Digitalization and Education
in the Context of COVID-19

https://doi.org/10.53656/ped2022-3s.01

DIGITAL TRANSFORMATION CATALYZED BY COVID-19 PANDEMIC: CHALLENGES AND SOLUTIONS

Prof. Dr. Eliza Stefanova
Sofia University "St. Kliment Ohridski" (Bulgaria)

Abstract. The article presents a case study of digital transformation at Sofia University "St. Kliment Ohridski", Bulgaria, catalyzed by COVID-19 pandemic. First, it summarizes challenges related to education and research, administrative processes, regulations, and culture from different perspectives – management of the university, professors and students. Next, the paper presents solutions, implemented as the answers of the challenges in order for transformation to happen in technological and non-technological directions. In the discussion section, we discuss the choices made to realize the digital transformation at Sofia University and the reasons behind them. In the final part of the paper, we conclude summarizing the main point of our case study and present expectations and perspectives for the future.

Keywords: digital transformation; COVID-19 higher education challenges; university education technological solutions

Introduction

In the past two years many publications (Liebowitz 2020; Gaudiot & Kasahara 2020; Strawn 2021) deal with questions related to the COVID-19 pandemic effects on the daily work of the people in different fields. The education is one of the areas, which tried to adapt as fast as possible to this newly developed way of living. Everywhere around the globe, society as a whole has become aware of how teachers and university professors perform their job, because the online education has entered almost every home. How this has become possible and what has been needed to happen behind the scenes in order for this to be possible is not clear even for the participants in the education process and those involved involuntarily – the students, their parents, teachers, professors. In order to organize the process many activities have to be performed at the management, administrative and technical level. This article presents the main challenges and actions taken from that point of view in the case of Sofia University "St. Kliment Ohridski".

Challenges for education process and research

Everybody has faced challenges during the pandemic – institutions and people. We are discussing some of them, related to the functioning of Sofia University "St. Kliment Ohridski" as a higher education institution.

With respect to main university functions, the management of the university first has had the task to face the challenges related to educational process and research.

Before the COVID-19 pandemic, Learning Course and Management Systems (LCMS) were available in advance, but not systematically used. Some of the faculties as Faculty of mathematics and informatics were already using LCMS Moodle1) introduced in courses since 2004. The platform has been installed for the whole university2) since 2007. At some other faculties as Faculty of Pedagogy, Faculty of Philosophy and Faculty of Classical and Modern Philology some of the professors also used it to support their students with materials in e-environment. Since 2010, LCMS Moodle has been used more actively. Thanks to several projects in the period between 2010 and 2015 dedicated do development of distance learning courses, materials and programs, university professors were trained how to use Moodle. It is important to note that this was not a massive practice for the academic community in general.

After the start of the pandemic, due to the missing functionality for interactive live lecturing in Moodle, the already existing solution Big Blue Button was installed as an additional module in all existing Moodle platforms (both of Faculty of Mathematics and Informatics and that of the University). That was required, because as university management we were aware that for the education process to be successful we needed a tool for synchronous communication which could support online teaching.

We were aware of the limits with regard to the speed of the links of the network, as well as the fact that the available data storage was not enough to cover the needs of the whole University (with 16 faculties, more than 1500 academic staff, more than 20 000 students, and continue development students – more than 10 000 last year before pandemic). In addition, for some classes (e.g. at Faculty of Law) specialized databases were installed at computer laboratories. The access to them is allowed just from the intranet of the University, without remote access to them. The same was applied to the access to the research databases.

In addition to all these mainly technical challenges, there were also other – related to them, but non-technical.

First, one of them was the necessity for a 24-hour support not only for equipment, but also for Help desk supporting people, answering different questions, related, in most of the cases, to the functionalities of LCMS. Until that point, we did not have such a group of people, who were able to cover this task.

From someone's point of view these challenges – technical capacity, network limits, supporting staff – could be easily solvable, e.g. through hiring cloud service from a big company. Here we faced other restrictions: finances and time. As public

organization, Sofia University is obliged to follow the Law of Public Procurement, which requires time, that we did not have. In addition, we did not have a planned budget for such expenses.

Challenges related to the administrative processes

A second group of challenges is related to technologies used for administrative processes supporting university functioning. Before COVID-19 pandemic times, some services that could help in administrative processes were available, but not widely used.

One such examples is the payment of student fees. The usual practice before the pandemic was the students to pay their fees at pay desks at the university and immediately after that visiting in person inspectors to enroll for their study for the next semester. More than 3/4 of the fees were paid in this way. However, with the start of COVID-19 pandemic it became important to not have such a large group of students paying taxes at pay desks. It was necessary to reorganize the whole process which involved mainly students and administrators.

Another process, which could not be performed as usual during the COVID-19, was the process of presenting protocols with students' grades after exams. Regular practice until the start of the pandemic was university professors to fill the grades in a hard copy of the protocols, to sign them and present them to the administrative office. With the start of the COVID-19, it was recommended to reduce the use of paper and meeting of people at one place as much as possible. That is why the electronic signature started to be used as an answer to that challenge. The University Center for Information and Communication Technologies had issued digital signature for staff at the University even before the start of the pandemic, but only a small number of people had been using it.

Reducing the live contacts and the use of paper was important also for the documents' workflow at the University. An inner Document Management System (DMS) was used at the University. However, the usual practice was everybody to present their documents on paper in person at the desk at the University. Then the document was registered by an administrator. Next, the document on paper was passed through the administrative channels. Finally, the decision was presented again on paper to the initiator. The system allows the initiator to follow electronically the document, but that service was used rarely.

As many other countries, in the last two years, Bulgaria was in lockdowns several times, some of them very strict. During these lockdowns, distance work was strictly recommended. Although some challenges existed in organizing education processes online, it was clearer as conception and as application. It was necessary to find a solution for the successful integration of distance work processes with distance education services. The electronic desks were not available until that moment, but COVID-19 provoke us to introduce them.

The academic procedures were also paper-based and were affected also by the pandemic. The university management was forced to find a digital solution.

Challenges regarding regulations, knowledge, skills and culture

At university level, many information technologies were available, but regulations for their use were not. One such example mentioned already was linked to the protocols with the exam grades of the students which had to be signed on paper, although the University Center for Information and Communication Technologies could issue an electronic signature for everyone from the academic staff under request. National legislation states that both signatures are equivalent, but there was no internal regulation of the possibility to use digital signature to sign electronically internal university documents. COVID-19 forced us to fill that gap very fast, allowing the use of electronically signed documents including grade protocols.

Nevertheless, even when technologies and regulations were available, other three big challenges had to be overcome since they could stop any transformation. These three challenges – knowledge, skills and culture – are related to the most important factor for each transformation – people.

From university managers' point of view, we had observed a lack of knowledge of information technologies, which was a challenge for introducing very fast some of the proposed technical solutions as answers of the challenges faced. One such example is how electronic signature can be used.

Lack of skills for applying IT in specific contexts and rapid acquisition of new, unused so far technologies were even more critical challenges to overcome. in the beginning, a large number of the administrative staff was scared that they need to use new for them information technologies. Students were ready to accept mainly technologies known to them. University professors fell in three groups: experts, people who knew that they needed to find a way to use new technologies (some of them with good skills in the use of new technologies, others – just beginners), and people who tried to avoid the use of new technologies.

Finally, yet importantly, the lack of culture for electronic communication was also a big challenge. That was obvious in most of the cases of such a communication between students and administrative staff, but it happened also in some cases with academic staff.

Challenges from professors, students and staff perspective

Previously mentioned challenges are mainly from the university management point of view. All the professors, students and staff have also had to face their own specific challenges. For some of them they have expected solutions to be provided from the university management. For example, the technological tools proposed to be used in the education process were unknown or unintuitive to some of them and

because of that there have been professors and students who prefer the University to propose to them tools which they know or see as intuitive, despite the fact that they have been not feasible in terms of budget and tender necessity.

Solutions for educational process and research

Complex situations require complex solutions. In order to answer the above-mentioned challenges as fast as possible, we have chosen a hybrid solution for an E-Learning Management System based on environment in which the educational process could continue in an online distance format at Sofia University.

First, we started using the available E-Learning Course Management System Moodle. To provide possibilities for synchronized communication, we added the virtual classroom modules Big Blue Button (BBB) and Jitsi. In addition, experts from the University Center for Information and Communication Technologies has integrated the E-LCMS with the Students' Information Management System SUSI, which keeps records of students, curriculums, lecturers, etc. An advantage of this solution has been that it takes into account the necessity for personal data protection.

Next, based on the information available in the SUSI system, we have generated all the courses for the online platform Moodle and enrolled all lecturers and students. Figure 1 shows the total number of online courses for the sixteen University faculties available per 2020/2021 year in the university e-learning course management system.

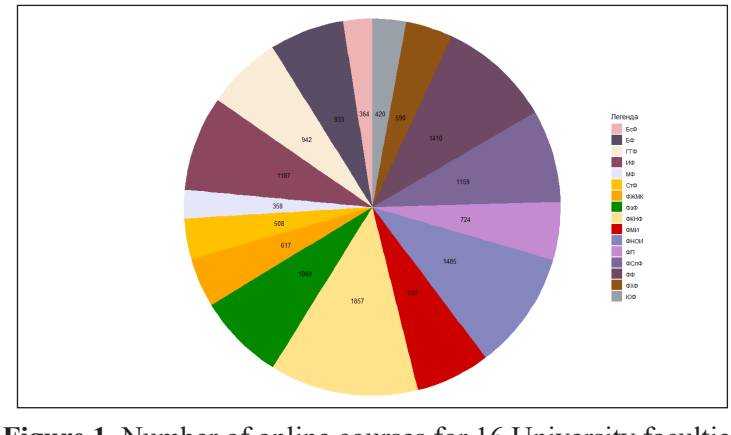

Figure 1. Number of online courses for 16 University faculties in Moodle per 2020/2021 year

In addition, all university professors and students were granted access to the MS Teams system, available for the University also in advance. Their accounts in

MS Teams were generated automatically on the base of the information from the information management system SUSI.

Access to MS Teams was important because we used not paid version of BBB with limitation of 100 participants in one online class, while MS Teams allows up to 250 participants in one online class. Other alternative we used was Google Classroom, where online lectures are possible for 120-140 students. Unfortunately, these limits made online lectures not possible at some faculties, e.g. Faculty of Law, where the number of students in some classes reaches 400. For such big classes we had to start using the Zoom webinar system as virtual classroom environment since it allows up to 1500 active participants.

The MS Teams and Zoom webinars have also been used for organizing conferences and other scholarly events at Sofia University.

In order to access the research database JSTOR the gateway jstor.uni-sofia.bg was configured to allow users from the University to identify themselves with their university accounts.

Although lectures were online, many of the lecturers preferred to deliver their classes from University lecture rooms. There, they have had at their disposal advanced computer equipment – cameras, graphical tablets, laptops, etc., bought at some faculties once the COVID-19 pandemic started. In addition, there has been a very good local and global network connectivity at the University. In order to provide even better internet connectivity, we have upgraded links at three of the main campuses of the University up to 10 Gb/s speed.

In addition, we have upgraded the data storage and organized BBB cluster with 7 nodes for data load balancing. That has become possible on the basis of the combination of university resources with additional equipment bought by funds provided by certain research projects (in the case of BBB cluster – projects Nasledstvo.BG and ICT for SES). As Figure 2 and Figure 3 show, thanks to these additional resources, there is enough network capacity.

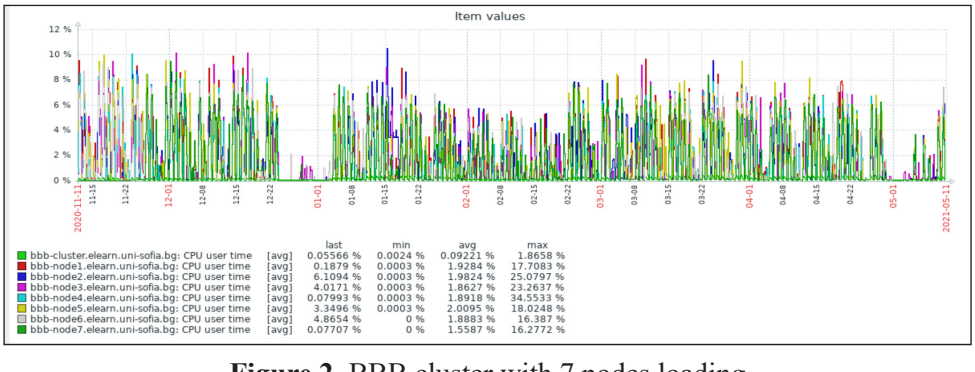

Figure 2. BBB cluster with 7 nodes loading

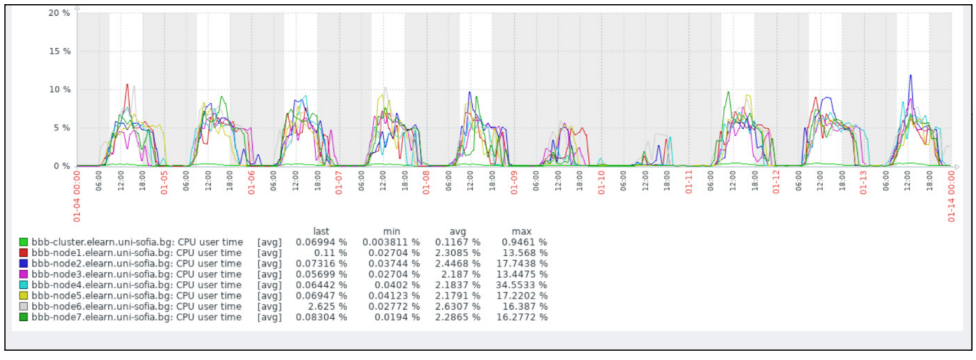

Figure 3. Daily BBB loading

However, that does not mean that resources are free.

Figure 4 shows loading in terms of number of classes and number of users at each of the nodes in one of the least busy days – a day between two holidays.

HOSTNAME	MEETINGS	USERS	LARGEST MEETING	VIDEOS
bbb-node1.elearn.uni-sofia.bg	12	23	5	0
bbb-node2.elearn.uni-sofia.bg	14	50	12	1
bbb-node3.elearn.uni-sofia.bg	10	59	25	2
bbb-node4.elearn.uni-sofia.bg	11	60	22	7
bbb-node5.elearn.uni-sofia.bg	15	67	22	2
bbb-node6.elearn.uni-sofia.bg	14	66	15	1
bbb-node7.elearn.uni-sofia.bg	14	46	13	2

Figure 4. BBB loading by nodes in the least busy day

The involvement of users in different activities and the use of resources depend on the period in the year and on other factors related to the educational process. Some of them are predictable, as New Year holidays being the least busy days, which is visible in Figure 5. Even at such periods, the total number of performed daily activities by all roles in the LCMS is big enough. Other days, such as the ones at the end of the semester, are the most busy days, with five times bigger number of involvements and respectively, resource requiring periods.

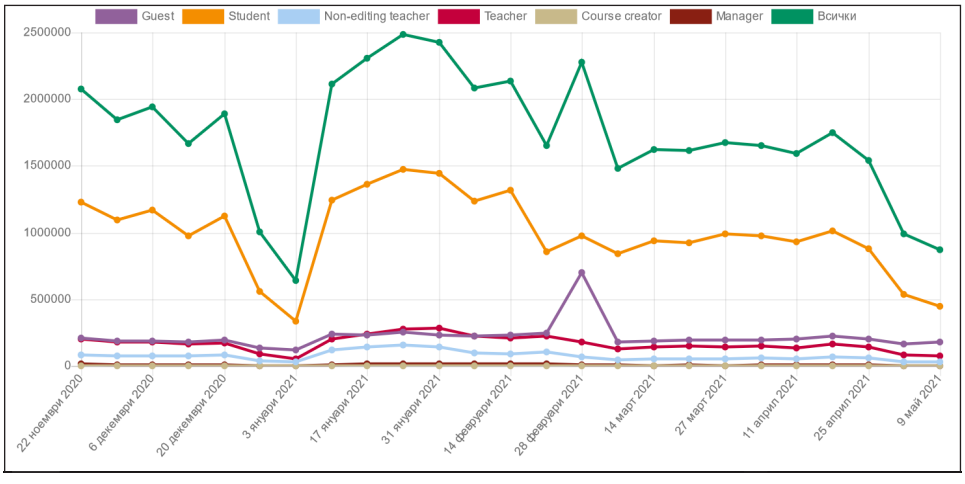

Figure 5. Involvement of students and professors – all activities and all roles

In order to support such a big number of users we have had to organize work at two levels: University and Faculty level. The administrators and more experienced users at different faculties supported university professors for frequently asked questions and needed help. More complicated and difficult to solve questions and cases were directed to the experts at the University Center for Information and Communication Technologies.

Solutions regarding the regulations

Sofia University has adopted many new regulations needed due to pandemic changes.

One month after start of the COVID-19 pandemic, the Rector issued an order that all type of documents should be signed by a digital signature. This regulation included also the electronic signing of protocols with exam grades.

Two months later, electronic submission of all documents for academic procedure was regulated with the rules adopted by the Academic Council.

The meetings of the Department Councils, Faculty Councils, Academic Council, Faculty and University General Assemblies were held online via Moodle and BBB or via MS Teams.

Just before the start of 2020/2021 academic year, the Academic Council approved the University Quality Standard for Development and Delivery of Blended Learning mainly because of the COVID-19 pressure.

PhD students' defenses and Academic Staff procedures have exclusively been carried out online via MS Teams and Zoom, enabling both internal and external users to join freely.

The admission exams of PhD students have been organized online on the Moodle platform via BBB after registration of all PhD candidates in the systems.

In addition, special environment for the continuous professional development courses has been installed in order to be able to organized them online. The decision to install a separate branch of the LCMS at [3] has been dictated by security reasons.

Solutions for technologies for administrative processes

COVID-19 pandemic has stimulated students to pay their fees electronically. The highest percentage of paid students' fees before the pandemic was 19.55%. When payment at the cash desks at the universities was not allowed during the pandemic, that percentage became 68.43 %.

Three weeks after the COVID-19 measures were introduced in Bulgaria, changes in the documents management system were also applied. The electronic flow of all the documents was arranged by making a new configuration at the document management system. In addition, we created special email address for the submission of electronic documents[4]**.** With Rector's order a new rule was introduced to processes all documents entirely in an electronic form.

In order to prepare duly signed electronic documents, which are required by academic and administrative staff and students, the University Center for Information and Communication Technologies issued very fast digital certificates to almost all 1600 university professors, 1000 PhD students and about 400 administrative staff. This took less than a month after approving the regulation for accepting documents with an electronic signature.

A new service was provided in order to make possible the online communication with the university administration – electronic desks serviced by the central and faculty administration. We organized them via Moodle and separate BBB sessions for each administrative division. The Vice-Rector for Information Activities and Academic Staff, as well as the Vice-Rector for Administration also opened their own online desks to lead the change.

The transformation of academic procedures was first done through regulations approved by the Academic Council and then was technically started. It has also been realized via Moodle.

Solutions concerning the knowledge, skills and culture

Immediately after COVID-19 restrictions in the country were announced, the Vice-Rector of Information Activities and Academic Staff initiated and organized a series of webinars for developing new knowledge and skills and upskilling the staff of Sofia University. In the period from the end of March till June 2020 more than 18 webinars of two-to-three-hour duration on different topics were organized. More experienced university professor and information technologies (IT) staff taught other university professors how to use learning management systems,

how to manage their courses, how to conduct online testing (including use of safe exam browser), how to use virtual classrooms, MS Teams, etc. IT professionals led also the webinars for administrative staff. The goal was to introduce the novelties in the use of digital technologies in the daily work at the University. Finally, day by day the use of electronic communications has made it possible to change the work culture through action.

In order to help both students and university professors with additional materials Sofia University became a partner in Coursera for campus initiative. All the courses provided there were available till November 2020 to the academic community of the university.

Discussion

As you could see, many of the solutions are based on Moodle functionalities. It is a natural choice because:

– The system has been ready to use and did not require any additional development. When the COVID-19 pandemic started, only already available solutions could be applied, because there was no time for the development of new solutions.

– It provides the needed functionalities provided you know how to model and use it for different purposes.

– The integration with other university systems has been vital in order to be able to follow GDPR rules as well.

– All users (professors, students, administrations) are registered. They could use their existing accounts to work with the system.

– Due to other activities, they had already been acquainted with the system functionalities. As a consequence, there was no need for additional education and training especially for different systems.

– We had already had the expertise needed for administration and support of the system.

For the education purposes, the Moodle is the entrance point. When we generate all the courses in Moodle based on students' curricula, and enroll students and lecturers using the database of the Information Management System, each student and professor know where to find their classes. Next, university professors could organize their learning materials and activities, including the creation of links to the online classes in BBB, Jitsi, MS Teams, Zoom or other preferred available online virtual classroom tools.

Conclusion

The most difficult part of the digital transformation is the transformation of the peoples' minds – to overcome the resistance to change, to new processes, to novel technologies introduced. As it is obvious now, many technologies were available

at Sofia University, installed and provided, even before the start of the pandemic, but a small number of people were able and ready to use them. The COVID-19 pandemic has been the key that opened the eyes and the minds of people to see the available technologies as useful new possibilities at their daily work at the University.

The massive use of many digital technologies during COVID-19 pandemic has shown that software engineers need to work harder in order to make some of the tools more convenient and more suitable to the end-users' tasks.

Sofia University management team hopes that the digital transformation at our institution that has happened during the COVID-19 will continue, at least for the most of the processes, regulations and tools introduced. We have been slightly concerned that academic staff and students could come to hate some of the introduced rules and technologies because of the pandemic linkage, associating them with difficult, compulsory, unpleasant times. But we believe that all the new elements introduced that have made people's work more efficient, effective and easy, will definitely remain to in use. Several surveys give us such confidence: two of them done in the middle of 2020 by the University Center for Distance Education – one with more than 1100 students, second with 379 university professors, and one done with academic staff in the middle of 2021 year by University Center for Quality Management. The results from the first two surveys show that regardless of the fact that all professors have had to adapt very quickly to the changes, most of them have succeeded to transform their teaching – not in all cases and not everyone in the best possible way, but the digital transformation has not only started and but continues as of now. In addition, the third survey shows that more than 70% of 195 respondents answer they will continue to use electronic services made available during the COVID-19 pandemic. Because of that we could look at the digital transformation that has happened at Sofia University as an irreversible process.

NOTES

1. https://learn.fmi.uni-sofia.bg
2. https://elearn.uni-sofia.bg
3. Installation of a separate branch of LCMS at https://sdk.uni-sofia.bg
4. Email address for the submission of electronic documents: delovodstvo@uni-sofia.bg.

REFERENCES

GAUDIOT, J.-L. & KASAHARA, H., 2020. Computer Education in the Age of COVID-19. *IEEE Computer*, **53**(10), 114 – 118.

LIEBOWITZ, J., 2020. Life as a Professor Amid COVID-19. *IEEE Computer*, **53**(12), 126 – 128.
STRAWN, G., 2021. Pandemics, Public Education, and the Future. *IEEE Computer,* **54**(2), 63 – 65.

✉ **Prof. Dr. Eliza Stefanova**
ORCID ID: 0000-0002-9697-2028
Scopus ID: 7004567025
Web of Science ID: AAL-5081-2021
Faculty of Mathematics and Informatics
Sofia University "St. Kliment Ohridski"
Sofia, Bulgaria
E-mail: eliza@fmi.uni-sofia.bg