DISTANCE TEACHING EXPERIENCES OF ENGINEERING LECTURERS AT LATVIAN AND LITHUANIAN UNIVERSITIES DURING COVID-19 LOCKDOWN

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Abstract. COVID-19 has changed the pedagogical work of university lecturers. All lecturers have been forced to learn quickly and to find new educational solutions for distance learning. The biggest challenges were in organizing and conducting laboratory work remotely and in motivating students to participate actively in the learning process. During the online teaching period, university lecturers have gained new knowledge, skills and tried various pedagogical solutions. These include the use of different software applications, creation of short video lectures, the use of pre-prepared video and audio instructions, and many more. In this paper, a qualitative content analysis was used to study the case of teaching with technologies to engineering students at universities in Latvia and Lithuania. The study discloses the challenges faced by university lecturers in preparing video materials, organizing laboratory work, and assessing student performance. Recommendations based on the research findings have been provided. These recommendations could be useful not only for university lecturers who teach engineering subjects but also for science, technology, engineering, arts, and mathematics pedagogues and vocational education trainers and educators.

Keywords: teaching challenges, distance teaching, teaching engineering subjects, university lecturers, COVID-19 lockdown.

Introduction

In March 2020, COVID-19 caused Latvian and Lithuanian universities to make an unplanned change from face-to-face to distance learning. Some universities were already familiar with the benefits of distance education, some had distance education specialists or even distance education support centers. Although until the lockdown, there were no full-fledged distance education courses in Latvian and Lithuanian universities. Some engineering lecturers before the COVID-19 lockdown had already experienced the benefits of distance learning through individual participation in project activities or through informal distance learning courses. However, the number of such lecturers at Latvian and Lithuanian universities was small. The vast majority of university teachers gave lectures, organized exercises and laboratory work, and conducted practical student activities in a contact teaching mode – physically attending university lecture theatres, laboratories, and computer labs.

Distance teaching experiences during COVID-19 lockdown are continuously analyzed in different contexts. In a systematic literature review [1] are examined 47 studies in various countries around the world and conclusions made – i) the best prepared higher education institutions for distance learning were those that used technology in their teaching and contact work; ii) some lecturers and students had technical difficulties when working or studying remotely, but it was often impossible to determine whether students were actually experiencing technical difficulties due to poor internet connections or whether they were simply cheating and did not want to study with the camera on; iii) student engagement was sometimes lacking due to factors such as reliance on recorded lectures, a lack of motivation or interest, stress and boredom, as well as the distraction caused by using electronic devices; iv) due to the difficulties associated with bringing students to campus to administer tests, academic staff was faced with the challenge of redesigning evaluations in a way that fairly and reliably captured student performance. This was particularly challenging in practical courses.

All of these issues are not new, and the question of "what, how, and where" the learning process should take place has been debated for a long time. Adedoyin and Soykan (2020) question the transition of universities to fully distance education and monitored the planning, design, and development of online curricula due to the challenges of the pandemic [2]. According to these researchers, the methods used by universities are limited to delivery tools, without considering effective theories, models, and methods of online education. A 2020 survey of university lecturers and students in Indonesia [3] clarified that lecturers are challenged by competence, performance, self-regulation, and isolation issues. The same authors assume that the biggest challenges for higher education students in distance learning are due to the Internet connectivity, distance learning system support, technology acceptance, and self-regulation problems [3].

Many scholars agree that COVID-19 lockdown was the biggest catalyst for educational change, inspiring positive transformation, and educational reform [4-6]. During the COVID-19 lockdown period, the practice of applying the same content to all students disappeared. University lecturers sought to differentiate their curricula because the same content did not meet the needs of every learner [4]. Scholars discussed the importance of the differentiated and decentralized approach to education management. During the pandemic, university lecturers themselves expressed the need for professional development – for them, needs-based professional development has become particularly important for remote teaching [5]. In online teaching, educational design has become crucial, regardless of the nature and extent of technology use. University teachers themselves have become learners who continuously share with each other the vision of teaching and learning processes, values, and principles that underpin the design and implementation of the philosophy of engineering and any other university curriculum [6].

In Latvia and Lithuania distance learning during the COVID-19 pandemic has been analyzed quite extensively. For example, Navickiene et al. [7], analyzing managerial decisions of universities during the lockdown, found which decisions were successful. These researchers discussed that the development and maintenance of the technical base, the timely and continuous academic support for university lecturers, and the multifaceted support for students made the teacher feel as comfortable as possible during the COVID-19 period of distance learning. Competencies needed by Latvian and Lithuanian educators to deliver quality lectures remotely were analyzed in [8]. The competencies were divided into the following groups-learning to learn; personal; social; cognitive; communication; information and communication technologies. These researchers concluded that the institutions that adapted most easily to the lockdown situation were those that had started the digital change process earlier, before the COVID-19 pandemic. Schools that took the initiative sooner, shifted their operational strategies from contact to distance learning, and invested in the digitization of the institution had less stress and solved problems easily. In addition, they were able to ensure uninterrupted provision and quality of educational services. The results of a survey from [8] showed that more than half of the Lithuanian and Latvian educators reported that the performance of their education services had remained the same or even improved. The advantages and disadvantages of teaching mathematics in the first year of the COVID-19 pandemic to conducting a survey of mathematics teachers from Latvian universities were analyzed in [9]. The results of the survey show that lecturers learned much more about new technologies and opportunities in learning mathematics, at the same time students mostly lost their knowledge because they would have better opportunities to learn the material while studying in person.

Although there is a large body of research, our aim was to analyze the experiences of engineering lecturers in higher education institutions. The aim of this research was to identify the difficulties and challenges faced by lecturers and professors of engineering subjects at Latvian and Lithuanian universities in the COVID-19 lockdown distance-teaching and how they addressed these challenges, as well as offer some recommendations based on the findings and personal experiences of the authors.

Materials and methods

Semi-structured individual interviews ([10; 11]) with university lecturers of engineering subjects were used to collect the data. The participants were 8 university lecturers from Latvia and Lithuania - 6 women and 2 men with 5 to 30 years of academic work experience in higher education institutions. Professors and lecturers working with information technology, construction, agricultural and energetics engineering were interviewed. The participants teach higher mathematics, basics of programming, systems modelling, electrical engineering, electronics and building construction. None of the university lecturers had ever taught remotely before. The participants were asked how they managed to organize distance teaching. Examples of interview questions: *How quickly did you manage to restructure your work and switch to online teaching? How do you organize the distance teaching process? What was the most difficult part of the transition to distance teaching? What was the best thing during distance teaching?* It was important for the researchers to find out which technologies (hardware and software) and educational solutions were used by engineering teachers. Examples of interview questions: *What technologies or computer programs do you think would be best for a teacher working remotely or partially remotely? What computer applications do you work with? How did you hear about them? Which applications do you find very useful and which not? Why?* The participants were asked to advise

their colleagues on how to organize distance learning to make it run more smoothly. Examples of interview questions: *What suggestions could you give to your colleagues?* Later research participants were asked to share what challenges they faced and how they solved them. Examples of interview questions: *What do you think are the biggest teaching challenges for you? What were the challenges at the beginning of the distance learning process that remained? How do you plan to solve them? What are your benefits from distance teaching?* All the interviews were done online, using MS Teams and Zoom. Interviews were recorded and manually transcribed. All the data were anonymized. Consent to the use of aggregated and anonymized data was obtained from all participants prior to the interviews. While developing qualitative content analysis [12] we focused on abstraction and interpretation of interview data.

Results and discussion

In the first part of the interview, we found out how the research participants organized online training, which was the most difficult and best transition to a distance learning process.

Answers to the question *"How fast did you manage to restructure your work and switch to online teaching?"* were different. Younger lecturers noted that this happened relatively quickly, that it took only a week or two, while lecturers with bigger teaching experience indicated that it took longer to restructure and adapt to new circumstances. It should be noted that all the senior teachers interviewed worked in classrooms without presentations until the beginning of the pandemic, so the preparation of the studying materials took a long time. < … > *It seemed to me that I would collapse in the first distance learning semeste*r. < … > The material and technical provision of universities were also important. Most lecturers noted that only in the autumn semester (the second wave of the pandemic) the study process was organized strictly according to the study program, when lecture schedules were arranged, universities purchased graphic tablets or lecturers provided technical files and improved internet connection. Many lecturers already had presentations and electronic resources in the university study environment before the pandemic, which, of course, accelerated the transition to distance learning, but it still took time, as the materials prepared before the pandemic were intended only as supplementary materials.

Answers to the question *"How do you organize the distance teaching process?"* were different, mainly due to the opportunities offered by the lecturers of the specific universities. In the first wave of the pandemic, there were no strict management instructions on how to organize the study process remotely, in Latvia lecturers were free to choose the tools and methods. Starting from the autumn of 2020, the lecturers from the Latvia University of Life Sciences and Technologies were invited to use the *Big Blue Button (BBB)* tool, which became possible thanks to the launch of the most powerful servers. Other Latvian research participants used the free version of *Zoom* for the distance learning study process, but later they used the *Zoom* paid version, which allowed them to provide the online study process according to the lecture schedule. In Lithuania, participants were allowed to choose *Adobe Connect* or *BBB* tools for video lectures. These tools were integrated into the university's virtual learning environment *Moodle*. When all the lecturers started using these video lecture tools at the same time, it was not always possible to share their own computer screens or to lecture with the video due to server load. Therefore, some lecturers have addressed this problem individually by looking for new video conferencing tools. In this way, the participants discovered a new and attractive *Zoom* tool during their first quarantine teaching period. Others tried *Google Meet*, *Facebook Rooms*, or *Discord* and used these tools for teaching. Later, some of the lecturers bought paid *Zoom* access themselves. Sometime later, the university made *MS Teams* available to all lecturers. Many lecturers enjoyed giving virtual lectures using *MS Teams*, although there were some lecturers who had been using both *MS Teams* and *Zoom* for quite a while.

One of the respondents in the first wave of the pandemic created a video file before each lecture and was available online to answer students' questions during class. Even now that the lectures are in person, this teacher makes recordings during the lectures so that those who did not attend the lectures have the opportunity to listen to the recordings. All lecturers of Latvian universities who participated in the interview have made video recordings of lectures and only a few lecturers have recorded practical classes. Several lecturers have prepared presentations for their lectures, but one of the respondents still does not prepare presentations and any additional printed materials and believes that this motivates

students to create summaries. < … > *There were no presentations, students only had access to what I read during the lecture.* < … > One Lithuanian participant was strongly opposed to lecture recording. She argued that by not recording lectures, she was motivating students to actively participate in virtual lectures and discussions. For these students, the lecturer prepared detailed course summaries (slides and text material in PDF format), but there was no verbal explanation of these summaries online.

As the most difficult in the transition to the distance learning process, some teachers noted the psychological factor of having to work without seeing the students' faces, several mentioned the lack of motivation of students and the fact that teachers were not sure whether students were really listening or just joining the lecture. Participants in the study said that it is sometimes difficult to 'force' students to attend lectures with cameras on. Students argue that their cameras do not work, they do not have cameras at all, or they cannot turn them on. Sometimes students attended lectures even without a microphone and answered questions in writing instead of orally. The research participants suggest that students often do not tell the truth and thus try to "get out" of answering questions, especially if they do not fully understand the lecture material. However, such distractions make the lecturer's job even more difficult, and the lecturer begins to lose track of whether the students have absorbed the learning material.

As the best thing about the distance learning, several lecturers noted the time savings, as they did not have to spend time traveling to and from university, technical skills acquired during this period, created materials, and the opportunity (through video lectures) to look at their work from different points of view. The best things for the students were that they had the opportunity to watch the recording of the lecture several times to better understand the study material. In the case of large student flows, there were no disciplinary problems and students were able to see well everything the teacher writes on screen, which is not always possible during a face-to-face lecture. Some students also preferred virtual lectures and expressed a desire to continue learning in this way after lockdown.

In the second part of the interview, we summarize the experience of the last year of study, when universities worked in very different ways depending on the epidemiological conditions in the region, and the teachers' recommendations to their colleagues in this regard. It was found that only a few lecturers worked in hybrid mode (when some students are in person and some are connected to the lesson remotely), most of them either only in person or only remotely. < … > *I work either in person or remotely. If you are sick, then you are sick. The student then needs to think about how to get the notes from lectures.* < … > Some lecturers from Latvia noted that they did not object to organizing classes in the form of a hybrid, but for the time being such high-quality material support is not available for such lectures. In opposite, Lithuanian universities welcomed the availability of special videoconferencing equipment for hybrid teaching, which allows the lecturer to write and explain on a whiteboard simultaneously to students who are present in the classroom and virtually connected.

Lecturers believe that in today's world, each teacher must constantly improve their digital skills, including those who work with information technology students, the distance learning process must be completely identical to the full-time study process in terms of study content. One of the research participants spent a lot of time thinking about how to implement the final test in a remote format. In his view, which the authors fully agree with, the lecturer must give the students clear instructions on how to take the exams. Teachers need to be aware of the places where a student may take the opportunity to work unfairly during an exam. < … > *I gave strict instructions on how to place the camera, telephone, computer screen during the exam. And only if everything is observed I gave the opportunity to take the exam* < … >

In the third part of the interview, the authors found out the biggest challenges for university lecturers during the distance learning process, the benefits, and what lecturers thought could change in the study process after the pandemic, especially how it would affect the education of future engineers.

In the initial phase of the pandemic, the biggest challenge for many teachers was to learn the tools for distance learning and how to work at all. Several lecturers noted the responsiveness of the specialists of the university IT department, as well as the mutual communication of colleagues to share their experience in remote work. Another challenge in the initial stage was managing students' work, some teachers initially allowed the completed work to be sent by e-mail, use the university's electronic system and *WhatsApp* communication, making it difficult to keep track of everything. Several lecturers mentioned the organization of the examination process as the biggest challenge from the beginning of

the distance learning process and which remains still relevant, student motivation for study work, and the reluctance of several students to actively participate in the distance learning online lecture process. < … > *Students are afraid to say something wrong. Students join in the consultation time, but no one asks anything. Some students wait until they are left alone in a virtual room and only then ask questions*. < … > The Lithuanian research participants noted that the communication between teachers helped resolve these problems. Participants also mentioned that they always had access to the person or department at the university responsible for the development of distance learning. So, the lecturer was never left alone with his or her problems.

As benefits of distance learning, teachers mentioned the prepared study materials and improved digital skills, noting that university management and teachers themselves have become more flexible about the possibility of performing work duties not only in the official workplace, including the possibility to conduct a lecture during a business trip in the future, if necessary. The remote form of work allowed students to organize consultations in late evenings when they can all join them and the lecturer does not need to follow the list of student classes to schedule a suitable consultation time.

Regarding the technologies and applications used that were useful for remote work, all research participants noted that they used tools offered or recommended by the university management. Several lecturers noted that the work is not possible without the use of a graphic tablet, the other lecturers used *MS Word* to write, either by writing during the lesson by preparing the materials in time or by filming the lessons before the official time of the lecture, using the *Zoom* or *ActivePresenter* options.

Answers to the question "*What distance learning methods do you think will remain after the end of the pandemic? Why?*" were different. Some lecturers, including mathematics teachers, believe that both lectures and practical work could take place remotely, but tests and examinations should only take place in person. Conducting a lecture remotely would be very good because in this case, you would not have to think about suitable rooms for large student flows, but of course, you would have to think about the planning process, because it is not a good idea for the same students to have some classes in face-to-face form and some in distance form on the same day. At the same time lecturers from Latvia who teach study courses related to construction and electrical engineering considered that only contact methods are suitable for teaching engineering subjects, consultations can be organized remotely and video materials, including video collections, can only be used as additional study material. According to several lecturers, the offer of distance learning programs will be further developed. Oppositely, one professor from Lithuania who took part in the study expressed the opinion that distance learning has already failed and that she will never go back to it. In the opinion of this participant, it is only through contact teaching that students are able to master the basics of mathematics and other practical study courses.

It is difficult to discuss whether and how the changes in the education system experienced during the pandemic will affect the future education of engineers. Some lecturers think that < ... > *We will continue to use the new opportunities in the future* < ... >, at the same time other teachers think that < … > *Many teachers will want to go back and return to face-to-face form. Because it takes a lot of enthusiasm and ingenuity to create a quality course online.* < … >

Some recommendations based on their own experience and research findings will be provided below. Most of the recommendations apply both to the distance learning of future engineers and to students in any other field.

First, as it has been done in schools, common recommendations should be developed at the university level on what students should do to better organize their work. Do not think that the students already know and understand everything. Several interview participants noted that it was difficult to motivate students for work and help them mobilize. To partially solve this challenge from the authors' point of view very simple advice provided at the university level could help students, such as turning on the phone in silent mode, using the desk for training, using the headset, writing the daily list, taking notes, using the timer to take breaks, and more.

Second, in order to be able to work with quality, lecturers must constantly improve their digital skills, as well as learn about pedagogy and psychology. It is important to learn various methods that promote student activity. There is a need for teamwork, that includes both specialists in the field of IT and methodology specialists, as well as specialists who work with engineering students in everyday life,

in order to think together about which activity-promoting methods to apply in the future engineering study subjects. Because there are several methods that work well in social subjects but are not suitable for engineering study courses. It should be mentioned that it is important for colleagues to communicate and share experiences. University management needs to motivate academic staff to share experiences both in their departments and at a wider level.

Third, the lecturers have to think about the length of the online lectures. It is clear that it will be difficult for the student to endure long hours online, it is impossible to keep his or her attention, the student gets tired, etc. To partially address this challenge, it may be useful to prepare short pre-lesson video instructions that allow the teacher to change the form of teaching during the lesson, thus keeping students' attention. The authors of this research have personal experience in preparing video instructions, which is evaluated very positively by both the authors themselves and the students. Pre-created video files are also good because they can be shared with students and any other audience without violating our privacy policies which is a problem that arises when recording an online lecture or practical lesson. The lecturers also need to think about the extra time needed to do the remote work, because using digital tools takes extra time to take pictures, add them to the website or send them to lecturers.

The fourth is organizing training lessons with engineering students, where it is necessary to stabilize skills in solving various tasks (including mathematics). According to the authors of the research, students must be offered small self-tests. These could take various forms, both online tests and calculation tasks, for which solutions are later offered and the student can compare them with his/her own solution.

Organizing tests and exams in distance was a big challenge for both the interview participants and the authors of this research. In the distance learning process, it is relatively easy to organize formative assessments which can be organized using a variety of computer technologies, it requires a large investment of time, but pays off in the long run. A more difficult situation is with summative assessment. One of the authors of the study discussed the tests and exams work with each student to assess the fairness of the work and the acquired skills and abilities, but this took time and was unlikely to pay off in the long run. One of the interview participants who works with future construction engineers offered his own scenario on how to organize the test. He provided students with precise instructions on how the camera should be located, and where the computer and telephone, etc. should be placed (Fig. 1).
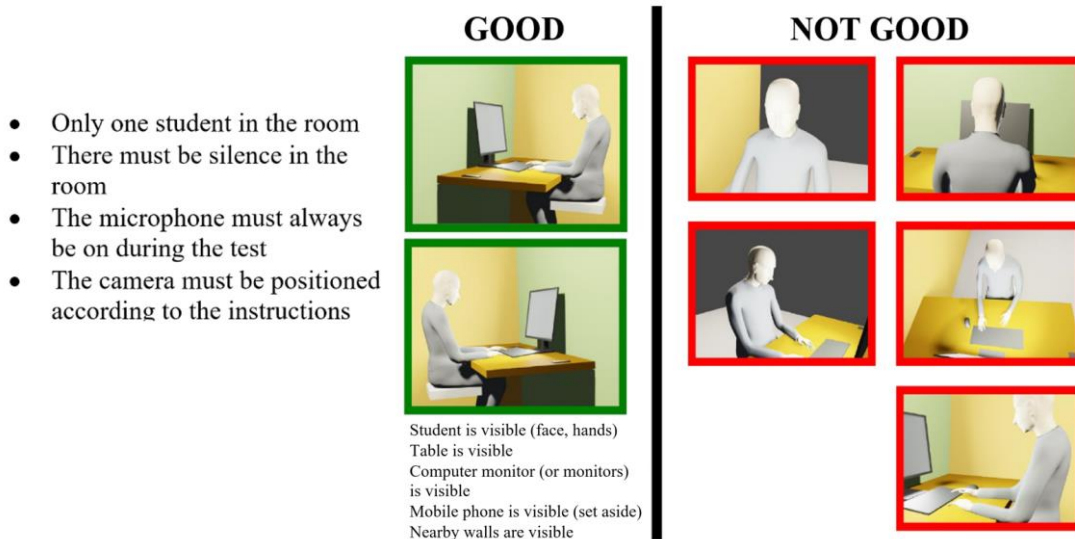

Fig. 1. **Camera location instructions (*visualization done by research participant*)**

This experience could certainly be used by other teachers. The disadvantage could be that it could be inefficient in the case of a large flow of students, in which case tests should be organized for small groups of students, other alternatives should be developed, which also requires time. Finally, the lecturer must clearly define the requirements and objectives of the study course, regardless of whether the lectures are remote or in person. It is important to set clear criteria for each task that is done.

Conclusions

1. Although all of the university engineering lecturers- research participants had no experience of distance learning prior to the COVID-19 lockdown, they were able to adapt quickly to lecturing remotely, and many of them found this way of delivering lectures acceptable.

2. As the most difficult, some teachers noted the psychological factor of having to work without seeing the students' faces, the lack of motivation of students, and the fact that teachers were not sure whether students were really listening or just joining the lecture.

3. There were several positive things during the COVID-19 lockdown in the study process: time saving, lecturers' advanced digital skills, developed teaching materials, and the opportunity for teachers to look at their work from another perspective.

4. Respondents suggest that the preparation of short video instructions could be a successful solution to help the lecturer keep the students' attention.

5. Lecturers of engineering subjects mark the execution of exercises and practical work remotely as the biggest challenge. To ensure the quality of the distance learning process for future engineers, teamwork is required, which includes both IT specialists and methodologists, as well as specialists who work with engineering students on daily basis.

Author contributions

Both authors equally contributed to the conceptualization of research. J.K. has led the way in developing the Methodology section. N.S has led the way in developing the Recommendations section. N.S. collected and analyzed data from Latvian research participants; J.K. collected and analyzed data from Lithuanian research participants. Both authors equally contributed to the manuscript preparation. All authors have read and agreed to the published version of the manuscript.

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