Transforming Higher Education Learning Ecosystem: Teachers' Perspective

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Abstract. As a result of the COVID-19 crisis, organizing, designing and delivering learning programs in higher educational institutions needed to be revised and transferred to the digital world without destroying the overall cohesion and balance of the educational ecosystem. We present a case study of transformation challenges of the institution during COVID-19 from the perspective of teaching staff. The results of a survey indicate, that the learning ecosystem was able to respond to the sudden external disturbances as it had the basic conditions fulfilled. However, the transformation represents rather a first-order change, being an online extension of previous everyday practices and not bringing forth deep changes in ways of learning and teaching. As a result, the institution's management needs to invest in additional infrastructure as well as in educational technologists who would support the teaching staff to systematically widen their pedagogical repertoire and raise their digital competencies to the next level.

Keywords: COVID-19, digital transformation, learning ecosystem, higher education, ecosystem responsiveness

1 Introduction

Due to the COVID-19 situation higher education institutions found themselves in the middle of unexpected and unprecedented challenges. Traditional ways of organizing, designing and delivering learning programs needed to be revised and transferred to the digital world without destroying overall cohesion and balance of the educational system. Usually change in higher education institutions occurs over time altering inter- and intra-individual processes and strategies. This sudden situation, however, called for higher education institutions to mobilize all its parts to jointly deal with the external interruption, build new capabilities and invest in those capabilities that had not been essential before, revise and adjust their regulations, rules and strategies as

well as try to transform the overall mindset of people. Being thrown in the middle of an unknown landscape and rupturing the usual functioning of the educational organization, now the question is to what extent were higher education institutions as complex learning ecosystems able to transform, what was transformed and what can be taken from this experience to future endeavors.

The general aim of the study presented in this paper is to understand the responsiveness of one higher education institution in Estonia as a learning ecosystem to transform and adjust its parts and processes to the unpredictable circumstances coming from outside the system. In particular, although a well-functioning learning ecosystem comprises different actors, we will focus on the teaching staff whose responsiveness defines the success of the educational institution as a higher education provider. The research question is as follows: How responsive was the higher education institution to the sudden external disturbance from the perspective of teaching staff and what were the bottlenecks the teaching staff experienced that impeded the learning ecosystem to transform?

2 Theoretical Background

2.1 Learning Ecosystems

An ecosystem metaphor for explaining dynamic human interactions between people and their environment, relationships, resources and occurring processes has been widely used and applied in education. It has been often implemented as an analytical framework to describe the dynamics of interaction of actors, components and the whole system [1,2].

Similarly to Jeladze, Pata & Quaicoe [3], Ficheman & Lopes [4], Sarnok, Wannapiroon, & Nilsook [5] and many others, we base our understanding of a Learning Ecosystem on nature ecosystems consisting of species, populations and communities interacting with each other and with the environment. We conceptualize a higher education institution as a gradually evolving and responsive learning ecosystem, which constantly adapts and self-regulates itself according to internal and external interruptions and needs. This socio-technical system consists of mutually interacting
- tools, services, digital resources, curricula, policy
- co-existing communities of users such as learners, experts, teachers, management
- social, economical and cultural environment with various rules, affordances and constraints, principles, dynamics and flows.

The overall learning ecosystem forms the sum of its interconnected parts, which have to co-exist without destroying overall cohesion and balance of the system. It also consists of interdependent processes, within which relationships are developed and enacted [6]. Learning ecosystems have to constantly deal with disturbances from inside and outside and respond to both internal and external changes. The balance of an ecosystem is impacted when one or more components become dominant, radically modify, disappear, or a new component is introduced. Being interconnected, the way in which various actors perform and adapt can contribute to or hinder the success of

learning ecosystem's operation. In order to keep the balance and efficient performance of the organisation, the system has to be agile, responsive and resilient. Taking the ecological perspective provides us with tools to analyse and interpret behavior of single actors as well as the entire complex higher education system, its interactions and interdependence during external disturbances.

2.2 Responsiveness of Learning Ecosystems and Its Actors

The need to distance people from each other caused by the COVID-19 situation required all educational institutions to quickly find digital technological solutions to keep educational systems operational. Digital technology has been considered as a powerful driver of transformations and change in education [7]. Making use of technologies causes disturbances to the educational system, challenges its structures and rules, and constantly redefines available opportunities [8]. Digital transformation may create chaos and breakdowns as a system in which technology is extensively implemented may or may not be supportive of beneficial technology integration [9]. However, digital technology itself does not trigger instant direct change, rather, it may facilitate and amplify educational practices, accelerate cultural change [10]. In addition to new technological solutions, digital transformation is also about a shift in attitudes and behaviors, it should incorporate fundamental and complex changes that exceed existing paradigms and need new knowledge and skills, and new ways of thinking and acting [11]. In this case we can talk about second-order change, while transformation, that touches only the surface and existing practices of the educational system not bringing forth deep changes in practices of learning and teaching, is referred as a first-order change [11]. To take advantage of technologies, digital innovation requires restructuring systems and transforming their practices [8,1].

For describing the ecosystem's and its actors' ability to transform we utilize the concept of system responsiveness. It entails organisation's ability to identify interruption and capacity to change its underlying processes to recognize changes coming from outside the system [12] and to respond to the disturbances by mitigating negative threats or capitalizing on positive opportunities generated by the environment [13]. To be able to deal with the interruptions, the system, especially its key actors, have to meet some basic conditions that allow being responsive. Responsiveness depends on the system's and its actors' agility as one of the most important factors governing an organization's potential success in digital transformation.

In educational institutions the key actors and critical change agents of the learning ecosystem are teachers [14], who define the success of change, system's agility, responsiveness and resilience by adapting their behavior according to the outside needs and requirements. Bringing in digital technology is one of the prominent disturbances of the system, which has a potential to influence actors' behaviors and mindset. Referring back to Marzano et al. [11], the level of system responsiveness to the extensive digitization depends on its key actors' digital competencies, their attitudes towards technology and changed digital practices. Especially actor's digital competencies such as teaching staff's collaboration with colleagues and inside organisation communication, selection, creation and modification of materials as well

as sharing them with others, skills and knowledge to select methods and tools for teaching, collaborative learning and student guidance, planning and giving feedback based on the analysis of available evidence and differentiate and personalise learning are essential competencies defined by the European Framework for the digital competence of educators (DigCompEdu) [15]. In addition, focusing particularly on digital transformation, responsiveness is also influenced by the system's infrastructure, available tools and services as well as agile management support and decisions. Comprising a set of aforementioned challenging aspects, digital transformation is a comprehensive and time-consuming process, which takes place step-by-step depending on the available resources and knowledge and the actors' ability to adapt to the situation and develop new knowledge and skills. How quickly and efficiently the system's key actors are able to mobilise their resources and knowledge under sudden and unexpected conditions defines the system's responsiveness.

We embrace Jeladze et al. [16] cycle of disturbance, in which new technology disrupts the learning ecosystem functioning and balance. Teaching staff being the major mediators of change, acknowledge the interruption and begin to change their behavior to match the disordered situation, often as a bottom-up approach in the system. As a result the ecosystem begins actuating itself (processes, tools, etc.) to meet the requirements i.e. demonstrating the ecosystem's ability to take control [16] and direct the system to a balanced state. Therefore, the aim of the learning ecosystem is to go through the developmental phases, reach again the stable state of the learning ecosystem in order to be able to adapt and be responsive to future disturbances. In the following sections we'll provide insights of the teaching staff's behavioral and attitude changes in one higher education institution, caused by the sudden and unexpected need to technologically mediate everyday learning and teaching practices.

3   Methods

3.1   Research Context

The higher education institution presented in this article as a case is located in Estonia, in the country where technology-driven innovation has been selected as one of the three main focus areas for smart specialization. ICT horizontally via other sectors has been outlined as the growth priority area with a highest growth potential. Most of the digital public services and private services are largely internet-based. Having stable and fast internet connection is considered as a basic human right. According to Statistics Estonia 90% of households have an internet connection at home, which is used almost daily by 98% of people between the ages of 16-44. This means that citizens are equipped with digital technologies and have at least a basic level of digital competencies. Focus on digital innovation in all sectors on a state level has also influenced higher education institutions. There is a drive from the industry as well as from the government to make education more digital and innovative. The lifelong learning strategy 2020 has provided guidelines for educational institutions to implement a digital turn in terms of digital learning resources, digital infrastructure

for learning, development of digital competencies, changed teaching and learning practices.

We present a case study of the higher education institution whose role in Estonia is to promote a smart lifestyle and digital transformation in society with a key role in innovations in education, thus being itself a leading university and supposedly a model case of educational changes and a role model for other higher education institutions in Estonia and abroad. The higher education institution with humanitarian focus has around 7 000 students and 968 staff members from which 502 are academic staff. The institution provides a set of digital services for teachers: Moodle, Google Classroom and a locally developed eDidaktikum (mainly for teacher training curricula) for supporting learning and teaching activities, study information system for providing an overview of courses and curricula, an option to enroll to courses and apply for scholarships, electronic timetable, etc. Learning and teaching practices have mainly taken place as face-to-face sessions with some support from different technological solutions, however, a few units out of 6 institutes (such as Institute of Digital Technologies, Institute of Educational Sciences) have been providing blended courses. The university has a dedicated e-learning center to support academic staff to integrate technology into their everyday work activities. They organise e-learning related training for the academic staff, provide detailed instructions in the form of video and text of how to use technology for teaching and learning as well as offer personalised consultations whenever needed. Since 2009 the university has also been training educational technologists to support digital transformation in primary and secondary schools.

As a result of the COVID-19 outbreak, face-to-face teaching had to be transferred to the online world overnight and education had to continue remotely from March 14th. The situation lasted till the end of semester in mid June 2020. The teaching staff was asked to adjust and publish course programs within one week and follow the time schedule set in the course timetable if possible. The management of the university announced the e-learning center one week before to be ready to provide fully online courses of the whole university. The e-learning center developed a special webpage with the most important information about the transfer. They also developed a quick guide for online learning, for instance, the first three steps to move to the online world, how to record video lectures, how to create a course in Moodle, etc. The management informed the teaching staff regularly through all available communication channels, such as newsletters, online information sessions, university's intraweb. In addition, the management organised weekly meetings with the university's study heads to guarantee the continuation of regular studies.

3.2 Research Design

The study presented in this paper follows an interpretative case study research design [17] in which an in-depth insight is provided of the university's teaching staff's response to a sudden online teaching period caused by COVID-19 lockdown in Estonia. The university has been chosen due to its role in Estonian education landscape as a leading institution for digital transformation and developing innovative educational solutions on all education levels. The focus on teaching staff is explained

by the fact that they play a key role determining the learning ecosystem's viability and responsiveness i.e. to be operational and be able to provide high quality higher education.

3.3 Data Collection and Analysis

To reflect upon this extraordinary sudden change in teaching a survey was carried out amongst institutions' teaching staff (Professors, Lecturers, etc; later referred to as teaching staff). The survey aimed to measure the teaching staff's experiences, challenges, changes in their teaching practices during the distance learning period. The survey consisted of 5 sections: distance learning experience and environment, working load, organisation of studies, teaching practices, digital competencies. Every section of the survey had both closed and open-ended questions. The survey was developed by the authors requested from the university's management and was based on instruments developed by other universities to explore and map teaching staff's experiences of a higher education institution. The data collection took place at the end of the distance teaching period in May-June 2020.

The quantitative part of the data analysis included descriptive statistical methods (distribution, mean and standard deviation of the items), for the comparative analysis Pearson's chi-squared test was used. The qualitative data analysis followed a thematic-coding approach [18], in which open answers were coded, revised and categorised by two authors of this paper.

3.4 Sample

Altogether 153 teaching staff (61,4 % (94) female and 38,6 % (59) male) answered the questionnaire. The average number of courses the teaching staff taught during the semester was 3. The average age of the respondents was 48, ranging from 24 to 73 years. Nearly 40% of the respondents belonged to the age group 42-53, 33% were older than 53 and almost 30% of the respondents were below 40 years. Almost half of the respondents were lecturers (47%) and 18% were docents. In addition, professors formed 15% of the respondents, teachers 12% and other professions such as junior and senior researchers; teaching assistants formed altogether 8%.

4 Results

First we'll provide an overview of the basic conditions that define the learning ecosystem's responsiveness and its overall ability to transform from the teaching staff's perspective as the key actors of the ecosystem.

4.1 Basic Conditions for Learning Ecosystem Transformation

In order to be able to respond to the sudden change i.e. to move studies to online environments requires some basic conditions to be fulfilled. Available infrastructure, tools, resources and environment for carrying out distance learning are some of the important factors, which are presented in Table 1 together with their distribution, item mean and standard deviation.

The majority of teaching staff acknowledged that the basic infrastructure such as Internet connection, desk computers and laptops as well as other devices for carrying out successful distance learning was on an acceptable level. It has to be noted here that every person in an academic position gets a laptop with a built in camera and microphone. The teaching staff had access to software, environments and digital materials that were needed for distance teaching and that were supposed to be provided by the university. Furthermore, the results also show that in the middle of this extraordinary life situation most of them were able to create a suitable physical environment for their work activities without any substantial external disturbances. Table 2 below represents the teaching staff's self-opinion about the level of their digital competencies and technical knowledge as another set of basic conditions for digital transformation.

Table 1. The distribution and averages of "Available infrastructure, tools and resources" items.

	1 completely disagree	2	3	4	5	6 completely agree	mean	SD
The equipment at my disposal enabled me to carry out distance learning effectively	4,6%	3,3%	3,3%	11,8%	26,1%	51,0%	5,05	1,339
My internet connection was good enough to carry out distance learning effectively	2,6%	2,0%	3,9%	15,0%	21,6%	54,9%	5,16	1,198
I had access to software and platforms, which I needed	2,0%	5,2%	3,9%	13,7%	19,6%	55,6%	5,10	1,278
I had access to different materials, which I needed for distance learning	2,6%	2,0%	11,1%	12,4%	25,5%	46,4%	4,95	1,279
It was possible for me to create an environment in the distance learning conditions that enabled concentration and had no interruptive elements	5,9%	7,8%	8,5%	15,0%	21,6%	41,2%	4,62	1,556

Table 2. The distribution and averages of "Teaching staff's digital competencies" items.

	1 completely disagree	2	3	4	5	6 completely agree	mean	SD
My digital competence was sufficient to carry out distance learning efficiently	1,3%	2,0%	6,5%	18,3%	34,0%	37,9%	4,95	1,102
I managed to solve technical problems during distance learning	2,0%	2,0%	3,3%	12,4%	41,2%	39,2%	5,07	1,068
I had enough technical knowledge to compile necessary teaching materials in different formats (text, presentation, video, etc.)	0,0%	3,3%	7,8%	17,6%	32,0%	39,2%	4,96	1,088

Regarding the level of digital competencies teaching staff self-assessed their digital competencies to be on a sufficient level for moving their courses to online environments. They claimed they were able to solve technical problems during the distance learning period and had enough technical knowledge to create different learning materials by themselves according to their needs. Concerning the perceived act of management and available support to the teaching staff provided by the institution during the distance learning period the results are a bit more critical. The following seven statements (Table 3) represent the teaching staff's assessment of available support and perception of management operation.

There were more respondents who claimed that they had clear instructions of how to use web-based learning tools and materials, than those whose perception was more critical in terms of available support and instructions of how to organise and implement online teaching. Yet around 13% of the respondents were not satisfied with technical support and claimed not getting enough support from the university for implementing e-learning strategies. Furthermore, the results show that 24% of the respondents said that the management of their institute did not show any interest in their coping, 30% had a neutral opinion and only 47% claimed that the institute's management showed interest in the teaching staff's activities. On the other hand, the majority of the teaching staff acknowledged that the management took into account specifics of courses while organising distance learning and implementing changes in overall teaching arrangements.

Table 3. The distribution and averages of "Available support for teaching staff and act of management" items.

	1 completely disagree	2	3	4	5	6 completely agree	mean	SD
Clear directions were available for using web-based teaching materials	4,6%	5,9%	13,7%	15,0%	25,5%	35,3%	4,57	1,463
Technical assistance was available when needed	2,6%	11,1%	9,2%	17,6%	28,1%	31,4%	4,52	1,433
I received support from the university, when needed for the application of e-learning strategies	7,2%	5,2%	12,4%	17,0%	26,1%	32,0%	4,46	1,526
I had a clear understanding about the organisation of distance learning	3,3%	5,9%	11,8%	24,8%	27,5%	26,8%	4,48	1,333
I had enough opportunities to communicate with my colleagues during the distance learning period	4,6%	10,5%	16,3%	19,6%	24,8%	24,2%	4,22	1,474
My institute was interested in how I am doing as a teacher in the new conditions	10,5%	13,7%	10,5%	18,3%	25,5%	21,6%	3,99	1,652
The specificity of the practical courses were taken into account when changing teaching arrangements	4,6%	6,5%	18,3%	22,2%	29,4%	19,0%	4,22	1,368

Table 4 with their three statements illuminates the teaching staff's self-assessed perception of success and productivity.

Four respondents out of every ten (ca 39 %) said that they were able to teach as efficiently during the distance learning period as they did in face-to-face classroom settings. 44% of teaching staff were neutral, and around 16% acknowledged that they were not as successful as in classroom settings.

The teaching staff's reflection of managing with teaching during distance learning in comparison with normal conditions, e.g. ordinary face to face learning is presented in Figure 1.

Table 4. The distribution and averages of "Teaching staff's perception of success and productivity" items.

|	1 completely disagree	2	3	4	5	6 completely agree	mean	SD
I managed to carry out teaching in the distance learning condition as efficiently as I would have in case of face-to-face teaching at the university	7,2%	9,2%	20,3%	23,5%	22,9%	17,0%	3,97	1,462
Constant web-based work environment did not decrease my capability to focus on my work tasks	3,9%	8,5%	14,4%	19,0%	28,8%	25,5%	4,37	1,422
I could plan my time to complete work tasks efficiently in the distance learning conditions	4,6%	7,8%	10,5%	21,6%	23,5%	32,0%	4,48	1,460
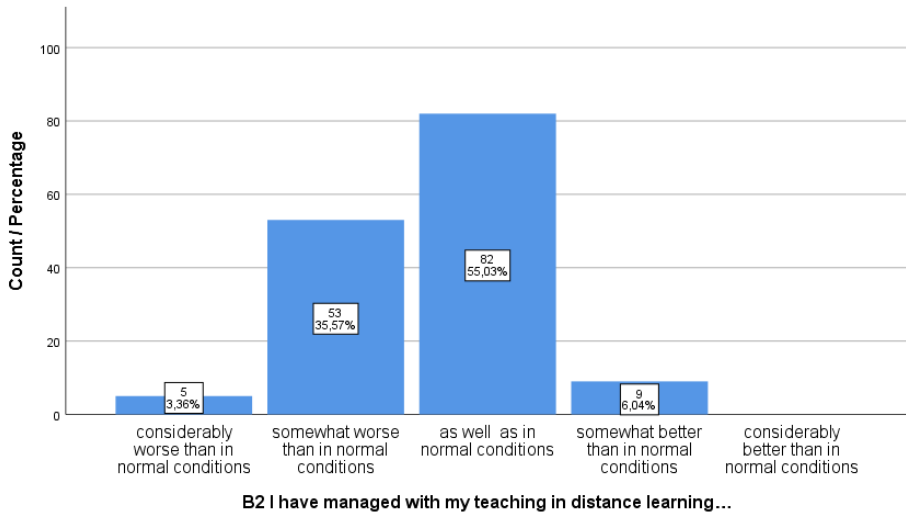
Fig. 1. Distribution of the answers comparing distance learning with face-to-face learning.

More than half of the respondents were convinced that they managed with their teaching at the same level as before the distance learning period. Nevertheless, almost 40% of the teaching staff acknowledged that they were not so successful in their

teaching compared to normal conditions. The comparative analysis showed that females agreed statistically significantly more that they have managed with their teaching as well as before than males (Pearson Chi-Square = 12.06, sig. < 0.05). In other group comparisons, such as between the professions and age groups, no statistically significant differences were noted. With regard to the teaching staff's perception on students' progress during the distance learning period, Table 5 below demonstrates the results. More than 60% of the respondents thought that the distance learning was not an obstacle for students to acquire necessary knowledge and skills set in course programs and they progressed with their studies as expected in normal circumstances. Similarly, around 50% of the teaching staff believed that the students were able to actively participate in distance learning activities.

Table 5. Teaching staff's perception on students' progress.

	1 completely disagree	2	3	4	5	6 completely agree	mean	SD
Distance learning did not prevent students to acquire necessary knowledge and skills	3,9%	15,0%	11,8%	26,8%	28,8%	13,7%	4,03	1,386
Students were able to participate in distance learning as actively as in university campus	11,1%	12,4%	20,9%	17,0%	25,5%	13,1%	3,73	1,557
Students have progressed with their studies as much as they would have done it in university campus	4,6%	10,5%	20,3%	22,2%	27,5%	15,0%	4,03	1,386

4.2 Potential Changes in Learning Ecosystem

Digital transformation has a potential to bring in changes in actors' behaviors and tools they start to utilise. The following sections provide insights into potential changes with respect to the key actors of the higher education learning ecosystem.

Overall mindset and attitudes of teaching staff. The teaching staff responses to a statement representing the teaching staff's teaching preferences about his/her teaching approach (distance either/or face to face either/or combined), are presented in Figure 2 below.
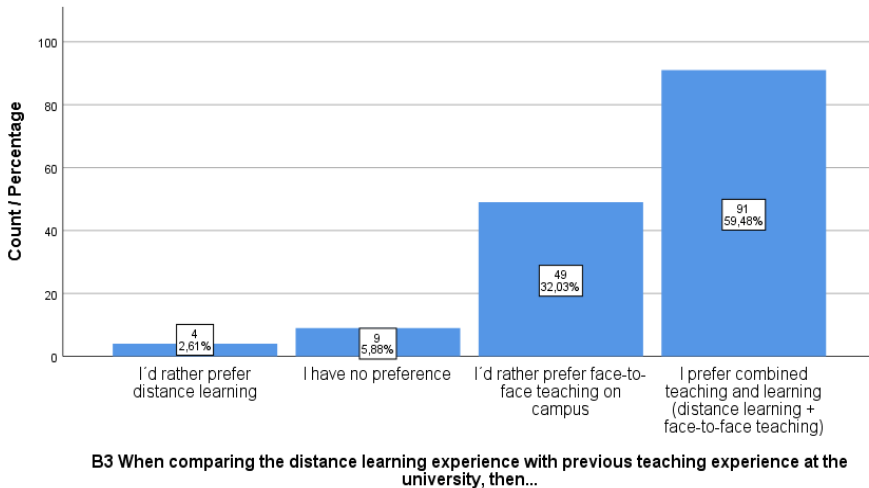
Fig. 2. Distribution of the answers considering the teaching staff's preferences about their teaching and learning approach.

More than one third of the respondents preferred face-to-face teaching. Nevertheless, six teachers out of every ten preferred a combined learning and teaching approach although the university has been providing mainly face-to-face studies, thus they showed interest to design their courses as blended and partially complemented with online activities. With regard to gender differences, female teaching staff preferred face-to-face teaching statistically significantly less and combined teaching more than male teachers (Pearson Chi-Square = 15.30, sig. < 0.05). In age and professions groups no statistical differences were identified.

Although the move from classrooms to home offices happened unexpectedly and very quickly, the teaching staff was able to point out some positive aspects of this move. Being forced to stay at home, 63 teaching staff out of 153 mentioned that because of no need to commute they had much more time to spend on different activities. Another positive aspect for the teaching staff was the fact that more students who under normal conditions might not have had a chance to attend courses, could participate. Quite many respondents realized that in the future online teaching would allow them to be more flexible while being on sick leave, visiting conferences, etc. Around 10% of teaching staff acknowledged that online teaching provides a more individualized approach to students, increases students' responsibility, and their commitment to distance learning rather increases. On ten occasions it was even pointed out that teaching was more effective and students' participation was better, and it was easier to control discussions in large groups as a teacher. Nine respondents pointed out that thanks to testing different environments, they found new exciting solutions and could be more creative, the possibilities for conducting studies expanded. Four respondents stated that it was an exciting challenge for both students and teaching staff, and two respondents stated that it enabled involvement of foreign

specialists, including international ones, who would not otherwise have participated in the courses. The fact that there was nothing positive in distance learning was expressed by seven respondents who teach practical subjects as they felt that distance learning was not suitable for teaching these subjects.

Changes in digital competencies. Digitizing courses and providing online teaching, allowed the teaching staff to acquire new skills and competencies they would have not learned in normal circumstances. While Table 2 presented earlier demonstrates the teaching staff's self-opinion about the level of digital competencies for carrying out unexpected distance learning, Table 6 below brings out the respondents' self-assessment regarding changes in their digital competencies based on DigCompEdu. The respondents were asked to "assess how much the following statements described their digital competence before and after the distance learning period".

Skills to use digital tools to collaborate with colleagues, ability to create digital materials and choosing suitable digital tools for mentoring and counselling increased the most. At the same time, skills to analyze and interpret digital evidence about learners' learning activities and digital knowledge about differentiation of learning increased the least, although for successful online learning these skills are also of great importance. Thus, the basic digital skills of the teaching staff were enhanced, however, the higher level digital competencies remained to a great extent intact.

Table 6. The distribution and averages of "Assess how much the following statements describe your digital competence before and after the distance learning period" items.

	1 skills stayed the same	2	3	4	5	6 I can do significantly more than before	mean	SD
I know how to use digital tools for cooperation with my colleagues	16,3%	12,4%	9,2%	20,9%	16,3%	24,8%	3,83	1,791
I know how to search, evaluate and choose digital learning materials	29,4%	13,1%	8,5%	23,5%	12,4%	13,1%	3,16	1,792
I know how to create and adapt digital learning material (e.g. create a video lecture, web-based test)	20,9%	17,6%	13,7%	17,0%	13,1%	17,6%	3,37	1,784
I know how to share digital learning materials with the others	31,4%	12,4%	14,4%	18,3%	12,4%	11,1%	3,01	1,755
I know how to use digital tools to enhance the teaching process (e.g. illustrate topics)	31,4%	12,4%	11,8%	18,3%	15,7%	10,5%	3,06	1,774

I know how to use digital tools to enhance learner cooperation (e.g. recommend platforms suitable for cooperation)	21,6%	17,0%	19,0%	17,0%	15,0%	10,5%	3,18	1,652
I know how to choose suitable digital tools for mentoring and counseling	22,9%	13,7%	13,7%	22,2%	15,0%	12,4%	3,30	1,709
I know how to analyse and interpret digital evidence about the students' learning activities (e.g. analyse Moodle data about student progress)	47,1%	14,4%	15,0%	11,8%	7,2%	4,6%	2,31	1,545
I know how to use digital tools for giving students timely and task specific feedback	37,3%	12,4%	15,0%	15,7%	12,4%	7,2%	2,75	1,695
I know how to use digital tools for differentiation and individualisation	37,9%	13,7%	15,0%	15,0%	11,8%	6,5%	2,69	1,668

New skills and competencies. Additionally an open question was asked, which allowed teaching staff to express their opinion regarding new skills and competencies they acquired during the distance learning period. As expected, the respondents mentioned 70 times that they learned about new digital environments and tools, such as Zoom and Moodle. Learning how to record and conduct video lectures was pointed out 29 times. One of the respondents explained: "*How to do the lecture when you are not in the same room as the students. That was the hardest part to figure out how to do that. I eventually came up with the short Youtube videos from Youtube, I put the links into the Moodle, added my questions about the videos and we were discussing it during the Zoom lecture*". In addition to acquiring knowledge and skills about how to run video lectures, designing online tests was mentioned by the teaching staff 13 times. Besides, recording one's video lectures allowed one to see oneself as a presenter, which encouraged the teaching staff to improve their presentation skills. The teaching staff competencies were also improved in terms of planning remote teaching, creating learning materials and better instructions (mentioned 11 times). One respondent said that: "*Online courses have different dynamics, I learned how to encourage discussion in a seminar that is organized online*". In addition, the distance teaching period taught them to deal with an extensive amount of information, technical problems and work in complicated situations.

Changes in teaching practices and supporting tools. One of the first decisions one has to make while transferring teaching and learning activities to an online environment is whether to follow a pre-set face-to-face timetable for courses or restructure the courses in a way that the timetable becomes irrelevant. 80,4% of the respondents kept their pre-set timetable for their courses and organised synchronous meetings with their students, while 11,1% somewhat followed their timetable and

8,5% of the respondents either agreed to contact students at some other times or did not organise synchronous meetings.

Table 7. The distribution and averages of "Assess how much you used the following teaching activities during distance learning" items.

	1 didn´t use at all	2	3	4	5	6 used extensively	mean	SD
Student independent work with literature and completing tasks based on the reading	7,8%	2,0%	9,8%	30,7%	29,4%	20,3%	4,33	1,376
Web-based lectures	11,8%	4,6%	8,5%	17,6%	22,9%	34,6%	4,39	1,675
Web-based groupwork	31,4%	10,5%	4,6%	13,1%	19,6%	20,9%	3,42	2,002
Web-based seminars	11,8%	2,6%	6,5%	16,3%	28,1%	34,6%	4,50	1,631
Watching video lectures	35,3%	11,1%	9,8%	18,3%	8,5%	17,0%	3,05	1,896
Individual web-based consultations	17,0%	10,5%	13,1%	21,6%	19,0%	19,0%	3,72	1,722
Individual web-based tests	41,8%	7,8%	5,9%	13,1%	17,0%	14,4%	2,99	1,970
Web-based games	77,1%	7,8%	3,3%	3,3%	4,6%	3,9%	1,62	1,357
Web-based simulations/animations	81,0%	6,5%	2,0%	7,8%	1,3%	1,3%	1,46	1,088
Virtual labs	88,2%	5,2%	2,6%	2,0%	1,3%	0,7%	1,25	,805
Web-based tasks on different platforms	43,1%	6,5%	9,8%	17,6%	13,1%	9,8%	2,80	1,832

Furthermore, decisions regarding different components of teaching and learning as well as tools and services that mediate these components need to be taken. Table 7 gives an overview of different online teaching possibilities that were implemented by the teaching staff.

Web-based lectures and seminars were most often used teaching activities in addition to students' independent work with literature and solving assignments based on reading. The least used activities were virtual labs, simulations and web-based games.

Table 8 below provides a deeper view on changes in teaching practices. Growth tendency (mean > 0.2) was visible in giving feedback, individual consultations, individual work and asking feedback to teaching. On the other hand lectures, workshops and group work showed the tendency to decrease (mean < -0.2).

Table 8. The distribution and averages of "When comparing to the initial teaching plan, how much did the ratio of the following aspects change in your courses" items.

	-3 decreased significantly	-2	-1	0 stayed the same	1	2	3 increased significantly	do not use	mean	SD
Lectures	9,8%	6,5%	17,6%	51,0%	5,9%	2,6%	3,9%	2,6%	-,38	1,323
Seminars	2,6%	6,5%	10,5%	55,6%	9,2%	4,6%	5,9%	5,2%	,05	1,221
Practical training	17,0%	7,8%	5,9%	40,5%	1,3%	3,9%	3,3%	20,3%	-,67	1,593
Groupwork	11,8%	9,2%	11,1%	42,5%	6,5%	5,9%	2,0%	11,1%	-,46	1,439
Individual work	1,3%	0,7%	1,3%	45,8%	17,6%	17,0%	13,7%	2,6%	,89	1,239
Feedback	0,7%	1,3%	5,9%	32,7%	20,3%	19,6%	17,0%	2,6%	1,03	1,310
Individual consultations	0,0%	3,9%	5,2%	32,7%	24,8%	15,7%	13,1%	4,6%	,86	1,279
Group consultations	3,9%	5,2%	5,2%	41,2%	13,7%	5,9%	5,2%	19,6%	,17	1,341
Asking feedback about teaching and learning	1,3%	2,0%	2,6%	55,6%	14,4%	8,5%	9,8%	5,9%	,53	1,188

Regarding the changes in course designs and teaching methods to engage and support students as well as to efficiently provide feedback, open questions were asked from the teaching staff. Around 60% of respondents claimed that they did not make any changes in their course designs while transferring them to online environments in order to engage students, provide more support or feedback. Nearly 40% of respondents became more active in communicating with students through different communication channels, offered additional consultations and seminars or incorporated more discussions and group work. They felt that they have to be more accessible for students and support them in every possible way. 13% of respondents adjusted their learning material by adding additional sources, recorded lectures etc. and around 10% of teaching staff provided more personal feedback to students' work which they would have not done under normal circumstances.

To get an understanding of which tools and services the teaching staff selected to serve best different teaching activities (Table 9), the survey consisted of 6 open

questions. Table 9 provides an overview of the tools and services used by the teaching staff.

Table 9. Overview of the tools and services for teaching activities.

Tool	Lecture	Seminar	Group work	Assessment	Consultation	Feedback
Zoom	127	106	83	21	95	50
Google Meets		16	9		20	11
Microsoft Teams	31	16	20		24	10
Moodle	27	27	44	119	16	107
Big Blue Button	18	13	11			
Skype	8	9	8		44	
Google Drive			8	14		12
e-Mails				16	36	51
eDidaktikum				14		16
Google Classroom				9		8
Study Information System						8

Table 9 shows the most popular tools for different teaching activities, which was mentioned by the respondents at least 8 times. Although the list of different tools and services was much longer as shown in the table, they were used only by some teaching staff. The most popular tool for supporting almost every distance teaching activity was Zoom. For assessing students' progress and providing feedback the teaching staff made use of Moodle.

4.3 Occurring Challenges

Moving courses to online environments within one week's time period quite likely brings along a number of challenges.

Workload of teaching staff. As mentioned earlier, digital transformation is a time-consuming process which happens step by step as actors gradually develop required competencies, adopt different teaching practices and get to know various mediating technologies. Unexpected and sudden need to provide a quick response to outside disturbances interrupts teaching staff's normal everyday planning and workload. Figure 3 below shows the distribution of the responses regarding assessment on their workload compared between the distance learning and face to face campus teaching.

Around 60% of respondents experienced an increase in their workload, almost a quarter of the respondents stated that their workload remained the same. There were no statistically significant differences between genders, age and profession groups. 72 times were pointed out that the increase in workload was mainly related to increased individual communication and feedback. Guidance and counseling, which could otherwise be done in classrooms and for everyone at the same time, was replaced by more individual guidance and consultations. In addition, the number of students' written assignments increased, thus increasing the need to spend more time on assessment and feedback. One teacher claimed that: "*The amount of time to prepare, answering endless emails, and dealing with Moodle increased the workload by 50% or more. Very problematic when already having too high workload.*"

Immediately re-organising courses, finding suitable tools and services, searching for materials etc. was mentioned 66 times as a reason for increased workload. One of the respondents said that: "*I had to prepare everything from scratch in the middle of the semester. If the core of the teaching is the frontal education (and we have a lot of it), you cannot just move this to an online world. I mean you can, but it would not work. The group dynamics are very different in the online world…I have to come up with new teaching techniques.*"
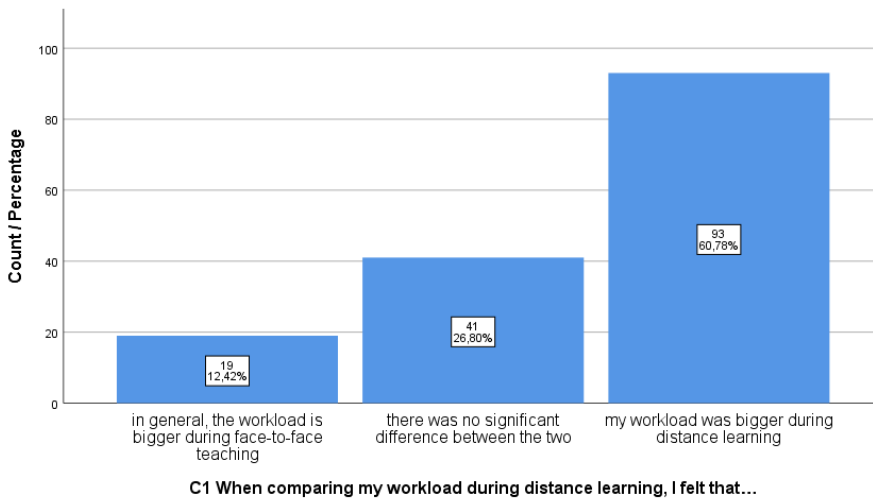

Fig. 3. Distribution of the answers considering teaching staff's self-assessed workload.

Missing technological solutions. The majority of teaching staff were satisfied with their devices and available software, however, some of their additional needs are presented in Table 10.

The teaching staff mentioned 28 times that they were missing specific software, such as a digital pencil, web-based whiteboard, synchronous collaboration options, testing environments. Some (mentioned 17 times) pointed out that for a good online teaching they needed a better computer, headsets, microphone or a camera. In some cases successful online learning and teaching experience was hindered by students' limited hardware not allowing them to properly participate in online synchronous learning activities. The respondents also realised that they lack some knowledge and are in need for more instructions and specific online learning methods.

Table 10. Teaching staff additional needs for technology.

Teaching staff additional needs	Occurrence
No additional needs	156 times
Specific software	28
Different hardware	17
Students limited opportunities	11
Video production	8
Methods and instructions	7
Additional knowledge	5
Software licenses	4
Limited internet connection	4
Distance lab	4

Negative aspects of distance teaching. One of the main negative factors about distance teaching (mentioned 59 times) was the lack of direct human contact and direct communication. One of the respondents mentioned: "*Everything else -- impersonal, disconnected, annoying, isolating, no interactivity with students, relationships boiled down to emails*". On 30 occasions, it was mentioned that being in front of a computer screen was excessive, which was related to the increased workload because of re-planning of studies, providing individual feedback, which led to both mental exhaustion and physical health problems. Furthermore, the distance teaching period was blurring the boundaries between personal life and working life. Being isolated in one's home office, made it challenging to find solutions to technical problems. In 28 cases it was mentioned that the participation of students decreased, the so-called black boxes in Zoom, lack of interactivity made the students passive and also decreased students' motivation. One respondent claimed that: "*Lack of contact with students meant that some probably did not feel as engaged as in face-to-face sessions*". In 16 cases it was mentioned that such a form of study is not suitable or imposes significant restrictions on practical subjects. Finally, 4 respondents mentioned personal uncertainty in conducting distance teaching i.e. methodological as well as technical uncertainty, lack of skills. As one of the respondents said: "*We were not ready for this. Not technically, but methodologically... (Almost) everyone knows how to start a Zoom or a Skype call. But how to do that efficiently, is a completely different thing*".

5 Discussion

How responsive was the higher education institution to the sudden external disturbance from the perspective of teaching staff and what were the bottlenecks the teaching staff experienced that impeded the learning ecosystem to transform?

To be able to respond to external disturbances and transform the learning ecosystem, the system needs to have some basic conditions fulfilled, especially when we talk about digital transformation. Without a question, teaching staff in higher education institutions is the key change agents in the process of transforming learning ecosystems and realizing the potential of technology for distance teaching and learning. As the timeframe for transformation was very short, the teaching staff was not given any time or training to digitize their educational offerings. Despite that the majority of the teaching staff were able to perform basic digital operations, such as setting up virtual online meetings, recording video lectures, etc. Even if the teaching staff had not used some of these tools before, they were quickly able to acquire the skills to manage technology for teaching purposes. Quite likely their basic level of digital competencies and everyday use of technology for purposes outside their work regardless of their age plays a huge role here.

Another important component of the learning ecosystem as a basic condition for activating digital transformation is infrastructure and tools for mediating online learning and teaching activities. Based on the results the overall infrastructure for the teaching staff to be used was on a level that allowed them to carry out and mediate distance teaching. Therefore, basic digital competencies of teaching staff and available infrastructure was sufficient for the ecosystem not to fall apart, reach its stable state and be somewhat responsive i.e. to continue providing higher education in the online world.

Nevertheless, this demonstrates only an incremental, first-order change in the learning ecosystem. Although digital technology was quickly utilized, which can be seen as a first step towards transforming the learning ecosystem, however, this sudden, unplanned circumstance was only able to touch the surface and slightly changed the teaching staff's teaching practices despite the fact that around 60% of the respondents have started to see value and potential in combined teaching formats. Hodges, Moore, Lockee, Trust & Bond [19] call it as an emergency remote teaching as an alternative instructional delivery mode due to crisis circumstances [20].

On the one hand the reason for first-order responsiveness lies in limited digital competencies and pedagogical technological knowledge of the teaching staff. Namely, although the majority of teaching staff assessed their digital competencies sufficiently, according to the DigCompEdu framework they developed less high-level digital competencies needed for more sophisticated processes and practices (Table 6). This prevented them to take full advantage of affordances and possibilities of the online format and design of high quality learning experiences. As acknowledged by many teaching staff, they were not equipped with distance learning strategies and methods, thus presenting a limited pedagogical and didactical repertoire. On the other hand the available list of tools and services at the teaching staff's hands was limited and constrained implementation of more comprehensive teaching methods.

Furthermore, the teaching staff is not the only change agents of a learning ecosystem. Management and leadership of the institution play an important role in

facilitating teaching staff's response to digital transformation. The teaching staff's experiences and perception demonstrated that the management and e-learning support was not meeting some of their expectations (Table 3), thus, being yet another factor that contributes only to the cosmetic, fine-tuning change. In addition, according to the teaching staff's perception students as learning ecosystem actors did not experience full potential of higher education during the lockdown period. Transferring learning and teaching activities to online environments sets limits to students' participation in learning activities and prevents them from acquiring necessary knowledge and skills regardless of teaching staff's attempts to mitigate negative threats on students by providing more detailed instructions, additional personal consultations or making learning materials more accessible.

To conclude, being the leading university in Estonia in exploring and developing educational innovations and located in a digital enhanced country, responsiveness of the learning ecosystem and its key actors to the digital transformation still remained shallow. This emergency distance teaching did not bring in a revolution and a qualitative jump in the higher education ecosystem, however, it definitely abruptly raised teaching staff's awareness of technology-enhanced learning, encouraged them to explore new possibilities for online teaching in terms of strategies and technological solutions, understand their weaknesses and strengths and plan further development, thus accelerating the process of digital transformation. Partially the teaching staff's rather poor response to digital transformation lies in fact that academic staff is more valued based on their research not on their innovative teaching methods and digital tools.

One of the limitations of our study relates to capturing a snapshot of only teaching staff's experiences and views, not involving all the ecosystem's stakeholders, however, mapping the situation caused by the COVID-19 crisis from the perspective of teaching staff including also their perception on how management and students deal with outside disturbances, allows us to understand key actors behaviors and the overall transformation of a learning ecosystem as well as gives us a starting point to explore connections and incorporate into research other ecosystem's players.

6   Conclusions and Future Directions

We have described one higher education learning ecosystem and its digital transformation attempts during the period of COVID-19 from the teaching staff's perspective. Although this relatively well functioning learning ecosystem was quickly able to mobilise its parts and reorganise its resources for the basic transformation, based on our pool of evidence we can conclude that in order to be responsive for future disturbances the management needs to take actions to be able to cope with similar challenges in the future. Namely, based on the teaching staff's experience, the management of the institution needs to invest in better infrastructure as well as in educational technologists as mentors and distance learning designers who would support the teaching staff to systematically widen their pedagogical repertoire and raise their digital competencies to the next level. Because of the COVID-19 period, the nature and format of higher education delivery has been changed. The turbulence

created by this unexpected circumstance has brought to our awareness pedagogical and didactic knowledge of higher education teachers and acknowledging them as designers of technology-enhanced learning experiences who need to have a set of skills and competencies in addition to their subject specific knowledge. On the other hand, the forced distance learning situation raised the awareness of possibilities and affordances of online learning and created a good basis for integrating innovative technology-enhanced teaching methods into higher education settings and not only directing its focus on exploring and developing new opportunities for schools.

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