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'Lockdown': Digital and Emergency eLearning Technologies—A Student Perspective

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Abstract: The COVID-19 pandemic and the subsequent emergency measures had a fundamental and disruptive impact on societies and, in particular, on the educational sector. The transition of the modality of educational delivery from face-to-face to online occurred within days; this research study considered the concepts of digital trust and digital access, using structuration, postmodernism, and critical social theory as lenses to understand Higher Education (HE) student experiences during the first wave of the lockdown. The study compared these aspects in Hungary, South Africa, and Wales (UK) with different digital and network readiness indices. The digital development of the countries is presented using both the Digital Intelligence and Network Readiness indices. The research approach was cross-country, international, comparative, inductive, and quantitative. The research study found that there was a significant relationship between the countries' GDP and their network readiness, impacting students' online learning experiences. Significant differences were found between the participating universities in terms of digital access and digital trust; this research provides valuable insights for informing future pedagogical approaches and teaching best practice, specifically for residential universities. Understanding challenges and barriers to student learning experiences, and the impact of inequitable access to digital technologies and communication, is key for future pedagogical policy and practice. Several recommendations are made to inform practice.

Keywords: COVID-19; higher education; student learning; digital technologies; digital trust; digital access; online learning; equitable access; country comparisons

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1. Introduction

The pandemic disrupted all aspects of citizens' lives—health services, the economy and educational practices. Government-mandated social distancing and stay-at-home injunctions required a drastic change in educational processes and delivery. The digital economy became the glue holding the "*socially-distanced economy*" together. As Bhaskar et al. [1] (p. 6) contended, digitalization helped people to work, learn, shop, and socialize while locked down; it allowed society to cling to some semblance of normalcy.

It has become imperative for higher education institutions to understand the pandemic-related challenges and experiences of their students: i.e., how did the sudden shift to online learning impact them? Such insights can inform policy makers, education managers and academics and help them to plan for future disruptions to normal practice.

The sudden shift to remote learning and tuition placed a huge burden on both educators and learners [2] with both being unprepared for the shift [3]. Both, in many instances, were confronted with technologies that had to be mastered in a very short period to prepare and deliver/consume online content. Moreover, new ways of working and communicating between students and educators had to emerge, which impacted students' learning experiences, and possibly their satisfaction and well-being. Furthermore, new assessment

strategies had to be adopted to be more conducive to online assessment to prevent irregular and unethical behaviours—such as cheating during online examinations [4]; this was a transition from traditional face-to-face or blended approaches to a purely digital mode of tuition: i.e. eLearning. Khalid et al. [5] suggest several criteria (see Figure 1) to be considered for eLearning readiness; these are: content, equipment (upgrading and maintenance), psychology (attitudes), sociology (relationships), technology (connectivity), physical environment (home), financial (ability and costs to access the Internet) and human resources (for training and support). However, there was too little time for universities to satisfy these criteria, especially in traditional universities where teaching is usually delivered face-to-face.

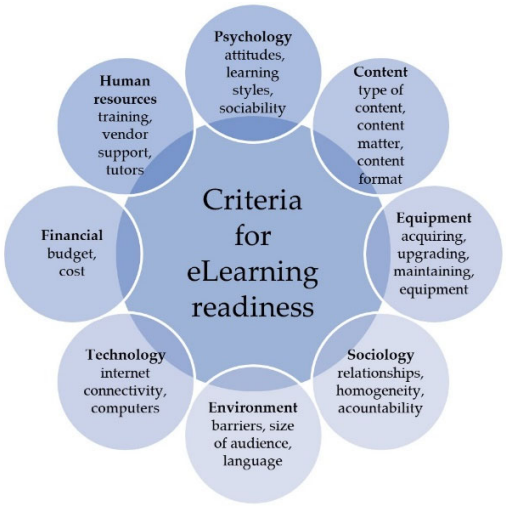


Figure 1. Criteria for eLearning readiness—adapted from Khalid, Jahan and Sobhan [5].

For many students, it was difficult to switch to home learning. Challenges could often be linked to socio-economic status, living space and the number of people cohabiting with them. To access online learning environments, a computer (rather than a smartphone) with Internet access is required. However, according to Van Lancker and Parolin [6], this is not even available to all first-world citizens, since five percent of European learners are living in conditions without a decent place to do homework and seven percent have no access to the Internet [6]. In Hungary, the majority of students have broadband Internet access [7]. Students who rely on part-or full-time work may not have been able to continue earning during the pandemic, which could have impacted their economic situation [2]. In South Africa, access to the Internet is mostly via mobile phone and data costs render access economically infeasible for many [8], which is confirmed by Woltran et al. [9].

The global impact of the COVID-19 pandemic, as well as the path of countries' post-pandemic recovery, is yet to be scoped; it is quite possible that the best practices that have emerged since 2020 can feed into future best practices. As we emerge from the COVID-19 pandemic, it is imperative for Higher Education Institutions (HEIs) to understand the challenges that students faced, and still face, and to explore their experiences of remote learning. Measures should be put in place to ensure good student outcomes and engender positive student learning experiences post-pandemic; it is also important to determine how to deal with the consequences of the shift to online learning on 2020–2021 cohorts' academic careers.

It was found that the emergency eLearning and the pandemic required academic staff to revolutionize their teaching methods to include innovative practices, to accommodate students demands. Higher education institutions need to be prepared to transform their educational practices. Additionally, the timing of the development of digital skills was found to be important, the earlier it is introduced into the curriculum, the more beneficial for the student experience.

The paper is structured as follows: the next section describes the terms and theories used, followed by the materials and methods section which describes the data collection and data analysis methods, it is followed by the results and discussion sections. The paper concludes with sections on limitations, recommendations and conclusions.

2. Background Terms and Theories

2.1. Related Terms and Theories Used

To enhance the clarity of the discussion, some definitions are provided:

Digital access is the physical ability to gain access to the Internet; it encompasses the digital learning environment—namely, location, devices, ownership, and affordability [10].

The *digital divide*, or technology gap, refers to the difference between those with, and those without, *access* to the Internet and related technologies [10].

Bhaskar et al. [1] (p. 25) define the term *digital trust* as " . . . *the confidence that causes users to exercise a choice to interact, transact, and consume online. Fundamentally, it determines the quality of the interaction between those who give trust and those who guarantee to uphold said trust*". Bhaskar et al. delineate four drivers of digital trust:

- *Environment*—How to build trust in the digital environment?
- *Experience*—How is the digital trust environment provided by the guarantors of institutions and governments experienced?
- *Attitudes*—Do users trust the digital trust environment?
- *Behaviour*—Are consumers engaged in the digital environment?

For this study, *digital trust* includes attitudes—towards their Internet access, quality of access and system functionality—and behaviours—focusing on their approach to collaborative tools, their Learning Management System (LMS), the transition to e-Learning, digital tools used, and digital features (see Figure 2).

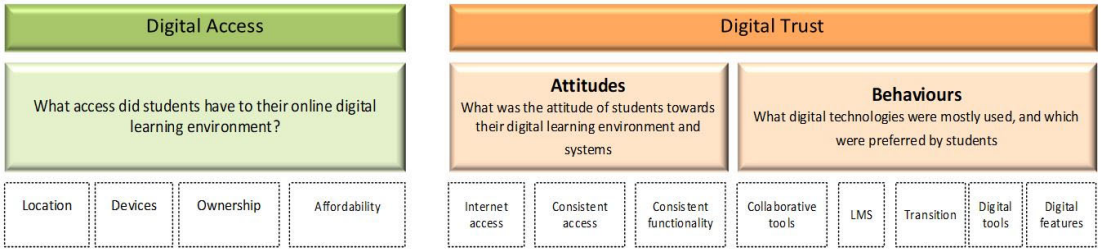


Figure 2. Research questions in relation to digital trust and digital access.

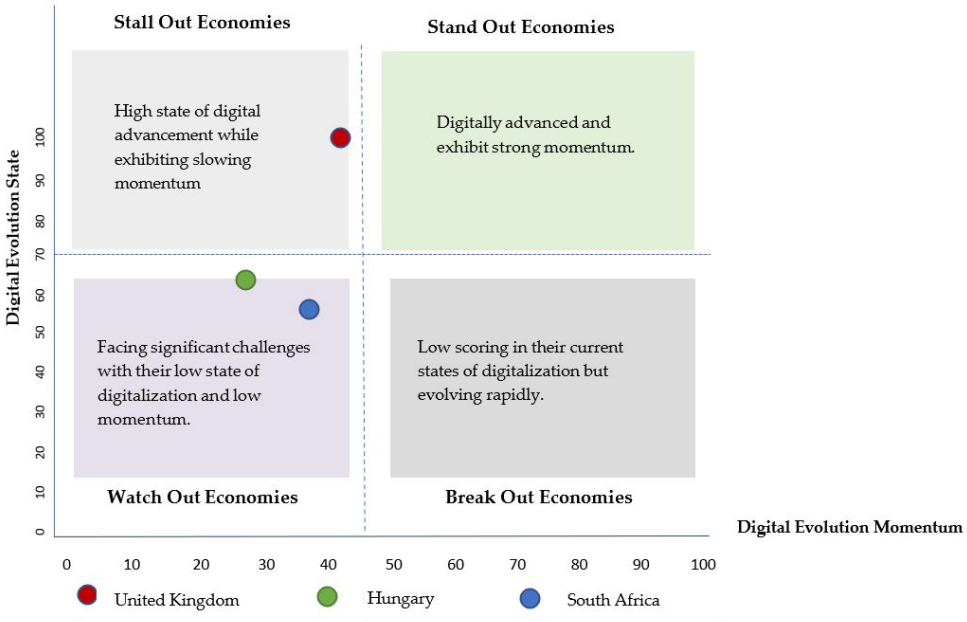
2.2. The Digital Development of Participating Countries

The universities in each of the three countries—South Africa, United Kingdom (Wales), Hungary—are not homogenous entities; their students come from diverse cultures, backgrounds, and countries of birth. Yet, as groups of residential students, they were equally impacted by the ways in which their universities supported them during this period—for example, in South Africa, students were provided with laptops and data to access online learning material. The way the country's government supported the university during the transition to online learning was also relevant; it is important to describe the context of each country's digital technology development, given the focus on digital access, attitudes and the behaviours of students (as described in our construct in (Figure 2). Several research studies have been conducted to better understand and measure country-specific stances on information and communications technology use, capacity, and readiness. In addition, several frameworks have been developed that measure the digital intelligence and readiness of countries. The next section introduces two of these frameworks.

2.2.1. Digital Intelligence Index (DII) of Participating Countries

The Digital Intelligence Index (DII) considers several criteria (Digital Evolution, Digital Trust, Remote Work Readiness, New GDP, AI readiness). The first two measures are pertinent here.

Digital Evolution tracks the rate of digitalization of 90 economies—comprising 95% of the world's online population—from 2008 to 2019; this DII measure provides business and policy guidance for digital growth [1]. The DII is represented as a function of two factors: (1) its current state of digitalization (*state*), and (2) its pace of digitalization over time (*momentum*) [1]. The digital trajectory of higher education can also be considered a function of these two factors. Countries are segmented into four quadrants, namely 'Stand Out', 'Break Out', 'Stall Out', and 'Watch Out' economies [11]. The DII places the United Kingdom in the 'Stall Out' quadrant, which represents a high state of digital advancement while slowing down. Hungary and South Africa are placed in the 'Watch Out' quadrant, both facing significant challenges with their low state of digitalization, and slow development. None of these universities are in the 'Stand Out' or 'Break Out' quadrants. The 'Stand Out' quadrant suggests a digitally advanced economy with high momentum (top right), while the 'Break Out' quadrant represents economies that exhibit a current state of low digitalization but are evolving rapidly. Figure 3 captures how digitalization or digital evolution varies in economies across the three participating universities.



	Digital Evolution State	Digital Evolution Momentum
	score	score
United Kingdom (Stall Out)	81.48	44.81
South Africa (Watch Out)	50.79	42.52
Hungary (Watch Out)	57.74	30.64

Figure 3. The Digital Intelligence Index by country—United Kingdom, South Africa, Hungary-adapted from Bhaskar, Chaturvedi, Filipovic and Brewer [1].

2.2.2. The Network Readiness Index

The Network Readiness Index (NRI) was launched in 2000, and considered 50 high-income economies, 35 upper-middle countries, 34 lower-middle income countries, and 15 low-income countries: a total of 134 economies were considered. The index included countries from all continents [12], and offers a balance between the technology and human dimensions of network readiness, emphasizing the importance of measuring trust, security, privacy, and our abilities to leverage technological change to address

global challenges. These include climate change, and thereby accelerate the realization of the related Sustainable Development Goals (SDGs) as set out by the United Nations (https://sdgs.un.org/#goal_section, accessed on 19 January 2022) see Figure 4.

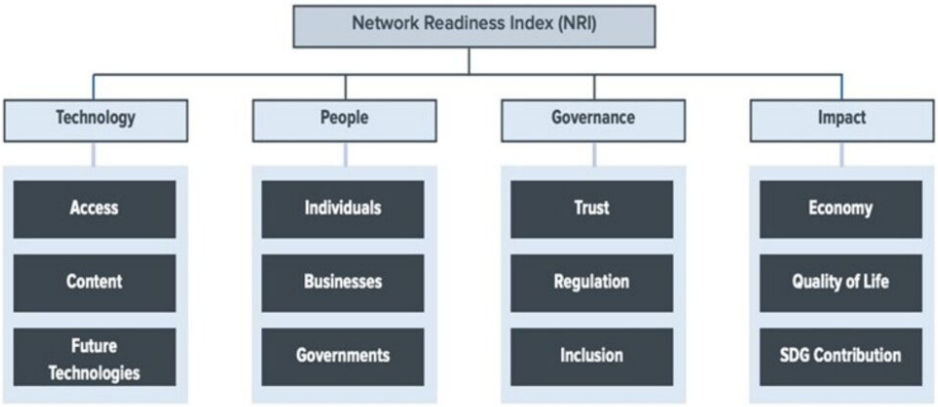


Figure 4. The Network Readiness Index [12] (p. 31).

This index focuses on four dimensions, namely Technology, People, Governance, and Impact. **Technology** measures the *access* to communications infrastructure and affordability; both in terms of local *content* and *applications* and a country's preparedness to adopt future technologies. The **People** dimension examines individuals, businesses, and governments, namely *how* they use technology, and *how* they leverage their skills to participate in the economy. In the **Governance** dimension, pillars such as *trust* (trust behaviour), *regulations* (promoting participation), and *inclusion* (digital divide addressed), are considered, all being central to successful digital transformation. The fourth dimension, **Impact** on economy (the economic impact of participating), includes the *quality of life* (social impact of participating), and *sustainability* i.e., SDG contribution, participating in the sustainable development goals set by the United Nations.

Each of the countries was given a Network Readiness Ranking Index score for each of the four dimensions, as can be seen in Figure 5. Hungary and the United Kingdom have similar rankings for each of their individual dimensions, but South Africa shows quite a difference in its individual ranking for each dimension.

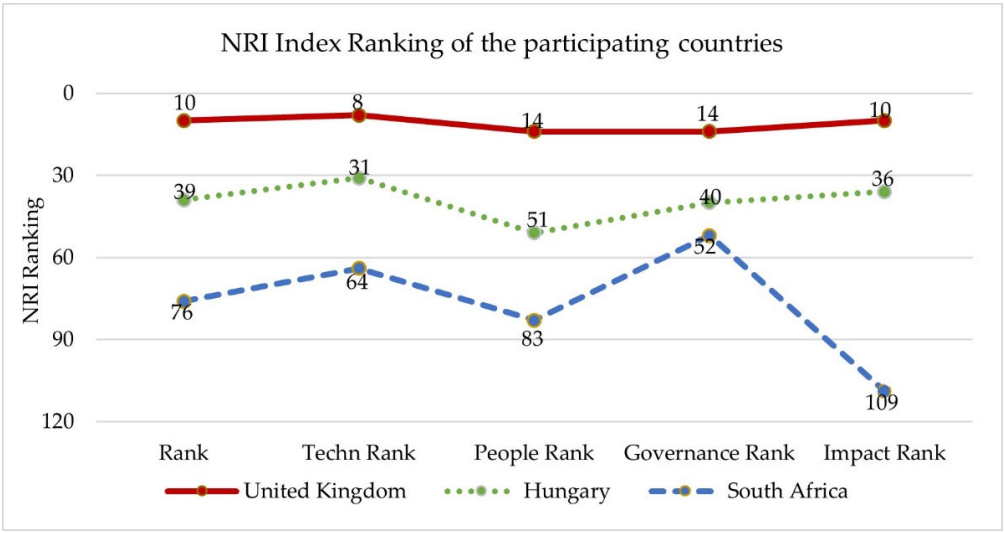


Figure 5. Network Readiness Index rankings of Hungary, South Africa, and the United Kingdom by dimension [12].

It is also important to understand the participating countries' economic development, which impacts each country's readiness for digital transformation. Figure 6 presents each participating country's Network Readiness in relation to its economic development (Gross Domestic Product (GDP) per capita). South Africa belongs to the 'upper-middle income' group, while Hungary and the United Kingdom (Wales) are considered 'high income' countries.

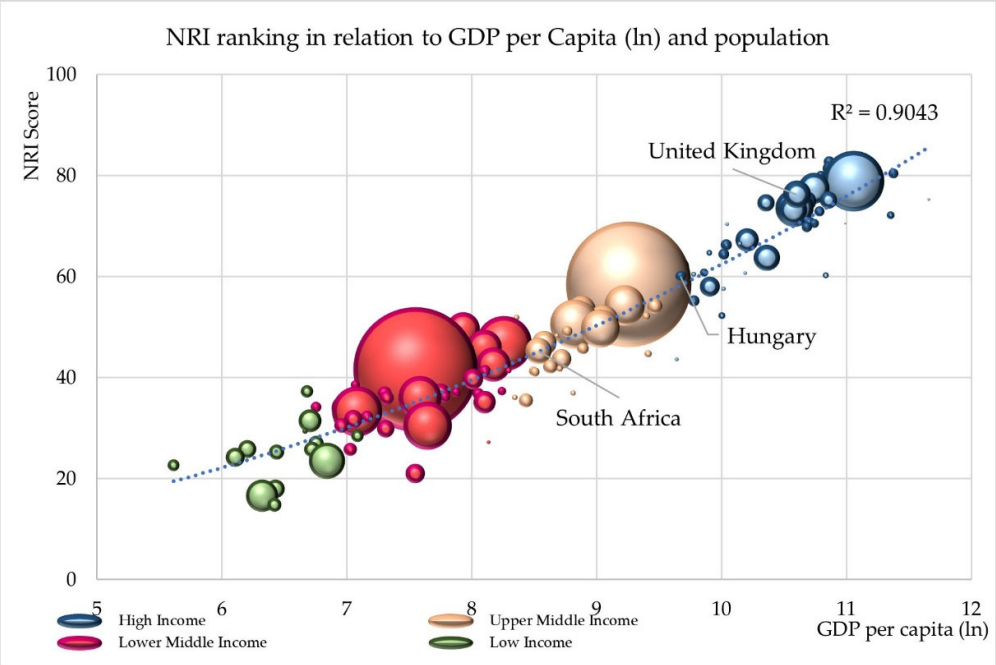


Figure 6. The three participating countries position by NRI based on GDP per capita (Source: developed from data from [12]).

2.3. Participating Countries' Digital Access

This section focuses on the number of households with Internet access at home, the speed and cost of accessing the Internet, and the average download speed. Each of these factors has an impact on students' learning experience in terms of studying at each participating university within the relevant country.

2.3.1. Households Having Internet Access at Home

Figure 7 provides a snapshot (2019 and 2020) of the percentage of households having Internet access in South Africa, the United Kingdom and Hungary [13]. The number of households in South Africa who have Internet access is substantially lower (63%) than for households in Hungary (88%) and the United Kingdom (95%); this would have a direct impact on the ability of students to access digital learning education materials from home, creating a particular challenge for South African students.

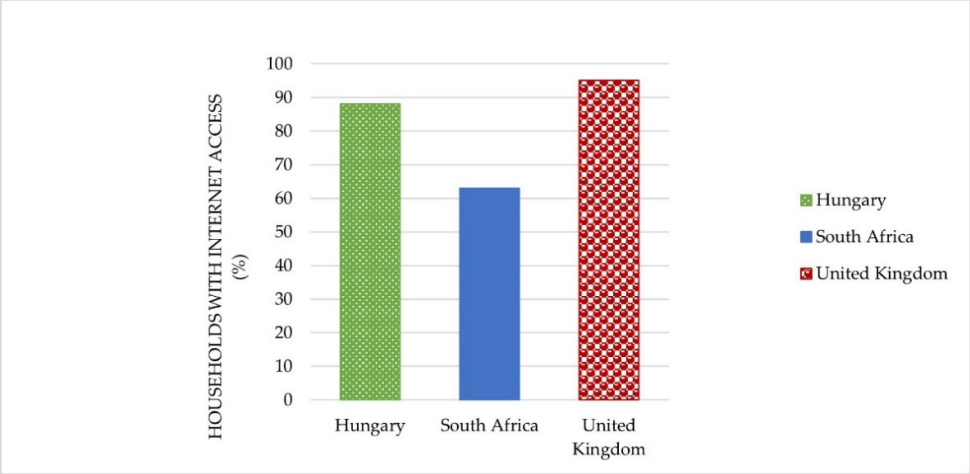


Figure 7. Households with Internet access at home (%) [13].

2.3.2. Internet Speed and Cost

When considering the populations of the countries, it should be noted that the population of the UK and South Africa is similar, whereas Hungary's population is considerably smaller. Furthermore, South Africa is a larger country geographically, as compared to Hungary and the UK (thirteen times larger than Hungary and 5 times larger than the UK). The population size and physical distances might impact the costs of broadband and mobile Internet; it is interesting to note that Hungary's broadband speed is notably faster than that of the UK, and the speed in South Africa is even slower (see Figure 8) but costs are considerably lower than in both South Africa and the UK, with South Africa paying the most [14].

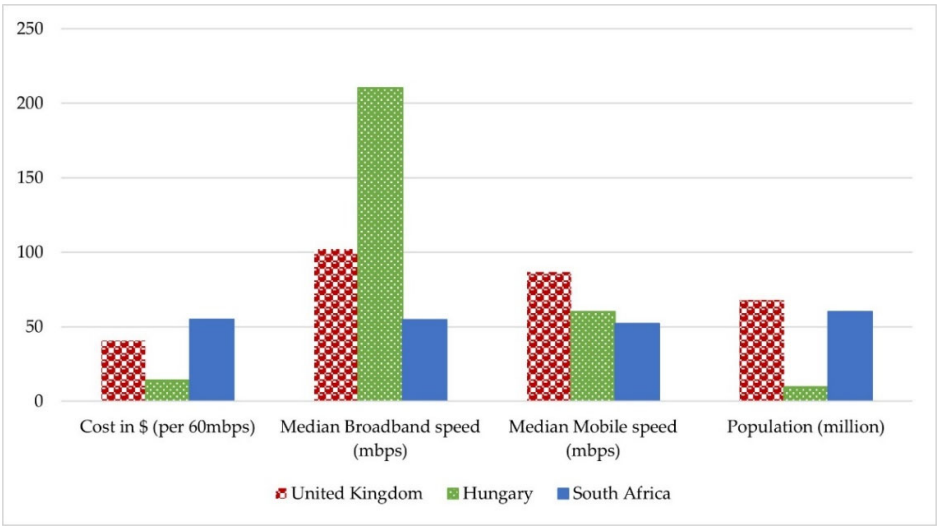


Figure 8. Internet speed and cost by country 2021 [14,15].

2.4. Theoretical Underpinnings

Structuration, postmodernism, and critical social theory were used as lenses to understand the student experience of the participating students engaging in online learning during the first wave of the pandemic; these lenses will be described in this section.

2.4.1. Postmodernism

The society we live in has radically changed—"*our world is now a world of postmodernity*" [16] (p. 191); it is important to make a distinction between *postmodernity* and *postmodernism*. Postmodernity can be defined as a "distinctive historical period in the development

of society" whereas postmodernism considers a "*qualitative*" new society, that is, it signals the transformation of the concept of art—social science, modern art, philosophy, music and literature—and its relationship to other social practices. Postmodernity can thus be seen as postmodernism at a moment of time and represents a different way of thinking and communicating.

2.4.2. Critical Social Theory

Critical social theory, a neo-humanist approach, which considers how to improve the human condition [17]. Hence, its aim is an all-encompassing approach to active participation, observation and analysis of the situation and the design of an intervention to accomplish change. According to Habermas [17], "*content*" and "*relationship*" are two criteria that can be used to analyse and validate discussion about research.

Ngwenyama [18] (p. 269) is of the opinion that critical social theory is based on five assumptions, namely:

1. The social world is created by humans and can thus be changed if they so desire.
2. Scientific knowledge is value-laden, more specifically when considering the social world.
3. Reason and critique are two sides of a coin. Reason allows for the understanding of the social world, and to critique, it allows the search for alternatives. Reason and critique can, therefore, not be separated.
4. Critical social theory creates the environment for the reconciliation of 'knowledge' with 'the human need for self-improvement' and, as such, theory and praxis are interconnected.
5. Finally, those affected by research should be allowed to collaborate with the researchers for the research to be open to public debate.

2.4.3. Structuration

Giddens [19] contends that structuration is a 'social theory' that scrutinizes both structure and agents, without valuing the one above the other. Information technology has transformed modern society with its globalizing tendencies and the consequential reorganization of social structures.

According to Giddens [20], time and space impact social practices. The separation of time and space 'removes' the local context of the interaction. In our era, 'late modernity', social interaction is continuously revised, see Figure 9, where interaction between structure and agency can lead to changed preferences and perceived ease of use [21]. Giddens [19] suggests that structuration purports the duality of structure, which includes rules (*how things are done*) and resources (*how things can help get things done*). Each person's rules are developed by three elements, *significance*—how an event is interpreted, *legitimization*—what should happen in a situation, and *domination*-what means should be used to accomplish goals [22]. Each student would therefore have a combination of these elements. Panigraphi et al. [23] (p. 1843) suggest that individuals have the capacity to reflect on their behaviour and make changes where required and when engaging with structures.



Figure 9. Interaction between structure and agent, leads to change, adapted from [24].

The global burden of the pandemic has catapulted society into embracing these new practices and organizations and society has needed to rely on and transform digitally, reaching a new level of 'digital maturity'.

2.5. Justification for This Research

The intention of this research was to explore and understand the challenges and experiences related to digital access and digital trust of higher education students during the COVID-19 pandemic. The aim was to inform future pedagogical approaches and teaching and learning policies.

Another reason would be to understand the opportunities created by the pandemic for teaching and learning best practices. Aristovnik et al. [25] suggested that the COVID-19 outbreak had impacted higher education institutions in an unprecedented way. Thus, it is imperative for in-depth studies to be conducted so as to better comprehend the ways in which students living around the world were affected. Since the inception of this research study, and the collection of data in November 2020, several related studies have been conducted [2,4,9,26–29] to investigate the impact of the COVID-19 pandemic on higher education students, with a view to providing insights that can be used to feed into future planning, but very few studies compared and contrasted the experiences and perceptions of students from developing and developed countries.

2.6. Research Aims and Objectives

This research study was conducted at three universities—in South Africa, Wales, and Hungary—and aimed to investigate and understand the impact of COVID-19 on the student learning experience during the COVID-19 pandemic. The focus of the study was on how digital educational technologies impacted equitable digital access, as well as digital trust —attitudes and behaviours—of participating students. The following research questions were posed:

RQ1. **[Digital Access]** What **access** did students have to their online digital learning environment?

RQ2. **[Digital Trust]** How confident were the students in using the digital learning environment and systems?

- RQ2a. [*Attitudes*] What was the attitude of students towards their digital learning environment and systems?
- RQ2a. [*Behaviours*] Which digital technologies were mostly used, and preferred by students when engaging with the emergency eLearning during the pandemic?

3. Materials and Methods

This research study is part of a larger study investigating the perspectives of students and staff during the COVID-19 pandemic; it focuses on emergency eLearning and the impact it had on the student and staff experience and workload. For this study, the focus is on *digital access* to the online learning environment and systems, the confidence that students had in their digital learning environment (*digital trust*), specifically focusing on the *attitudes* of students towards their learning environment management system, and the *behaviours* of students when engaging with the eLearning systems.

The study used a survey to collect data to be quantitatively analysed. Exploratory data analysis was carried out to discover, explore and empirically detect phenomena in the data [30] using a variety of statistical tests. Given the nature of the research and the uniqueness of the pandemic situation as a phenomenon, an inductive strategy was used; this is a process whereby general conclusions are drawn from individual instances or observations [31]. Inductive strategies are usually associated with qualitative research but Bryman and Bell [32] (p. 32) contend that it can also be associated with quantitative analysis, where hypotheses are not used at the beginning of the research prior to data collection. Instead, conclusions, frameworks and theories can be developed inductively

throughout the analysis. Dudovsky [30] supports this view and argues that the inductive approach can be adopted to conduct quantitative research.

The survey questionnaire included 18 questions on digital access, and digital trust, specifically focusing on the attitudes and preferences of students to their online learning environment. To test the survey, it was piloted at each of the participating universities (n = 30) to enhance clarity.

3.1. Ethics

Ethical clearance was sought to disseminate the questionnaire amongst the student population of the participating universities; it was approved by the ethical review boards of each institution. Students anonymously completed the questionnaires online.

3.2. Recruiting and Data Collection

The questionnaire was completed in English or in Hungarian, depending on the student's preferred language. Qualtrics^{XM} was used to host the online questionnaire, which was distributed to the students during the last quarter of 2020 [33].

3.3. Analysis

The analysis aimed to identify similarities and differences between the three countries and student perceptions of digital access and trust in the learning management systems. Comparative analysis was conducted using the Chi^2 test to identify the significant differences in the self-reported preferences, perceived ease of use, and attitudes of students toward their online learning experience. The statistical programs this study used were Statistical Analysis System (SAS) version 9.4 and Statistical Package for the Social Sciences (SPSS) version 25.

4. Results

4.1. Student Demographics

The self-administered online questionnaire was completed by 559 participating students, of which only 512 responses could be analysed; these comprised: 240 from Hungary, 141 from Wales, and 131 from South Africa (see Figure 10).

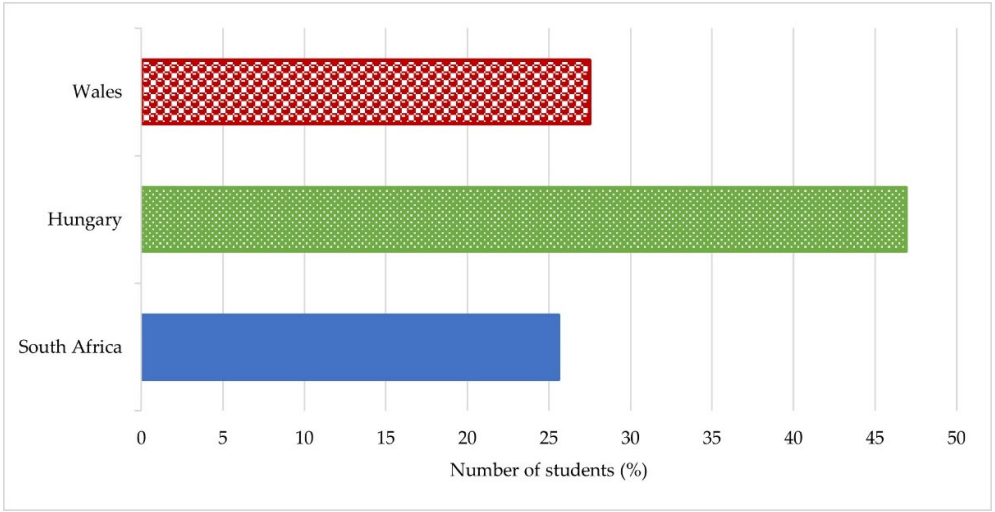


Figure 10. Students participating in the study by country (%).

Most respondents (95%) were undergraduates studying toward a variety of degrees. Only a few, 4.1%, postgraduates participated in the study (Figure 11).

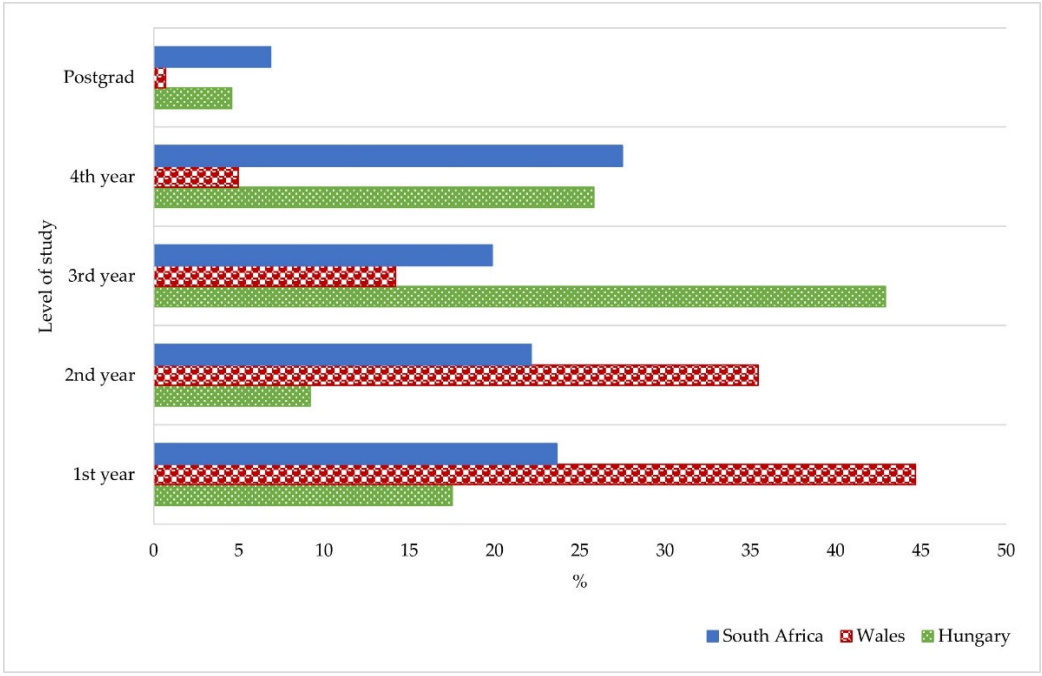
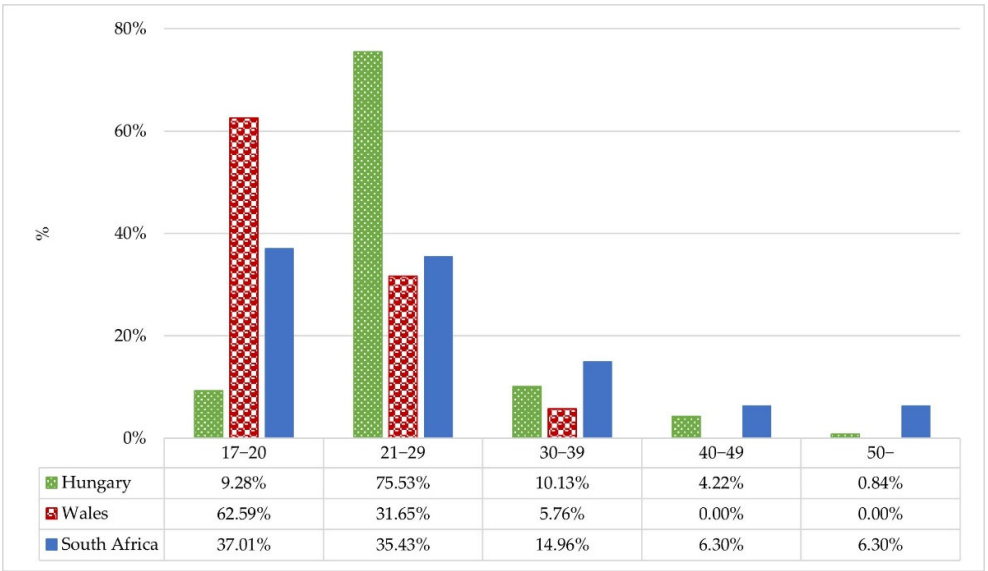


Figure 11. Student participants' year of study by country (%).

Figure 12 shows that most of the students studying at the Hungarian university (76%) were in the age range 21–29, while the participating students studying in Wales were younger, with 63% being in the 17–20 age category. The students studying in South Africa were quite equally spread between the two younger age ranges with a small proportion (6.3%) being in the 50+ age range. Most of the participating students were in the age range of young university students.



	17–20	21–29	30–39	40–49	50–
Hungary	9.28%	75.53%	10.13%	4.22%	0.84%
Wales	62.59%	31.65%	5.76%	0.00%	0.00%
South Africa	37.01%	35.43%	14.96%	6.30%	6.30%

Figure 12. Participating students by age and country.

More males (54%) than females (45%) completed the questionnaire. The participating students were from 46 different countries spread over four continents. Africa (Angola, Congo, Ethiopia, Ghana, Kenya, Lesotho, Libya, Morocco, Namibia, Nigeria, Rwanda, South Africa, Zambia and Zimbabwe), Asia (Azerbaijan, Hong Kong, Indonesia, Japan, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Malaysia, Mongolia, Thailand, Turkey, Vietnam, Yemen, Russia, Saudi Arabia), Europe (Britain, China, France, Greece, Hungary Ireland,

Latvia, Lithuania, Norway, Moldovia, Poland, Portugal, Romania, Slovakia, and Spain) as well as North America (Mexico). The student demographics across these three universities are thus heterogeneous.

4.2. Digital Access

4.2.1. Digital Access Location

More of the Welsh (92%) and Hungarian (90%) students accessed their university's online environment from home using broadband Wi-Fi, only 41% of South Africans ($Chi^2 = 145.36$ and $p < 0.0001$) did so (see Figure 13).

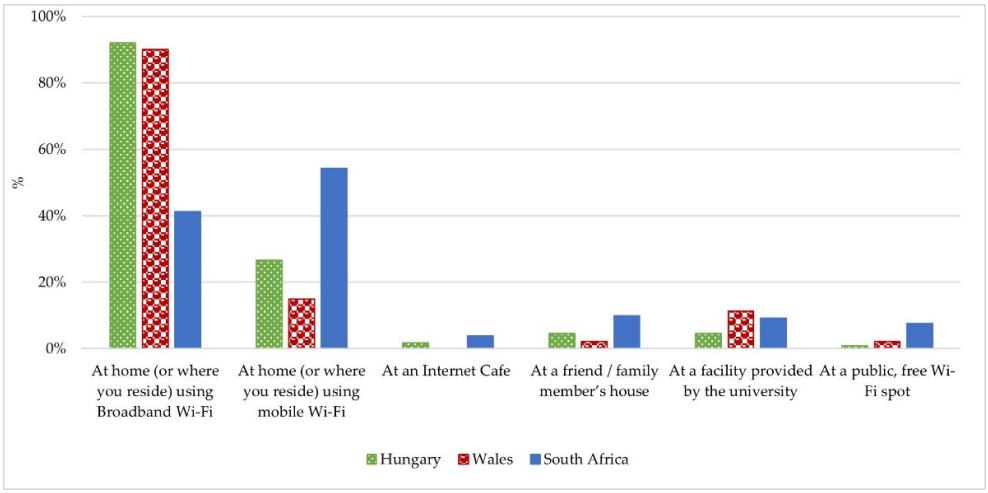


Figure 13. Student access to the online university environment.

Most of the students from all three participating universities used Broadband Wi-Fi (78.52%) and mobile Wi-Fi from home (30.47%). The third most popular digital access in the survey was "at a facility provided by the university" (7.62%).

More of the South African students (54%) accessed their university's online environment from home using their mobile Wi-Fi, whereas only 28% of Hungarian and 15% of Welsh students used mobile Wi-Fi ($Chi^2 = 51.56$ and $p < 0.0001$).

4.2.2. Digital Access Devices Used

Although not significant, it is interesting that the majority of all students (81%) used their own laptops to access online material ($Chi^2 = 1.80$ and $p = 0.4072$). A few South Africans (12%) used someone else's laptop, and more of the Hungarian students (27%) also used their own personal computer (PC) (see Figure 14). Most of the students preferred using their own laptop (81.05%), the second most frequently used device was their own smart phone (54.15%). PC users made up 17.77% of the respondents.

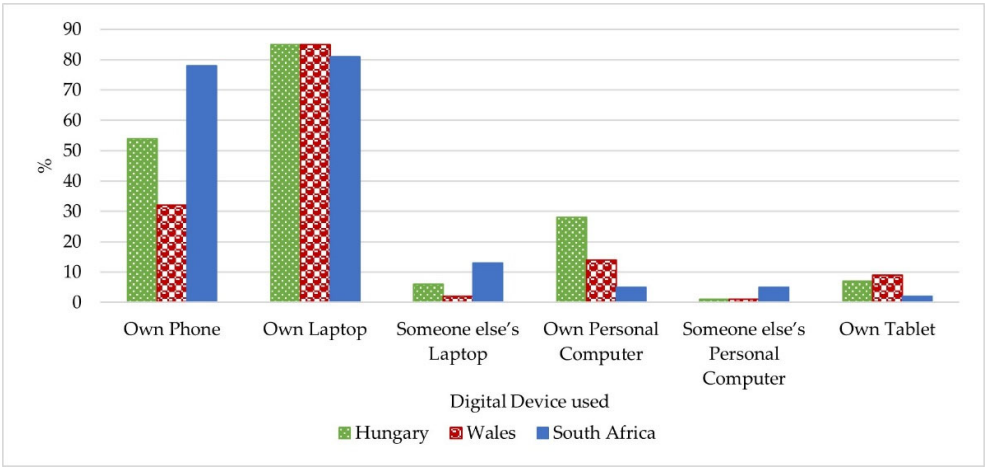


Figure 14. Digital device used for online learning (%).

4.2.3. Digital Device Ownership

More of the Hungarians (95%) and Welsh (85%) participants had used a digital device for more than 5 years while far fewer of the South Africans (60%) did so (Chi^2 = 73.48 and $p < 0.0001$) (see Figure 15). Despite the significant university differences in the three participating countries, the majority of the respondents (60.66%) have been using digital devices for more than five years. Students with less experience equalled around 5% for each of the other options.

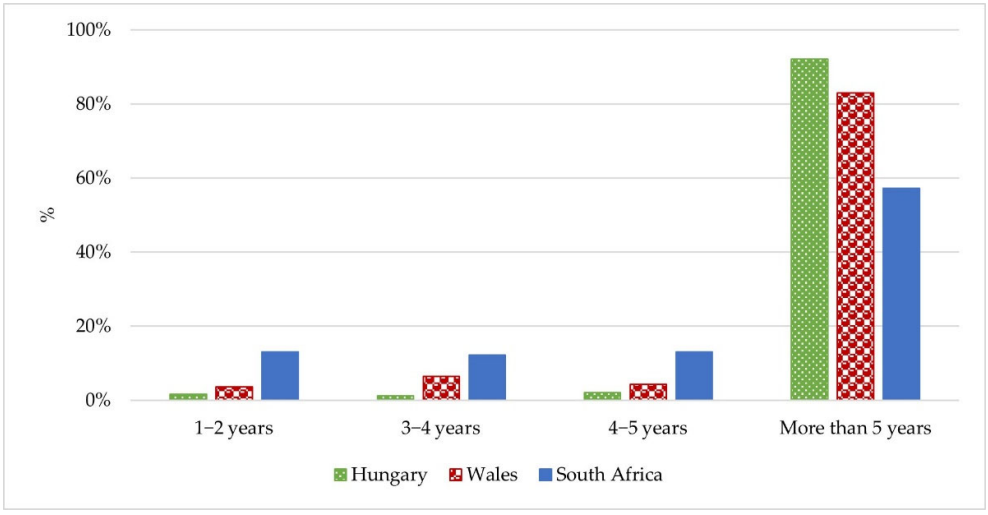


Figure 15. The number of years students have been using digital devices.

4.2.4. Costs of Accommodation and Digital Access

Most students (73.91%), probably because they did not relocate during lockdown, felt that their accommodation costs stayed the same, but 40% of the South Africans (as compared to 10% Welsh and Hungarians) indicated that their accommodation costs increased (Chi^2 = 55.49 and $p < 0.0001$) (Table 1). 17.39% of the respondents reported an increase in their accommodation costs.

Most South African students (73%) indicated that their Internet access cost had increased, whereas the Welsh (84%) and Hungarian (75%) students indicated that it had not changed (Chi^2 = 132.59 and $p < 0.0001$). Almost all felt that their Internet costs were the same or increased (96.50%), while one-third of them experienced that they had to pay more for internet access (31.69%).

Table 1. The impact of the pandemic on learning costs.

Costs Increase (%)	Hungary n = 240	Wales n = 141	South Africa n = 131	Chi^2 and *p*-Value
Accommodation costs	10	10	40	$Chi^2 = 55.49$, $p < 0.0001$ *
Internet access costs	20	14	73	$Chi^2 = 132.59$, $p < 0.0001$ *
Digital equipment costs	30	40	53	$Chi^2 = 20.4$, $p = 0.0004$ *

* Significant at a 5% level of significance.

A very similar percentage (96.50%) felt that their equipment costs increased (38.35%) (or stayed the same (59.59%)). In South Africa, 53% of students indicated that digital equipment costs increased, whereas in Wales, 40% and in Hungary, 30% mentioned this ($Chi^2 = 20.4$ and $p = 0.0004$).

4.3. Digital Trust

Aspects of Bhaskar et al.'s [1] (p. 25) definition of the term *digital trust*, defined earlier in Section 2.1, was used, namely: *Attitudes* and *Behaviour*, to understand the students' online learning experiences. The following section will report on these constructs.

4.3.1. Attitudes

Perceptions (Internet Access, Consistency of LMS Access and LMS Functionality)

Although not significant, more than half of the students were satisfied with their Internet access (63%) and 68% felt that the university's digital environment was accessible, slightly more than half of the students (55.9%) said that it was always fully operational (Figure 16). As can be seen in Figure 16, students from the participating universities agreed that the universities provided an accessible and operational digital environment.

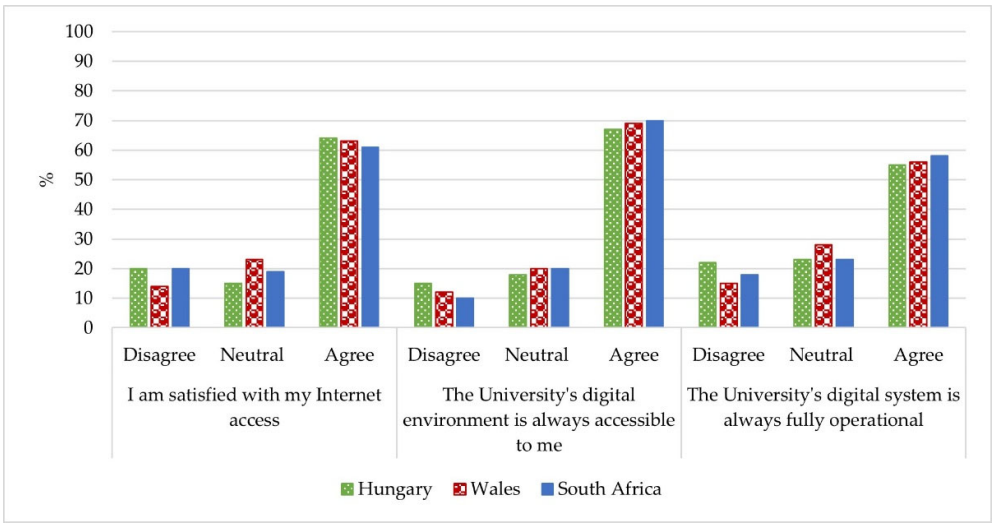


Figure 16. Digital access to the learning environment (%).

In trying to understand the student satisfaction of the online learning environment, three subthemes of digital technologies were included, namely: (1) ease of use of eLearning technologies, (2) the actual digital technologies used, and (3) their digital technologies preferences. Analyses were conducted for all the students, and further comparative analysis was undertaken to compare student responses from each of the participating universities. Half of the students (55.03%) found the university online learning platforms easy to use, with slightly more than half (59%) finding the online collaborative tools (e.g., Zoom, Skype, Teams) easy to use. Less than half of all the students said that it took too long (5.15%) or some time (39.82%) to get used to the platform and the tools (Figure 17).

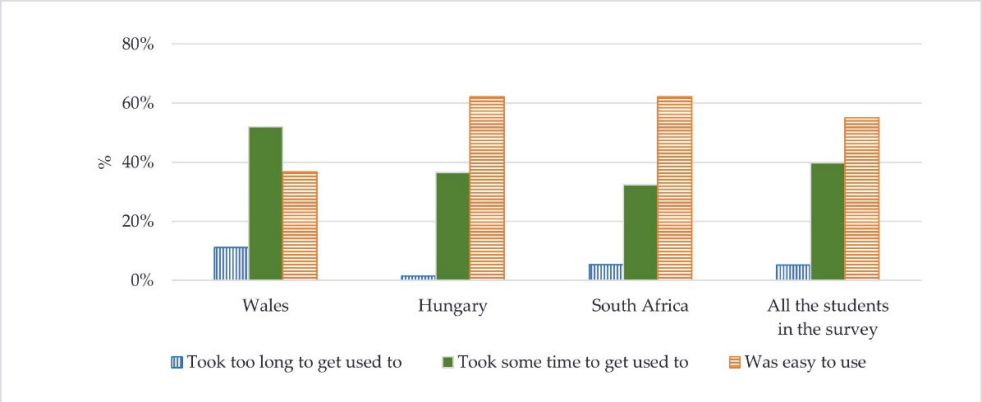


Figure 17. Student experience of the university's online learning platform.

An even larger difference was revealed in the perceived ease of use of university online learning platforms when comparing students' experiences (Figure 17). The majority (62%) of the South African and Hungarian students felt that the universities online learning platforms were easy to get used to, whereas only 37% of the Welsh students agreed with the statement ($Chi^2 = 31.85$ and $p < 0.0001$).

4.3.2. Behaviours

Perception of Collaborative Tools

Most of all students (58.61%) felt that it was easy to make use of online collaborative tools (like Zoom, Skype, and Teams, etc.). However, 50% of South Africans felt that it did take some time to get used to these, whereas 44% of the Welsh and 35% of the Hungarian students considered them easy to use. As Figure 18 shows, students from the Hungarian university found it easy to use online collaborative tools compared to the students from the participating Welsh and South African universities.

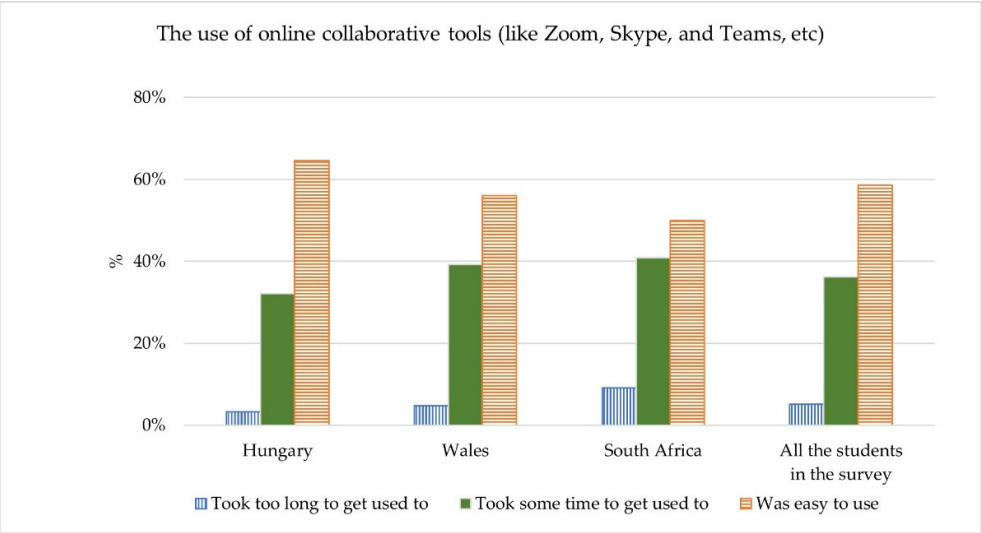


Figure 18. Student experience of online collaborative tools.

When comparing the student experience of *online collaborative tools*, a significant difference was detected ($Chi^2 = 9.58$ and $p = 0.0481$). Two-thirds of the Hungarian students found it easy to use *online collaborative tools* but for about half of the South African and Welsh students, it took time to get used to these tools (see Figure 18).

Perception of Transition to Digital Learning

Most of the Hungarian students (62%) found it easy to transition to online learning, while only 30% of the Welsh and 20% of the South Africans agreed with the statement ($Chi^2 = 68.7$ and $p < 0.0001$). Comparatively, 47% of South Africans found the transition challenging (Figure 19). Less than half of the students from the three universities found the transition to online learning easy (42.92%), while 27.89% found it challenging, and 29.19% of the students found it neither easy nor challenging.

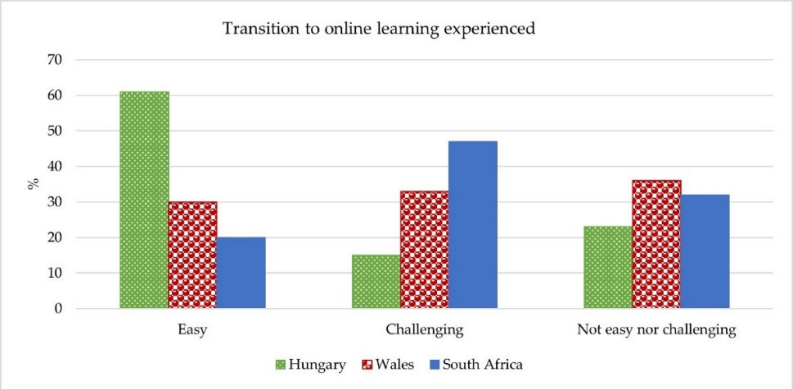


Figure 19. Perceived ease of transition to online learning (%).

The question of whether the transition to online learning was easy or challenging raised the question of how students experienced their personal digital literacy improvement. The answers for '*improvement in digital literacy*' and '*transition to online learning*' were compared. While a significant relationship was found between how students experienced their digital skill improvements and how they managed the transition to online learning ($Chi^2 = 18.606$, $p = 0.017$), the ones who strongly disagreed or strongly agreed that their digital literacy had improved (either because they possessed good digital literacy or improved it to a great extent) found it easy to manage the transition to online learning (Figure 19).

Technologies Used

The aim of this research was to understand the most-used technologies. Students were asked which digital tools they used to access and engage with remote learning. Upon comparing students, the difference is significant ($Chi^2 = 906.442$, $p = 0.000$). Students at the Hungarian university did not favour 'WhatsApp' but used 'Microsoft Teams' and 'Skype', while South Africans preferred Google Hangouts, Google Meets, Dropbox, and email. Welsh students used Zoom more than Hungarians and South Africans. There was no significant difference in the use of the university's online platforms; it must be noted that after the transition to online learning, universities determined which collaborative platform to use for the delivery of education.

Table 2 presents the digital applications that were mostly used by the students. In South Africa, WhatsApp was used by most students (77%) to communicate with their peers and lecturers and to access or send learning material ($Chi^2 = 182.29$ and $p < 0.0001$). WhatsApp is the least used in Hungary. In all countries more than 63% of the students used the universities' online learning platform to access peers, lecturers, learning material ($Chi^2 = 0.37$ and $p = 0.8321$). In Wales, 75% of students used Zoom to access the online learning platform to access peers, lecturers, learning material ($Chi^2 = 92.17$ and $p < 0.0001$), however, it was not commonly used in South Africa and Hungary. Microsoft Teams was not regularly used in South Africa or Wales, but was dominant in Hungary, being used by 90% of the students ($Chi^2 = 277.24$ and $p < 0.0001$).

Table 2. Digital technologies most used by students.

Technologies (%)	Hungary n = 240	Wales n = 141	South Africa n = 131	Chi^2 and p-Value
WhatsApp	9	30	77	Chi^2 = 182.29, $p < 0.0001$ *
Zoom	26	75	34	Chi^2 = 92.17, $p < 0.0001$ *
Microsoft Teams	90	30	6	Chi^2 = 277.24, $p < 0.0001$ *
Email	55	48	73	Chi^2 = 18.75, $p < 0.0001$ *
Google Hangouts	3	0	11	Chi^2 = 23.74, $p < 0.0001$ *
Google Meets	6	0	29	Chi^2 = 59.76, $p < 0.0001$ *
Google Drive	31	21	4	Chi^2 = 40.03, $p < 0.0001$ *
Dropbox	1	0	5	Chi^2 = 8.92, $p = 0.0115$ (not valid)
iMessage	17	16	1	Chi^2 = 21.82, $p < 0.0001$ *
Telegram	7	0	0	Chi^2 = 5.64, $p = 0.0595$ (not valid)
SMS	0	5	5	Chi^2 = 9.16, $p = 0.0102$ (not valid)
Skype	30	1	3	Chi^2 = 734.93, $p < 0.0001$ *

* Significant at a 5% level of significance.

As universities typically decide on the platform to be used for delivering content, the results show that Zoom and Microsoft Teams were used mostly by the Welsh university, while Microsoft Teams and Skype, were used by the Hungarians. Google Hangouts and Google Meets were mostly used by the South Africans.

Drobox, Telegram and short message service (SMS) were not used very much. Google Drive was used to some extent in Hungary (31%) and in South Africa (21%) but not in Wales (4%) (Chi^2 = 40.03 and $p < 0.0001$). iMessage was used to some extent in Hungary and Wales but very little in South Africa (it is limited to iPhone and these are not owned by many South Africans) (Chi^2 = 21.82 and $p < 0.0001$). All made some use of email (Hungary 55% and Wales 48%), but it was used more by South Africans (73%) to access peers, lecturers and learning material (Chi^2 = 18.75 and $p < 0.0001$).

Preferences of LMS Features

Students were asked several questions in relation to their preferences for online technology features, namely, what provision, what kind of interactivity, delivery mode and type of digital support they preferred during online learning. The results suggest that the majority of students, (1) preferred completing tasks online that could form part of their final grade (76%), (2) preferred assignment questions and/or quizzes with feedback (74%), and (3) found mobility important, indicating that the content should be accessible on a mobile device (73%). A third of the students found teamwork unimportant (34%), see Figure 20.

All students felt that end-of course assessment was important; with more of the South Africans (91%) agreeing contrasting with 79% Welsh and 63% Hungarian students (Chi^2 = 48.91 and $p < 0.0001$), see Table 3.

All felt that it was important for online tasks to form part of the final grade, with more South Africans (92%) indicating the importance, which contrasts with 77% of the Welsh and 68% of the Hungarian students (Chi^2 = 48.2 and $p < 0.0001$). All considered the importance of mobile access to content, but the South Africans felt more so (85%) than Hungarians (69%) and Welsh (71%) students (Chi^2 = 34.35 and $p < 0.0001$), see Table 3.

More South Africans (82%) and Welsh (85%) considered slides with "voice-over" to be important for digital learning, with 57% Hungarians agreeing (Chi^2 = 56.75 and $p < 0.0001$). Most (65%) wanted interactive online lectures, slightly more so in Wales, and South African students felt strongly about it (Chi^2 = 32.82 and $p < 0.0001$). Slightly more South African students (63%) indicated that teamwork and working together was important, whereas 49% Welsh and 49% Hungarian students agreed with the statement (Chi^2 = 20.11 and $p = 0.0099$). More South Africans (88%) and Welsh (67%) students preferred prescribed e-books to be

available whereas 43% of Hungarian students agreed with the statement (Chi^2 = 98.49 and $p < 0.0001$). The preferences by country and the significant differences related to the preferences are presented in Table 3.

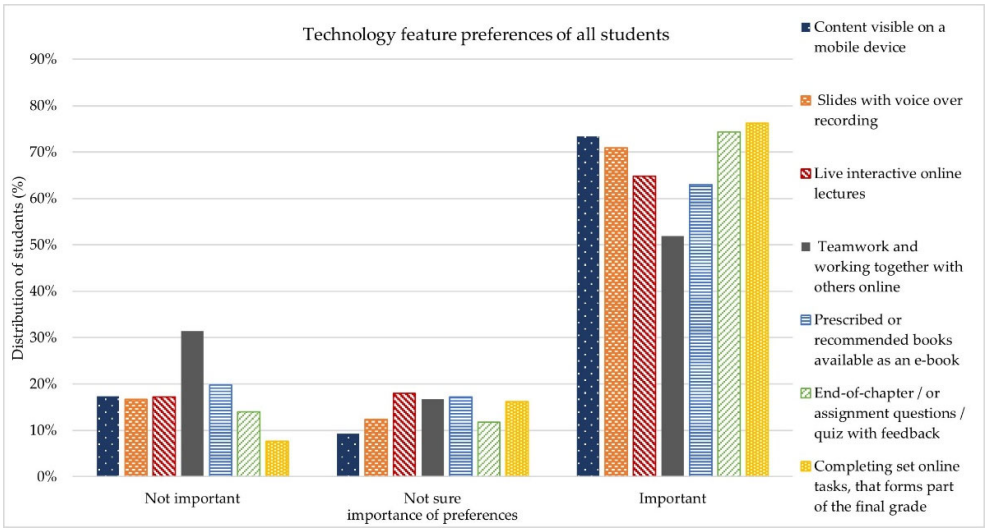


Figure 20. Online preferences of all students.

Table 3. Preference for digital technology features.

Important (%)	All the Students in the Survey n = 512	Hungary n = 240	Wales n = 141	South Africa n = 131	Chi^2 and *p*-Value *
Online tasks form part of the final grade	76	68	76	92	$Chi^2 = 48.20$, $p < 0.0001$ *
End of chapter quiz with feedback	74	63	79	91	$Chi^2 = 48.91$, $p < 0.0001$ *
Content visible on mobile device	73	69	71	85	$Chi^2 = 34.35$, $p < 0.0001$ *
Slides with voice-over	71	57	85	82	$Chi^2 = 56.75$, $p < 0.0001$ *
Live interactive online lectures	65	56	78	67	$Chi^2 = 32.82$, $p < 0.0001$ *
Prescribed e-books available	63	43	67	88	$Chi^2 = 98.49$, $p < 0.0001$ *
Teamwork and working together with others online	52	49	49	63	$Chi^2 = 20.11$, $p = 0.0099$ *

* Significant at a 5% level of significance.

5. Discussion

This study considered the online challenges and experiences of students during the pandemic and how their access to digital technologies impacted their learning. The following were considered for the study: **Digital Access** and **Digital Trust**.

Figure 21 presents all the constructs used within the research study.

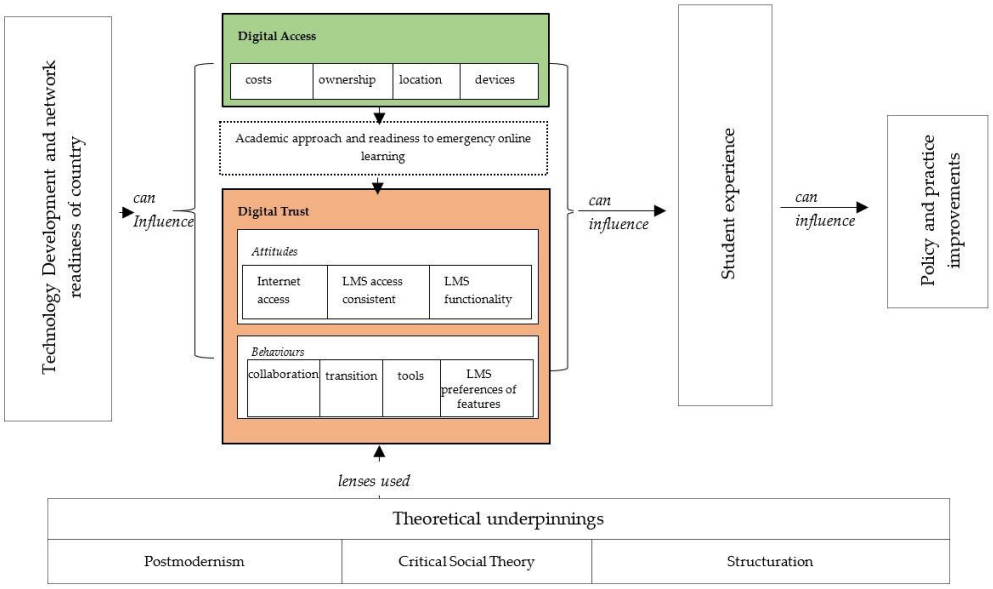


Figure 21. Research study constructs.

5.1. Technology Development and Network Readiness of Countries Considered

In high-income countries such as Wales and Hungary, students were not generally provided with digital devices when the transition to remote learning occurred; it was assumed that they possessed suitable digital devices to participate in online learning. However, in the UK, those students from low-income families could apply to the nationwide computer subsidy scheme for support (https://www.choose.co.uk/guide/free-computer-schemes-on-benefits.html, accessed on 19 January 2022) At the South African university, students were provided with laptops which they could purchase at reduced rates or acquire via their bursary funding as well as free data bundles, with some mobile networks allowing students free access to their network.

5.2. Digital Access through the Lens of Structuration and Postmodernism

The study aimed to understand the access students had to their digital learning environment by focusing on the costs, ownership, location of access (where students accessed the learning materials from), and the devices used. Access to digital learning platforms was not as equitable across South Africa as in the other two countries. However, South Africa can be highly commended for ensuring that higher education students were given digital access and the equipment to access their learning.

Costs-most students indicated that their accommodation costs stayed the same. However, significantly more South African students indicated that their accommodation, digital equipment, and Internet access costs increased (see Table 1, Figures 7 and 8).

Ownership and devices used—the current generation of students seem familiar with digital technologies and were receptive to remote learning. Most used their own laptops to access the learning environment, with more South Africans using their mobile phones to access the online content (see Figure 14). Significantly fewer of the South African students compared to the Hungarian and Welsh students, owned their digital device for more than 5 years.

Location—most of the participating Welsh and Hungarian students accessed their online learning environment from home using broadband Wi-Fi, with fewer of the participating South African students accessing their learning environment from home using broadband Wi-Fi. Most of the South African students accessed the learning management environment using mobile Wi-Fi access (see Figure 13).

The pandemic has propelled academia into late modernity where social interaction must be continuously revised. Thus, the concept of mobility, as defined by Giddens [19]

highlights the irrelevance of place, time and space of learning [34]. The transformation of time and place concepts in postmodernism has had an impact on education, enabling asynchronous, individually driven learning, as an integral part of the learning process. In addition, the digital society are increasingly problem-solvers as well as communicators [35], and use networks and mobile applications (apps) requiring instant availability of information and knowledge.

5.3. Digital Trust through the Theoretical Lens of Critical Social Theory and Structuration

The transition from face-to-face to remote teaching and learning presented some students and their lecturers, with challenges (see Figure 19). Critical social theory encourages social inclusion in education and implies a shift to participative and interactive learning. The emergency educational situation required a concerted effort from academics and students to become more supportive, with academics trying to deliver an interactive learning experience to maintain attention and engender student involvement. Participating universities used a variety of approaches to remote delivery, including synchronous and asynchronous teaching; these approaches included the 'flipped classroom', 'project- and problem-based learning', which allowed students to be reflective and engage with their lecturer and peers.

5.3.1. Attitudes

Quality of Internet access: all participating students were satisfied with their Internet access and online learning environment (see Figure 16). More than half of the students were satisfied with their Internet access (in all three countries) despite the fact that Hungary and South Africa faced significant challenges with the country's low state of digitalization and slow development. Given the Network Readiness index and the Digital Intelligence Index, one would assume that the Hungarians and Welsh would be more satisfied with their digital access than the South Africans. However, this could be explained by the ability of the South African university to provide their students with digital equipment and data access, ensuring that they were sufficiently equipped for remote learning. A study conducted by Almekhlafy [36], found that poor Internet access and lack of technical skills [37] were two challenges of online learning during COVID-19.

LMS system consistency and functionality—Most students agreed that the online learning platform was fully accessible and operational, therefore most were satisfied with the LMS system quality. Although at the different participating universities, different learning management systems were used. A study conducted by Nguyen [38] found the same.

5.3.2. Behaviours

This study was interested in the behaviour of students in relation to the digital technologies that were mostly used and preferred. The study suggests that digital technologies preferences were more important to the South African student learning process. Students were asked several questions in relation to their preferences for online technological features.

Collaborative behaviours—More than half of the students indicated that the online collaborative tools and online learning platforms were easy to use (see Figure 18). The study highlighted the fact that more of the South Africans found the transition to online learning challenging; this could relate to the fact that most South African students needed to find spaces to access the university online learning due to not having appropriate study environments at home. Understandably, more South Africans experienced cost increases—both to access digital technologies and equipment. Fewer Hungarian and Welsh students experienced these increases. South African students also indicated that their digital literacy skills had improved substantially. The current generation of 'digital natives' are able to take advantage of access to digital technologies while others improved their digital skills during the pandemic [39]. Fewer than half of all the students experienced "teamwork and working together with others online" as the least important feature of online learning. Collaborative

learning, communication, teamwork (with extra online support) were more important to the South African students than to the Hungarian or Welsh students. According to a study by Li et al., social connectivity is important for social well-being as well as academic achievement [40].

South African students preferred more digital support, interactivity and engagement in the learning process compared to the Welsh and Hungarian students. Panigraphi et al. [23] (p. 1843) suggest that "*People cannot live in individual autonomy; rather, they work together or learn from others to obtain what they cannot achieve on their own*."

Transition: The Hungarian and Welsh students found the transition to digital platforms easy (see Figure 19). The South Africans found it a bit more challenging, with several contributors, one being the network readiness of the resident country, the home Internet access, and earlier educational practices. A study conducted in North America by Lemay et al. [41] also found that students experienced the transition to online learning quite positively. However, they argue that related challenges like additional workload, and added stress was experienced, and suggested that the students require support in an online learning environment where educational technologists and academics address the social and affective dimensions of online learning as well. In contrast to this, Chen et al. [42] suggest that individuals who struggle with psychosocial problems and social deficits engage in more social media use, which provides more opportunities to meet their social needs than face-to-face interaction.

Tools and Learning Management Systems preferences: The most popular tools used by the participating universities were Microsoft Teams and Zoom. "*Recreating physical learning spaces in cyberspace was found to be a common approach to dealing with in-class engagement issues*" [43] (p. 6409); this study also reported that Zoom was a popular tool.

A large majority of students: (1) preferred completing tasks online that could form part of their final grade, (2) preferred end of course assignment questions and/or quizzes with feedback as an assessment type, and (3) found the feature of mobility important, indicating that the content should be accessible on mobile devices (see Figure 20); these technological features are noteworthy and can inform the development and creation of online learning materials for students in future. A large majority of the students also considered "live interactive online lectures" as important, which aligns with the critical social theory within education. Students preferred autonomous, individual learning methods, and slides with voice-over recordings.

The use of digital technologies, digital tools and online learning environments, and the preference for different technological features, does not only depend on the digital development of a country. The maturity level of the digital society involving social aspects within education can also impact students' digital trust, attitudes, and behaviours and, as such, influence their student learning experience. Giddens [19] contends that each person has an identity: how they view themselves within social structures, their capability and knowledge, and the way people behave, is influenced by the structures already in existence which can also be changed by the behaviours of those (students) interacting with the structures. Giddens [19] further contends that the foundational elements of structuration purport the duality of structure, including rules (how things are done) and resources (how things can help get things done). Each person's rules are developed by three elements, significance—how an event is interpreted, legitimization—what should happen in a situation, and domination-what means should be used to accomplish goals [22]. Each student would have had a variation of these three elements as they engaged with, and experienced, remote learning (see Figure 22).

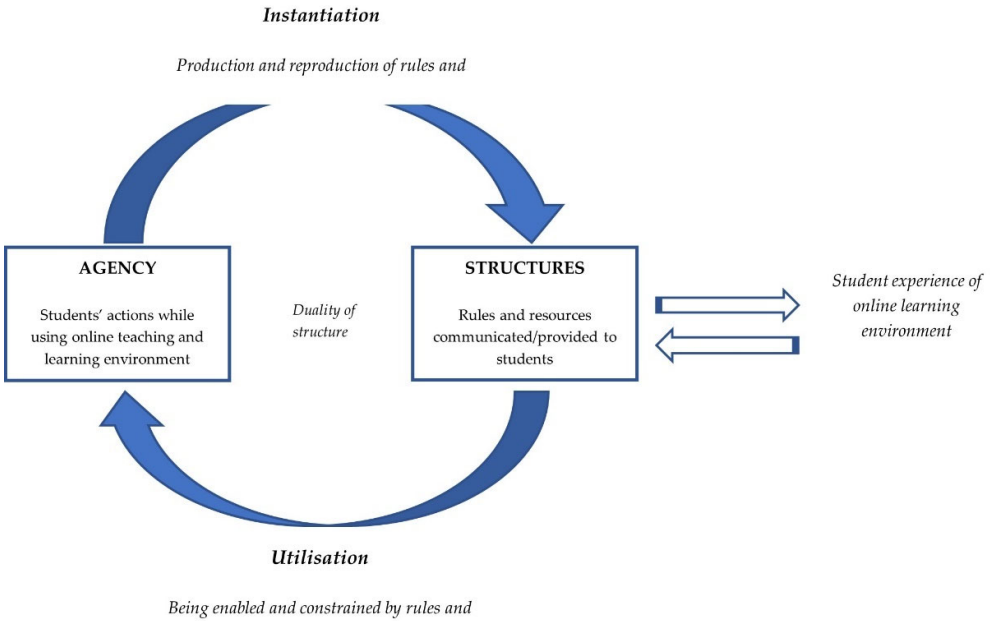


Figure 22. Application of structuration in the study, adapted from Groves et al. [44].

6. Limitations

This study could have been strengthened by the inclusion of an in-depth qualitative analysis to understand some of the challenges experienced by students in greater depth. Despite this, the findings of this study regarding student perceptions of online learning during the transition could add to the literature and help to reveal the positive and negative factors contributing to online learning. The research focused on one university in each country, enabling conclusions to be drawn related to the learning experience and perceptions of participating students at these three universities. Further data collection is planned to broaden the scope of the research and include university students from other universities in the three observed countries. However, the results identified the similarities and significant differences between these universities, and provided a general view of how the students experienced and perceived the digital learning environment. In addition, upon reflection, the development of the questionnaire could have included more open-ended questions to allow students to provide more qualitative responses to support qualitative analysis.

7. Recommendations

The following conclusions can be drawn from this research study in relation to attitudes, behaviours (preferences and perceived ease of use), and experiences of the online learning experience of students within three higher education institutions:

Digital Development and **Network Readiness:** This research study found that there was a significant relationship between the countries' GDP and its network readiness. Each of the following factors had an impact on the students' online learning experiences.

Digital Access: The costs related to digital access, the quality of access to online learning materials, and the location from where students access the learning material, impact the students' learning experience. As the pandemic has transformed the educational landscape, making online tuition an integral part of higher education, policy makers should consider the importance of time, place and space of learning [19,34], and maximize the opportunities of both modalities of teaching and learning. Policies and practices would need to take cognizance of this shift, and a rethink of equitable student digital access in terms of costs, ownership, devices, location, and connectivity.

Digital Trust: Although the *attitudes* and *behaviours* of more than half of all the students towards their online learning environment, digital technologies and collaborative tools were positive, improved digital skills training or more opportunities to engage with digital

tools is required. More than expected did find some of the tools less intuitive than is ideal. An additional important factor in the experience of their online learning management system was whether it was new to them or not.

For those students who did not have access to suitable spaces and digital technologies for online learning, the additional support provided by the university was key to their learning experience. Therefore, the digital requirements of students, both in terms of access, learning spaces, and equipment, must be considered carefully, and adequate and appropriate support structures and mechanisms provided.

Although students generally found the *transition* to online learning easy, there were several related challenges which further require adequate and appropriate support. Several technological and online learning *preferences* were identified and can inform the development and creation of online learning materials for students in the future. The two most popular tools used for online learning were Microsoft Teams and Zoom, with live interactive learning and mobility of the learning materials being important preferences.

Student experience: it is important to understand the factors that had an influence on the student online learning experiences, in particular, the network readiness of a country and the duality of structure.

Policy and practice improvements: Valuable insights were gained, which can inform policy makers, education managers and academics in developing future pedagogical approaches and teaching best practice, and, in particular, knowing how to deal with future unplanned disruptions.

8. Conclusions and Implications for Future Research

To inform future development of teaching and learning practices, it is important to accommodate the diverse student populations and their preferences. Moreover, it is important to understand student perceptions of online learning. According to Panigraphi et al., being an independent learner is significant for online learning [23], and therefore introducing the early development of these skills into the curriculum is advisable.

Mobile Internet access is fundamental to accessing online learning materials and thus the development of these systems and content should be suitable for all types of digital devices; it is critical to improve access, affordability, and quality of mobile Internet, and not to lose sight of the need to invest in more equitable access to broadband connectivity and appropriate devices to unlock the full potential of digitalization [1].

It is clear that students (generation Z) were receptive to the new digital learning platforms, however, the digital environmental readiness of the staff, institution, and country, as well as the capacity of the institution and country, can have an influence on the student learning experience. In future the issue will be, how to maximize the best features of traditional face-to-face instruction, and to incorporate tools and technology so that quickly deployed, as and when needed [43]; it is important to gauge student perceptions of the online learning experience to be able to maximize the opportunities to develop successful teaching and learning practices and policies.

Several opportunities have surfaced from the emergency eLearning during the pandemic. A greater demand for innovative teaching practices has materialized. Students will demand best practices from these new modes of teaching as part of the normal higher education experience, which higher education institutions will must engage with.

Economies at all levels of the 'digital evolution' must invest in empowering citizens with the necessary digital and literacy skills to counteract the related challenges. Furthermore, understanding the challenges and barriers to the student learning experience, and ensuring equitable access to digital technologies and communication across the student population, is vital to engendering successful outcomes.

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review and editing—D.J.C., I.M.V., A.T., R.J.B. and K.V.R.; visualization—I.M.V., D.J.C., A.T. and R.J.B. All authors have read and agreed to the published version of the manuscript.

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