THE HINDERING BARRIERS OF DIGITAL EDUCATION - ROMANIAN AND ICELANDIC STUDENTS INSIGHTS

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Abstract. *The COVID-19 pandemic urged higher education to drastically change the educational process by shifting from onsite to online learning. The transition was short; students and teachers had to adapt and find solutions concerning technology assets (devices and software), conditions for studying, and digital skills. Universities heavily invested in boosting the use of technology and development of online teaching, learning, and assessing methods. But barriers to online education, such as lack of access to an adequate Internet connection, lack of resources to acquire the necessary devices and software, lack of adequate conditions for studies in the students' private homes as well as lack of training to support the enhancement of digital skills were reported, but rarely addresses and analyzed in relation to educational performances and motivation for studying on the long run. So, the paper aims to better understand the factors hindering full engagement in online education by using the data collected among students from Romania and Iceland and to discuss the implications on institutional policies to provide high-quality online learning.*

Keywords: *online education, perceived barriers, e-learning technology.*

Introduction

The sudden and profound transition from onsite education to online education since the beginning of the covid-19 pandemic surprised all the actors involved in the educational process at all levels, from educational staff to students, to parents, to educational institutions and policymakers.

Many challenges arose due to moving education to an online setting, being largely approached by multiple studies. Among students, the transition to online education impacted physical and mental well-being. Thus, some of the studies carried out in recent years have highlighted the adverse effects of increasing study workload on the level of stress and anxiety (Bray et al., 2020). Other studies pointed out the negative impact of extensive time spent on electronic devices on physical health (such as eye problems, back problems, etc.) (Srinivasan et al., 2021; Chaturvedi et al., 2021). Other adverse effects of online education on students' lives were related to a lack of social interaction in the online educational setting and feelings of isolation (García-Morales et al., 2021; Chaturvedi et al., 2021). Moreover, other authors showed a decrease in students' academic achievements and motivation during the pandemic compared to the period before the pandemic (Gillis & Krull, 2020; Meinck et al., 2022).

Although the pandemic had negative effects, it also had positive facets, leaving now higher education institutions in the face of a new challenge, namely how to include online education on a constant basis in teaching and learning. Some of these positives were the emergence and use of innovative learning and teaching methods and technological tools (Mseleku, 2020; Adedoyin & Soykan, 2020). Moreover, some educational institutions were forced by the situation to technologically modernize and pressured to support the teaching staff in developing digital skills. Adedoyin and Soykan (2020) noted that other inherent advantages of online education are flexibility and self-paced learning capability, the agency of both students and teachers in balancing their careers with their private lives without losing engagement, and performance increasing significantly.

The shift to online education and the duration and depth of the changes operated upon institutions' infrastructure, as well as upon teaching and learning processes are currently almost impossible to be forgotten, many teachers and students want in fact to find a balance in between advantages and disadvantages of online education and urge higher institutions to find solutions for hybrid/mixt education.

Literature review

Many of the students' challenges during the pandemic were directly caused by barriers preventing adequate access to education. Baticulon et al. (2021) identify five types of barriers to online education: technological (related to technological infrastructure), individual (related to learning styles and mental well-being), domestic (family-related issues), institutional (related to resources, teachers, or curriculum) and community barriers (related to lockdown restriction and political climate). Similarly, Akhter et al. (2022) identified four types of challenges in online education for students: financial (lack of financial resources to participate in online education and issues related to basic needs), institutional support (lack of training or support from the institution, low digital

skills among teachers), technological (devices, Internet, and digital skills) and personal (physical or mental health or well-being).

One of the main barriers to online education discussed extensively in the literature is connectivity (Arnhold et al., 2020; Darmody et al., 2021; Akhter et al., 2022; Gu, 2021; Mathrani et al., 2021; Srinivasan et al., 2021, Katz, Jordan & Ognyanova, 2021; Gillis & Krull, 2020). Online education, especially real-time education, requires a fast Internet connection (broadband or mobile). Students with a slow or no Internet connection were especially disadvantaged during online education.

Another technology access factor that obstructed access to online education during the pandemic was the absence of necessary electronic devices or quality devices. Thus, many authors state that the absence of PCs, laptops, smartphones, tablets (as well as other peripheral devices), and poor-quality devices impacted students' access to education during the pandemic, further deepening the inequalities in education. Many authors (Srinivasan et al., 2021, Gu, 2021; Akhter et al., 2022; Katz et al., 2021; Gillis & Krull, 2020) remarked that the lack of electronic devices is among the main factors hindering online education participation during the pandemic.

Another factor regarding the technological infrastructure, but more related to basic needs, which is less discussed in the literature, but prevented access to education during the pandemic, was the lack of electricity or problems with power cuts, which are more common in developing countries. Srinivasan et al. (2021), Akhter et al. (2022), and Azionya and Nhedzi (2021) observed the harmful impact of electricity problems in developing countries on student participation in education during the pandemic.

The shift from face-to-face interactions to online education required students to learn to use new software programs and platforms to keep up with the changes brought by the pandemic. The lack of knowledge and digital skills necessary to use devices, platforms, and software programs posed difficulties to students in online learning. Studies (Baticulon et al., 2021, Akhter et al., 2022; Srinivasan et al., 2021; Katz et al., 2021, Grigorescu et al, 2021) showed that many students could not adequately use online resources during the pandemic due to the lack of knowledge to use the Internet and platforms.

The literature also showed the lack of institutional support and school resources as hindrances to online education. Consequently, previous research (Srinivasan, Jishnu & Shamala, 2021; Akhter et al., 2022; Baticulon et al., 2021; Aboagye et al., 2021) illustrated the lack of training and assistance on the use of devices and platforms, the lack of involvement in solving potential problems with the platforms, and the lack of digital skills among instructors as obstacles for students to participate in online courses. Other researchers argued that some students did not have adequate software tools to communicate with teachers or for coursework, nor the possibility to access online library materials (Kerres,2020; Mseleku, 2020).

The lack of adequate physical learning space was another challenge for students during online education. The lack of distraction-free learning spaces, the use of learning room space simultaneously with other family members due to the housing situation, and house chores that interfere with online education have created real issues in participating to online education (Srinivasan et al., 2021, Mathrani et al. 2021).

Other factors that hindered online education among students, identified by researchers, were financial barriers of students' families related to the expense of buying devices and paying Internet and electricity bills (Baticulon et al., 2021; Akhter et al., 2022). Srinivasan et al., 2021; Baticulon et al.,(2021) also emphasized the importance of obstacles to online education related to students' mental and physical health amplified by confinement restrictions, lockdowns, and uncertainty.

Many researchers attributed the difficulties some students experienced to the pre-existing educational inequalities before the pandemic, amplified even more by the transition of education to the online environment. Other authors emphasize in their studies de term "digital inequality" (Katz et al., 2021; Srinivasan et al., 2021) or "digital divide" (Gu, 2021; van de Werfhorst et al., 2022; Mathrani et al., 2021; Gillis & Krull, 2020). Digital inequality or digital divide is defined in the context of online education as "the disparity in the access, distribution of technology, information because of various socioeconomic and cultural factors" (Srinivasan, Jishnu & Shamala, 2021, p. 34). In the literature, three levels of the digital divide are distinguished: the first level of the digital divide is related to access to technology, the second level is related to skills and usage, and the third level is related to outcomes or effects of technology access and skill usage for a specific goal (Katz et al., 2021; van de Werfhorst et al., 2022; Mathrani et al., 2021). The digital divide among disadvantaged students impacted their participation in online education because of the lack of access to technologies and digital skills.

Researchers observed differences in online education participation and barriers faced among students by socioeconomic status, gender, and area of residence. Students belonging to families with low socioeconomic status, with difficulties regarding access to technology had a reduced probability of participating in online education compared to those with higher socioeconomic status (Gu, 2021; Katz et al., 2021). Researchers also observed that students with a socioeconomic status have a lower probability of having the necessary digital skills (van de Werfhorst et al., 2022; Mathrani et al., 2021). Researchers also observed differences in online education participation and experiences along gender. Werfhorst et al. (2022) showed that male students have lower levels of digital skills than female students. On the other hand, female students reported more often issues related to household and family care responsibilities or issues related to inadequate devices that prevented participation in online education (Mathrani et al., 2021). Studies also revealed that students from rural areas were disproportionally more disadvantaged during online education than those from urban areas (Srinivasan et al., 2021).

Methodology

As said before, for this paper, we aim to analyze perceived barriers to online education among students from Romania and Iceland and how these barriers are associated with different educational experiences and outcomes.

In order to reach the paper objectives we use the survey data collected under the project ”Moving towards the new normal in digital education – the new dimension of human capital in higher education” NEW-DIGI-EDU, financed under EEA Grants 2014-2021. The survey was carried out in the first three weeks of June 2022 and reached 944 respondents with a completion rate of up to 58%. The questionnaire was applied online,

using the facilities provided by SurveyMonkey, to higher education students at all levels of education, from bachelor to post-doctorate programs, mostly public universities being addressed. In the final sample, 61.5% of respondents were from Romania, while 35.6 were from Iceland.

Students were consulted via the survey on different topics related to online education, such as: pros and cons opinions, barriers to online education, experiences during a pandemic and the last academic year, workload, motivation for education, ways to upgrade digital skills, perceived educational performances, as well as expectations with respect to future of online educations after the end of the pandemic. Barriers addressed in the survey and analyzed below-covered access to the Internet, personal or household endowment with needed devices and software, the studying conditions, and the level of digital skills required to participate fully in education. The students were required to rank the above-mentioned barriers' importance in hindering their online education participation.

Starting with the selected barriers, we employed a K-means clustering in order to profile the mix of barriers that students had to cope with during the two years of the pandemic. Then, the identified profiles were analyzed using the exploratory technique of correspondence analysis in relation to workload, motivation, perceived performances, etc. We used SPSS 21 in order to process and analyze the data collected.

Results and discussion

Barriers to online education in Romania and Iceland

Network connectivity, along with electricity rank at the very top of the problems that students had to cope with during the pandemic (see Table 1), the obstacles being assessed as important with small differences in between Romanian and Icelandic students. Electricity scores higher among Romanians (as in other developing countries), while connectivity ranks higher among Icelanders (probably mostly due to their geographical features). Having to leave the campuses and the university centers, where Internet connection had an adequate quality, and having to move back to their own homes or their family homes left the students in the face of the more general problem of access to the Internet. Even if Network connectivity scored higher among the Icelandic sample, limited data seems to be a problem higher among students from Romania. As expected, when access to the Internet is limited, we could expect also difficulties in acquiring needed devices for online education, the problem scoring again significantly higher among Romanians. The socio-economic background of students, more diverse among the Romanian sample is in fact reflected by the answers to these items.

In the second place as important, we find in both samples, the conditions for studying,, back to their families or homes during a pandemic, were considered rather inappropriate by almost one-third of respondents.

And, for those succeeding in coping with previous barriers, the last obstacle resides in the level of digital skills and access to needed programs and software in order to fully engage in online education. As expected, digital skills, even among higher education students, proved to be a significantly bigger problem for the Romanian sample as against the Icelandic one, but in accordance with the digital statistics for both countries.

Table 1. Factors hindering participation to online education in Romania and Iceland (% important and very important)

Factors	Romania	Iceland
Network connectivity	70.0	81.6
Limited data	51.0	29.5
Problems with needed electronic devices (computer, webcam, laptop, etc.)	55.1	34.8
Electricity	57.9	47.7
I had no quiet place to study	38.8	35.7
I had no desk for myself	31.3	23.4
I had no programs and software required	41.0	22.5
I had low skills to use technology	25.1	16.1

Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043

We can conclude that there is a high diversity of students with respect to their socio-economic background, coming from different strata of the society, diversity being higher in Romania, a developing country characterized by higher inequalities. The rapid shift to online education and the measures adopted to contain the pandemic practically gave weight to the socio-economic background in influencing participation, engagement, and educational performances of students in both countries, with obstacles slightly more prominent among Romanians students.

In order to correlate perceived barriers to online education with different experiences and outcomes of online education, we proceeded to segment the population of students and identify different profiles/mixes of barriers to online education. In order to do so, we run a K-means clustering, all variables being significant in designing the clusters. We obtained 4 clusters (Figure 1) with a balanced distribution of the identified profiles within the analyzed sample (Figure 2).

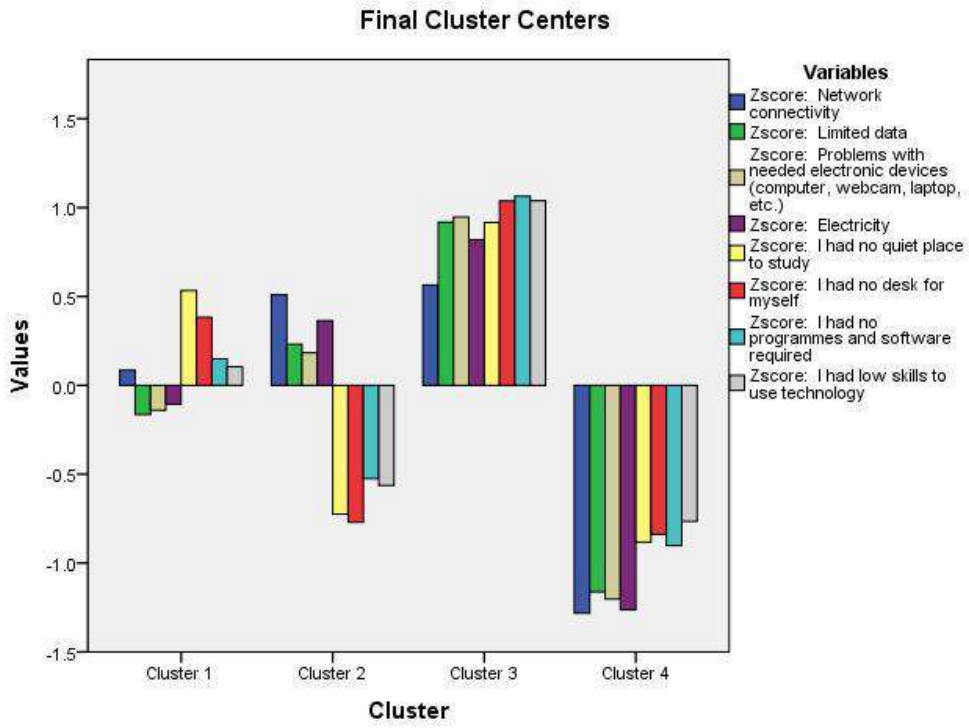

Figure 1. Cluster solution

Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043, Authors' estimations

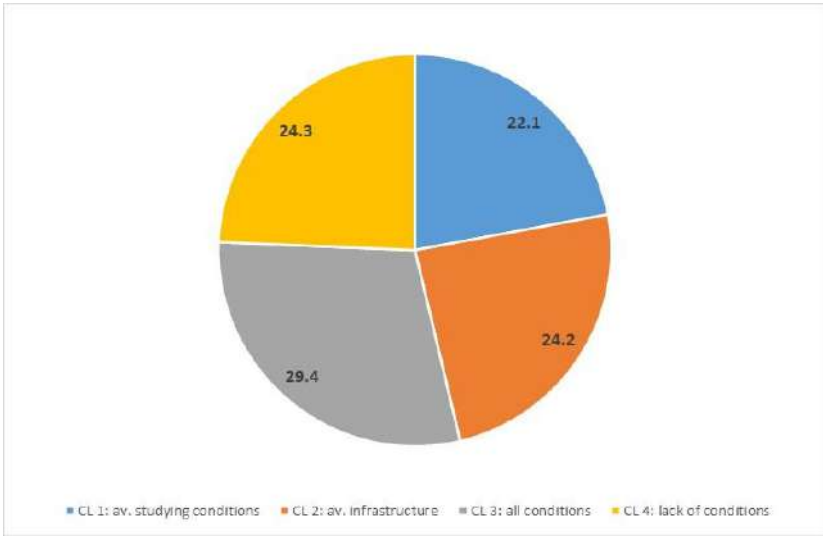

Figure 2. Distribution of clusters in the sample (%)

Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043, Authors' estimations

The identified clusters have the following characteristics:

Cluster 1 is characterized by low access to Internet infrastructure and needed devices, but with average access to quality conditions for education.

Cluster 2 is characterized by average access to Internet infrastructure but low access to quality conditions for studying and low digital skills.

Cluster 3 gathers those students with good access to Internet infrastructure, devices and software, good conditions for online education and also good level of digital skills.

Cluster 4 gathers the most disadvantaged students that had to face all barriers in order to engage and perform in online education

Table 2. Socio-demographic characteristics of clusters (%)

	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**
Country				
Romania	18.7	21.0	35.6	24.6
Iceland	26.9	29.9	19.3	23.9
Level of study				
Bachelor	21.7	24.6	30.6	23.1
Master	22.9	24.8	27.1	25.2
Doctorate +	18.9	22.6	26.4	32.1
Age class				
18-24 years old	23.5	21.8	33.0	21.8
25-34 years old	21.3	28.2	19.1	31.4
35+ years old	20.3	25.6	31.9	22.2
Gender				
Women	24.3	25.2	32.0	18.4
Men	17.9	21.4	23.2	37.5
Occupational status during studies				
Full-time jobs	19.4	23.3	33.2	24.1
Part-time and occasional jobs	24.7	27.8	21.2	26.3
No job	22.5	23.3	31.3	22.9

Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043

Table 2 displays different characteristics of the clusters. We can notice that Cluster 3 is more prominent among Romanian sample, possible due to the fact that public universities in Romania tend to attract more likely the students from the medium and upper class of society and to a less extent those from disadvantaged communities. Also, Cluster 3 reaches higher shares among bachelor students and also aged 18-24 years old,

these being in fact those students participating to education by making use of the Internet infrastructure and technological endowments of their parents/families. Those aged 25-34 years old being in process of transiting from living with their families to living by their own are also more likely to be found among Cluster 4. Surprisingly women have higher shares among Cluster 3, while men reach higher shares among Cluster 4, the structure of the samples by age explaining the distribution. As expected, students aged 25+ are more likely to have full-time jobs and access to all needed resources, along with students aged 18-24 years old and living with their families (that are more likely not-employed).

Barriers to online education, study workload and skills development

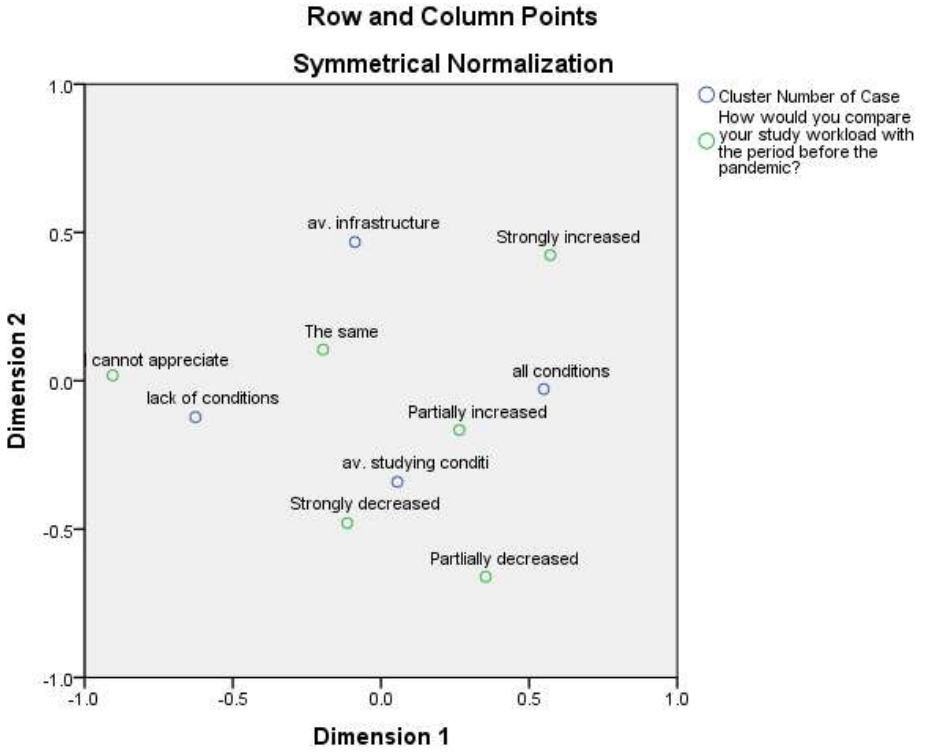

Figure 3. Correspondence analysis between type of clusters and perceived study workload during pandemic

Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043, Authors' estimations

Figure 3 presents the plot of the correspondence analysis between the clusters identified based on factors hindering participation to online education and the subjective assessment of the students with respect to changes in their workload. First, the results indicate an opposition between those having all conditions needed for online education and students characterized by lack of such conditions. Those with no adequate conditions for participating to online education tend to be unable to assess changes in the education-related workload during pandemic. Obviously, lack of

adequate conditions has limited the access of students to educational activities. On the other hand, students possessing all the needed conditions more probably experienced a partial increase in the education related workload. Moreover, they are more similar with students having average studying conditions and poor infrastructure who more probably experienced a decrease in their workload. It is clear that lack of infrastructure prevented some students to be as engaged as before pandemic in educational activities. Also, students with average infrastructure, but poor studying conditions and those reporting no change or a strong increase in their workload are quite distinct by the rest of the students.

In addition, the correspondence analysis between clusters of students based on factors hindering online education and their need for skills development in this respect indicate a strong association between these characteristics (Figure 4). The results confirm the opposition between students having all the needed conditions and those lacking the adequate conditions for online education. The plot suggests that students possessing all the conditions experienced the need to develop their skills to a large extent in order to participate to online courses and seminars. On the other hand, students who didn't need to develop their skills are more probably among those lacking conditions for online education or those possessing some infrastructure, but with poor studying conditions. In these cases, students didn't feel the need to acquire new skills for online education. In the same time, possessing average studying conditions, but poor infrastructure resulted in the need to develop skills to a certain extent in order to attend online education.

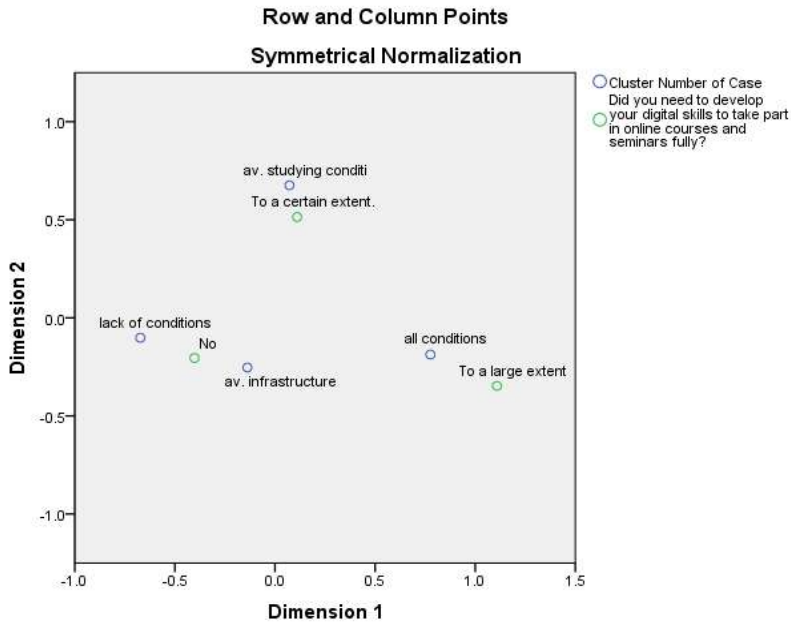

Figure 4. Correspondence analysis between type of clusters and investment in digital skills development

Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043, Authors' estimations

Barriers to online education, motivation for studying and perceived educational performances

Moreover, factors hindering online education seem to be related to how the motivation of students evolve during the pandemic (Figure 5). Again, students lacking all the needed conditions tend to be unable to assess their motivation change, showing a disengagement from educational activities. Students possessing some infrastructure and poor studying conditions are more likely to report a strong increase in their motivation. Also, students having all the needed conditions are more associated with an increase in their motivation level. In the same time, students with average studying conditions are more probably to experience a decrease in their motivation. In this respect, our results suggest that the needed infrastructure has been a relevant element of influence for students' motivation when shifting to online education.

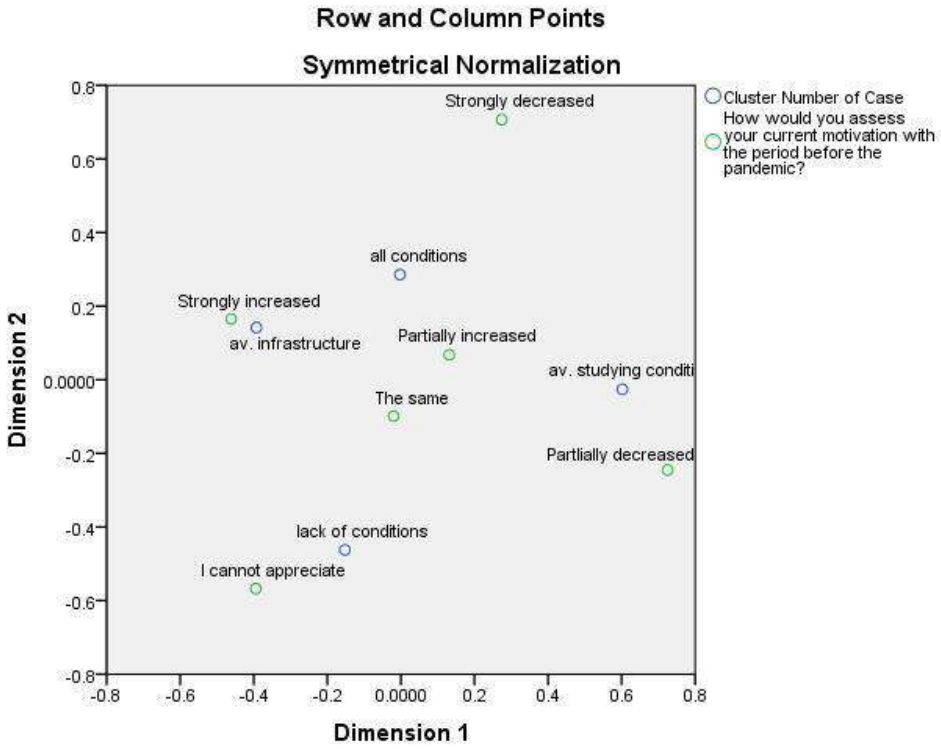

Figure 5. Correspondence analysis between type of clusters and perceived evolution of motivation for studying during pandemic

Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043, Authors' estimations

Figure 6 presents the results of the correspondence analysis between clusters of students and how their educational performances evolve in the pandemic. Students possessing all the needed conditions are not related to a specific pattern of evolution with respect to their educational performances. On the other hand, students with

average studying conditions, but poor infrastructure are associated with low probability of improvements in educational performances. In the same time, students possessing some infrastructure, but poor studying conditions and those lacking conditions report an increase in their educational performances during pandemic. So, lacking proper studying conditions seem to be associated with an improvement in educational performances when shifting to online education, but we have to keep in mind that the item measures perceived educational performances.

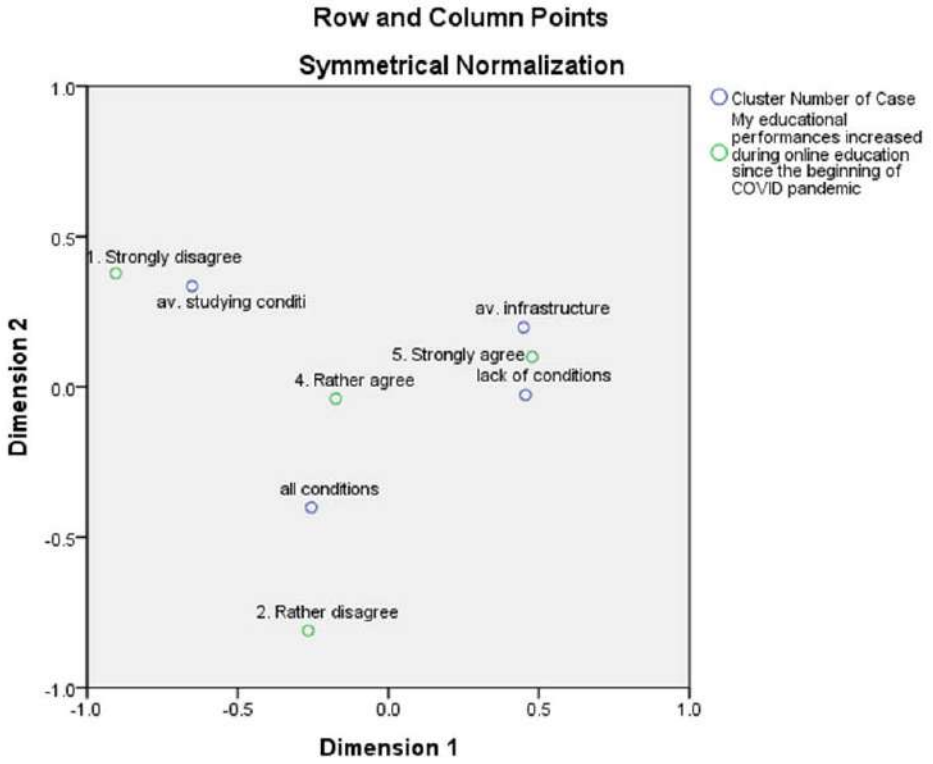

Figure 6. Correspondence analysis between type of clusters and perceived evolution of educational performances during pandemic
Source: Survey among higher education students from Romania and Iceland carried out within the project NEW-DIGI-EDU 20-COP-0043, Authors' estimations

Conclusions

Transformations generated by the shift to online education, investments that higher institutions already carried out in technological infrastructures, as well as the positive changes witnessed in the lives of students and teachers will probably urge institutions to develop mixed education, combining onsite and online education. But the designing and implementation of mixed education must consider a balance between advantages and disadvantages generated by the use of new technologies, as well as the implications on the quality of education.

Our paper aimed to explore the links between barriers to education and different experiences on online education, considering the diversity of students. Students have experienced unequally the barriers hindering online education during pandemic. Furthermore, these differences in barriers are associated with differences in how students experienced the workload, skills need, motivation and educational performances. Most important, students with no conditions at all for online education have been mostly disengaged from the educational activities. On the other hand, students having all the needed conditions who were probably the ones most engaged in online education reported an increase in their workload, higher level of skills needed and a higher level of motivation after shifting to online. However, they experienced no important changes in their perceived educational performances.

For students in Romania and Iceland, not having the needed infrastructure for online education has been a factor of demotivation during pandemic, findings being similar to other studies in the field. On the other hand, shifting to online education brought some improvements in educational performances of students lacking proper studying conditions as probably new teaching and learning practices specific to online education have been more accessible for them. Moreover, students possessing some infrastructure but poor studying conditions, and also poor digital skills, benefited the most from the shift to online education as they reported an increase in both their motivation and educational performances.

Concluding, public interventions focused on improving the infrastructure available to students seem to be most effective for supporting educational resilience in contexts of online education. Also, a specific importance has to be put on developing IT departments in universities in order to support the proper digital upskilling among students in their efforts to fully make use of platforms and software.

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