It Can't Be Taught Online: Applied Sciences Students during the Pandemic

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Abstract   Transition to distance learning during the Covid-19 lockdown in spring 2020 was a challenge to the education system in general and higher education in particular. Applied Sciences were unanimously recognized as the most affected due to their focus on practical skills, being closely tied to the institutional infrastructure, and a moderate curriculum digitalization. This article describes student experiences during the spring semester of academic year 2019/20, using data obtained from 30 interviews with students in Engineering & Technology, Health & Medical Sciences, and Arts & Culture degrees. Delivery of lectures and practical classes, placements, dissertations, and faculty–student interactions are analyzed. Findings are consistent with the widely discussed perception of education during the pandemic not as distance learning but rather as emergency remote teaching that requires supportive measures to compensate for time loss in learning as well as solutions to technical and methodological issues.

The emergency transition to distance learning formats during the COVID-19 pandemic became a challenge to the system of higher education as most university students had no previous experience of distance learning [Tsener, Oshkina 2020]. Studies carried out during the pandemic show that students have faced a number of difficulties, first of all problems caused by poor Internet connection and lack of nec-

essary devices [Gruzdev, Kamaldinova, Kalinin 2020; Tsener, Oshkina 2020; Kapasia et al. 2020]. Other issues include reduced interactions with peers and faculty and the feelings of loneliness [Gruzdev, Kamaldinova, Kalinin 2020; Elmer, Mepham, Stadtfeld 2020]. A lot of students experienced problems with self-management during the lockdown [Gruzdev, Kamaldinova, Kalinin 2020; Kapasia et al. 2020]. Their mental health was also affected by the transition to distance learning [Aleshkovsky et al. 2020; Elmer, Mepham, Stadtfeld 2020].

The urgent transition to distance learning in the lockdown has had a number of long-term consequences. For instance, some students have delayed graduation and avoided entering the labor market, being unable to complete their studies [Aucejo et al. 2020]. Nearly one third of students have been expecting to earn less in the future.

Students in Applied Sciences are the most vulnerable group: despite technological progress, the transition to distance learning has become a real challenge for universities offering programs in engineering, medicine, and arts. Due to the focus on practical skills, the learning process in those fields is largely contingent on the facilities and equipment available at the university or partner corporation. Access to institutional and corporate infrastructure has been limited or denied during the COVID-19 pandemic. Most Applied Sciences programs are impossible to deliver online or remotely [Shibanova et al. 2020]. Researchers emphasize the importance of in-person student–faculty interactions in Applied Sciences [Abramyan, Katasonova 2020; Levanov, Perevezentsev, Gavrilova 2020], which are hard to ensure in distance learning formats. Changes have affected not only the learning process but also the way exams are conducted. Art school students have complained that online learning prevents them from demonstrating the quality of their work to the full extent[1], and the impossibility of taking licensure exams may have negative effects on employment of medical graduates [Chandratre 2020; Choi et al. 2020, Hilburg et al. 2020].

A lot of researchers doubt that educational practices emerging during the pandemic can be considered proper online learning. Rather, the new phenomenon is referred to as Emergency Remote Teaching and Learning[2] or Emergency Remote Teaching (ERT) [Hodges et al. 2020]. ERT is not fully equivalent to in-person or distance learning. Online learning is aimed at recreating a full-scale learning environment, whereas ERT is temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances [Ibid.]. Authors of such studies agree that in the absence of theoretical underpinning for ERT, the focus of their research is on the narratives of key players in education,

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[1] Toner P. (2020) How Are Final Year Art School Students Dealing with the Impact of COVID-19 on their Education? https://www.10magazine.com/arts/covid-19-fashion-art-design-students-csm-lcf/

[2] Milman N. B. Pandemic pedagogy // Phi Delta Kappan. https://kappanonline.org/pandemic-pedagogy-covid-19-online-milman/

and their paramount objectives are to analyze the situation and provide recommendations for the future [Bozkurt et al. 2020; Hodges et al. 2020]. The goal of this paper is to investigate into experiences of Applied Sciences students during the COVID-19 pandemic.

1. Distance Learning Experiences as Reported by Students

Even before the distance learning period was over, ample literature devoted to students' learning experiences during the COVID-19 pandemic in spring 2020 had been produced in Russia [Aleshkovsky et al. 2020; Gruzdev, Kamaldinova, Kalinin 2020; Tsener, Oshkina 2020] and beyond [Aucejo et al. 2020; Elmer, Mepham, Stadtfeld 2020; Kapasia et al. 2020], analyzing the organization of learning and the challenges faced by university students. All of these studies are descriptive, as the changes that have occurred in education are so radical that they cannot be fitted into any of the existing theoretical models.

In a survey of students from Siberian State University of Telecommunications and Informatics [Tsener, Oshkina 2020], only 5% of the respondents reported having pre-pandemic distance learning experience. At the same time, 92% of students believe that "in-person learning is superior in quality". Similar results have been obtained in India, where an overwhelming majority of medical students (84%) consider distance learning ineffective [Kumar et al. 2020].

The reason for students' dissatisfaction with distance education may be their passive role in learning formats of this kind [Aleshkovsky et al. 2020]. However, they also name some specific characteristics of distance learning organization that they believe degrade the quality and effectiveness of education. According to a survey of Russian university students [Aleshkovsky et al. 2020], only some lectures were delivered as synchronous webinars and could be accessed later as recordings or were replaced with third-party online courses from open platforms. The majority of lectures were left to self-study with the use of lecture slides and reading materials provided by instructors or sources from the recommended reading list. Meanwhile, analysis of changes in engineering education during the pandemic shows, in particular, that despite the advancement of digital technology and infrastructure, engineering students usually learn their practical skills only in face-to-face interactions with the instructor [Abramyan, Katasonova 2020].

As for exam organization, about 40% of students did not notice any significant difference between in-person and distance exams, the latter being easier for 28% and harder for 20% of the respondents [Tsener, Oshkina 2020].

Survey data allows analyzing students' emotions and perceived effectiveness of education. The experience of distance learning is assessed as positive by hardly one third of the students, while half of the respondents have "mixed feelings", and one in five refers to this experience as negative [Aleshkovsky et al. 2020]. A study of Swiss students

found that social ties among students became weaker during the period of distance learning, students growing more likely to feel lonely [Elmer, Mepham, Stadtfeld 2020]. Similar results were obtained in a national survey of university students in Russia [Gruzdev, Kamaldinova, Kalinin 2020]. The lack of peer contact and in-person discussions with instructors were mentioned among the most significant difficulties [Ibid.]. The absence of regular interactions affected students' mental health, increasing the frequency of depressive symptoms, anxiety, and stress [Elmer, Mepham, Stadtfeld 2020]. A possible contributor to this result may have been the need to adapt quickly and without help to an unfamiliar e-learning environment [Horita, Nishio, Yamamoto 2020]. Students had to study on their own and organize their learning process themselves—and many exhibited low levels of self-regulation.

Essential difficulties were experienced with technological infrastructure. Students often had to learn to use new tools on their own [Tsener, Oshkina 2020], and many of them had no suitable space or devices for learning [Gruzdev, Kamaldinova, Kalinin 2020; Kapasia et al. 2020]. Internet connection issues were reported not only by Russian students [Gruzdev, Kamaldinova, Kalinin 2020; Tsener, Oshkina 2020] but also by their counterparts in India [Kapasia et al. 2020] and Nepal [Koirala et al. 2020].

International scholars point out that pandemic-induced distress was considerably higher among medical students than in any other population group. Clinical practice constitutes a large part of medical education, the most important exams being taken in clinics as well. Impossibility to access hospitals jeopardized practical training as well as licensure exams, which might have negative effects on the job prospects of medical students [Chandratre 2020; Choi et al. 2020, Hilburg et al. 2020]. Despite the integration of some distance learning components over the recent years, the system of medical education turned out to be unprepared for the urgent transition to distance learning formats [Hilburg et al. 2020]. Physical examinations were replaced with clinical data analysis. Students were encouraged to train their practical skills on family and friends. Virtual simulations were sometimes used; however, researchers believe these techniques to be inadequate substitutes for direct patient care. Many of the clinical teachers were overloaded with inpatient care and unable to pay due attention to distance learning organization [Ibid.]. Based on their distance teaching experiences, medical faculty members came to a conclusion that in-person class schedule is an important motivational and organizational factor for students, while the transition to communication via messaging apps often makes instructors adapt to students' personal schedules, leading to problems with planning and time management [Levanov, Perevezentsev, Gavrilova 2020].

The only real chance for medical students to practice their newly learned skills was volunteering on COVID-19 wards, which did not provide, however, any knowledge or skills beyond a specific area [O'Bryne,

Gavin, McNicholas 2020]. Access to clinical practice was also limited due to residence hall closures and the outflow of non-resident students to their home towns [Lucey, Johnston 2020]. A number of medical institutions in the United States and Great Britain graduated their fourth-year students two months early in order to solve the shortage of healthcare professionals and avoid the challenges of distance learning organization [Flotte et al. 2020; Macdougall et al. 2020]. Many of such graduates felt less prepared for beginning work as doctors [Chandratre 2020; Choi 2020].

Students in music and art departments also faced difficulties specific to their fields of study. Signing or playing instruments at home could be irritating for apartment residents and sometimes led to conflicts. Internet connection was the most important problem for student musicians, as poor sound transmission made it impossible to learn the techniques from instructors [Ozer, Ustun 2020]. In art and design, practical work often depends upon access to machinery and equipment, so final-year students found themselves unable to complete their projects at home. Degree shows are usually attended by potential employers, and final-year-students had every reason to doubt that an online graduate exhibition would allow making an adequate inference about the quality and unique features of their works[3].

As we can see, learning in a lockdown is particularly challenging for students in Applied Sciences due to the focus on practical skills, dependence on the institutional infrastructure, and a low level of curriculum digitalization [Shibanova et al. 2020]. Organization of laboratory classes and work placements is not even addressed in the literature described.

This study aims at exploring the pre-pandemic learning environments in medical, engineering, music, and art programs, organization of the transition to distance learning, and lockdown learning experiences including such elements of the learning process as lectures and seminars, term papers and theses, and work placement internships.

2. Research Design
2.1. Interviewee Recruitment

Semi-structured interviews with students from five Russian universities served as empirical basis of the research. Relying upon the findings obtained by Ekaterina Shibanova and her colleagues [2020], we came up with a list of fields of study in which students will be unable to complete their degrees at a distance: Engineering & Technology, Health & Medical Sciences, and Arts & Culture. Interviewees were recruited by university representatives from among students in the relevant degrees. Their contact information was provided by faculty members and senior administrators.

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[3] Toner P. How Are Final Year Art School Students Dealing with the Impact of COVID-19 on their Education? https://www.10magazine.com/arts/covid-19-fashion-art-design-students-csm-lcf/

2.2. Sampling

The method of criterion sampling was applied so that students from the three selected fields of study would be represented equally in the sample. Sample size was determined by the principle of saturation: data collection was stopped as soon as no new substantive information was acquired from the interviewees.

The sample consisted of 30 students, of whom 16 were female, aged on average 21 (SD = 1.97). They represented five Russian universities: two medical, two technical, and one specialized in the humanities. Ten of the interviewees were enrolled in Engineering & Technology, eleven in Health & Medical Sciences, and nine in Arts & Culture. For more details on the participants' profiles, see the Appendix.

2.3. Interviewing

Interviews were conducted online in June 2020 with the use of video- and audioconferencing apps such as Skype, Zoom, and WhatsApp. The participants provided informed consent their permission to use interview recordings and transcripts for research purposes. The names of students and universities are not disclosed for reasons of confidentiality. Every interview lasted from 37 to 90 minutes, the average length being about an hour. The interview guide contained the following modules of questions: biographical data; students' experiences before and during the pandemic; and their expectations of post-pandemic life.

2.4. Data Analysis

The method of categorization [Kvale 2003] was used to analyze the data collected. First, key categories of student experiences were determined: time spending, work/internship in the field of study, practice-oriented learning, learning during the pandemic, communication with peers and faculty, self-regulated learning skills, and future expectations. Next, each of the categories was divided into subcategories, according to which the interviews were coded. Categorization at the first stage was carried out by two experts independently. At the second stage, the experts discussed the results obtained, and another expert joined the coding procedure in case of discrepancies.

3. Results

3.1. "There Were Only a Couple of Courses Where We Would Just Sit and Listen": Pre-Pandemic Learning

Before universities went into the lockdown, a typical day of a student involved attending classes at the campus or at other institutions (hospitals and kindergartens for medical students, museums for art students). Students made extensive use of the opportunities provided by universities: musical instruments, expandable materials at workshops, libraries with anatomical charts that are "easier to work with than online anatomy atlases", equipped laboratories, computers with expensive licensed engineering design software, etc. Students spent their time outside classes on homework, supplementary courses, scientific communities and research groups, but most of all on working. Engineering undergraduates often had jobs that mismatched their field of study but did not take much of their time. The situation was different for medical students who normally combined study with clinical shifts

and often worked at nights, and art and music students who worked under short-term contracts, at nominal cost, or free of charge.

According to the interviewees, the use of modern learning technology before the lockdown was rather moderate: many of them cannot remember using any digital tools. Some of the interviewees mention PowerPoint presentations and transfer of study material by instructors on computer media or by email as typical pre-pandemic learning technologies. The use of computer media was not always welcomed by faculty out of copyright concerns, and PowerPoint presentations were not always fully realizable.

> I remember one day when we had no screen, so we had to hang up a large bedsheet (interview #30, Health & Medical Sciences, 6th year).

Other technologies, except for discussion of organizational issues with instructors via messaging apps, were rarely used in learning. That is why some isolated cases of technology use particularly stuck in students' memory: videos of surgery procedures, video lectures recorded by faculty, webinars in cases of teacher illness, interactive boards, instant mobile surveys, and muscle anatomy apps in medical degrees.

Students showed the most interest in practical classes where they learned professional skills in real life by watching their instructor—a practicing engineer, doctor, musician, or artist—work, or by working together with them, be that communication with patients, operation of equipment, visits to places of art or playing with a band outside the university, or during one-on-one sessions.

> There were only a couple of courses in the fourth year where we would just sit and listen: Public Health and Healthcare, and Innovation Management, but the latter was taught remotely <during the lockdown> (interview #12, Health & Medical Sciences, 4th year).

3.2. "It Seemed It Would Not Be Long": The Transition to Distance Learning

Students reacted to the news about campus closures differently. Some were caught by surprise when they came to classes that had been cancelled by the relevant order or when their supervisors notified them about possible event cancellation. Some interviewees were happy about getting a two-week break from their busy student schedule—"It seemed it would not be long" (interview #29, Health & Medical Sciences, 2nd year)—while others were puzzled by unprecedented measures and upset by the anticipation that "it wouldn't be normal education and <we> would basically have to learn on our own" (interview #17, Engineering & Technology, 2nd year).

> We all experienced severe emotional stress, because of all this anxiety transmitted by mass media <...> We all just wandered and didn't know what to do or what would come of it (interview #13, Arts & Culture, 3rd year).

Some students monitored the situation in Russia and the rest of the world. They knew that some campuses had already been closed and expected similar notice from their rectors. Medical students were outraged at continuing clinical practice in hospitals, which increased the risks of infection for their family members. A few students were thinking of getting a job to fill their freed-up time.

> Everyone started slagging off the university: why are they doing nothing if the ministerial decree has already been issued? As a pragmatic person, I knew that it would take a while for the system. So I was totally cool about it (interview #30, Health & Medical Sciences, 6th year).

> Everything worked as scheduled. <University name> switched over to Mirapolis quickly, and we just kept doing our work. In fact, the lockdown coincided with our pre-graduate internships, the very end of them. All the companies were shut down: we got our journals back real fast, and everything was closed in two days (interview #20, Engineering & Technology, 4th year).

Educational interactions were transitioned to distance formats in different ways and with varying degrees of success. It took a while to resume some courses online. Students relate this delay to the difficulty of carrying out the university's key activities remotely with the use of digital technology and to the advanced age of faculty members, who had to learn to use tools they had never dealt with before. However, few courses were postponed until the fall semester: universities mostly chose to deliver the spring semester courses at least in a reduced form.

3.3. "The Instructor's Mood Defined the Way the Class Would Go": Lectures During the Self-Isolation Period

Lectures during lockdown were delivered with the use of various technologies and in a variety of formats, the most widespread ones being synchronous webinars with the instructor and self-study of lecture texts.

Webinar lecture is a format most closely resembling the type of student–faculty interactions in traditional in-person lectures, which allows students to ask questions and receive immediate answers and requires no substantial content reorganization. Webinars were delivered using such videoconferencing apps as Zoom, Skype, Mirapolis, and Megafon. In addition to making the lecturer seen and heard, such apps also make it possible for instructors to demonstrate PowerPoint slides or share their screen with students. Effectiveness of this format is determined by the ability of participants, lecturers in the first place, to use videoconferencing apps, their access to properly functioning web cameras and microphones, reliable Internet connection, and flawless app operation.

> The university obliged all lecturers to turn up in Zoom meetings on time according to the schedule. And we had to attend with our web

cams on. That kept us quite disciplined (interview #22, Health & Medical Sciences, 5th year).

We didn't have to do anything in lectures; listening was all we did (interview #10, Arts & Culture, 4th year).

As simple as this format may seem, a number of interviewees report that it was ignored by faculty.

It would have been better if we had had lectures via Zoom. With anatomic pathology and all those tests, and with gross anatomy too… I mean, our lectures should have been organized better: the course is tough, but all we did was just going to the website, answering some questions, and moving to the next module (interview #25, Health & Medical Sciences, 3rd year).

When lecturers chose self-study as a way of consuming lecture material, they would upload presentations, articles, and textbooks to the distance learning environment or send them to students by email. Some interviewees believe that this method was applied "due to some negligence on the part of the instructor" (interview #15, Engineering & Technology, 2nd year). Many students complain that material for self-study was often too extensive and explain this high level of workload either by faculty's desire to get them occupied during lockdown or faculty's lack of distance learning experience. Interviewees claim that instructors in extramural learning programs are more accurate in distributing workload when organizing self-study work of students.

Some instructors would give us assignments for the whole week. Not that it's a bad thing, of course. Plus, six books for good measure. But then again, we are learning, and someone should tell <us> something (interview #30, Health & Medical Sciences, 6th year).

In this scenario, students should send a photo of handwritten lecture notes or take a test at the end of the module. The quality of student work was largely contingent on the lecturer's support, specifically on the possibility of asking them a clarifying question and getting a prompt response. Since some instructors only replied by email, ignoring messaging apps and social media, answers could be delayed for an indefinite period. If students could not be sure about getting an answer to their question, they would have to spend additional time on searching for the necessary information or seek help from their peers and join efforts to find the solution.

You come across something confusing, and you have no one to ask a question to. But you don't want to delay finishing the notes that you're going to complete in, like, 20 minutes. And you have no idea

when the lecturer will get back to you. So you think, "Whatever, let's pretend I got it." And you keep writing. In this example, <it becomes clear that> effectiveness is obviously lower (interview #19, Engineering & Technology, 3rd year).

Students point out that the quality of learning degrades when notes are taken at home as compared to classroom-based lectures due to lower concentration and engagement. Quite often, they would listen to music or just mind-wander while taking notes because the environment was unconducive to learning. Moreover, even note-taking could not guarantee acquisition of knowledge, as time was only enough for putting everything down but not learning the lecture notes by heart.

End-of-module tests were another form of control. Automatically assessed assignments would often imply finding answers within the lecture text without any reflection or reformulation.

All you had to do was open the PowerPoint presentation, find the necessary slide containing answers to two or three questions, and just copy and paste them (interview #12, Health & Medical Sciences, 4th year).

With tests on large modules, students asked for answers among their peers who had already done the module. Alternatively, they divided the module into portions so that everyone would search for specific answers, and then brought the results together. Students are critical about this type of assessment, contending that tests only assess retention in memory, while comprehension requires other methods of evaluation. Some interviewees report having been given much lower grades for tests submitted during lockdown than for written or oral tests taken pre-pandemic, even though the latter had been more in-depth and challenging. They believe that low performance is partially explained by the way such tests were developed by their instructors or by technological shortcomings of the distance learning system.

And then we had tests with Google Forms to fill in, and the tests seemed more difficult because it was multi select multiple choice, and if you got at least one answer wrong, you would get zero points for the item (interview #25, Health & Medical Sciences, 3rd year).

If lecture material called for no assessment, students would postpone reading it until later and focus instead on assignments with deadlines. In such cases, they would sometimes never get to the postponed material.

It could be inferred from students' answers that pre-pandemic distance learning infrastructure of universities was unable to withstand the increased load.

> Our university had a distance learning website. It had a major problem, which still persists: with too many concurrent users, it gets overloaded and goes down (interview #12, Health & Medical Sciences, 4th year).

A lot of faculty members do not know how to use the university's distance learning system, so they either ignore it or use its most basic functions.

> Some <instructors> make active use of this website as they find it easier this way. Others have never used it, not even once—they would just email us assignments in PDF or Word formats, and that was it (interview #17, Engineering & Technology, 2nd year).

3.4. "That'll Do, They'll Give me Credits Anyway": Learning Practical Skills During Lockdown

Students in Applied Sciences consider practical training an indispensable part of becoming a professional. According to the interview data, practice constitutes a major part of the learning process.

> Practice-oriented learning is everything in medicine. You can read every book in the world, but if you have a poor imagination, there is no way you can visualize it <...> You have to watch someone else performing a surgical procedure a few times before you do it yourself (interview #11, Health & Medical Sciences, 6th year).

Students do not think of distance learning as effective. The key problems with this format are the lack of access to laboratories and workshops, the impossibility of hands-on skill practice sessions, and the absence of direct interactions with the instructor.

> It helps a lot when the instructor comes and does a bit of your work. Some tiny grapelet in your still life, but she'll do it and show you what it is exactly that she means. Sometimes words are useless because you just can't get what she's talking about, and she can't get what exactly you're not getting, so the whole communication is a failure (interview #5, Arts & Culture, 5th year).

Changes in the format of practical training affected its content, making it more generalized and theory-oriented.

> We could see, me and my peers, <...> we learned nearly nothing, as compared to in-person classes <...> basically, we discussed the same things day after day, some no-brainer stuff. Meanwhile, in face-to-face training, we would dwell on specific subtle aspects, and we knew why we were doing what we were doing <...> We could all see that we would have learned more from training offline (interview #26, Health & Medical Sciences, 5th year).

The new format of practical training also had a negative effect on the motivation of students, who reported feeling less engaged in learning.

> There was less practice, less engagement, less commitment… I think it was due to inconvenience. Conducting via video conference is inconvenient, you need a concertmaster for this <…> So, I considered it ineffective <…> and I would think, "That'll do, they'll give me credits anyway" (interview #10, Arts & Culture, 4th year).

Some students believe that their practical skills remained unchanged during the period of distance learning, while others report a degradation. First-year students had not mastered practical skills to a sufficient degree when the pandemic broke out, so their losses were not too great. Meanwhile, senior students had already practiced a number of their skills long enough to reach a level of automatic action—and yet they were concerned about possible negative effects of distance learning on their future careers in the relevant field of study.

> Yes, you may know how to recognize a pathologic condition, but people are all different, and so are their conditions, so you need to see it with your eyes at least once <…> In this sense, it was hard for me. We were about to graduate, and yet we'd never even set eye on a kid (interview #30, Health & Medical Sciences, 6th year).

3.5. "We're Just Sitting There and Reading": Theses, Term Papers, and Work Placement Internships

Students who had embarked on their theses and were not anymore in need of the institutional or corporate infrastructure were happy to work from home and contact their academic supervisors remotely. Moreover, one engineering student said he had saved on printing out the different versions of drawings upon every review by his supervisor, as sending them by email did not involve any expenses. At the same time, it was inconvenient to demonstrate works from a distance, as instructors had not got used to the new technology yet. Art school students found it especially challenging: it was not always possible for them to take the degree paintings home because of their size or the prohibition against taking them out of the university building. For such students, working on degree projects was suspended for the whole period of mandatory self-isolation.

> I am one of the few students who were able to take their project home and keep working on it. But all the others had no such opportunity, I just had a big luck with the owners of my piece, and the faculty supervised me all the time (interview #8, Arts & Culture, 4th year).

Work placement internships scheduled for the spring semester were also affected. Some of them were cancelled, others were postponed until fall, and yet others were carried out in the format of self-study, where students filled out their journals but never visited manufacturing facilities or engaged in any actual work.

> We should be doing our first work placements right now <…> We should have been employed in plants for a month to practice on fa-

cilities, each on their own. <...> and now, we're doing it in a distance format. They've just sent us assignments, like a term paper, and we're sitting there and reading (interview #16, Engineering & Technology, 3rd year).

Students wait to return to laboratories and workshops. Some medical students have a chance to practice their skills during summer internships, while others try to integrate hands-on practice as on-the-job training. Art school and engineering students say that they are going to spend a large portion of their time in the upcoming academic year on catching up on the practice they missed.

Before the lockdown was announced, we had enough time <...> to submit our projects by the end of the fourth year and take on new ones for the next academic year. But now the upcoming year will be spent on finishing the work from the previous year, and we won't be assigned any new projects (interview #6, Arts & Culture, 4th year).

Due to the impossibility of organizing practical classes, skill assessment was excluded from degree exams.

They had nothing—<the degree show was> cancelled. All they did was writing a thesis (interview #10, Arts & Culture, 4th year).

4. Lessons from the Pandemic

Rapid digitalization in education and professional activities engenders solutions that optimize and expand human capabilities. However, even with virtual labs, training simulators, and a broad array of online learning opportunities, a number of degrees turned out to have not enough digital learning technology tools to complete the academic year amidst the pandemic. In this study, problems faced by higher education institutions preparing doctors, engineers, musicians, and artists during the lockdown are analyzed through the prism of student experiences before, during, and after the COVID-19 pandemic.

Pre-pandemic, the use of digital technology in Applied Sciences degrees in nonselective Russian universities was kept to a minimum. Practical skills were normally trained at university laboratories or in real-life conditions. Distance learning systems were available, but they were not used in classroom-based learning; in isolated cases, they served as a digital repository of learning materials and as a platform for testing. These inferences about the pre-pandemic system of digital learning technology are consistent with the findings obtained from interviews with faculty members [Abramov et al. 2020].

Immediately following the emergency transition to distance learning, instructors used messaging apps and email as familiar means of communication. Later on, they added videoconferencing services to their repertoire, Zoom and Mirapolis in the first place—but they only

used the very basic function of direct video calls. Replacing in-person lectures with video conferences requires very few changes to the lesson plan, unlike with other digital learning formats, and yet even videoconferencing was not available to all students, the reason being low faculty access to information and technology. Similar results have been achieved in other studies [Aleshkovsky et al. 2020, Levanov, Perevezentsev, Gavrilova 2020]. The interviews conducted with students allow suggesting that, provided there is strong Internet connection, students are far more enthusiastic about synchronous forms of learning than instructors, who find the format uncomfortable.

The data collected demonstrates the prevalence of summative over formative assessment. Isolated cases of using formative assessment were infallibly welcomed by students and strengthened the instructor's authority in their eyes. A lot of faculty members struggled to organize and plan students' independent work during the period of self-isolation. For them, student workload in a course was still synonymous to classroom hours, not the amount of time required for students to perform all the actions necessary to complete the course. Students need help with organizing their self-study activities, as they are used to external regulation—particularly the one mediated by the schedule—and face difficulties with self-management [Gruzdev, Kamaldinova, Kalinin 2020].

The problem of professional skills formation is not solved by substituting empirical data analysis, relevant paperwork, and demonstration of video-recorded procedures for actual practical training. Of all Applied Sciences majors analyzed in this study, medical and art school programs have suffered the most from the transition to distance learning, while engineering degrees associated with calculations and computer modelling have been affected somewhat less. The impossibility to develop and train practical skills had a direct consequence of practical modules being removed from the midterm and end-of-term examinations, and sometimes of classes being postponed until the next semester. However, students themselves did not consider the damage incurred during the spring lockdown irreparable, provided that they would be able to resume their studies and work as normal in the fall semester.

Because the lockdown was extended, students failed to catch up on what they had missed in the spring semester, and the 2020 graduates lost this opportunity for good. Given this, it became imperative for new studies to find out how the second wave of the coronavirus and lockdown measures changed students' perceptions of the learning environment imposed by the pandemic as well as of universities' efforts in restructuring the learning process.

Current expert predictions concerning the COVID-19 pandemic blatantly contradict the interviewees' assumption that the university, the learning process, and their professional activities on which they have already embarked with varying degrees of intensity will come back to

normal almost unaffected as soon as the pandemic is over as well as their desire for events to follow this scenario.

The widely discussed opinion that a sharp increase in the share of distance learning in education will become the new normal does not resonate with the interview participants. Applied Sciences students and their instructors unanimously agree that only soft-skill courses can be moved online, while practical skills can only be developed in face-to-face interactions [Zakharova, Vilkova 2020]. This point of view may stem from the lack of quality alternatives to in-person instruction in the market of digital learning technology, low proficiency of all players—students, faculty, and administrators—in applying the existing solutions, and the ongoing professionalization of higher education, which results in humanities and social sciences being perceived as less important and thus easily optimizable. A promising area of research would be a more detailed analysis of the grounds for skepticism about distance learning on the part of Applied Sciences students and their instructors.

Judging by the interview results, it is not distance learning but emergency remote teaching that was implemented in all the universities from which participants were sampled, with extremely rare exceptions that apparently stayed within specific departments or even activities of specific faculty members. For this reason, the assessments and comparisons presented in this article should not be applied to distance learning as such. Universities have been able to find more or less successful ways of completing the academic year, but this is not enough to ensure a fully-fledged training in Applied Sciences. Obviously, the problems are not restricted to poor technological infrastructure or low faculty preparedness. Apart from this, the repertoire of "classical" distance learning simply lacks the necessary tools. During the period of remote learning, Applied Sciences were taught in just the same way as theoretical disciplines, with no allowances made for their peculiarities.

This study has some methodological limitations, which at the same time represent promising areas for further research. First, the interviews paid little attention to specific types of hardware and apps that students used for communication. Such information would be useful for assessing the differences in learning process organization depending on the devices available to students. Second, the qualitative methodology of research allowed only description of the process of transitioning to distance learning. Reliable inferences require quantitative data, including digital footprints of all the participants in the learning process.

Appendix Table 1. **Characteristics of interviewees**

Inter-view #	University specialization	Field of study	Year of study	Age (years)	Sex
1	Technical	Engineering & Technology	2	19	Male
2	Technical	Engineering & Technology	2	20	Male
3	Technical	Engineering & Technology	2	19	Male
4	Humanities	Arts & Culture	3	21	Female
5	Humanities	Arts & Culture	5	22	Female
6	Humanities	Arts & Culture	4	26	Female
7	Humanities	Arts & Culture	4	21	Female
8	Humanities	Arts & Culture	4	22	Female
9	Humanities	Arts & Culture	2	22	Female
10	Humanities	Arts & Culture	4	23	Female
11	Medical	Health & Medical Sciences	6	25	Female
12	Medical	Health & Medical Sciences	4	21	Male
13	Humanities	Arts & Culture	3	23	Female
14	Humanities	Arts & Culture	1	21	Female
15	Technical	Engineering & Technology	2	19	Male
16	Technical	Engineering & Technology	3	20	Male
17	Technical	Engineering & Technology	2	19	Male
18	Technical	Engineering & Technology	4	22	Female
19	Technical	Engineering & Technology	3	20	Male
20	Technical	Engineering & Technology	4	22	Male
21	Technical	Engineering & Technology	1	18	Male
22	Medical	Health & Medical Sciences	5	22	Female
23	Medical	Health & Medical Sciences	1	19	Male
24	Medical	Health & Medical Sciences	4	22	Male
25	Medical	Health & Medical Sciences	3	23	Female
26	Medical	Health & Medical Sciences	5	25	Male
27	Medical	Health & Medical Sciences	5	22	Female
28	Medical	Health & Medical Sciences	4	22	Male
29	Medical	Health & Medical Sciences	2	20	Female
30	Medical	Health & Medical Sciences	6	24	Female

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