trakia University has a learning management system Moodle and therefore the first distance learning classes were conducted using this system. However, the materials available so far in the system were not sufficiently detailed and suitable for independent preparation of students. They were provided in addition to the face-to-face lectures.

Some lecturers chose to implement a live connection with the students and thus lead their lectures. However, not all students had enough quality personal computer equipment at home and not all students had ability to attend at the time of the scheduled classes. In addition, in the teaching of technical disciplines, the lecturer must derive formulas and draw diagrams at the moment, which requires specialized software.

The other method of distance learning, which was preferred by some lecturers, was the provision of audio and video recordings with lectures in the e-learning system. However, this required time to prepare the recordings. In addition, due to the specifics of the technical courses related to deriving complex dependencies and explaining complex schemes, the use of presentations with ready results is not always appropriate. It is necessary to invent a variant in which the formulas are derived and the schemes are drawn simultaneously with the explanations. This could be achieved using appropriate equipment - document camera, interactive whiteboard and more.

The problem with conducting seminars, laboratories and practical exercises, which are typical for technical courses, is even bigger. When conducting them, lecturers can use video link, provide recordings or use simulation software.

The preferences of the lecturers for the proposed options are different, but the most important thing is that they correspond to the wishes of the students. Therefore, at the very beginning of the state of emergency, I conducted a survey of students' opinions on distance learning methods during the crisis. The results obtained for student preferences can be used after the end of the crisis.

It was studied the students' opinion on "Which of the following ways of conducting remote lectures achieves the highest quality of teaching in the technical courses?".

The largest percentage of respondents believe that this is obtained by using video recordings of lectures (a total of 55.74%). Most of them, however (36.07%) think that the lecturer at the moment of the lecture should draw diagrams and derive formulas so as to maximally imitate conducting a lecture in present form.

There is also a large percentage of students (34.43%) who consider the use of a live video link to be the most appropriate method. The use of written materials is considered appropriate by only 8.2%.

Those who indicated another answer prefer to be applied a combination of the listed methods. This refers for all questions from the survey.

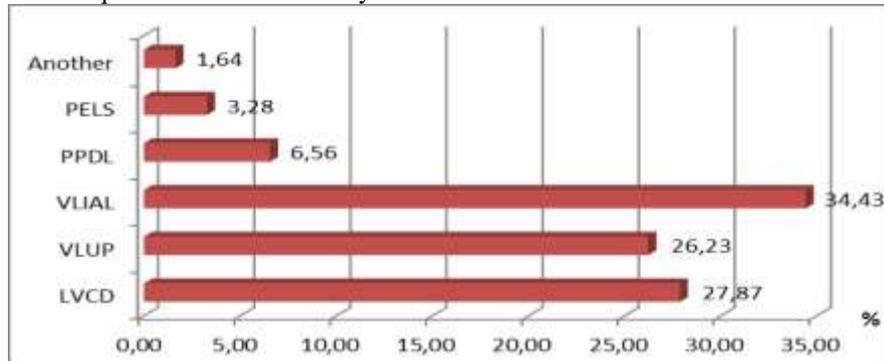


Figure 1. Distribution of the Answers to the Question Regarding the Lectures

In Figure 1, the abbreviations are used: LVCD - Live video communication with written or oral discussion (using the capabilities of e-learning system, Google and more); VLUP - Video lectures using presentations with pre-drawn diagrams and derived formulas available in e-learning system; VLIAL - Video where the lecturer draws diagrams and formulas at the moment of the lecture so that he maximally imitates an attendance lecture; PPDL - Preliminary provision of detailed lectures in the e-learning system; PELS - Presentations in e-learning system.

Students do not always prefer these teaching methods, which they believe will achieve the highest quality. The percentage of those who prefer to use videos is 60.67%. The share of preferred videos and detailed written materials increases at the expense of those who prefer video connection (Figure 1).

The reasons for this are different. The most common reason is inability to attend at the time of the scheduled classes - 66.67% of those who answered the first 2 questions differently. And 22.22% have problems with equipment at home.

The students also added that the provision of videos and detailed written materials allowed them to view them repeatedly at a time convenient to them.

The purpose of distance learning is not only to provide the necessary materials. Students should be able to give feedback to teachers to ask questions and have discussions with lecturers and other students. Lecturers no less need feedback to monitor student progress. It should include solving tests, tasks and developing projects. If necessary, the lecturers should provide additional materials and instructions.

Feedback can be done synchronously (orally, via video and audio connection or in writing, via chat at a pre-arranged time) or asynchronously (using email, chat, forums, etc.).

The largest percentage (44%) of the respondents prefer the feedback to be provided through a video link and discussion of the learning content. Different forms of written questions are preferred by 25% of students.

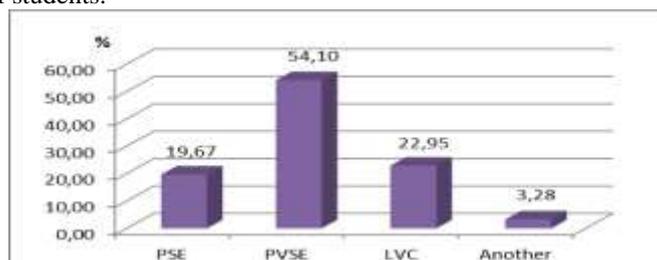


Figure 2. Distribution of the Answers to the Question Regarding the Seminars

The possibilities for conducting seminars are more limited. Possible options for this are direct video connection, providing solved examples and videos with solving sample tasks. More than half of the respondents 54.1% prefer to get videos with solving sample tasks and tasks for self-execution, which lecturers should check timely (Figure 2).

The main reason for this is again the inability to attend at the time of the scheduled classes and the ability to view the videos repeatedly. Here the trend is even more pronounced.

In Figure 2, the abbreviations are used: PSE - Providing solved examples through the e-learning system. Setting tasks for self-performance; PVSE - Providing in the e-learning system videos with solving examples. Setting tasks for self-performance; LVC - Live video and chat. Discussion of tasks that have been solved in advance.

The biggest challenge for lecturers is the remote conduct of laboratory and practical exercises. In this case, the methods are reduced to (Figure 3):

- Live video from a laboratory where the lecturer demonstrates the exercise - LVD;
- Video of the exercise, available in the e-learning system - VE
- Use of simulations (virtual laboratories), with the help of which the lecturer sets tasks and students complete the tasks - US
- Providing detailed theoretical part and written instructions for the exercise and setting tasks that do not require equipment - DIT

54.1% of the respondents prefer to have a video of the exercise. A surprisingly small percentage prefers the use of simulations and virtual laboratories (6.56%).

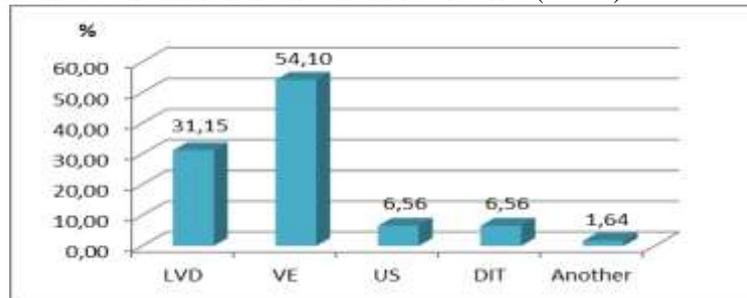


Figure 3. Distribution of the Answers to the Question Regarding the Laboratory and Practical Exercises

The other challenge in distance learning in technical disciplines is testing. The main danger in distance assessment is the possibility of fraud on the part of dishonest students. Here the students are almost unanimous. 77.05% of them prefer the assessment to be conducted through a quiz in the e-learning system (Figure 4). The probable reason for this is that students find this way of assessment easier - the quizzes do not require memorizing a large amount of learning content, there are questions with answers for selection from which unprepared students can choose at random and last but not least is the opportunity for the use of unallowed materials. Methods for prevention of cheatings when using quizzes in Moodle are discussed in (Pehlivanova, 2019).

None of the respondents prefers an oral discussion conducted via video or audio connection. Few students prefer to develop projects.

When solving tests remotely, students have a greater opportunity to use additional materials. Therefore, teachers must be very careful in composing the questions. Questions aimed at reproducing the learning content should not be used, but preference should be given to those aimed at verifying a higher level of content assimilation.

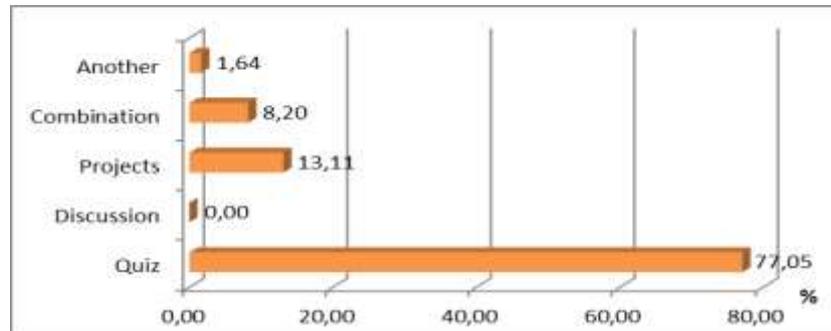


Figure 4. Student Preferences for Conducting Semester Exams

Due to the specifics of technical disciplines, when conducting tests from home, it is recommended to use test questions that: are focused on the student's ability to synthesize information; require multi-stage considerations to arrive at an answer; check knowledge that cannot be found online (eg interpretation of images / data).

After analyzing the attitudes of students, the following techniques for improving the conduct of online training in technical disciplines can be defined and suggested:

1. Video recordings of the lectures - The provision of video recordings of lectures is more preferred by students than the live broadcast of lectures. This way, students can watch them at a suitable time. In addition, they can watch them as many times as they need to assimilate the content.

2. Video duration - Videos longer than 15-20 minutes can cause problems with slow downloading and distraction for learners. It is better to record two or three short videos for each lecture.

3. Use of existing resources - It is unrealistic to expect that high quality videos can be produced in a short time. It is possible to provide students with pre-designed resources available online. Only open access ones should be selected.

4. Interactive activities - The higher level of assimilation of the material is achieved with more active forms - Development of projects, case studies, discussions, use of simulations, demonstrations, etc.

5. Setting reasonable tasks - Tasks such as: summarize the lecture or video are not appropriate. This engages many students and does not develop their thinking. When creating tests, questions must be asked that can be answered using the learning resources provided. However, they should not be aimed at reproducing the learning content.

6. Use of group communication - Group communication is not best suited for direct teaching. It is preferred as a form of communication with students. Through it, discussions, consultations, etc. can be held. This can be a great way to collect student feedback on online teaching.

7. Flipped Classroom - In the traditional classroom, the teacher presents the lesson during class and can ask questions to students to make sure they understand it. In the Flipped Classroom, students are provided with materials and encouraged to prepare before class (to read certain material or even to solve certain tasks). The time of the class is used to discuss the lesson, share ideas and interact in a dynamic environment.

8. Mixing different forms of training and ways of providing information - In order to engage students, the course should not include long lectures, but should consist of short portions. Change the forms of training. Mix discussions, videos and audio clips, practical exercises, individual or collaborative work.

9. Organization of the course - Courses should be organized so that students can easily and quickly access the necessary materials. When students use a lot of cognitive resources, videos,

discussions or quizzes, they find it difficult to understand where and what to read, are discouraged and have difficulty perceiving the learning content.

10. Checking the attendance and effectiveness of the course - Attendance and effectiveness of the course can be checked by setting tasks (tests, projects, etc.). If it is not possible to check the set tasks manually, the automatic checking and ranking functions in the learning management systems can be used. When students know that their presence is controlled, they begin to comply with the requirements.

#### 4. Conclusion

Due to the COVID-19 pandemic, universities were forced to stop face-to-face classes and move very quickly to distance learning and assessment. They were not prepared for such a rapid transition. However, the academic year ended successfully without reducing the quality of education. The students welcomed with interest the new teaching methods.

The report presents the results of a study among students related to the methods for distance lectures, exercises and exams in technical disciplines.

The results show that in terms of lectures, the largest number of students prefer lecturers to provide them with a video of the lecture, in which the lecturer draws diagrams and formulas at the moment of the lecture so that he maximally imitates an attendance lecture. When conducting exercises online, more than 50% of the respondents prefer to prepare from videos of the conducted experiments, solved sample tasks, etc. The reasons for this are inability to attend at the time of the scheduled classes and the ability to view the videos as many times as necessary to master the content.

77% of the respondents prefer the exams to be conducted as a test in the e-learning system. When using this form of assessment, lecturers must take all possible measures to prevent the possibility of cheating (Pehlivanova, 2019). Questions should be used whose answers cannot be easily and quickly found on the Internet, but those that require reflection and test students' ability to synthesize information.

The report also makes recommendations for improving the conduct of online training in technical courses. They relate to teaching methods and the organization of courses.

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