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Sustainable Education and Digitalization through the Prism of the COVID-19 Pandemic

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Abstract: Our paper discusses how sustainable education has evolved at higher education institutions (HEIs) during the COVID-19 pandemic by embracing digitalization and novel technologies. In addition, it describes the innovative methods for integrating technology into professional education during and after the COVID-19 pandemic. We evaluate the global practices and fundamental changes in the sphere of higher education, particularly regarding sustainable education and digitalization. The paper aims at describing the challenges faced by higher education institutions in adopting sustainable education and digitalization, as well as the opportunities for growth and innovation that have arisen due to the pandemic. Our methods include the empirical model, which assesses the acceptance and usage of novel digital technologies for promoting sustainable education by university professors and academic researchers in four major Russian cities (Moscow, Krasnodar, Kazan, and Saint Petersburg) during the COVID-19 pandemic. The results of the model reveal the significance of implementing sustainability in the classroom, which could bring positive outcomes to both students and teachers. Our study provides a valuable resource for educators seeking techniques, models, and practical advice to overcome the obstacles of teaching in a digitally connected learning environment in Russia and beyond. Specifically, we propose that the primary focus of digitalizing professional education should be on teachers and instructors who are enthusiastic about leveraging technology for learning and who are familiar with novel digital technologies. It appears that digital technologies are capable of transforming teaching practices for sustainable education and economic development.

Keywords: sustainable education; digital transformation; sustainability; COVID-19 pandemic

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1. Introduction

The COVID-19 pandemic caused many profound and unexpected changes all around the world affecting almost every aspect of human life [1,2]. Higher education has been no exception, as the pandemic forced higher education institutions (HEIs) to rethink the way they teach and engage with students [3–5]. Our study focuses on two areas of higher education that have been impacted by the pandemic: sustainable education and digitalization of higher education.

In general terms, sustainable education refers to the incorporation of environmental, social, and economic sustainability into the curriculum and learning outcomes [6,7]. The COVID-19 pandemic has highlighted the importance of sustainable education, as it has revealed the vulnerabilities of the current economic and social systems. In addition,

the pandemic has made it clear that students need to be prepared to be critical thinkers and problem solvers who will be able to navigate and address the challenges of the future and orient themselves in the issues of global climate change threats and sustainable development [8–10].

Over the past two years, the COVID-19 pandemic has noticeably diverted public attention away from climate change, which represents a more profound and serious problem for humanity [11,12]. The emergence of the COVID-19 pandemic in March 2020 challenged the role of climate change as an ordinary problem. Climate change denial due to the pandemic is an issue for long-term resolutions of climate change because it seems to turn climate change back into an intractable problem [13]. Even though the worst effects of the novel coronavirus are hopefully in the past, their legacy will heavily burden efforts to slow down climate change. If the coronavirus has been the test case to combat an enormous global problem such as climate change, then so far, the developments are not promising. We are already beginning to see how the fierce pandemic could alter climate action as well as have effects on jobs, capital, and economic resilience [14]. This global challenge can speed up several policy changes that have been evolving over the course of a few years on global health. What that means is that the global climate crisis, when it arrives, may turn out to be much longer in duration, and much more devastating, than we are seeing now in terms of fierce pandemics. The recent pandemic has given us perhaps a preview of what a full-blown climate crisis might involve, in terms of concurrent exogenous shocks to supply and demand, supply chain disruptions, and global mechanisms for transmission and intensification [15]. Thence, the global health crisis is rapidly turning into an economic crisis, which is likely to have significant social and geopolitical consequences in the coming years.

Addressing the worsening climate crisis necessitates aligning governmental actions, financial programs, and education initiatives to support robust climate action, with a comprehensive approach required to reduce climate pollution across all sectors of the economy. Such a strategy would enhance resilience to the adverse impacts of climate change, safeguard public health, protect natural habitats and biodiversity, advance environmental justice, and drive economic growth through the innovation, commercialization, and deployment of clean energy technologies and infrastructure [16]. To achieve these goals, significant global cuts in greenhouse gas emissions must be made in the near term, with global net-zero emissions required by mid-century or earlier [17]. Climate action would remain vital over the next decade, and investments in climate-resilient infrastructure and a low-carbon future could generate substantial job opportunities, increasing both economic and environmental resilience all around the globe [18]. The critical takeaway is that, if we have learned from the lessons of COVID-19, we can face climate change with greater awareness about the consequences of action, and with greater preparations for saving lives and preventing the worst outcomes. Saving lives requires immediate action to tackle both the COVID-19 pandemic and climate emergencies. By investing in concrete climate solutions, we are ensuring public health is protected while facing the ongoing COVID-19 pandemic and the climate crisis. While actions taken during the pandemic may provide immediate concrete benefits for populations, the success of efforts to slow climate change depends in large part on whether other international actors will also take similar steps [19]. Climate change is similarly global as far as the impacts of warming climates and increased natural disasters would be felt in all countries around the globe. Therefore, it represents a powerful risk multiplier that may, in fact, contribute to the pandemic's adverse effects [20]. Even as the world works to stem a new coronavirus and begins recovering from it, it must also act now to avert climate catastrophe, building and deploying innovations that allow us to eliminate our greenhouse gas emissions as well as to educate young people on how to tackle climate change.

The aim of the paper is to study the acceptance and usage of novel digital technologies for promoting sustainable education that resulted from the disruptions and changes caused by the COVID-19 pandemic by university professors and researchers. Even though there are quite a few papers covering this topic in the research literature, the novelty of our paper

and its contribution to the literature is that we focused on the university professors and researchers from four major Russian cities (Moscow, Krasnodar, Kazan, and Saint Petersburg) and there is just a handful of studies on that topic conducted in Russia (which otherwise represents a very interesting and peculiar study subject that is rarely touched upon).

Our research questions are the following: Does the integration of sustainable education and digitalization in the Russian Federation (as well as in other countries) have the potential to create a sustainable future and enhance the quality of the education system? Would the policies aimed at promoting digital sustainable education, incorporating sustainability topics into the courses, and using digital technologies to make learning more interactive and engaging bring positive outcomes to both students and teachers and prepare them for a sustainable future? What factors (e.g., demographic, educational) influence the acceptance and usage of digital technologies for promoting sustainable education during the COVID-19 pandemic?

The paper is structured in the following manner: Section 2 presents an in-depth literature review on the impact of digitalization on higher education in the post-COVID era, highlighting the significance of sustainable education. In the subsequent section, we outline our sample and detail the data collection process employed to obtain the data that informed our study. Section 4 explains the empirical model utilized to evaluate the acceptance and use of novel digital technologies in promoting sustainable education by university professors and academic researchers in four Russian cities and presents the principal findings. Section 5 provides a comprehensive analysis of the results obtained, followed by the final section, which summarizes the overall conclusions and implications, as well as future research directions and limitations of our study.

2. Literature Review

2.1. COVID-19 and the "Digital Surge" in Educational Institutions

In general terms, many researchers demonstrated that the vision of leaders has been the main driving force behind the digital transformation of educational institutions. Governance strategies that acknowledge the heterogeneity of educational institutions across the globe and enable the shift from vision to action through digital technologies need to be formulated and implemented with regard to the current situation in the world [21,22].

According to some scientists, COVID-19 has brought the so-called digital surge that resulted in higher adoption of information and communication technologies (ICTs) in virtually every sphere of business, economics, and education—from Zoom meetings to MS Teams classes and group calls in business companies and educational establishments [23].

During the ongoing COVID-19 pandemic, where ICTs are still being heavily used in education, it is believed that examining teachers' views regarding the digital leadership roles of principals would be valuable for the relevant academic experience [24–27]. For instance, Fülöp et al. studied the role of universities' sustainability, teachers' well-being, and attitudes toward e-learning during COVID-19 and found some discontent and discomfort for the teachers who had to adapt to the new technologies which hampered their involvement in sustainable development [28,29]. Principals and university managers are expected to be those leaders who can lead their educational institutions into the digital age. They are crucial when transforming educational institutions into the digital era [30,31]. Many researchers note that effective communication regarding digital learning is crucial to ensure that parents and families are informed and involved and that they trust the decisions made by educators. Institutional leaders identified as part of the digital learning leadership team are critical to setting expectations for effective digital learning [32,33]. It is essential that the digital learning leadership teams think about how to use technology effectively, collaborate with parents, set protections, and create safe, supportive communities. Thence, digital transformation is a process of organizational change that requires a unique view, perspective, and set of leadership skills, and involves changes in the universities' curriculum and the entire teaching-learning culture. Some research suggests that digital transformation is not focused on a particular strategy or software, but instead uses technologies to advance

improvements to fundamental strategic and operational challenges. It requires adopting new ways of learning and leadership, driving cultural change, and aligning strategies, talent, and resources throughout the organization [34–36].

Thus, in order to successfully become a truly digital-first organization, having leaders who are committed to transformation becomes the key. The integration of technology into education is expected to respond to challenges, such as creating more flexible, motivating ways to learn that are self-directed and collaborative [37]. The use of digital instructional resources allows for new roles for teachers and students. Digital transformation processes incorporate a range of technologies, such as digital technologies, social networks, learning management systems, big data, digital education technologies, software, machine learning, computers, and information systems. These tools facilitate a complex process that involves various actors, including students, teachers, content providers, administrators, industries, digital platforms, governments, faculty preparation units, information systems, and communities, as detailed in the academic literature [38,39].

2.2. Digitalization of Higher Education

Even prior to the COVID-19 pandemic, it has always been crucial for educational systems to support lecturers' and teachers' professional learning and development around digital citizenship, tailoring instruction to individual student's needs. Teachers and lecturers have an additional role in facilitating professional learning opportunities. They require professional learning investments from leadership teams that lead the charge in digital learning and need time and support, just like students who learn through digital tools [40,41]. The research literature suggests that the rewards for leaders who innovate and collaborate with lecturers and teachers at their systems will be stronger, safer, and more successful student populations who are better equipped to keep up with digital learning, possessing enduring resilience and yielding greater transition and workforce readiness [42].

In the Russian Federation, digitalization has become a significant trend, with the government implementing policies to enhance digital literacy and infrastructure. Table 1 below reports the levels of e-government development and e-participation indices in the Russian Federation over the span of nine years from 2003 to 2022. The rising trend is quite obvious and the interest in e-government and e-participation is apparent (apart from the last year).

Table 1. Digitalization and e-government in the Russian Federation (2003–2022).

Year	e-Government Development Index	Rank	e-Participation Index	Rank
2022	0.8162	42	0.6023	57
2020	0.8244	36	0.8690	27
2018	0.7969	32	0.9213	23
2016	0.7215	35	0.7458	32
2014	0.7296	27	0.6863	30
2012	0.7345	27	0.6579	19
2010	0.5136	59	0.1286	86
2008	0.5120	60	0.0909	98
2005	0.5329	50	0.1429	61
2004	0.5017	52	0.2131	41
2003	0.4426	58	0.0517	91

Source: United Nations (2023). Adapted from Ref. [43].

In 2019, the Russian government launched a "Digital Economy" program aimed at increasing the country's digital literacy and technology adoption rates. The program included plans to develop digital skills training, increase access to digital devices, and create digital content, which aimed to increase the country's digital literacy and technology adoption rates [44]. The program included plans to develop digital skills training, increase access to digital devices, and create digital content. The "Digital Economy" program aimed at

increasing digital literacy rates among the Russian population, particularly among the elderly and rural community dwellers, which was intended to lead to increased productivity, better communication, and greater access to information [45].

Furthermore, the "Digital Economy" included plans to develop digital content for the education sector, providing students with access to high-quality educational resources. E-learning platforms would provide students with remote access to course materials, facilitating learning and collaboration. Programs focused on developing a digital economy can drive innovation and create new job opportunities. The government also planned to develop a digital infrastructure to support start-ups and small businesses for encouraging entrepreneurship and innovation [46]. The program's emphasis on digitalization was envisaged to improve the efficiency of government operations, reduce administrative costs, and streamline processes. Researchers noted that the digital platforms would facilitate communication between government agencies and citizens, increasing transparency and accountability [47].

Despite the program's aim to increase access to digital devices and infrastructure, many Russians, particularly those living in rural areas and in low-income households, still may not have the resources to access them. This could lead to a digital divide, with some groups being left behind in the digital economy. The increasing use of digital technologies in the economy also raises concerns about data privacy and security. As more personal data are collected and shared, there is a risk of data breaches and cyber-attacks [48]. This could undermine public trust in the digital economy and lead to economic losses. In addition, the adoption of digital technologies could lead to job displacement, particularly in industries such as manufacturing and transportation. Automation could lead to fewer job opportunities, creating economic and social challenges for those affected.

Figure 1 shows the results of an analytical analysis based on the Google Trends toolkit showing the frequency dynamics of the search requests for such terms as "sustainable education" and "digitalization" and "sustainable development" and "digitalization" all around the world for the past 10 years.

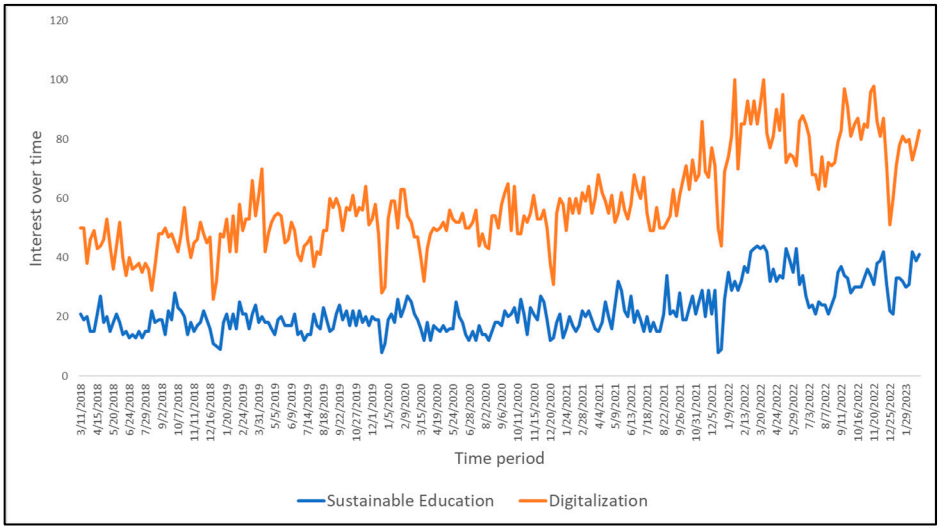

Figure 1. The dynamics of frequency of search requests of the concepts of "sustainable education" and "digitalization" all around the world (2013–2023). Source: Own results based on the data retrieved from Google Trends (2023). Adapted from Ref. [49].

By contrast, Figure 2 shown below depicts the results of the analytical analysis based on Google Trends showing the frequency dynamics of the search requests for the terms "sustainable development" and "digitalization" in the Russian Federation in the past 10 years. One can see that the interest and focus on sustainability has considerably increased

in Russia and coincides with the interest in digitalization all around the world. The "Digital Economy" program might be one of the reasons for this change.

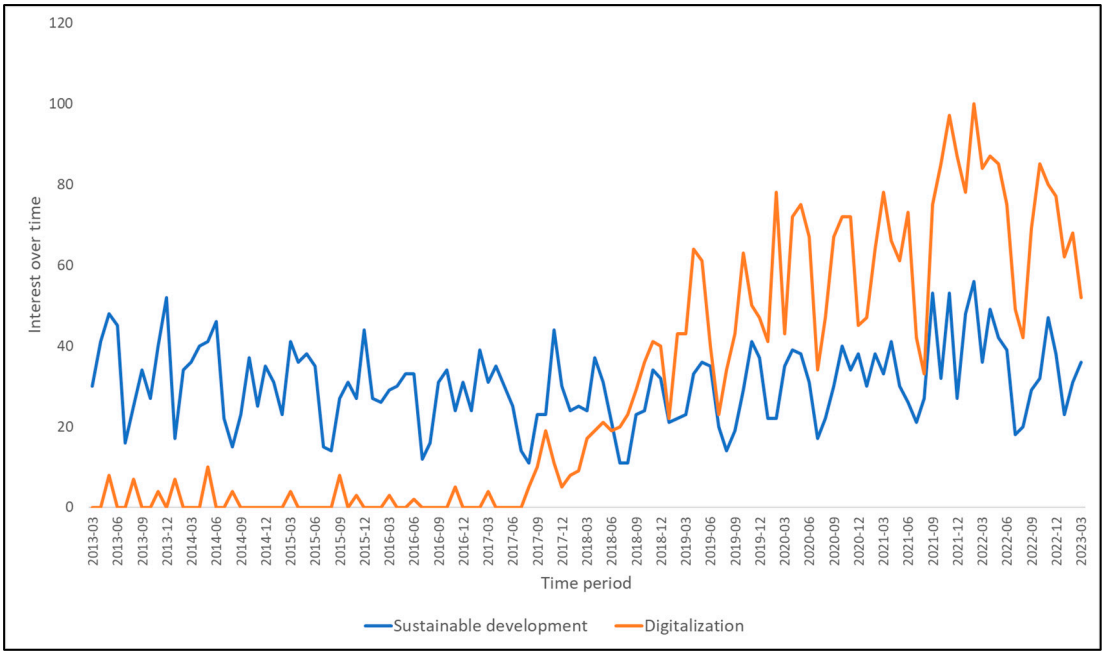

Figure 2. The dynamics of frequency of search requests of the concepts of "sustainable development" and "digitalization" in the Russian Federation (2013–2023). Source: Own results based on the data retrieved from Google Trends (2023). Adapted from Ref. [49].

All in all, the "Digital Economy" program has the potential to improve digital literacy rates, stimulate economic growth, and improve government efficiency. However, the program also raises concerns about unequal access, data security, and job displacement. To mitigate these concerns, the government needs to ensure that the benefits of digitalization are accessible to all, promote data security and privacy, and invest in reskilling and training programs to support workers affected by job displacement. In addition, it has to be noted that digital technologies are well integrated into the Russian education system. For instance, e-learning platforms are common in universities and colleges, providing students with remote access to course materials and facilitating collaboration. Additionally, digital assessment tools are used to evaluate student performance and to provide feedback [50,51].

Moreover, the research literature suggests that digitalization generally enhances sustainable management practices in educational institutions, reducing the environmental impact of operations. For example, digital assessment tools can reduce paper consumption, while energy-efficient devices can reduce energy consumption. Sustainable education, in turn, can enhance digital literacy and promote responsible technology use, reducing the negative impact of digitalization on the environment and society [52,53].

Researchers emphasize the importance of digital leaders in creating universities that effectively serve students. They stress that these leaders must articulate a bold vision of change that challenges the traditional industrialized education model and recognizes the inherent value of technology in enhancing the teaching and learning process [54]. Researchers suggest that educational leaders should devise strategies for deploying technology within their higher education institutions (HEIs), considering the constantly evolving nature of the field and the need to manage staffing and shift toward innovative teaching and learning practices [55]. They also advocate for teachers and lecturers to actively promote a technology-enabled learning environment, encouraging students to engage in learning processes that incorporate technology. Such measures will prepare students for a rapidly evolving world [56,57].

According to many researchers, in the near future, all administrators, teachers, and university personnel will be using technology in the blended learning approach to effectively help students achieve higher standards and prepare for the workforce of tomorrow. Digital technology tools will provide records of students' learning histories and ways to manage learning progress and activities. Technology tools providing feedback and data in real time enable teachers to meet students where they are and assist them in developing individualized learning plans [58,59].

In addition to managing technology usage across digital platforms to ensure students use it for its intended purpose, teachers and lecturers must also ensure that systems, supports, and practices are in place to ensure students develop the skills and competencies to best use these digital resources [60]. If this capability is not distributed across a university, and if universities do not have the tools needed for lecturers and teachers to teach effectively in the digital world, students will ultimately suffer. A vision developed by working collaboratively with a large educational community will become a lighthouse in times of uncertainty, serving as a guide to all students' future learning when shared widely across the academic community [61].

For creating a future-ready educational culture, leadership teams must be built, a cohesive vision for change developed, a systemic action plan developed, effective ways for leaders to use digital tools for increased impact modeled, and ways for teachers and lecturers to use tools to support student learning modeled [62]. Districts must align local tech and digital learning plans with best practices in instruction, implemented by highly trained teachers, and result in customized learning experiences for all students, especially those from traditionally underserved communities. Working with leaders in education, both in a research capacity and a consultancy capacity, is key to understanding more about and leading their HEIs in developing and implementing digital learning programs that are transformative and sustainable. Learning technology allows students, teachers, and parents to focus on the process of learning and growth [63].

2.3. Sustainable Education in Higher Education Institutions

As many studies demonstrate, the COVID-19 pandemic has undoubtedly accelerated the shift toward sustainable education in higher education institutions [64–68]. Institutions have started to incorporate sustainability into their curricula, teaching methods, and learning outcomes. For example, universities have begun to offer courses on sustainable development, green energy, and environmental economics. Additionally, institutions are collaborating with businesses and industries to provide students with hands-on experience in sustainability-related projects [69,70].

Moreover, the pandemic has forced higher education institutions to rely heavily on digital technology for teaching and learning. Furthermore, it has accelerated the adoption of digital technology in higher education, as institutions have had to quickly pivot to online teaching and learning [71–73].

Digitalization has transformed higher education in several ways. It has made education more accessible and flexible. Students can now access educational resources from anywhere in the world, at any time. In addition, digitalization has enabled institutions to personalize learning experiences for students, using data analytics to track student progress and adapt teaching methods accordingly. Additionally, digitalization has enabled institutions to collaborate and share resources more easily, leading to increased innovation and efficiency [74–77].

Despite the benefits of sustainable education and digitalization, there are also challenges that institutions face in adopting them. There is a lack of resources and funding for sustainable education initiatives as many institutions struggle to find the resources to integrate sustainability into their curricula and teaching methods. In addition, not all students have access to digital technology, which can lead to inequalities in access to education. There are also some concerns about the quality of online education and whether it is as effective as in-person education [78,79].

The incorporation of digital technologies in higher education is crucial for its advancement and refinement, as learning has become increasingly reliant on digital tools and methods. However, the development of digital-based teaching and learning poses a challenge to media education and e-learning studies, as they need to establish a transdisciplinary dialogue with other academic fields [80]. The integration of emerging technologies and educational concepts is necessary to cultivate practical digital expertise, which can enhance student learning and social belonging and reduce attrition rates [81].

While technology has the potential to support student-centered learning, some researchers argue that traditional teaching and learning practices need to be strengthened and augmented deliberately [82]. It is important to note that classroom instruction can be strengthened by technology when used appropriately. As technology continues to advance rapidly, traditional ways of teaching and learning are no longer sufficient to push students and teachers to reach their full potential. Consequently, professional development for teachers is becoming a priority, with many HEIs embracing new technologies to improve their pedagogical foundations [83].

The integration of sustainable development and digitalization has become an important agenda for educational institutions worldwide, including Russia [84]. Sustainable education aims to educate students on environmental, social, and economic issues to create a sustainable future. On the other hand, digitalization in Russia has transformed the education system, providing opportunities for enhanced learning, teaching, and collaboration [85].

Sustainable education in Russia is relatively new but it is gaining momentum. In 2019, the Russian government passed a decree to integrate sustainable development principles into the country's education system, including primary, secondary, and higher education institutions [86]. The decree aimed to create a new generation of environmentally and socially responsible citizens capable of contributing to the country's sustainable development. One initiative in sustainable education in Russia is the "Green University" project. The project aims to introduce sustainable development principles into the country's universities and colleges through environmental education, eco-design, and sustainable management practices [87]. Another initiative is the "Eco-School" program, which targets primary and secondary schools. The program educates students on environmental issues and promotes sustainable behavior [88].

The integration of sustainable education and digitalization in Russia has the potential to enhance the country's education system's quality and create a sustainable future. Digital technologies can support sustainable education in this country by providing access to digital content on sustainable development issues, facilitating remote learning, and encouraging collaboration between students and educators. For example, e-learning platforms can provide access to digital libraries on environmental and social issues, while digital collaboration tools can facilitate group work on sustainable projects [89].

3. The Data

In the empirical portion of our study, we undertake an analysis of the acceptance and utilization of innovative digital technologies to promote sustainable education by university professors and researchers in four Russian cities (Moscow, Krasnodar, Kazan, and Saint Petersburg) during the COVID-19 pandemic. Our data were obtained from an independent survey that we administered in these cities between September 2020 and March 2021. Our sampling approach utilized both quasi-random selection and a combination of snowball, opportunity, and convenience sampling techniques. We recruited respondents through social networks such as Telegram messenger and VKontakte, as well as personalized emails. The use of this sampling method was motivated by the opportunity to reach an Internet-based population that would have otherwise been inaccessible (see e.g., [90–92]). Nevertheless, due to the profound changes in higher education not only in the Russian Federation but also worldwide in recent years, it should be clear that the penetration of digital tools and techniques in teaching and research is massive and the recent COVID-19

pandemic and the distance learning and meetings it promoted and further popularized made this trend a real "digital surge".

We utilized non-random sampling methods, in particular, the snowball technique and opportunity sampling through our contact points, or the so-called gatekeepers (graduate students who had the local knowledge and logistics and often possessed the contacts to the other respondents in the academia thus ensuring the trusted assess to the respondents and assisted data collection (see e.g., [93,94])). We have chosen this particular method in order to reach the younger and better-educated Internet-based population who may not be reachable otherwise and to communicate with those who may not have time for face-to-face meetings. We prepared our graduate students to approach and select respondents and obtain their answers while adhering to ethical standards. In terms of ethical considerations or ethical standards as a basis for gathering primary data, the present study has adhered to the principles of the Declaration of Helsinki and was sanctioned by the Institutional Review Board of the Czech University of Life Sciences.

We must admit that our sample might be slightly skewed toward better-educated respondents who might be not very representative of the population. Nevertheless, we think that our results still provide valuable insight into the usefulness of promoting sustainable education and digitalization in higher educational facilities and research institutions and might offer important lessons for higher education professionals and policymakers in the Russian Federation as well as beyond.

We have obtained a sample size of 265 participants from the Russian Federation, consisting of 58% females and 42% males. The mean age of the participants was 45.53 years with a standard deviation of 11.46, and the median age was 45 years. All participants voluntarily and anonymously completed our questionnaire. The descriptive statistics of the sample are reported in Table 2.

Table 2. Descriptive statistics of the respondents.

		Numbers	**%**
Age	22–26 years	32	12%
	27–40 years	77	29%
	41–60 years	148	56%
	61–80 years	8	3%
Gender	Female	154	58%
	Male	111	42%
Degree	Bachelor's or Master's	53	20%
	PhD and higher (Full Professor)	212	80%
Position at the university	Lecturer	192	73%
	Researcher (Research Fellow)	37	14%
	Academic managers	31	12%
	Other staff	5	2%
Area of specialization	Social sciences	188	71%
	Formal sciences	29	11%
	Natural sciences	13	5%
	Applied sciences	34	13%
N = 265			

Source: Own results.

Our survey covered several topics related to digitalization and the attitudes to the topics of sustainable development and sustainable education during the COVID-19 pandemic and consisted of 21 questions. However, for the purpose of this paper, we selected just a few relevant questions that were analyzed and used in our empirical analysis. The questions in the questionnaire included the usual socio-demographic characteristics (age, gender, level of education, area of occupation or type of work, or the annual net personal income) as

well as questions that were composed on a 5-point (Likert-type) scale and ranged from 1 (strongly disagree) to 5 (strongly agree) or from 1 (weak) to 5 (strong).

4. Empirical Model

In this section, we present the results of the empirical model focusing on embracing digitalization and sustainable education due to the COVID-19 pandemic. Table 1 reports the cross-tabulation of the responses showing the acceptance and usage of novel digital technologies for promoting sustainable education by university professors and researchers from the four Russian cities contained in our sample of respondents.

Looking at the results from Table 3, one can see that the usage of digital technologies was met with quite positive attitudes across our sample from four Russian cities. This might be explained by the fact that there were not many alternatives to embracing these technologies for lecturers and researchers, even though some of them were not quite happy about it. The second question confirms it showing that the acceptance of distance learning (both teaching students online and attending online lectures for personal development) was lower. This finding can be explained by the fact that the changes and the "digital surge" brought about by the pandemic are yet to become rooted in society, which might take quite some time. On the contrary, the third question regarding sustainable education showed that this topic has gained some attention with more than 50% of our respondents tending to get some interest in it or even starting to promote and popularize it in their work or teaching due to the pandemic.

Table 3. Acceptance of digital tools and approaches for sustainable education (cross-tabulations of responses).

	1—Disagree [a]	2 [a]	3 [a]	4 [a]	5—Agree [a]	Total
Using digital technologies	18%	20%	20%	22%	20%	100%
Applying distance learning	24%	16%	20%	24%	16%	100%
Sustainable education	12%	18%	20%	21%	29%	100%

Note: [a] The pandemic made me to use novel digital technologies (e.g., teleconferencing, remote research collaboration, or distance learning); the pandemic made me to apply distance learning and collaboration in my work; the pandemic made me to promote sustainable education, 1—strongly disagree, 5—strongly agree. Source: Own results.

Furthermore, we utilized our gathered data to conduct an ordinal regression analysis with the aim of evaluating the variables that influence the acceptance of new digital technologies and their role in promoting sustainable education in teaching and research. The formal model that we developed is presented in Equation (1) below:

$$Acceptance = logit\ (\alpha_0 Age + \alpha_1 Gender + \alpha_2 Educ + \alpha_3 Spec + \alpha_4 Position + e) \quad (1)$$

where:

Acceptance—acceptance of novel digital technologies and sustainable education;
Age—age of the respondent;
Gender—gender of the respondent;
Educ—level of education of the respondent;
Spec—area of specialization (social sciences (sociology, economics, humanities, etc.) or formal sciences (e.g., logic, mathematics, etc.), natural sciences (geology, physics, chemistry, biology, etc.), and applied sciences (validating theoretical models of formal science));
Position—position at the university (lecturer, researcher, academic manager, other);
e—an error term.

Table 4 reports the results of our ordinal regression empirical model divided into three main categories (digital technologies, distance learning, and sustainable education).

Table 4. Acceptance of digital technologies for promoting sustainable education during the COVID-19 pandemic (ordinal regression analysis).

	Digital Technologies		**Distance Learning**		**Sustainable Education**	
	Estimate	**Sig.**	**Estimate**	**Sig.**	**Estimate**	**Sig.**
Threshold 1	2.166	0.365	−0.366	0.920	2.742	0.083
Threshold 2	3.431	0.025	0.997	0.512	3.652	0.005
Threshold 3	4.874	0.000	2.974	0.049	4.578	0.000
Threshold 4	6.355	0.000	4.476	0.000	5.958	0.000
Age	−0.042 *	0.202	−0.048 **	0.055	−0.042	0.237
Gender (men)	0.243	0.752	−0.624	0.557	0.634 **	0.086
Educ	0.511 **	0.498	0.565 ***	0.388	0.492 *	0.622
SocSci	0.611 **	0.017	0.454 *	0.125	0.354 *	0.226
FormSci	0.477	0.668	0.472	0.668	0.102	0.785
NaturSci	0.867 **	0.017	0.766 **	0.334	0.567 *	0.312
ApplSci	0.742 **	0.088	0.011 *	0.891	0.776 *	0.081
Lecturer	0.442 **	0.086	0.709 **	0.006	0.389 ***	0.145
Researcher	0.150 **	0.654	0.611 *	0.069	0.649 **	0.057
Cox and Snell	0.081		0.076		0.085	
Nagelkerke	0.097		0.067		0.085	
McFadden	0.051		0.048		0.043	
Sig.		0.004		0.007		0.004
N			265			

Note: *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level. Source: own results.

Our results demonstrate that demographic factors such as age tend to be negatively related to the acceptance of digital technologies for promoting sustainable education during the COVID-19 pandemic. This is quite understandable since older people tend to be more negative about accepting novel things in general. Gender appears to have no significant effect, perhaps due to the gender diversification in Russian science (the majority of university lecturers are females, while a high number of researchers are males (of course this also depends on the branch and type of science)).

On the other hand, factors such as the level of education, area of specialization (science), and being a lecturer or researcher increase the acceptance of digital technologies. People working in natural sciences are inclined to accept these technologies as well as sustainable education agenda more than those in applied sciences or social sciences. This is quite understandable due to the nature of their work which included a high level of digitalization and internalization before the pandemic. In addition, lecturers were more inclined to focus on sustainable education during the COVID-19 pandemic than researchers. This shows that lots of them probably already included the sustainability-related topic in their teaching agenda.

Our results clearly reveal that the acceptance of digital sustainable education in our sample of Russian lecturers and researchers during the pandemic was quite high and significant (even though it might be that many respondents accepted it because they had to and had no other choice or alternative to opt out). The results also demonstrate that the familiarity with these concepts and technologies was quite high for some respondents before the pandemic and that the pandemic only deepened the existing and ongoing trends. These results reflect upon the importance of further implementing digitalization and sustainability into educational strategies, plans, and policies of HEIs not only in the Russian Federation but also in other countries all around the world once the pandemic is finally over and new threats and challenges emerge.

5. Discussion of Results

The COVID-19 pandemic and associated restrictions have highlighted the limitations of educational systems' digital infrastructure, as well as the significant digital divide between students and lecturers. As a result, there has been increased attention on education digitalization policies, with most universities and HEIs embracing digitization in the post-

COVID-19 era. Prior to the pandemic, many organizations cited a lack of prioritization as the main reason for not embracing digital transformation. However, the pandemic forced them to re-evaluate their tech investments and capabilities, leading to the removal of barriers that previously hindered digital implementation.

During the lockdowns, new digital platforms featuring teacher-video classes and game-based learning activities helped to provide curriculum support and teacher professional development during temporary school and university closures. Various learning platforms, such as Google Suite Education, Smart Class, Microsoft Teams, or Zoom (just to name a few), have also been used to assist students.

Following the pandemic, authorities have identified key areas for using digital technologies for secondary and higher education. Thence, it is important that leaders conduct workshops on digital literacy for teachers, families, and students. They also need to think about how to use technology effectively, work collaboratively with parents, set protections, and create safe, supportive communities. Teachers also require professional learning investments from the digital learning leadership team.

In addition, it is apparent that the interest in sustainable development and sustainable education has also increased during the pandemic (as our case study from the Russian Federation featuring lecturers and researchers from four Russian cities), which reflects the importance of the threats posed by global warming and climate change. This interest fits well into the concept of digitalized sustainable academic leadership and, therefore, needs to be further promoted and supported both at the local level of HEIs and at the governmental level. The exchange of the best practices from different countries can also be very beneficial and would lead to formidable results.

6. Conclusions and Implications

Overall, it has become clear that the COVID-19 pandemic has accelerated the shift toward sustainable education and digitalization in higher education. Institutions have started to incorporate sustainability into their curricula and teaching methods, while digital technology has made education more accessible and flexible. While there are challenges to adopting these changes, such as lack of resources and concerns about online education quality, there are also opportunities for growth and innovation. The pandemic has highlighted the importance of preparing students for the challenges of the future, and sustainable education and digitalization are crucial components of that preparation.

The COVID-19 pandemic has led to unprecedented disruptions in education systems globally, with university closures affecting billions of students and young people worldwide. The crisis has highlighted pre-existing disparities in access to quality instruction and has raised fundamental concerns about human rights, both in the present moment and after the crisis. At the national and international levels, stakeholders, including Ministries of Education, the European Commission, the World Bank, and the OECD, see the pandemic as a pivotal moment to promote digitization in educational systems. Educational systems worldwide have debated the potential of learning platforms and online learning, the role of exams and external assessments, and how to design effective policies for addressing new forms of educational inequalities.

This paper provides an overview of the impacts of the COVID-19 crisis on educational systems globally, highlighting the potential role of national education systems in mediating countries' responses to common external challenges created by the pandemic. The study examines the predictors of perceived job strain for teachers and guidance counselors in a transitional period for in-house e-learning during the COVID-19 pandemic. The findings reveal challenges and opportunities for education systems in the post-pandemic world, including the need to develop students' skills, create new learning methodologies, and enhance assessment flexibility.

Efforts have been made to support education systems during the pandemic, such as teacher inoculations, increased support, and resources. However, the economic and social crises resulting from the pandemic are expected to raise levels of poverty among children

and young people in many countries, with significant impacts on inequality of access to education. In response to the challenges presented by COVID-19, curriculum affairs teams in various countries have developed and implemented a blended learning model that prioritizes safety while providing critical in-person learning experiences. Educational systems have been engaged in cross-professional learning, such as working with online educational platforms and cultivating partnerships with international providers. Universities have been re-examined as catalysts of growth and development, with the focus on building ecosystems of learning that ease students' movement across structures.

Addressing education's complexity in a digital era requires a dialogue that draws upon insights and research from diverse fields. Key changes are forcing teachers and instructors to reconsider their goals and methods of instruction and identify the critical knowledge and skills that students need in a digital age. Emerging and innovative pedagogical approaches are crucial to help preservice teachers build the skills needed to teach in the discipline. In addition, equity issues need to be addressed by providing information and tools to preservice and in-service teachers to meet the varied needs of all students. Digital tools can be used to provide guidelines for using digital tools in an online instructional setting in a pedagogically sound manner.

Our results demonstrate that the integration of sustainable education and digitalization in the Russian Federation has the potential to create a sustainable future and enhance the quality of the country's education system. While sustainable education is relatively new in Russia, the government has initiated policies and programs to integrate sustainable development principles into the country's education system. Digitalization, on the other hand, has transformed the education system, providing opportunities for enhanced learning, teaching, and collaboration. By integrating these two trends, educational institutions can create a sustainable and technologically advanced future in the Russian Federation.

Overall, our study examined the acceptance and usage of digital technologies for promoting sustainable education during the COVID-19 pandemic. The results indicated that demographic factors, such as age, were negatively related to the acceptance of digital technologies for promoting sustainable education, while factors such as education level, area of specialization, and being a lecturer or researcher increased acceptance. The familiarity with these concepts and technologies was already high for some respondents before the pandemic, and the pandemic only deepened existing trends. The study suggests that HEIs should implement digitalization and sustainability into their educational strategies, plans, and policies. The results reveal the significance of implementing sustainability in the classroom, which could bring positive outcomes to both students and teachers.

It seems important to add more policies derived from this work to improve sustainability in higher education institutions. Our findings provide valuable insights for developing policies and strategies that could help universities to promote digital sustainable education. Higher education institutions need to promote digitalization and sustainability in their educational strategies and policies, which will benefit both students and teachers. Such policies could include mandatory training sessions and workshops for professors and researchers on digital sustainable education and encouraging them to integrate these concepts into their teaching curriculum.

Furthermore, higher education institutions can implement sustainability in the classroom by using digital technologies. For instance, they can use digital tools to make learning more interactive and engaging, such as through virtual simulations, online forums, and webinars. Additionally, they can incorporate sustainability topics into their courses, such as sustainability-focused case studies, projects, and assignments. This would help to create an awareness of the importance of sustainability and develop students' knowledge and skills.

It appears that implementing sustainability in the classroom will benefit both students and teachers. Students will develop a deeper understanding of sustainability and learn how to apply sustainable practices in their lives. Moreover, they would become more digitally literate and capable of using digital tools to solve complex problems. For teachers, implementing sustainability in the classroom will enable them to deliver more engaging

and relevant content, and it will also help them to better understand their students' needs and perspectives.

Our results highlight the significance of implementing digitalization and sustainability into the educational strategies, plans, and policies of higher education institutions. The findings suggest that familiarity with digital sustainable education was high for some respondents before the pandemic, and it only deepened existing trends. Therefore, HEIs should implement policies to promote digital sustainable education, incorporate sustainability topics into their courses, and use digital technologies to make learning more interactive and engaging. This would bring positive outcomes to both students and teachers and prepare them for a sustainable future. It needs to be acknowledged that our study has several limitations. One of the main limitations is that it only focuses on one country, and the results may not be generalizable to other countries with different socio-cultural and economic backgrounds. The study provides only a snapshot of the situation during the pandemic, and the acceptance of digital sustainable education may change after the pandemic.

Moreover, the sample used in this paper was obtained through convenience sampling, and the respondents volunteered to participate, which could result in a self-selection bias. The sample may not represent the entire population of Russian lecturers and researchers, and the results may not be generalizable to other groups of respondents in academia. Additionally, the study relies on self-reported data, which could be subject to social desirability bias or recall bias. In addition, our sample might be slightly skewed toward better-educated respondents who might be not very representative of the population.

Furthermore, our study only examines the factors that affect the acceptance of digital sustainable education, but it does not investigate the effectiveness or the impact of such education on the students or the environment. Therefore, future studies are needed to assess the effectiveness of digital sustainable education and its impact on students and the environment.

Finally, our research is limited to the factors that affect the acceptance of digital sustainable education during the COVID-19 pandemic. It does not explore the broader issues related to the implementation of digital sustainable education, such as the availability of technology, access to resources, and the training and support needed for teachers to effectively integrate sustainability into their teaching practices.

All in all, our study has several limitations that should be considered when interpreting the results. Future studies are needed to address these limitations and provide a more comprehensive understanding of the acceptance of digital sustainable education and its impact on students and the environment. The pathways for further research might also include applying our methodology and survey to different populations in other countries (both in Europe and beyond). For instance, it would be very interesting to compare our data with those from the United States or China and to run similar empirical models using the combined datasets to assess and compare the acceptance of digital sustainable education in various countries.

We can conclude that the COVID-19 pandemic has exposed the long-ignored cracks and limitations of the educational system, making it clear that universities and research institutions can quickly adapt to changing circumstances. The crisis has provided deeper challenges and opportunities to transform, and past crises in higher education show it is possible to rebuild in better ways. Our results offer some perspectives from both within and outside various points of view, providing useful insights that could assist the many countries struggling to keep their education systems functioning amidst the COVID-19 pandemic and in the post-COVID era marked by concerns over sustainable development and climate change.

In conclusion, it needs to be stressed that technology is a central goal in education, but it should not advocate for the complete replacement of the current human-based education system with a heavily computerized teaching model without proper consideration. As technology advances in the classroom, there will be increasing demand from students for its inclusion. Faculty members may be awarded grants to develop new teaching

technologies and utilize technology in their classrooms. Students need to be taught to negotiate effectively as a class, push their digital narratives further, and embrace the digitalization of education in the post-COVID era for its further development.

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