

Remote Study Work Challenges and the New Model in Post-COVID and Pre-AI Era

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Abstract – The aim of this research is to understand the complexity of student's and teaching staff behavior and experience in times when study work in real auditoriums is mixed with remote learning. Since 2020, the author has conducted an annual survey of several hundred students of computer science at the University of Latvia and Riga Technical University for 5 years about the possibilities, usefulness, problems, satisfaction, benefits and visions of remote and distance learning. The study shows the dynamics of changes in student opinions and technical capabilities over these 5 years, including COVID and post-COVID periods. The author offers a model of productive study work that includes mixed methods, Moodle e-course management and advanced technologies, increasing student responsibility in remote work in an environment where some technical problems and artificial intelligence are present, to achieve the best possible result.

Keywords – *e-course management, interactive learning, higher education, remote learning, online learning, mixed methods, Moodle.*

I. INTRODUCTION

The study process is part of the social, economic etc. life of society, so global changes are always reflected in it. E-learning is more complex than we usually see when viewed from the student or even the instructor's point of view. We need to look as broadly and deeply as possible at the links between e-learning in different directions. In the Khan model the eight dimensions of the e-learning framework are: institutional, pedagogical, technological, interface design, evaluation, management, resource support, and ethics [1]. The COVID-19 pandemic affected learning process of more than 1.6 billion students and youth worldwide, and some gains already made towards the goals of the 2030 Education Agenda were lost [2]. However, we can say with great positivism that e-study and remote learning saved the education system, maintaining its continuous functioning. It is likely that the importance of remote learning will only increase in the

future, so it is worth continuing to explore opportunities for improving distance learning and using blended methods in new layers of next models.

The origins of remote learning can be traced back to the 1960s as distance learning, when paper letter correspondence courses began to be introduced in the United Kingdom Open University. In 1970s Otto Peters described distance education as an industrialized form of education theory as principles of 1960s industrialization reflects in the proposition that distance education can be an industrialized form of teaching and learning. Peters root his theory in technology and economics. Then new theories related to pedagogy appeared from various authors. After the triumph of PCs in the 80s, paper correspondence turned into email correspondence in the end of 80s and 90s, but the 21st century began with web-based learning solutions [3]. In 1999. Moodle's founder and lead developer Martin Dougiamas in Australia introduced a new type of open source Learning Management System (LMS) – MOODLE, and in 2002 Moodle 1.0 was released [4]. In the last decades, MOODLE is the most popular and probably the best LMS for distance and remote learning, the current version is MOODLE 4.5, also used as the main LMS in Latvian universities, also next step of comprehensive modernization of study solutions is planned in the next five years.

With distance learning the author understands the system of teaching and learning where there is geographical distance between the teacher and the learner and technology and media are used for communication between them. Typically, distance learning takes place according to special programs, but remote learning is the transfer of face-to-face learning partially or temporarily completely in a remote/ online mode. Therefore, during COVID, we talk more about remote learning, but before and after that – more about blended/ mixed methods of learning.

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II. MATERIALS AND METHODS

The experimental part of the study consists of surveys of IT students over a 5-year period at two Latvian universities. However, the results of the study are published here for the first time.

The Latvian education system was relatively well-prepared for the 2019 pandemic, as Moodle e-learning had been implemented in all Latvian universities, and the University of Latvia and Riga Technical University provided schools with the opportunity to host their e-courses on university servers. But the implementation of Zoom or Teams was easy. It so happened that already in 2013, using the opportunities provided by ESF projects, we created a still-up-to-date MOODLE e-course designer manual [5] and a tutorial on creating educational institutions’ Moodle server [6]. Therefore, after more than 10 years of using LMS in universities and 5 in many schools, the transition to remote work in the 2019/2020 academic year was not a shock to either teachers or students, and we were able to continue our studies while simultaneously thinking about finding ways to improve the few problems we encountered.

Since 2020, for 5 years the author has conducted an annual survey in Operating systems course last lectures of 1174 students from the Latvian stream (by years: 214 in 2024/2025+ 285+ 233+ 264+ 179 in 2020/2021) of computer science at the University of Latvia (2020/21) and Riga Technical University (next 4 years) about the possibilities, usefulness, problems, satisfaction, benefits and visions of distance and remote learning. The study shows the dynamics of changes in student opinions, technical capabilities and some permanent problems over these 5 years, including COVID and post-COVID periods. Students were asked to respond not only to the courses taught by the research author, but to the entire study process as a whole.

Respondents were asked 12 self-rating questions, of which 10 questions used a 5-point Likert's scale, where answers are coded as “yes” = 1.00 point, “more yes than no” = 0.75, “neutral” = 0.50, “more no than yes” = 0.25 and “no” = 0.05 (no answer = 0), but one question had a multiple choice of 11 answers and one had a free text answer. The numerical results of the survey (average points of responses) are given in Table 1.

Usually, survey results indicate percentages, but here the author introduces a positivity coefficient because I want to study positive attitudes. Therefore, the higher the average positivity coefficient of Likert scale responses, the more positive the students' attitudes; the exception is the negative question J9, the results of which are given in percentages. However, for clarity, a link with percentages

can be indicated, for example, in the 20/21 academic year study, the positivity coefficient for question 6 (hereinafter Q6) is 0.978, but the Likert scale responses were distributed as yes = 91.06%, then 7.82%, 0.56%, 0% and no = 0%. Reliability for the total items is not less than $\alpha = 0.95$.

Full text of the questions asked in the survey: Question 1 or Q1 – Is the use of the e-study environment MOODLE in remote learning/ studies useful (materials, quizzes, uploading of work, assessments, communication, etc.)? Q2 – Is the use of remote conference environments Zoom, Teams or others for remote lectures useful? Q3 – Would it be important for you to have the same login name in e-study and Teams or Zoom to enter authentication data only once? Q4 – Is it important for you that the IT tools and environments used are also available on a mobile phone? Q5 – Is it enough if lecture video recordings are kept for 30 days? Q6 – Is it useful if approximately 40... 50 min. long topic overview videos are given that are kept for a long time (MS Stream, Zoom Cloud, YouTube)? Q7 – Did you find it useful to use short (1-5 questions) quiz at the end of each lecture to register attendance? Q8 – Is it worth supplementing the remote study process with other tools (e.g. Skype, WatsApp, HotPotatoes, group work environments, avatar 3D games, etc.)? Q9 – Did you have technical problems participating in remote lectures, practicals, consultations, meaning not only the Operating Systems course (computer performance, internet bandwidth and stability, webcam, etc.)? Q10 – Would you be okay if all communication (receiving materials and assignments, sending work) took place via email? Q11 – Are you ready to work remotely for at least half of the semester next semester without any significant problems (do not think about a specific study course, lecturer, but in general)? Q12 – If you wish, write down what else is important, what should be added about the process of remote studies.

III. RESULTS AND DISCUSSION

TABLE 1. SURVEY QUESTIONS AND RESULTS BY YEAR

Nr	Question	20/21	21/22	22/23	23/24	24/25
1	MOODLE is useful	0.90	0.87	0.86	0.88	0.85
2	Zoom, Teams are useful	0.93	0.95	0.95	0.87	0.88
3	Single Sign-on	0.72	0.71	0.77	0.67	0.65
4	Mobile phones support	0.67	0.66	0.77	0.77	0.78
5	Enough keep the videos for 30 days	0.51	0.50	0.62	0.57	0.49
6	Topic overview videos are useful	0.98	0.95	0.95	0.96	0.94
7	Usefulness of short attendance tests	0.83	0.79	0.80	0.79	0.80
8	Need more tools	0.50	0.44	0.51	0.49	0.49
9	There were technical problems	0.30	0.14	0.23	0.18	0.15
10	If everything is in the email	0.42	0.43	0.54	0.42	0.45
11	Ready for half a semester Remotely?	0.87	0.89	0.90	0.77	0.85

A. Primary survey results

1. As can be seen from Table 1, support for the main remote learning technologies remains consistently high: the average positivity coefficient all the time is about 0.85 for LMS Moodle (question Q1) and the video conferencing tools Zoom and Teams (Q2) get about 0.87, and no one has given them the lowest rating. However, support for Moodle has decreased by 5.6% in 5 years and for video conferencing tools by 5.3%, which is easy to understand as work in university classrooms has resumed. It is rather surprising that support for remote learning tools is still so high; perhaps students want to participate in lectures not only from home, but also from their workplaces, which is a relatively new motivation for introducing blended methods.

2. Usually, students do not like repressive control methods, but this time the author was pleasantly surprised by the large approximately 0.80 support for short attendance control quizzes (Q7) in the MOODLE environment (3...5 questions at the end of the lecture or a little earlier at the time of lecture). Perhaps the pandemic made students more conscious of the courses they want to learn, and proper motivation of students probably plays a role here: the author allowed with these quizzes to earn +1 point for final grade if 80% of the quizzes were completed 80% correctly (IT certification standard), and there was also a consolation prize of +0.5 for 70% to 70%, and some of the questions were repeated in the exam big quiz. It is important to note that over the past 5 years, satisfaction with lecture attendance quizzes has remained stable with a positivity coefficient of 0.8. This suggests that at least 80% of students are interested in their studies.

3. The desire to use used remote studies tools on a mobile phone/smartphone (Q4) has increased by 16.5% over the past 5 years (from 0.673 to 0.784), as well as shows an increase in the welfare of society. This shows a desire to use time effectively and study everywhere, but some students may also enjoy the opportunity to cheat on quizzes, exams from their smartphone or smartwatch; but in any case, we should support smartphones.

4. The greatest support from students (approximately 0.95) for in the e-course included approximately 40...45-minute theme overview videos (Q6) that contain the main ideas from the lectures and for the practical work of the Operating Systems course. These videos are rated the highest all the time, the decrease in positivity about them in 5 years is only 4.2%. Meanwhile, approximately half believe that videos should be available for longer than the standard 30 days (Q5) 0.5...0.6.

5. As expected, less positivity ~0.45 is about the idea all study work communicate in email (Q10) instead of Moodle. Also, less than half ~0.49 believe that more tools are needed (Q8). Maybe it's really not worth getting too carried away with external tools, because Moodle has everything essential for massive, rich e-courses: placement and grouping of materials, submission of reports, quizzes, surveys, a calendar, even a tool for virtual seminars and plagiarism check etc., the exception

is the placement of large video files (for example, over 100 MB, but it depends on the server settings), which the author published on YouTube (some as public, some as available only via the link provided in the e-course), because in Zoom and MS Teams/ Stream shared folders they were deleted every year or sooner.

6. There is no unequivocally convincing support for single sign-on authentication (0.65 in 2025), and it has been declining in 5 years by 10% (Q3). The motivation for this was not studied, perhaps there are security concerns (respondents are computer science and IT students), but perhaps it is related to the ability to save login information in the browser.

7. The most unpleasant discovery: still in 2025 at least 15% of students indicate significant technical problems in remote work (Q9); students are considered to have counted if they have at least two significant problems: insufficient computer performance, unstable or insufficient internet bandwidth, power outages (they were indicated by only 6 students and only in the first year of the survey); the disappearance of mobile Internet zones prevailing in certain places in Latvia (eastern border areas, as well as the 1st floors of Riga multi-storey buildings and some places in rural regions). It is positive that five years ago 29.61% of students had two big problems together, but in the last 3 years the situation has improved, and this level has remained constant at around 15%, which is a lot anyway. Minor problems were considered to be the absence of a webcam, microphone, insufficient performance of the student's computer for virtual machines, or the problem having occurred only once per semester.

8. There is reason to think more about blended study methods, as the positivity coefficient ~0.85 indicates that they are ready and willing to do half of their study work remotely (Q11). The coefficient has decreased by only 2.7%, which is close to the measurement errors. This also indicates that we are on the right path in the field of e-learning and remote studies.

B. The brilliance and bane of artificial intelligence in universities

The role of artificial intelligence (AI) in LMS could be the subject of separate studies and have a great future, so here the author will limit himself to observations from practice. The positive side is that AI allows for the rapid processing of large amounts of data, the generation of presentations, the assessment of students' works, for generating quizzes/tests, the detection of plagiarism in student work, face control in exams, etc.

However, the negative manifestations of AI are alarming. For example, all students who were caught using ChatGPT during an exam quiz later knew an absolute zero in the required oral answer, unlike the others. This raises concerns about the effectiveness of the above-mentioned lecture attendance quizzes for learning, because, together with AI they will only provide a record of attendance.

On the one hand, the author agrees that nothing will prevent a student who does not want to learn from not learning, so repressive methods must be developed to control real knowledge. However, it is important not to overdo them, e.g. international students often use AI-powered translators to get English text from their native language; such a translation sometimes looks like it was generated by AI, but they are not. It is important not to falsely penalize them.

In the discussion about what knowledge, skills, abilities, the author would like to add that it is what has lasting value in the student's mind. Imagine that the electricity is powered off for 3 months, then what you will be able to do, solve without a computer, phone and internet will also be what made studying worth it. The concept of competencies mentioned in the model can be understood as knowledge, skills, abilities with a creative application layer.

C. Another next model of remote learning

Before offering a new vision, it is useful to look back at the best existing remote study models. More popular theories and frameworks for online education are discussed in Picciano A. G. book "Theories and Frameworks for Online Education: Seeking an Integrated Model". From here, Bloom's taxonomy (1956) is based on six key elements. They can be drawn in a pyramid, then from the bottom: remembering, understanding, applying, analyzing, evaluating, creating. As next level, Robert Gagne developed another taxonomy that built on Bloom's and became the basis for cognitive instructional design; Gagne's nine events of instruction: gain attention, describe the goal, stimulate prior knowledge, present the material to be learned, provide guidance for learning, elicit performance, provide feedback, assess performance, enhance retention and transfer [7].

The old models were created by excellent educators and psychologists, but today the environment has changed, much is determined by IT capabilities, and often new tools are created by programmers themselves, intuitively sensing what educators might need. Consequently, our efforts to organize our ideas into models must be supplemented by new realities.

Anderson's Online Learning Model is based on new IT capabilities, using Semantic Web concept and technologies, so LMS can work with three agents: teacher agent, content agent and student agent. There are different collaborations between student – content, student – teacher, student – student, teacher – content; these interactions are affordable, reusable and facilitated by active agents. Knowledge content may be interactive, and implemented for asynchronous and synchronous learning. Supported studies types in LMS can be: independent study, paced collaborative learning, community of inquiry, structured learning resources [8].

Khan's popular model describes the eight dimensions of e-learning framework are: institutional, pedagogical, technological, interface design, evaluation, management, resource support, and ethics [1]. Khan's diagram of this

venerable model is flat and all sides of the octagon are of equal size.

The author of this article believes that the number of elements needed in the next model is more complex, and it is a multidimensional, multipolar, balanced. The next model of remote learning for today and the near future the author tries to offer in Figure 1.

The model diagram proposed by the author contains 20 elements, several of which have sub-elements, but only 7 links are indicated, without which the system would not work. The remaining links connect teachers and students to all elements. These connections they will create themselves during the learning process.

Everything is connected to everything, but you can try to count how many connections you make in your daily work. The author encourages teachers, lecturers, and professors to use all the key elements of remote and distance learning mentioned in the model. At any time, we can add something else, some more external tools, but too many tools distract students from the material being learned.

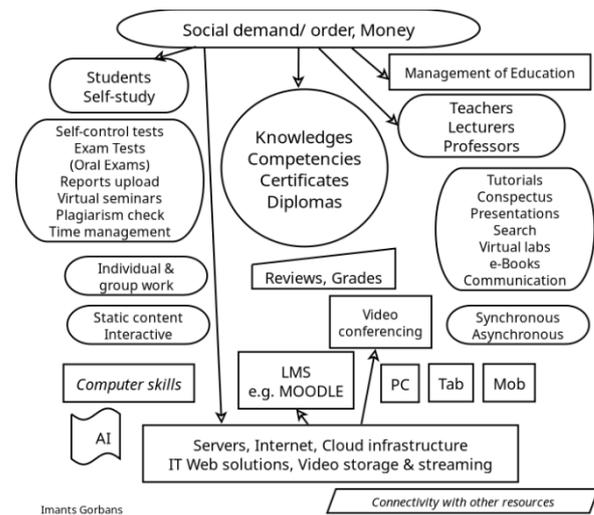


Fig. 1. The next model of remote learning for today. Imagine for yourself that students and teachers are connected with everything.

IV. CONCLUSIONS

In recent years, remote learning has developed rapidly, as remote studies were a real necessity during COVID-19. The intensive work remotely and author's survey and experience highlighted some additions to previously known models and recommendations for educational managers, professors, teachers:

a) As shown by the student survey responses, they accepts very well **self-control quizzes/tests** at the end of each lecture very positively, especially if they are also attendance registration; these quizzes should not be allowed to be taken in adaptive mode or repeated more than 1 or 2 times, so that students who did not attend the lecture cannot guess; in the fight against communication in social media and AI, only a very short quiz execution time is useful, maximum 1 minute per long question;

b) It is not useful to keep video recordings of lectures for a long time or to create them at all, but students appreciate highly shorter **videos of topic reviews** very positively, which makes sense to keep them for a long time;

c) Student collaboration is also possible in the MOODLE environment, for example, **in virtual seminars**; they are useful for discussions and grading of project reports, some practical works, they can be assessed by 5...7 randomly selected students (it happens automatically in virtual seminar tool);

d) Face-to-face **lectures can be broadcast** on a video conferencing tool after COVID-19 too; it is better for students to participate in lectures remotely from home, in a coffee shop or at work, surrounded by colleagues, than not to participate at all;

e) All remote learning tools must be available not only on computers, but also on tablets and, in recent years, especially on **smartphones**;

f) **Different methods** should be mixed, including synchronous and asynchronous study, and finally, remote work is cheaper for the university;

g) It is important for the student to always **receive feedback** from the teacher, and this can only be partially replaced by artificial intelligence (AI) or old algorithms;

h) It is necessary to continue to search for useful uses of AI and methods of combating **unethical use of AI**;

i) The situation with power outages and mobile internet coverage **has improved in Latvia** over the past 5 years, and the situation is good right now;

j) The **demands of society and employers** take precedence over the wishes of students;

k) Educational institutions must decide between their **own servers and a rented cloud** environment (remembering that in the Middle Ages, the basis of feudalism was land rent for farmers, but privatization led to higher work efficiency), the optimal solution could be that organization to have a low/middle-performance server supplemented by a cloud solution;

l) Individual countries and regions may be temporarily disconnected from the global Internet, so it is important to create **systems that can work locally** – if there is no doubt about MOODLE, then local video conferencing tools can be created from e.g. <https://jitsi.org/>;

m) By introducing **positivity coefficient** in survey analysis, the author tried to emphasize that in study work it is important to direct the process with a positive attitude.

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